Development of a Strategic Motorcycle Safety Program in Victoria, Australia.

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ABSTRACT

The introduction of a Motorcycle Safety Levy in Victoria, Australia has increased considerably the funding available for research and initiatives addressing motorcycle safety. Developing a strategic method for allocating funds was essential in maximising the safety benefits for riders within the limits of the amount raised. Research was undertaken to determine the key issues, appropriate countermeasures, the size of the effects, the overall cost of measures, and the acceptability of measures to riders and road safety stakeholders. Highest priority was accorded to measures demonstrating significant reductions in injuries to riders for relatively low cost. Research into critical safety issues was given priority where effective countermeasures have not been established. Preliminary evaluations of the countermeasures implemented to date show promising reductions in injuries to riders and it is expected that the measures will return crash cost savings well in excess of the program costs. Targeted research and development expenditure is expected to return considerable benefits over the longer term.

BACKGROUND

Victoria is the second most populus state of Australia's eight states and territories with approximately 5 million residents. Around 3.5 million people live in or around the state's capital city, Melbourne. The state is the smallest mainland state; it's land mass is about 60% of the size of California. Victoria is situated in the Southeast of Australia's mainland.

There are approximately 3.4 million licensed drivers and 280,000 licensed motorcycle riders in Victoria. There are around 120,000 registered motorcycles and motorcycles account for around 1% of the travel on Victorian roads. In 2005, motorcyclists represented 14% of all Victorian road fatalities. The crash risk associated with motorcycling in Melbourne has been estimated to be 30 times greater than that for car drivers (Diamantopolou, Skalova, & Cameron, 1996).

The number of motorcycles registered in the State of Victoria has grown rapidly since the late 1990's. A corresponding increase in the number of motorcyclists being seriously injured has also been experienced. In Victoria, serious casualty crashes involving motorcyclists increased by 31% between 1996 and 2001; fatalities increased by 64% during the same period (VicRoads, 2005).

In response to the increasing trauma to motorcyclists, the Victorian Government introduced a Motorcycle Safety Levy as part of a budget announcement. The Levy, introduced in Victoria on 1 October 2002, added approximately $AUD50 to the injury insurance premium on motorcycles with a capacity over 125cc and is paid at the time of vehicle registration renewal. VicRoads, the state road authority, were given the responsibility of developing and managing the program of research and initiatives funded from the Levy. The Victorian Motorcycle Advisory Council (VMAC)[1] were charged with the responsibility of providing advice to the Minister for Transport on which projects should be endorsed for funding from the Levy.

[1] VMAC was established in 1998 to provide strategic advice to the Victorian Minister for Transport on the broad range of issues that affect motorcyclists. VMAC has representatives from a range of motorcycle rider interest groups and motorcycle industry. It also contains representatives from independent research groups and government agencies with responsibility for road safety.

The Levy was expected to raise approximately $AUD10.2 million over three years. The funds raised were directed to motorcycle initiatives that would:

- significantly improve the safety of riders by addressing the critical issues in motorcycle safety;
- derive benefits for motorcyclists that exceed the costs of the program; and
- not otherwise be funded from existing road safety budgets.

The Motorcycle Safety Levy increased considerably the pool of funds directed to research and countermeasures in motorcycle safety. Recognising that the introduction of the Motorcycle Safety Levy was controversial among some sections of the motorcycle community, an approach was developed to ensure that expenditure of funds was open and transparent. Equally important was the allocation of funds to programs that represented best practice and were based on the best available evidence. Program planning was the critical first stage in the development of an effective program. This paper describes the process and issues considered in developing a program for expenditure of the Motorcycle Safety Levy.

METHODS

VicRoads commissioned research from the Monash University Accident Research Centre to develop a "Strategic Guide for Expenditure of Motorcycle Safety Levy Funding". The completed document provided strategic direction for the development of countermeasures and the allocation of Levy funds to prioritised initiatives and research in order to provide the greatest improvements in the safety of riders.

