

Motorcyclists' view of advanced technology for motorcycle safety

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Abstract

Intelligent Speed Adaptation (ISA), Automatic Crash Notification (ACN) and Advanced Braking Systems, which include anti-lock braking systems (ABS), linked braking systems and emergency brake assist (EBA) are developments which hold out promise for improving motorcycle safety. VicRoads engaged ARRB Group to investigate the feasibility of these technologies in the near future and the likelihood that these technologies would be accepted within the motorcycling community. Interviews were conducted with nine individuals who were expert in motorcycling safety or vehicle systems. Discussions were conducted with eight rider focus groups which attracted riders of different ages and motorcycling expertise, and who rode different types of machines. All ITS systems investigated were expected to have positive impacts on motorcycle safety by a group of experts interviewed separately from the motorcyclists. Riders were generally more sceptical. While they recognised that ACN would have safety benefits for a small number of riders, they were not convinced that ISA would have safety benefits and were divided over whether advanced braking systems would have safety benefits or not. Rider opinion about advanced braking systems was not based on practical experience since very few riders had ridden motorcycles with these features. Barriers to the uptake of ITS safety technologies, and actions to advance the case for safety-related ITS, are discussed.

Keywords

Motorcycle, ITS, focus groups, opinions.

Introduction

Travel by motorcycle represents a relatively high-risk form of transport, and motorcyclists are generally over-represented in fatal and serious injury crash statistics. High crash rates have been attributed to many factors, including motorcycle instability and low visibility, while high injury and fatality rates are primarily the result of the lack of protection offered by a motorcycle and motorcyclist apparel in a crash. VicRoads has identified vehicle-based Intelligent Transport Systems (ITS) as a possible method of reducing the number and severity of motorcycle crashes. The identification of ITS technologies most likely to provide benefits to motorcycle safety has been undertaken for VicRoads (Bayly *et al.*, 1). From this study, three ITS technologies with significant potential for either reducing the severity or occurrence of motorcycle crashes were identified, based on a review of the most frequent motorcycle crash types and the crash type potentially addressed by each ITS. The ITS technologies identified were:

- Intelligent Speed Adaptation (ISA)
- Automatic Crash Notification (ACN)
- Advanced Braking Systems, which include
 - anti-lock braking systems (ABS)
 - linked braking systems
 - emergency brake assist (EBA).

VicRoads engaged ARRB Group (ARRB) to investigate the feasibility of implementing these technologies, and the likelihood that these technologies would be accepted within the motorcycling community.

The objectives of this project were:

- to assess the feasibility of implementing each of the ITS technologies

- to assess the likelihood of acceptance of the ITS technologies by the motorcycling community.

Consultation Processes

Interviews were conducted by one of the authors with individuals from the transport industry who had intimate knowledge of motorcycles or ITS, and with a few individuals from motorcycle suppliers being expert in both areas. Interviews with individuals based in Melbourne were conducted face-to-face, while telephone was used for those few interviews held with people in other centres in Australia. Nine individuals, representing motorcycle manufacturers, the ITS industry, police and road safety interests, were interviewed.

Each consultation began with the co-author providing a brief explanation of the ITS systems. In almost all cases, these systems were well known and understood. The stakeholder was then asked a series of questions regarding their opinions on the feasibility of each ITS technology which focussed on the following areas:

- qualitative indication of the expected benefits for motorcycle safety
- current availability or level of development of the ITS technology
- potential for implementation
- level of applicability to motorcycles, in the expected potential for installation/retro-fitment of the ITS technology
- expected delivery timeframe for the ITS as a commercial product
- predicted or actual cost of purchase and installation
- extra features of the ITS technology
- potential for packaging ITS systems.

Individuals were asked slightly different asked questions, designed to tap into their particular area of expertise (for example, motorcycle manufacturers were primarily asked technical questions and police force members questions based on the expected effects on motorcycle safety). Their responses were collated to give an overview representative of the group.

The opinions of motorcyclists regarding ITS safety features were explored using a series of focus group sessions. Seven groups had between six and eight participants and one group had four. Each session began with the moderator delivering a Power Point presentation which explained the purpose and methods of operation of each of the ITS technologies. Participants were then provided with a handout containing reference material drawn from the presentation and asked to discuss each of the options in turn, the discussion being recorded in full. Each session lasted approximately 90 to 105 minutes. The moderator intervened as little as possible, allowing the discussion to follow its natural course. Interventions were necessary to change the topic and ensure all issues were covered, and to ensure only relevant topics were discussed.

