THE ROAD SAFETY RISK MANAGER: A MEANS TO PRIORITISE ENGINEERING INTERVENTIONS IN A SAFE SYSTEM

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1. A BRIEF STATEMENT OF THE ISSUE

A major objective of the Safe System strategy is to improve the safety performance of the road network. This will involve in part, the identification of those segments of the network which have a below par safety performance, prioritising those segments which are to be treated, the determination and prioritisation of appropriate road treatments (or other countermeasures), implementation of those treatments and their subsequent evaluation.

This paper will describe the role of the Road Safety Risk Manager (developed by ARRB in association with Austroads) and associated research in supporting these activities.

2. INTRODUCTION

The management of the road network to provide a safe road system is a key performance indicator for all road agencies. Significant levels of expenditure are dedicated to improving the safety of road infrastructure using engineering countermeasures. Most agencies implement a range of initiatives to improve road safety. The challenge faced by asset and road safety managers is where to direct funding so that the maximum road safety trauma reductions are achieved and the risks associated with road use are minimised.

The first challenge for the road authority is to target their attention to high risk sections of the road network. This has traditionally been undertaken as part of a blackspot program, where sections of road with high crash numbers are identified. This approach has proved very effective but results in those sections of road with low traffic numbers or a more scattered crash history to be overlooked. A vast majority of the Australian road network falls into this category and needs to be approached in a more proactive manner.

When road safety concerns have been identified the road agency then requires a systematic method to prioritise the required treatments and ensure the best road safety outcomes are achieved. This paper describes the role of the Road Safety Risk Manager and related research in assisting authorities to meet these needs.

3. THE ROAD SAFETY RISK MANAGER

3.1 Background

The research behind the Road Safety Risk Manager commenced in 1997 in response to a road authority need to prioritise the actions emanating from road safety audits. The audit process involves a proactive, road safety focussed, review of a new design or existing road to identify safety issues. With the cost of potential improvements often exceeding available budgets authorities required a tool to prioritise the remedial treatments.

The Road Safety Risk Manager meets this need without the need for a crash history at the location. The risk management approach developed allows the measurement of risk as a function of exposure, likelihood and severity. Users are provided with the ability to analyse the hazard risk and the treatment risk reduction for 57 different types of deficiencies, across a variety of different road types and severity outcomes. Following inclusion of treatment costs, the derived risk reduction cost ratio forms the basis of prioritising the proposed works.

3.2 Key Components of the Process

The key components of the Road Safety Risk Manager software include recording and analysis of the following (refer Figure 1):

- ***Exposure*** (number of vehicles / road users exposed to the hazard).

Most road authorities have traffic count data within their road management systems, or the volumes can be estimated from site visits or road use information.

- ***Likelihood*** (length of hazard, general crash risk at the location, the risk of the hazard and associated treatment and the risk of related road features at the site).

For the majority of locations the practitioner will have sufficient information from local knowledge, a photograph or video data to undertake the assessments. The relative risk models within the Road Safety Risk Manager make it easy for the practitioner to determine the risk levels associated with various features. For example, when considering lane width, the Road Safety Risk Manager provides the following risk levels:

LANE WIDTH

3.7 metre lane width Relative Risk 1.0

3.4 metre lane width Relative Risk 1.05

3.1 metre lane width Relative Risk 1.15

- *2.8 metre lane width Relative Risk 1.35*

2.5 metre lane width Relative Risk 1.64

That is, on a road with a 2.8 metre lane width a driver is 1.35 times as likely to have a crash as they would be on a road with 3.7 metre lanes.

Similar risk models are provided for all 57 deficiency types. All of the models are updated on a rolling basis as part of the ongoing Austroads research program to reflect latest knowledge and experience.

- Severity (speed and crash types likely as a result of the hazard)

Based on the hazard being assessed, the practitioner determines the crashes most likely to occur as a result of that hazard at that location. For example poor skid resistance at an intersection will most likely lead to rear end crashes and the possibility of adjacent approach crashes if a vehicle enters the intersection when the road is not clear. Where appropriate data are available, a review of the actual crash history at a location may assist in determining the appropriate crash mix[1].

- Treatment Details (Initial cost, ongoing costs and treatment life)

Based on the actual treatment to be installed at the location, an estimate of the treatment cost, ongoing maintenance costs and treatment life is required. This information may be determined from previous contracts for similar treatments, standard schedule of rates, maintenance data or discussions with construction personnel.