The following tasks were undertaken to develop the Strategic Guide:

1. Identification of motorcycle safety problems and trends to confirm the key issues contributing to motorcycle trauma;
2. Description of a range of approaches that could form the basis for development of a program of countermeasures to address the identified key issues;
3. Identification of appropriate measures to allocate funding to;
4. Broad assessment of the expected benefits; and
5. Obtaining input from members of the VMAC and motorcycle safety researchers.

Information limitations

A fundamental problem in motorcycle safety is the lack of reliable data as a basis for decisions. Many motorcycle injury crashes are not reported to Police, particularly those involving minor injury or illegal behaviour (e.g., unlicensed/unregistered use of motorcycles). This has important implications for estimating the size of the crash problem and assessing the role certain factors play in motorcycle crashes. In the absence of a detailed data set, there is often an over reliance on the detailed investigations into fatal crashes. This means that the sample size on which to draw conclusions is too small and extrapolation of the results may be misleading.

There is also a scarcity of information available to determine the pattern of use of motorcycles and how this is changing. Accurate exposure information is critical in measuring and comparing safety problems as well as interpreting changes in crash and injury patterns.

Motorcycle crash and injury contributing factors

Perhaps the most important factor in motorcycle casualty crashes is their vulnerability to injury. Compared with passenger vehicle occupants, riders (and their passengers) have very little protection against impacts with other vehicles, the ground and roadside objects. Therefore, riders can sustain injuries in minor crashes where vehicle occupants would not be injured and their injuries are often far more severe.

The Victorian Government has adopted a Safe System approach where all elements of the system are designed to work together to limit the impact forces exerted on road users in the event of a crash to within biomechanical tolerances. That is, if a crash occurs, the roadway, and the vehicle, travelling at an appropriate speed, will interact to protect road users from serious injury or death. In terms of their potential for injury, motorcycle riders are more closely associated with pedestrians and cyclists than restrained vehicle occupants. Therefore, the vulnerability of motorcyclists means that they cannot be adequately protected within the road system at speeds greater than about 40 km/h.

The number of motorcycles registered in Victoria has doubled over the 5 years to June 2005. The growth in motorcycle registrations started increasing in the late 1990s. The number of licences on issue has also been increasing particularly among older riders. This demographic change in riders is reflected in crash data. Figure 1 shows that the number of riders under 30 years of age being seriously injured has steadily decreased while the number of riders over 30 years has more than doubled.

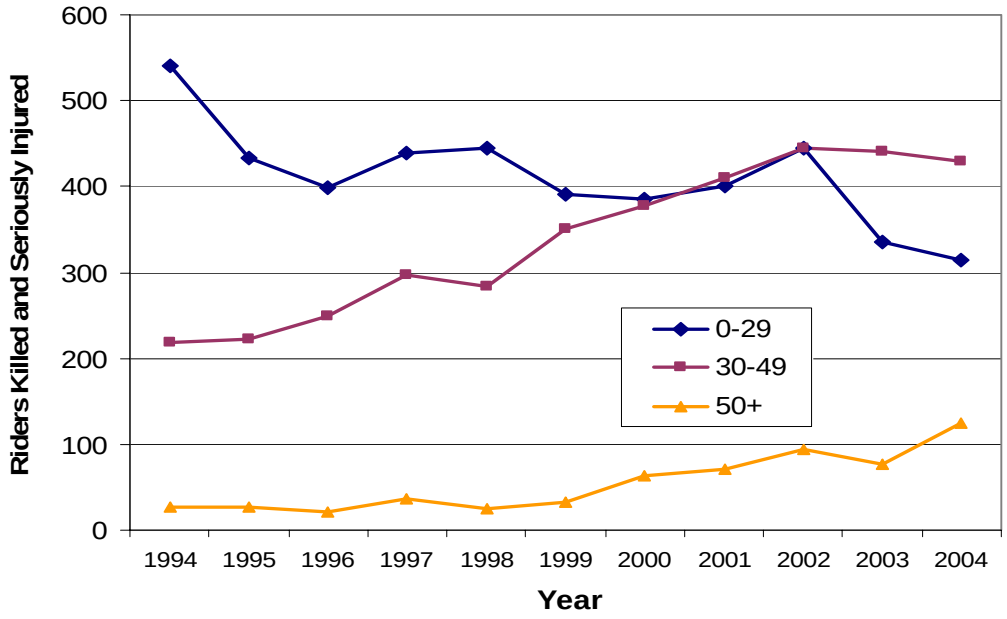

Figure 1. Number of younger and older motorcycle riders seriously injured or killed.