Recruitment was effected through a variety of means including motorcycling groups and websites, rider training and licensing facilities, and word of mouth. All participants were paid the sum of \$50 for their contribution. All focus groups were held at ARRB's head office in Melbourne's outer eastern suburbs.

These methods succeeded in recruiting a broad cross-section of riders who differed in age, experience, amount of riding they did and type of machine ridden. The groups may be broadly characterised as follows:

Group 1: Generally an older group, all riding large machines (with one exception, a scooter rider who began riding relatively late in life). This group did relatively little riding, and recruitment was by a variety of means.

Group 2: Similar to Group 1, but with greater weekly riding hours. Again, all but one rode large machines.

Group 3: A younger group with similar riding hours to Group 2, but with only two riding large bikes.

Group 4: Slightly younger than Group 1, but with similar riding hours and only riding large machines. Internet recruitment predominated.

Group 5: Similar age to Group 4, but with higher riding hours and all riding large machines; only one person in this group was recruited via the internet.

Group 6: Similar age and riding hours to Group 5, but with more internet recruitment.

Group 7: A younger group, recruited mainly through the internet, and generally riding 250 cc machines.

Group 8: Older than Group 7, but younger than all other groups. All rode scooters or 250 cc motorcycles. Most were recruited via the internet.

There were three stages to the analysis of the group discussions. First, each group discussion was recorded using a digital recorder, and the audio file stored on computer.

Second, each group discussion was transcribed from the recording. The transcription was not a verbatim description, but attempted to preserve the meaning and intent of the participants' input.

Third, a matrix was prepared for each of the issues discussed. The columns in this matrix represented the major themes raised in the discussion and the cell entries represented the distinctive features of the discussion of each group on that particular topic. While it was not possible always to use the participants' exact words and phrases, care was taken to ensure that the entries reflected the meaning intended.

Results

The results are reported as integrated overviews of the opinions relating to each of the ITS options. The distinctive aspects of the expert and rider groups have been maintained.

Experts took the view that ISA would reduce the incidence of rider speeding, and thus have a positive impact on motorcycle safety. Riders' opinions were mixed, some regarding ISA as unnecessary as they were well aware of their own speeds, or even as regarding ISA as unhelpful as it discouraged riders from being aware of their own speed. Others regarded it as useful for avoiding fines in areas where the speed limit changed frequently. As a result of these views, few riders thought it would improve safety.

Riders rejected the notion of ISA actively limiting the motorcycle's speed. Expert opinion reinforced the view that active control of speed had the potential for adverse safety outcomes, and indicated that it would be difficult and expensive to achieve.

Most riders did not regard ISA as being good value for money. Some riders would be prepared to pay more if a full navigation system based on GPS was included. Most riders seemed to be prepared to pay \$300 or less. At the time of the study, a version of ISA was available (although aimed primarily at the car market) for \$649 for the equipment plus \$72 annual subscription.

Riders wanted complete coverage of all types of speed zones, including variable and temporary zones e.g. school zones or road works. While there appears to be no obstacle to accommodating part-time zones, it may be difficult to do more than indicate that travel is occurring in a variable speed zone and the rider should look for the variable sign. Expert opinion was of the view that fixed roadside signs would not be feasible, due to significant cost and lead time, and possible tampering and theft, which may make it difficult to cater for temporary speed zones.

Expert opinion was of the view that the construction of a database which captures all national speed limits is not feasible, due to the significant cost and lead-time involved, and expected problems with accuracy. Some riders did express concern about the accuracy of the system and liability if the system gave the wrong information. The extent of coverage which can realistically be achieved by speed zone databases and the acceptability of this to riders require further investigation.

Expert opinion indicated that ISA could be distracting for riders, a view which riders themselves endorsed. There was no consensus amongst experts or riders as to what form of display would be best, although riders were clear that they wanted a simple display. Further detailed research is necessary to establish how easily riders can use different forms of display and what their preferences for different forms of display are.

ACN systems for passenger vehicles are already commercially available locally and overseas. Finlay and Morphet (2) demonstrated that ACN systems can be installed successfully on some types of motorcycle.

Both experts and riders expected ACN to provide safety benefits to riders (particularly solo riders in rural areas) by decreasing critical incident response times when crashes occur.

