AUSTRALIAN INSTITUTE FOR MOTOR SPORT SAFETY

AIMSS 'SAFETY-FIRST' SEMINAR PROGRAM

FRIDAY 12 OCTOBER 2007

aimss
Founded by CAMS
Australian Institute for Motor Sport Safety

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The following topics were presented during the AIMSS 'Safety–First' Seminar.
An outline of each is provided in this report.

WELCOME AND INTRODUCTION

DR MICHAEL HENDERSON - CHAIRMAN, AUSTRALIAN INSTITUTE FOR MOTOR SPORT SAFETY

Welcome to all to the first seminar of the Australian Institute for Motor Sport Safety (AIMSS). I am particularly pleased to welcome those who have taken the time and trouble to come from interstate to be with us today.

We all love motor sport, as is well shown by the number of people in this room today. But like all sports and activities that carry a risk of injury when things go wrong, motor sport has a dark side. As I think we will hear today, safety in motor sport has improved to a vast extent since its birth in the last years of the nineteenth century. However, serious injury and death still occurs, and in today's environment such unwanted events threaten the very future of the sport.

I have recently reviewed all reported fatalities in motor sport in Australia since 1925, and the findings are summarised in the table below.

The idea of this table is to provide some long-term perspective and a general guide to priorities. It demonstrates several matters of great interest. Up to and through the sixties, deaths were predominant in speedway events, which were often run on rudimentary tracks with little or no protection of any sort. By the mid-seventies circuit racing had taken over as the commonest scene for death in motor sport, and many of us can remember those years and these events only too well. Many very prominent drivers of the time died. But the annual incidence of circuit deaths then began to decline, while at the same time several fatalities occurred along with the emergence of the newer areas of the sport to become popular, especially including rallying of all kinds.

This table does not include non-fatal injuries, and the new efforts by AIMSS to create a database for injuries of all kinds will be described by Tom Gibson, one of the members of our Research Advisory Group who will be doing many of the presentations today. Many crashes require detailed examination to make sense of what occurred, and Rob Chadwick will be describing current approaches to crash investigation before joining me and others in a series of descriptions and discussions on several kinds of safety equipment. Historic racing and all kinds of rallies will then be the subject of presentations by experts in those fields, and some of the hard-working CAMS officials with regulatory duties will go on to describe some of the processes that lead to the rules that are inevitable for safety in the sport.

I have no doubt we will all learn a lot from today. We have tried to program time for questions following the presentations, but I draw attention to the time set aside at the end of the day for a full forum discussion which we at AIMSS hope will guide us in our current program planning.

The first session in the seminar is on current initiatives of the FIA Institute for Motor Sport Safety. The late John Large was the inaugural Deputy President of the FIA Institute, and was the main influence in persuading CAMS to form its own Institute with similar aims. Together with other members of the AIMSS Board and its General Manager, Rob Nethercote, we confidently expect that this seminar, one of the first important initiatives of AIMSS, will be one of the ways that John Large's vision is recognised and that the sport is made safer for all of its participants.

MOTOR SPORT DEATHS, AUSTRALIA (NOT INCLUDING DRAG RACING AND OFF ROAD)

	RACE CIRCUITS			RALLIES				SPEEDWAY		KARTS	HILLCLIMBS
	Driver	Official	Spectator	Driver	Co-driver	Official	Spectator	Driver	Spectator	Driver	Driver
1925-35	2							3			1
1936-45								1	3		
1946-55	6							5			1
1956-65	7							13			1
1966-75	11							1			
1976-85	6	2			2						1
1986-95	5		2	2	4	2	1		1		
1996-05	3	1		3	4			2		3	1
2005-	1			1	2					1	

CURRENT INITIATIVES OF THE FIA INSTITUTE FOR MOTOR SPORT SAFETY: AN OVERVIEW

DR MICHAEL HENDERSON - CHAIRMAN, AIMSS

The main aims of the FIA Institute for Motor Sport Safety are to encourage the rapid development of new and improved safety technologies, to facilitate ever higher standards of education and training, and to campaign to raise awareness of safety issues among all those involved in the sport.

The FIA Institute was established in October 2004 with a large financial grant from the FIA and the FIA Foundation, from which it continues to receive an annual grant. The Institute manages purely non-regulatory activities; it is not a regulatory body. When it was formed it took over from existing FIA research and training groups. Safety regulations, licensing and vehicle homologation remain the responsibility of the FIA World Council and its Commissions.