New and returning riders have a higher risk of being involved in a crash because of their inexperience in riding. Figure 2 shows that for both young and older riders, new riders have more crashes per year. Even many fully-licensed riders have little riding experience or little recent experience. Some research suggests that older riders who have returned to riding after a long absence have a higher crash rate per distance travelled than older riders who had continued to ride in the years since they were licensed (Haworth & Mulvihill, 2003).

Despite this effect of inexperience, rider age continues to be a greater risk factor for riders in Victoria (Haworth, Smith, Brumen, & Pronk, 1997) and in many other countries (e.g., MAIDS, 2004; Sexton, Baughan, Elliott, & Maycock, 2004). Figure 2 shows that regardless of experience, younger riders have more crashes per year than older riders. This is true even when adjusted for the amount of riding.

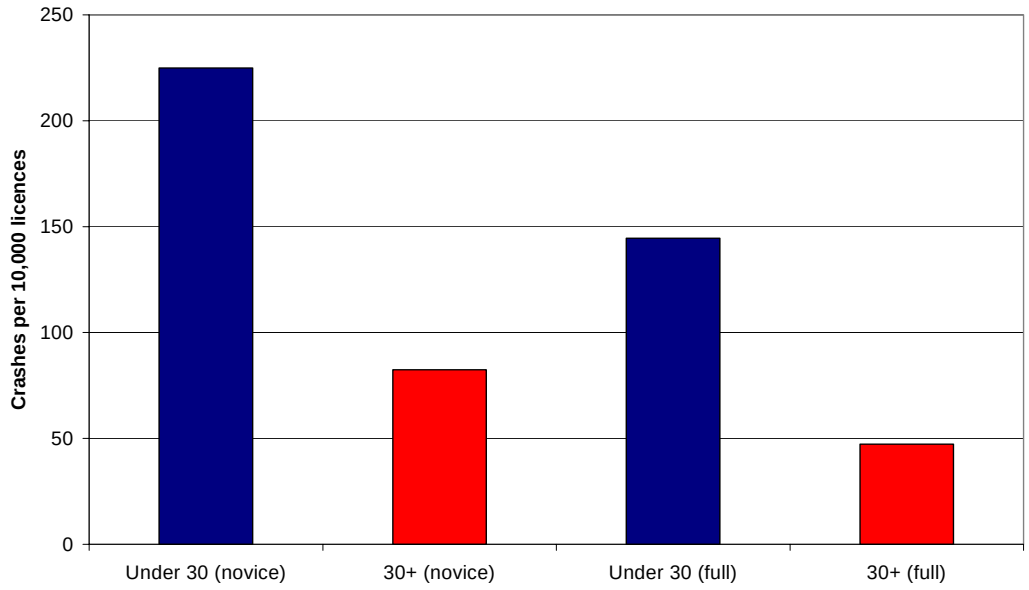

Figure 2. Crashes per 10,000 licences held per year – younger and older novice and fully licensed riders.

The most common types of crashes experienced in Victoria are similar to other industrialised countries. However, Victoria has a greater percentage of crashes when touring in non-urban areas than some other jurisdictions especially those in Europe. Over 50% of riders seriously injured in crashes are involved in loss-of-control crashes on straight lengths or curved sections of road. Approximately 26% of serious injuries to riders result from crashes at intersections. More often than not, the rider had right of way, but the other vehicle failed to give way. Around 10% of crashes involve a car driver turning right (left in USA) across the path of a rider. Driver failure to give way to motorcyclists has been documented as a major contributor to motorcycle crashes for many years (e.g., Hurt, Ouellet, & Thom, 1981). A number of issues are considered to play a part in these conflicts including poor conspicuity of riders, poor perceptual judgements of approaching motorcycles, and drivers attending to the most salient risks in the environment; motorcycles may not be in the schema of hazards that a driver has learnt to search for (Harrison, 2001).