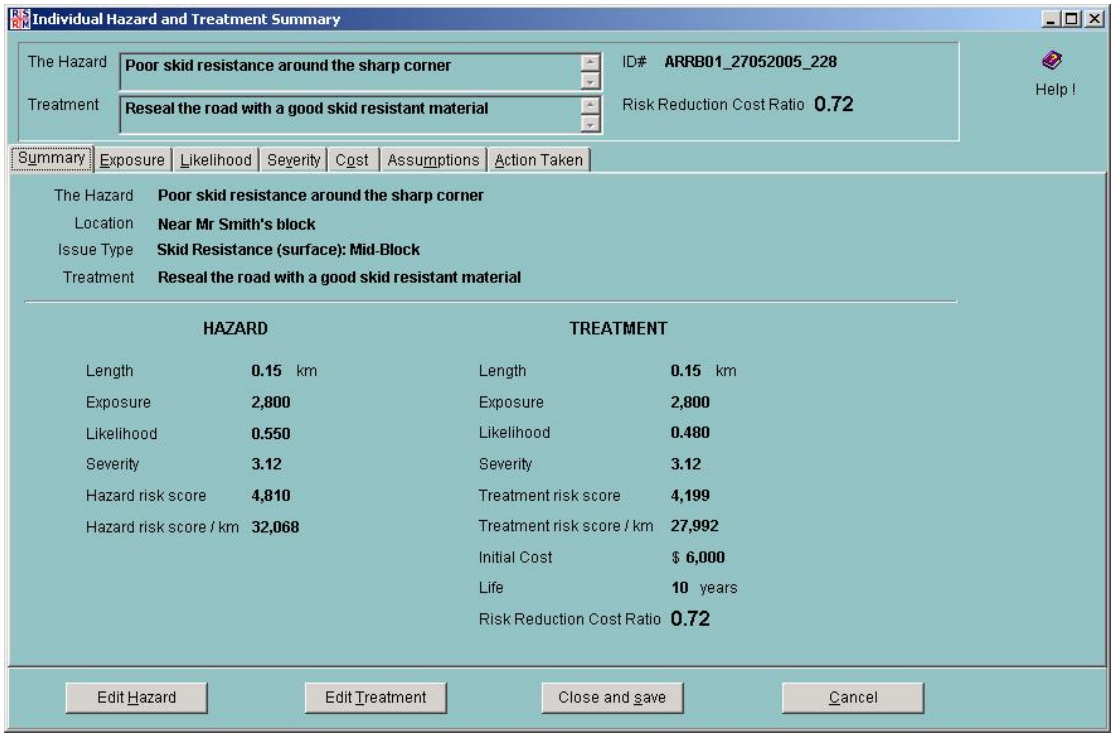

Figure 1: Individual Hazard and Treatment Summary form

[1] There is an argument that the road network risk assessment tool would be further enhanced if actual crash data were more comprehensively incorporated into the risk assessment analysis. It is considered that this additional element would assist in gaining further community and political support for the subsequent road improvement recommendations.

4. APPLICATION OF THE ROAD SAFETY RISK MANAGER

The purpose of the Road Safety Risk Manager is to provide road safety professionals with a tool to pro-actively assess road safety hazards and treatments for the purpose of prioritising actions. The ultimate aim of an authority is to maximise the risk reduction on the road network for a given budget. The software also includes the ability to record the action taken and the status of the issue, and provides a budget analysis tool to allow analysis of the effectiveness of a program of works.

The Roads Safety Risk Manager can be applied to a wide range of safety issues. As an example, the findings of a road safety audit can be assessed, potential treatments prioritised and a program of works developed within the budget constraints of the road agency.

Other areas where the Road Safety Risk Manager can provide assistance are:

- the prioritisation of a mass action program of works (e.g. guardrail, line marking, right turn lanes, etc.)
- assessment and prioritisation of safety-related routine maintenance and routine inspection operations
- assessment and prioritisation of safety projects as part of a wider ‘black-spot’ program
- tracking the status of any safety issues identified on a road network, assessing the benefits of treatment and recording any action taken.

Following the assessment of the candidate projects the road authority is able to generate a prioritised works program that maximises the reduction of risk on the road network (refer Figure 2).