Specifically, the objective of the FIA Institute is to promote improvements in the safety of motor sport across all disciplines and levels, by promoting research, disseminating results and providing information on safety procedures, practices and technologies.

This work covers the following fields:

- Driver equipment
- Vehicle design
- Circuit design and spectator protection
- Rescue and medical facilities
- Race control

Further, the Institute aims to improve motor sport safety by:

- Supporting the training of officials, circuit and race personnel in safety procedures, practices and the use of equipment;
- Supporting the protection of participants, officials and the public at international events;
- Monitoring motor sport safety trends in order to identify research and regulation priorities.

The President of the FIA Institute is Professor Sid Watkins, and he is supported by an Executive Committee which includes representatives from three ASNs, the FIA Foundation and the FIA. The Director General is Richard Woods, who also heads the communications activities of the FIA.

To aid and guide the technical and educational work of the Institute, three research groups have been established.

The Closed Car Research Group is currently directing its work towards the following fields:

- Occupant safety cell
- Side impact protection
- New FIA seat standard
- HANS security
- Helmet/airbag interaction
- Accident Data Recording (ADR)

The Open Car Research Group's work includes the following:

- Debris fence modelling
- Ear accelerometers
- High-speed barriers
- Circuit Safety Analysis System
- Car launching mechanisms
- Rear-impact seats
- F1 wheel tether testing
- F1 side impact
- F1 automatic race control marshalling system
- Accident database

The Karting Research Group is working on helmets for young drivers, the effects of kart-to-kart impact, and on chest and abdominal protection.

Additionally, the Institute's Training Groups cover medical matters and safety training for officials and other participants. An Industry Liaison Group facilitates discussion on matters such as the practicality and feasibility of measures put to them by the Institute. Finally, a Centre of Excellence network identifies facilities where the state of the art in some safety matters is demonstrated in the real world.

CURRENT INITIATIVES OF THE FIA MEDICAL COMMISSION

DR DAVID VISSENGA - CHAIRMAN, CAMS NATIONAL MEDICAL COMMITTEE

There could be no better time to consider what is new on the FIA medical scene. Until the establishment of the FIA Institute for Motor Sport Safety in October 2004, the FIA Medical Commission was the sole medical body of the FIA.

Following the establishment of the FIA Institute, there was a meeting in Rome in January 2006, in conjunction with the seminar for FIA Chief Medical Officers and the joint conference with the USICMS at which the FIA Institute Medical Training Working Group was formed with an initial brief to develop a core curriculum for motor sport medical training. That work is nearing completion.

In January 2007, FIA President Max Mosley wrote to Professor Gerard Saillant, the Vice-President of the FIA Institute, *"Could you possibly give some thought to the structure of the medical services which the FIA provides throughout motor sport as well as the structure of our Medical Commission? As we have now the FIA Institute and more recently the FIA Foundation I think it necessary to consider our entire approach to medicine as a vital element of motor sport safety".*

In April 2007 Gerard Saillant produced a paper titled: *Report on the FIA's Medical Department*. That report describes a five year plan under five 'directing principles':

1. Extension of the current excellence in Formula 1's medical safety across all motor sport; both horizontally across all world championship rounds including rallies and also vertically to national and lesser events
2. Continuity in medical policy between the FIA, the Institute and the Foundation
3. Greater international influence in particular with other international sports medicine bodies and the ASNs
4. Extensive training and recruitment policy for medical and paramedical staff
5. A new anti-doping policy

Under these five principles, Professor Saillant defined a number of proposed measures:

- Re write Appendix H and Chapter 2 of Appendix I of the International Sporting Code
- Conduct a review of each year's expenditure in the medical field across the FIA, the Institute and the Foundation in order to:
  - (i) Demonstrate the relationship between the expenditure in the medical field compared with other safety related departments
  - (ii) Establish a "sort of contract" between the FIA president and the president of the medical commission based upon previous expenditure and future targets
  - (iii) Make all parties responsible for outcomes
  - (iv) Ensure that proposals for greater resources would always result in effective meeting of targets
- Restructure the FIA Medical Commission from the current membership based on what some might consider "geographical and political considerations" to a "collegiate structure":
  - (i) Three (3) CMOs from circuits and rallies
  - (ii) Three (3) medical representatives from ASNs
  - (iii) The FIA's permanent medical delegates
  - (iv) The FIA's permanent medical inspector
  - (v) Specific medical specialists nominated by the WMSC (unless already represented as above)
  - (vi) A president nominated by the President of the FIA on advice from the WMSC