Powered two-wheel vehicles are inherently less stable than four-wheeled vehicles. The difficulties in braking effectively to avoid a crash are increased by most motorcycles having separate front and rear braking systems. The stability of motorcycles is also critical for cornering and is susceptible to road surface and environmental hazards. The Melbourne Case-Control Study of Motorcycle Crashes found that the road surface contributed to the occurrence of 15% of crashes and adverse road factors were present at many other sites (Haworth et al., 1997). The most common road factors were lack of visibility or obstructions, unclean road or loose material, poor road condition or road markings, and horizontal curvature.

Measures to improve rider safety

A review of the literature and motorcycle crash statistics was employed to identify the measures that had the highest potential for gains in understanding or implementing road safety initiatives for motorcyclists. However, the review identified few measures that have been scientifically proven to improve rider safety. Of the proven measures, most have already been implemented in Victoria (e.g., compulsory helmet wearing) or would require adoption

on a national or international level. Many measures have the potential to improve rider safety, but their benefits have not been scientifically tested.

The Motorcycle Safety Levy provides an opportunity to extend current motorcycle safety programs, evaluate the effects of general road safety programs on rider safety and to explore new ways of improving rider safety. The measures assessed as having the highest potential to improve rider safety were included in the Strategic Guide. The types of road safety measures were categorised according to:

- the key issue that they address;
- the type of approaches involved (i.e., engineering, education, enforcement, enhanced information); and
- the status of the measure (proven solutions that require implementation, implemented solutions that need evaluation, potential solutions that need implementation and evaluation, potential solutions that need further development).

How were the funds allocated?

Funds raised under the Motorcycle Safety Levy should be allocated in a way that is strategic and represents the maximum benefit for motorcyclists within the limits of the amount raised. The following issues were considered in determining the types of measures that were allocated funding under the Motorcycle Safety Levy Program and how much funding they received:

- The size of the rider safety issue addressed by the measure;
- How much effect the measure is likely to have on the issue;
- How long the effect would last;
- How confident we are about the estimated size of the effect;
- The cost of the measure;
- The acceptability of the measure to riders, other road users and road safety agencies;
- The likelihood that the measure would be funded from other sources.

Thus, measures that have been proven to produce major, lasting reductions in critical rider safety problems for relatively low cost were accorded highest priority.

Unfortunately, there was limited quantitative data to accurately assess some of these issues so expert judgment and rider consultation were employed. These included input from independent researchers, expert riders and motorcycle instructors, motorcycle industry professionals and representatives from government agencies responsible for implementing road safety countermeasures.

Use of Levy funds for implementation of enforcement measures received little support from motorcycle rider representatives and therefore the guidelines recommend that funding of these measures be confined to research and development and evaluation (with the operational costs being met from other sources).

The funding of enhanced collection of motorcycle crash data will improve the ability to monitor trends in motorcycle safety and to assess the effects of Levy and non-Levy funded motorcycle safety initiatives.

RESULTS

Table 1 summarises the types of measures identified through the review of the literature that are recommended for funding allocation from the Levy. Funding for implementation is recommended for some types of measures, however for most measures, it is recommended that funding should be directed to research and development (R&D) or evaluation. This is the case where it has been determined that funding for implementation should be provided from other sources or where the measure has potential for success, but needs further development (including trials, pilot schemes or demonstration projects). Some initiatives will require implementation funds if R&D demonstrates their potential value and efficacy. However, R&D can take considerable time especially if crash data needs to be collected. No implementation funds are available to be allocated beyond the end of the first three years of the Levy.