Riders recognised that a cancellation function was necessary to prevent false alarms when the system was activated but not required, and some thought that a voice link with the emergency call centre would be preferable.

Riders pointed out that the effectiveness of ACN systems depends on the communication system used. Both current and proposed systems use the cell phone network. Cell phone coverage across Australia is incomplete and has significant gaps in hilly country, where some of the most popular recreational motorcycling routes are located.

ACN systems can also be packaged with a tracking function, which can be activated if the motorcycle is stolen. Both experts and riders agreed that this would be an appealing feature for motorcyclists.

Industry estimates varied, but one manufacturer estimated the base cost for the equipment at \$300, plus an ongoing charge of approximately \$350 per year to cover the cost of the call centre and rescue services. Riders generally thought ACN would be good value for people who needed it, but the idea of an ongoing subscription to pay for the emergency call centre was widely disliked.

Anti-lock braking systems and linked braking systems are already commercially available on some motorcycles, particularly larger, more expensive sports motorcycles and touring bikes and also some scooters. The challenge is to make this technology more widely available on smaller machines suited to inexperienced riders who would be likely to benefit most.

Emergency braking assist is not yet available on motorcycles but is available on some models of car. There appears to be no technical barriers preventing the transfer of this technology to motorcycles.

Expert opinion expected that advanced braking systems would provide safety benefits to riders by providing assistance with braking manoeuvres, particularly in emergency situations. Rider opinion was divided. While some agreed that advanced braking systems would improve safety, many riders were apprehensive that advanced braking systems would undermine the development of braking skills and leave riders worse off.

Experts and riders agreed that advanced braking systems may provide safety benefits for the majority of braking manoeuvres but could possibly be detrimental in some scenarios, where a skilled rider could stop more effectively. However, it was pointed out that most riders do not attain this skill level, and that even highly skilled riders experience difficulty in performing required manoeuvres in emergency situations.

Riders had some concerns regarding the potential for the system to operate in a manner the rider did not expect, disrupting the rider's braking routine.

Rider opinion about advanced braking systems was not based on practical experience with the systems, very few riders actually having ridden motorcycles with any of these features.

Estimated costs were \$2-3000 for each of the three options, with savings if all three were packaged as one system. Riders thought that whether or not advanced braking systems appeared to be good value for money depended on the value of the motorcycle. At current costs, it was reasonable value on expensive motorcycles, but unrealistically high for the smaller motorcycles and scooters that learners were most likely to buy.

Discussion

Each of the ITS technologies investigated was primarily designed for use in passenger vehicles, and as a result may not be easily transferable to motorcycles, or be expected to have similar safety benefits. This is primarily due to the inherent differences between motorcycles and passenger vehicles in the following areas:

- on-road dynamic performance
- operating environment
- severity of crashes and their causal mechanisms
- the needs, habits and attitudes of riders compared to drivers

The expert group thought that all ITS systems investigated would have positive impacts on motorcycle safety, but riders were generally more sceptical. While they recognised that ACN would have safety benefits for a small number of riders, they were not convinced that ISA would have safety benefits, and were divided over whether advanced braking systems would have safety benefits or not.

All investigated ITS technologies should be fitted to the motorcycle at time of manufacture, for the following reasons:

- Aftermarket systems have the potential to require modifications to be made to the motorcycle. The level of modifications required in these cases would most likely void the manufacturers' warranties.
- Due to differences between motorcycles, aftermarket systems are required to be custom-built, as one solution would not suit all motorcycles. Thus, such systems have the potential to be costly, and all systems may not have similar functionality.
- Riders generally disliked the idea of retro-fitting equipment and wanted ITS to be provided as part of the initial purchase package.

If ITS have to be fitted by other than the manufacturer, the level of interface with the motorcycle and/or modifications required to the motorcycle should be the minimum consistent with system functionality.

It is feasible for extra features to be included in some ITS systems, or for some ITS systems to be packaged together. This is particularly applicable for ISA and ACN, as similar technology is used in each system. The advanced braking systems would also share many sub-systems and components.

While expert opinion considered that the ITS technologies presently available in the Australian marketplace were priced within reach of the average motorcyclist, riders generally considered the current estimated prices as too expensive for what they offered.

Many experienced riders were reluctant to have a technical system take decisions away from them. Coupled with this reluctance was a belief that widespread availability of ITS would undermine the development of riding skills to the ultimate detriment of rider safety, and that more emphasis should be put on training programs.