Multiple Hazard and Treatment Report
Executive Summary

Road Name	The Hazard and ID	Hazard Location	Proposed Treatment	Cost	RRCR	Status
Safety Road	Inappropriate regulatory controls at intersection	Uncertain Drive intersection with Hoogofurst Street	Relocate regulatory signs to other approaches	$500	160	Action Complete
Safety Road	No guideposts	Powerline straight alongside Gwen Wheatleys farm	Install guideposts along road	$2,500	44	Action Programmed
Safety Road	Icy road - no signage	Chilly Hwy	Sign road as slippery when frosty	$1,500	20	Action Pending
Safety Road	High angle parking.	Main Street	Replace with 30 degree parking	$6,000	8.7	Action Pending
Safety Road	Poor edge lines	Gum Tree Road	Re linemark edge lines	$8,000	4.9	Action Pending
Safety Road	No CAMS around sharp curve	Slippery Bend	Install CAMS	$4,000	4.8	Action Complete
Safety Road	Dangerous road in icy conditions not signed	Chilly Road	Sign location with slippery when frosty sign	$500	4.6	Action Pending
Safety Road	4 leg intersection - Inappropriate layout. (local)	Cross Road	Install roundabout	$95,000	2.5	Partially Complete
Safety Road	Poor mid-block turning provision into driveways etc.	McJacks Road	Widen through lane by reducing angle of parking	$16,000	2.5	Action Pending
Safety Road	Poor traffic flow and linking of signals.	Stopstart Street	Link signals for flow during peak times	$25,000	1.9	Action Pending
Safety Road	Vehicles leaving road - fatigue expected cause	Rumble Hwy	Install profile edge lines	$18,000	1.7	Action Programmed
Safety Road	Poor illumination of intersection at night	ARRB	Upgrade lighting to latest Aust Standard	$48,000	1.4	Action Pending
Safety Road	Poor skid resistance at intersection	Intersection of Pickett Road and Tank Street	Plane and reinstate road with stone mastic asphalt	$35,000	1.3	Action Pending
Safety Road	Poor skid resistance around corner	Slippery Bend	Treat flush patches and reseal road with 10mm reseal	$3,800	1.2	Action Pending
Safety Road	Inappropriate speeds and through traffic in residential street	Ratrun Road	Install various traffic calming devices	$48,000	1.2	Action Pending
Safety Road	No sealed shoulders	Pasture Drive	Widen and Construct 0.5m sealed shoulder and 0.6m unsealed shoulder	$180,000	1	Action Pending
Safety Road	Incorrect continuation of giveway line	Toolong Road T junction	Black out line marking to remove confusion	$500	0.93	Action Complete
Safety Road	Steep embankment with trees present (rural 1 photo)	Essbend Road	Install guardrail	$20,000	0.79	Action Pending
Safety Road	Mid-block - Insufficient provision for cycling.	Pedal Lane	Install cycling lane	$6,000	0.51	Action Pending
Safety Road	Poor horizontal alignment	12 k from start of road near at S Bend curves	Straighten curves	$180,000	0.44	Action Pending
Safety Road	Insufficient overtaking opportunities along road	Bankedup Hills	Install overtaking lanes (1 in each direction)	$165,000	0.42	Action Pending
Safety Road	Poor signal timing at intersection. (no photo) 14102002_34	Dee-Lay Street intersection with Plenty Road	Provide increased green time to adjoining leg.	$1,500	0.37	Partially Complete
Safety Road	Narrow bridge	Little River Crossing	Widen bridge to 7m	$85,000	0.34	Action Pending
Safety Road	Y junction on highway	Highway 33, intersection with Acute Road	Realign Y junction to standard T junction	$55,000	0.19	Action Pending
Safety Road	No cycling provision at intersection.	Pedal Lane intersection with Treddly Junction	Install cycling lane on approach with storage area and cycle sensor at intersection.	$8,000	0.18	Action Complete
Safety Road	Insufficient right turn lane width	Pocket Lane	Widen right turn lane	$18,500	0.073	No Action to be taken

Sound engineering judgement should be exercised when interpreting the outputs from the Road Safety Risk Manager

Figure 2: A sample report from the Road Safety Risk Manager

5. ROAD SAFETY RISK MANAGER MODELS AT THE NETWORK LEVEL

Recent developments in the use of the Road Safety Risk Manager research have seen the development of network level assessment tools utilising the same underlying risk models.