In Table 1, the amount of funding to be allocated to particular types of measures is categorised as Small (less than 1% of the Levy which equates to less than about $100,000), Medium (1% to 9% of the Levy) or Large (over 10% of the Levy or over $1 million). The percentages of funding were allocated to types of measures according to how much expenditure it was considered would be needed to undertake the measure and how likely it was that the measure would lead to significant improvements in the safety of riders. For example, road improvements at motorcycle run-off-road blackspots are relatively expensive with a strong likelihood of improving rider safety and therefore were allocated a large percentage of funding. The R&D and evaluations needed to optimise this program, while crucial, are relatively less expensive and therefore were allocated only a small/medium percentage of funding. Thus, the S, M and L recommendations in Table 1 relate to allocation of expenditure, rather than directly to the priorities that each type of measure should have.

Table 1. Recommended allocation of Levy funding.
Small (S)= <1%, Medium (M)=1-9%, Large (L)=10%+ of total funding ~ $10 million.

Type of measure	Main issue addressed	R&D, Trials	Implementation	Evaluation	Total
Education					
Improving rider hazard perception and responding	Inexperience or lack of recent experience	M	M (if R&D completed)	S (if implemented)	M
Training returned riders	Inexperience or lack of recent experience	S	M (if R&D completed)	S	M (if implemented)
Improving resources for novice riders	Inexperience or lack of recent experience	M	M	S	M
Improving the effectiveness of protective gear	Vulnerability to injury	S	S	S	S
Promotion of improved motorcycle maintenance	Instability and braking difficulties		S	S	S
Improving driver awareness of motorcycles	Intersection crashes, Failure to see motorcycles	S	S	-	S
Engineering, technology and ITS					
Improved vehicle safety of motorcycles	Various	S	-	-	S
Treat motorcycle run-off-road blackspots	Run-off-road crashes	S	L	M	L
Treat motorcycle blackspots (not run-off-road)	Intersection crashes	S	L	M	L
Treat selected high-volume motorcycle routes	Road surface and environmental hazards	S	L	M	L
Reducing injuries at barriers and roadside hazards	Vulnerability to injury	M	-	S	M
Improved signal technology (other than at blackspot and high volume locations)	Intersection crashes	S	S	S	S
Enforcement					
Improved detection of unriders	Unlicensed riding	S	-	S	S
Enforcement (cars and motorcyclists) at motorcycle blackspots	Vulnerability to injury	S	-	S	M
Improved enforcement of drink riding	Run-off-road crashes	S	-	S	S
Enhanced information for decision making					
Review of information availability and needs	Information Strategy	S	-	-	S
Better information about on-road motorcycle crashes	Under-reporting and biases in motorcycle crash statistics	M	S	-	M
Characteristics of good riders	Various	-	-	-	-
Speed and speeding in motorcycle crashes	The role of speed and speeding	M	-	-	M
Injuries in off-road motorcycling	The safety of off-road riding	S	S	-	S
Total		**L**	**L**	**L**	**L**

Estimating the benefits to rider safety

The Strategic Guide aimed to select the types of programs that are likely to have the greatest benefits in improving rider safety. The road-based programs have less risk of poor return on investment since there are known benefits for other road users. Most research will not provide a direct return, but R&D is needed to ensure that the best programs are implemented and funds are not wasted. Evaluation is essential for assessing what worked, and what did not, in order to guide future expenditure. As shown in Table 1, the Strategic Guide proposes that the Levy funds be spent on a mixture of research and development, implementation and evaluation.

To break even, (i.e., benefit:cost ratio (BCR) of 1), the programs funded from the Levy would need to result in about $10 million of reductions in injuries to riders. This equates to sparing about 30 riders from serious injury (based on BTE, 2000 figures). Road based countermeasures were considered to have the highest effectiveness and were allocated the majority of funding. Evaluations of blackspot programs in Australia have found BCRs ranging from 3 to 14. It is possible that if the measures prevent crashes, then the benefits will be greater to riders than to vehicle occupants, because of the greater likelihood of a rider being seriously injured in the event of a crash. With the influence of road-based factors on the safety of riders, a targeted motorcycle blackspot improvement program was expected to yield robust safety benefits if valid site identification procedures and effective treatment techniques could be identified.

The improvements in rider safety will extend beyond the 3 years of the Levy. The benefits of research and development are likely to occur in the future. The benefits of road improvements will begin once implementation occurs, but will continue to accrue for the next 20 years.