Some riders were suspicious of the authorities' interest in investigating ITS, and were concerned that it might be used for surveillance and enforcement purposes.

Barriers to the uptake of ITS by motorcyclists

A number of barriers to the uptake of the technologies were identified in the discussions. The barriers relate more to the perceived effectiveness and benefits of the technologies, though anticipated cost is a barrier in some cases. The points made about barriers are summarised below, organised by ITS technology.

Possibly the greatest barrier to the uptake of ISA was a widespread view that the system was not particularly useful as many riders felt they were aware of their operating speed and usually knew what the speed limit was, although it was generally conceded that ISA would be useful where speed zones changed frequently, e.g. in urban areas. An estimate of the proportion of riders who favoured the technology and who would be likely to take it up would have to be based on quantitative research with a larger sample of riders who were carefully selected to be representative of riders as a whole rather than the qualitative approach adopted in the present study.

Another potential barrier to the uptake of ISA was the type of display used to present the speed information. There was a widespread, clearly articulated demand for a system which:

- was as simple as possible
- could be easily noticed and absorbed under all lighting conditions
- if visual, was mounted close to or integrated with the speedometer
- took into account time-related speed zones and variable speed limits in some areas; ideally it would take into account temporary changes in speed limit as well, e.g. at road works.

There was some debate as to whether a visual or auditory signal would be preferable, which may come down to individual preference.

Cost was also a barrier with most groups believing that the \$650 outlay too much for the system. And there was resistance to an ongoing subscription in addition to this. Simplifying the display and other aspects of the system could help reduce costs.

Despite the need to reduce costs for all riders, some riders indicated it would be useful to have the full functionality of a GPS navigation system, since the ACN system required investment in the GPS platform. Lack of clear differentiation between options is another barrier to uptake.

A major barrier is the deeply held belief on the part of some riders, mainly experienced ones, that this type of support is likely to inhibit the development of riding skills. Their belief is that providing advice when the speed limit is exceeded will lower awareness about matching riding to the environment and result in less skilled riders and/or less attention to the riding task, with a consequent increase in crashes. It needs to be said that this view has evolved without any riders in Australia having directly experienced ISA on a motorcycle.

The main barrier to the uptake of ACN is its limited usefulness, as it would only be really useful for riding in the country, and then only for those who were riding alone, especially those riding at night. However, it was generally thought to be a useful system for those who needed it, and no serious objections were raised.

A second barrier is the need for a clear description of how the system would operate, given the range of possible options discussed in the groups. A cancellation function or voice link emerged as an essential feature. Some riders wanted the system to inform next of kin as well as the emergency centre, and another group requested the ability to make a 'good Samaritan' call on behalf of other road users.

Cost was another barrier to uptake. The large ongoing annual subscription was particularly disliked.

The extent of cell phone coverage was seen as a further disadvantage, there being many 'dead spots' on popular motorcycling routes, many of which tended to pass through or along mountainous or coastal country. It may therefore be the case that this technology would be least reliable where most needed.

The main barrier to uptake was the belief of experienced riders that they were able to brake as efficiently as any of the advanced braking systems. It was the opinion of many participants that they did not require assistance with braking. An approximately equal number of riders expressed opinions in favour of some sort of brake assistance, although they did not express their views in a similarly passionate manner. Experienced riders who did not want the system for themselves agreed that it would have value for inexperienced riders, but that they should not be too reliant on enhanced braking in case they never learned the basic skills adequately.

A major weakness in the 'skills rather than technology' argument was that hardly any of the riders who held these views had actually experienced ABS or any other form of braking assistance when riding a motorbike.

Cost and availability were also barriers. The cost of advanced braking systems was regarded as acceptable for large expensive motorcycles, but disproportionately high for smaller machines. At the moment, this technology is not available as an option on small motorcycles (engine capacity of 250 cc or less), and there were concerns raised regarding the satisfactory operation of smaller motorcycles with the additional weight of these systems. This is not expected to be a significant concern, as some scooters (which can have the lowest mass of the entire fleet) are equipped with ABS and linked braking system technology.

The 'skills versus technology' argument is probably the biggest obstacle. As already pointed out, this opinion has evolved largely in the absence of any direct experience of ABS or linked braking. It also seems to have developed without taking into account any objective evidence on the actual benefits of training. It was a view articulated by both the younger and the more experienced groups.