The most recent application of this approach has been undertaken in Queensland with the development of a Road Network Safety Assessment methodology. The process developed collaboratively by the LGAQ / Queensland Main Roads "Roads Alliance" team and ARRB, provides a tool to better identify and target road safety issues at a network level.

The aim of the Road Network Safety Assessment methodology is to provide authorities with a sound basis to pro-actively identify road safety issues across their network, and ultimately develop a well prioritised works program to address the concerns identified. The process serves two main purposes:

- assists the authorities ensure safety investment is directed in a way that saves the maximum number of lives, and maximises the reduction in injury and property damage crashes
- assist the authorities in meeting their duty of care in relation to legal responsibilities.

The process developed for the Roads Alliance involves a two-staged process.

A network level risk assessment is completed to focus attention on high risk sections of road or "road safety hot-spots" where the risk of crash and the associated treatment of that risk are expected to provide the greatest return. This assessment builds extensively on the risk models within the Road Safety Risk Manager and involves the assessment of the engineering features of the road and their contribution to crash risk.

The high risk sections are then investigated in greater detail to locate specific hazards and the preferred treatment options. This may be completed as part of a Road Safety Audit of the road length identified (Morgan & Epstein, 2002) or through other forms of investigation.

The individual treatments are then analysed using the Road Safety Risk Manager to prioritise all potential treatments across the authority to ensure the highest value projects are completed first.

6. ROAD SAFETY ENGINEERING RISK ASSESSMENT RESEARCH PROGRAM

In recognising the importance of safer roads in meeting the national road safety target Austroads has embarked on an ambitious research program to ensure Australasian authorities have access to the best road safety decision making information and tools.

The research is focussed on a number of key areas including:

- Road Safety Database development: A national database bringing together information on crash data, traffic data, network and road feature attributes and treatment information on a GIS backbone. The database is providing a very powerful analytical tool for all aspects of the research program.
- Relative risk improvements: Existing research within the Road Safety Risk Manager is being updated. Improvements include identification of risk models that account for the difference in rural and urban environments and mid-blocks and intersections, in addition to consideration of the latest road safety treatment options.

- Implications of varying road design standards: Research focussed on providing practitioners with objective data to guide decision making in regard to high cost design elements such as alignment, design speed, carriageway width and roadside clear zones.
- Monitoring of engineering treatments: Development of a suitable methodology to enable the ongoing monitoring of treatments on the road network so that a better understanding of treatment effectiveness is achieved.
- Improvement of crash costs as a measure of severity: Further refinement of crash costs associated with different crash types to include different speed environments (in 10km/h increments[2]); and different road environments (road stereotype).
- Rural head-on, and rural intersection crashes: Identification of causal factors and the effectiveness of treatment options for the common and high severity crash types on rural roads (research into the run-off road crash problem is also planned).
- Safety implications of road deterioration: Investigation of the safety impacts of road asset types that deteriorate in condition over time (such as linemarking, skid resistance, delineation) and determination of "critical condition points" in regard to safety outcomes.
- Crash risk migration: Research and investigation of the potential for treatments at one location having a negative impact on road safety outcomes at a nearby site.

The research results from the program will be made widely available and where appropriate the models within the Road Safety Risk Manager will be updated to ensure practitioners have access to the best available road safety research. The challenge will then be to ensure the research knowledge makes a difference at the "coal-face" where decisions are made, and budgets are set.

7. CONCLUSIONS

In striving towards a safe road system, a road agency is primarily interested in targeting their road safety investment in a way that maximises the reduction in road trauma. With 48% of the national road safety target improvements to be generated from safer roads (ATSB, 2000), authorities now have access to improved knowledge and tools to improve the safety of their roads.

The appropriate application of the risk assessment knowledge and tools being developed will result in many improvements, including:

- reductions in the risk of road crashes / road trauma
- reductions in the risk of fatal and serious injury crashes
- economic benefits to the community as a result of fewer road crashes
- minimising the risk of successful legal action against road agencies that may result from road crashes
- the development of a 'safe road system' that will not tolerate fatal or serious crash injury outcomes, irrespective of the circumstances that lead to the occurrence of the incident.

[2] Different speed zones might be considered as an alternative to using 10 km/h increments, as the model is developed and trialled: for example, 50 km/h and below, 60, 80 and 100-110 km/h areas.

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