The program for the three years of the Levy

October 2005 marked the end of the initial three years of the Motorcycle Safety Levy program. With increases in motorcycle registrations, funds raised from the Levy totalled $AUD11.6 million over the period. The Motorcycle Blackspot Program was established early in the Levy program and earmarked for approximately 75% of the original estimated funds. Two other projects were committed to early in the program and three others identified as priorities under the Strategic Guide during 2003. Two workshops involving expert riders and industry professionals as well as independent road safety researchers were held during 2004 to identify priority projects under the Strategic Guide for the unallocated funds from the initial $10.2 million and from anticipated additional funds. The workshops identified numerous projects with potential to improve rider safety or fill critical gaps in knowledge. Projects were prioritised based on evidence of their impact on rider safety, input of experts, feasibility and consistency with funding allocations in the Strategic Guide for each type of measure. An independent consultant then scoped the required tasks and costs of the 18 highest priority projects. A program fully allocating the first three years of Levy funding was approved by the Minister for Transport in late 2004. These projects are listed in Table 2 adjacent to the type of measure and priority motorcycle safety issue addressed. Table 2 also shows the progress.

Table 2 includes some types of measures where no allocation of funds has been approved (orange shaded sections). This occurred because no relevant project could be identified, projects identified were not considered of sufficient value to motorcycle safety, or funds were being allocated from other sources. The unallocated areas where government agencies have conducted projects with funding from other budgets are indicated.

Table 2. Motorcycle Safety Levy Projects and their progress under the Strategic Guide.

Type of measure	Main issue addressed	Projects	Progress
Education			
Improving rider hazard perception and responding	Inexperience or lack of recent experience	Research into hazard perception and responding by motorcyclists	Stage 1 completed, Stage 2 research underway
Training returned riders	Inexperience or lack of recent experience	Limited evaluations funded by Vic Gov	
Improving resources for novice riders	Inexperience or lack of recent experience	Redevelopment of the Victorian Rider Handbook for learner riders	Handbook released October 2004
		Redevelopment of the motorcycle knowledge test	Approved - in development
		Development of an information resource (DVD & website) on the Great Ocean Road	In progress - draft completed
Improving the effectiveness of protective gear	Vulnerability to injury	Protective clothing research, cost/benefit & star system	Approved - in development
Promotion of improved motorcycle maintenance	Instability and braking difficulties		
Improving driver awareness of motorcycles	Intersection crashes, failure to see motorcycles	Associative Learning Methods	Research completed March 2005. Next stage of research in development
Engineering, Technology and ITS			
Improved vehicle safety of motorcycles	Various		
Treat motorcycle run-off-road black spots	Reduction of run-off motorcycle road crashes	Blackspot treatments targeted to address rider crashes	74 projects approved for treatment, 62 completed
Treat motorcycle intersection blackspots	Reduction of intersection crashes by motorcyclists	Intersection blackspots targeted to rider crashes	One project approved
Treat selected high-volume motorcycle routes	Road surface and environmental hazards	Cost effective engineering treatments along the length of high risk roads for riders	21 projects approved
		Evaluation of engineering programs for motorcyclists	Assessing methods & timing of full evaluation
		Evaluation of prior blackspot programs for effects on motorcyclist crashes	Scoping underway
		Review of engineering maintenance practices	1st stage review complete - report being prepared
		Communications strategy for road designers & engineers to consider motorcycling needs	To commence once above project is completed
		Research into road based perceptual countermeasures	Approved - in development
Enforcement			
Improved detection of unriders	Unlicensed riding	Vic Gov funded project	
Enforcement (cars and motorcyclists) at motorcycle black spots	Vulnerability to injury	Vic Gov funded project	
Improved enforcement of drink riding	Run-off-road crashes		
Enhanced information for decision making			
Review of information availability and needs	Information Strategy	International Motorcycle Safety Conference	Preliminary investigations undertaken - on hold
Better information about on-road motorcycle crashes	Under-reporting and biases in motorcycle crash statistics	Motorcycle Exposure Study	Approved - in development
Characteristics of good riders	Various		
Speed & speeding in motorcycle crashes	The role of speed & speeding		
Injuries in off-road motorcycling	The safety of off-road riding	Extent of injury among off-road riders	In progress
Levy Support			
Direction/strategy		Development of Strategic Guide	Research completed. Contract report delivered
Communications		Communications to riders about the Levy	Brochure & website complete - updated Oct 05