A consequence of this commitment to the importance of skills in safe riding is the related belief that having the technology available to support riders will inhibit skill development, or at the very least reduce the incentive to acquire important riding skills. This argument tends to ignore three factors. The first is whether the skills taught can be brought into play quickly enough in an emergency situation unless the rider practises the skills frequently. The second issue is that any expansion in motorcycling may result in a large proportion of riders who are interested in motorcycling as affordable transport, rather than a life

style, and who may have little interest in acquiring any skills beyond basic riding skills. The third factor is that if the technology is truly effective, then advanced braking skills may become less important for safe riding. The history of motor transport has previous examples of once-critical skills which become redundant, e.g. using a starting handle without injuring yourself, double-declutching in the days before synchromesh gear boxes, and manual gear changing, now no longer an essential part of the driving test for candidates content to drive automatic cars.

The views on the inadequacy of current requirements for compulsory training are not particularly relevant to the discussion, but should be noted as they reflect the belief of many in the motorcycling community.

The other general issues which appear to be barriers to the uptake of the ITS options are:

- Riders generally dislike the idea of equipment which comes as an add-on rather than as a factory-fitted option.
- Riders dislike the idea of compulsion, particularly in regard to systems which they feel will take essential control away from them.
- Riders are suspicious of the long-term aims the authorities, particularly with regard to surveillance and enforcement.
- Many riders regard the technologies as too expensive, especially in relation to the costs of a small motorcycle or scooter.
- Rebates or discounts would greatly assist uptake.

What needs to be done to advance ITS for motorcycles in Victoria?

There are a number of specific actions which could be undertaken by VicRoads in partnership with road safety stakeholders in Victoria and elsewhere to advance ITS options.

A program of research and development to identify which type of display is best suited to riders' needs is required. This would involve both market research to identify the type of display preferred by riders, and human factors research to ensure that the display performed adequately under all light and/or noise conditions.

A program of technical research and development is required to ensure that the ISA system can accommodate part-time speed limits and variable speed limits. Ideally, the system should cater for temporary speed limits at road works and similar locations as well, but this may require the capacity to interact with on-road transmitters rather than rely solely on a GPS location being compared with stored information, and may be a significant complication. These first two items are essentially the responsibility of the manufacturing industry.

ISA for motorcycles should proceed along with the introduction of ISA for all vehicles generally; major demonstration programs should encompass all classes of vehicles.

Once the display and technical issues have been resolved, a demonstration program should be initiated to ensure that the riders engaged in the program have ample opportunities to convey their impressions of ISA and its effectiveness to other riders. It would be appropriate for VicRoads to be the lead agency in this, in partnership with motorcycle clubs and dealerships, as well as other state government stakeholders.

The riders interviewed in the present investigation had limited exposure to ISA and how it might operate. It would be worth conducting a similar exercise in the course of the demonstration project with a group of motorcyclists who had some involvement or familiarity with the trial to discover whether their assessment of ISA improved as a result of 'hands on' experience and a greater understanding of ISA and its operation.

A study should be conducted to determine how many single-vehicle motorcycle crashes occur in rural areas, during the day and at night. The injury outcomes of these crashes should also be examined. This would give an estimate of the number of occasions on which the technology might prove to be vital.

Market research needs to be carried out to determine what specific features it would be useful to include in the system.

A representative sample of riders needs to be asked about their riding patterns and willingness to invest in ACN.

There needs to be a systematic comparison of the benefits of rider training with the likely benefits of the ITS options, based as far as possible on direct empirical evidence. The results of this comparison need to be made widely available as a basis for reasoned debate. In the longer term, this study could perhaps be extended to examine the possibility that riders who use ITS most of the time become overly dependent on it, and that essential skills decline.

There also needs to be a systematic campaign to encourage riders to experience the current versions of ABS, linked braking and, if possible, EBA. Track days and other major motorcycling events could be a possible means of achieving this.

Rider responses to emergency situations with and without ABS, linked braking and EBA should be investigated using a sophisticated driving simulator. Full simulation of vehicle dynamics in three dimensions would be essential for this investigation. Riders should include highly experienced and relatively inexperienced riders. Views regarding ABS, linked braking and EBA and willingness to invest in them should be sought from a representative range of riders.

The case for enhanced braking systems for lower priced motorcycles should be presented to the industry, which should be encouraged to develop these options. The ground for this could perhaps be prepared by desk-top technical feasibility studies, focusing on issues of additional weight, implications of centre of gravity and likely impact on performance

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