To date, four research projects have been completed and two information resources have been completed. However, it is the road engineering projects that have seen the most implementation progress. A total of 96 locations with high motorcycle crash rates have been approved for treatment with road improvements completed at 61 locations. All of these 61 projects include expert motorcyclist and engineering reviews of the locations and the projects were developed with treatments targeted to address factors assessed as possible contributors to the motorcycle crashes. This represents a new approach to road engineering for motorcycle safety. It is believed that a large-scale targeted approach to treating motorcycle blackspots with detailed crash analysis and expert review has not been conducted anywhere else in the world. Of the 96 projects, 21 recently approved projects comprise treatments along the whole length of high risk motorcycle routes to improve the consistency of conditions and delineation as well as warning and advisory signs. This mass action approach was considered to be a cost effective proactive approach on routes experiencing consistent numbers of motorcycle injury crashes, but where no isolated location could be identified as a blackspot.

Evaluations

The estimated BCR of all projects in the Motorcycle Blackspot Program was 5.2 based on the calculated benefits derived for different treatments types implemented under blackspot programs for all road users. That equates to over $30 million in crash cost reductions derived from less than $6 million expenditure. More importantly this is sparing riders and the community from serious road trauma. Preliminary investigations suggest that this estimate could be conservative. An evaluation based on the first 50 treated blackspot sites indicated that there was a 37% reduction in rider casualty crashes after adjusting for exposure by using control sites from around the relevant local government area. If these findings could be applied over the life of the road treatments and continued across more recently implemented blackspot improvements, the benefits of the program would be considerably greater than 5.2 times the cost. However, these findings are preliminary and will require an additional 18 months of data in order to establish statistically reliable results.

Further benefits will accrue from the evaluation of which treatment types are most effective. This will allow development of road treatments that are the most cost effective in preventing motorcycle loss-of-control type crashes.

The benefits accruing from the research projects being conducted will not be able to be assessed until countermeasures identified in these investigations are implemented. The research program investigating new methods of training to increase driver awareness of motorcyclists is particularly speculative. However, if proven viable, then this would help to address one of the major intractable road safety problems for motorcyclists - drivers failing to give way.

Beyond the three years of the Levy

Prior to the end of the three years, the Victorian Government announced that the Levy would be continued for another two years to provide sufficient time to evaluate outcomes of the program. The continuation allows for some initiatives identified through R&D to be trialed or implemented. It also allows for some of the R&D programs identified through expert workshops to be undertaken. However, a process will need to be undertaken to adjust the Strategic Guide given greatly increased funding, additional time and the additional knowledge gained to ensure that the Strategic Guide remains relevant and continues to provide strategic direction.

This research and the other investigations aiming to identify or trial potential new countermeasures would never have been undertaken without the dedicated funding source because it could not be established that the returns would be justified for a small minority of road users.

CONCLUSIONS

The Levy has provided an opportunity to fund programs that will result in real gains in rider safety. The Strategic Guide provides direction for allocating funds encompassing best practice and knowledge in the area of motorcycle safety. This aids in the development of new initiatives that will provide the greatest value from the dedicated funding. Collaboration between VicRoads and VMAC has also been essential in the identification of a relevant and prioritised safety program. Funding has been expended on initiatives that address the predominant crash types and major contributing factors. A number of the funded projects are believed to be world firsts. The Motorcycle Blackspot Program in particular is showing early signs of valuable gains in motorcycle safety. It is hoped that the considered and strategic approach to determining funding allocations will result in meaningful road safety benefits for motorcyclists that far exceed the costs of the program. Programs that are proven effective can subsequently be implemented outside Victoria with limited development costs.

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Disclaimer:
The views expressed in this paper are those of the author and do no represent the views of VicRoads or the Victorian Government.