  Furthermore – allocate portfolios of responsibility to members of the Medical Commission who would form working groups and would report to the Commission
- Create a Director of Medical Affairs to oversee the work of three permanent medical delegates one of whom would be present at all events including all rallies
- Regionalise the permanent medical delegate roles with (where appropriate) interdisciplinary responsibilities. For example, the delegate in a particular region might be responsible for Formula 1, WTCC and GT in that region

OTHER PROPOSED ACTIONS:

- Continue the anti-doping policy, which should be intensified with more focus on prevention, particularly to young participants, as well as punitive measures
- The extension of dope testing
- Further development of on-going training of existing motor sport medical personnel with particular emphasis on practical scenario training exercises
- Continue CMO seminars as at present but to become two days with much enhanced content
- Consider the appointment (in conjunction with FOM) of a 'family doctor' to look after the 2000 to 3000 people who travel with the Formula 1 rounds

THE FIA INSTITUTE

- Introduce the active presence of a member of the Medical Commission on all the Institute research groups
- Strengthen the functions of the medical training working group
- Create an international motor sport 'medical faculty'
- Organise 'working days' prior to each round of each world championship to provide further training to existing medical personnel as well as to recruit and train newcomers with the emphasis to be on practical scenario training

THE FIA FOUNDATION

Focussing on road trauma, initiatives should be developed to make roads safer by:

- preventing accidents
- response to accidents that have occurred
- taking action afterwards to limit the consequences

Particular attention is recommended to road accidents in developing countries. Suggested measures include:

- An international conference under the aegis of the FIA Foundation and the WHO (possibly to be held in Africa)
- A pilot project over two years in a developing country to study all aspects of road trauma, and
- Rigorous scientific evaluation of the findings

There is clearly no shortage of food for thought.

CURRENT INITIATIVES OF THE FIA TECHNICAL COMMISSION / HOMOLOGATION AND TECHNICAL WORKING GROUP

PETER LAWRENCE - CAMS MANAGER, TECHNICAL SERVICES

The FIA Technical Commission and the Homologation and Technical Working Group are the primary bodies within the FIA structure that translate the safety initiatives proposed by the other working groups and Commissions into practical regulations. They also have the primary responsibility for safety cage regulations. The Working Group/Commission is made up from technical delegates from a number of European ASNs, plus Australia and Japan, as well as representatives from two manufacturers, chosen by the FIA Manufacturers Commission.

The most significant initiatives taken by the Technical Working Groups has been the complete restructure of the FIA Safety Cage Regulations over the past three years.

Today's regulations require a significantly stronger structure, and in the case of individually designed cages requiring ASN certification, one that has been tested by Engineering Test Houses specifically approved by the FIA. In order to gain such accreditation, the Test Houses had to demonstrate that their calculations using computer modelling technology closely matched the actual test results obtained by subjecting a cage to the physical tests. There are 11 test houses approved in the world for this purpose, seven of these are in Australia.

The requirements for self constructed cages made in compliance with the basic FIA requirements are also much stronger than previously required, with additional braces required in the roof and main hoop, side intrusion and A-pillar support members.

The most recent change to the harness standard was driven by an Australian manufacturer, Fabraications, who raised the issue about safety harnesses, and the fact that these were attached to the cage but that there was no testing to ensure that the cage was actually strong enough. This was dealt with for certified cages by the introduction of a safety harness "pull test" to be done at the time of cage assessment by the safety cage engineer.

The research by the FIA Institute Closed Car Working Group on side impact structures and seats, as reported elsewhere, will have a flow through effect to the Technical Working Group. Whilst the research group will produce recommendations in relation to side impact and seating structures, it will be the Technical Working Group who will be responsible for its implementation and assessment. It is expected that these findings will flow to the Technical Working Group during 2008.

Research by the Apparel Working Group has also produced a new standard for driving gloves, the last part of the revised 8856-2000 apparel standard. The previous 1986 standard, while revolutionary in its day, had been demonstrated to have weaknesses in labelling, and experience with gloves over several decades has shown up some things that were not well understood. The old glove standard uses traditional leather for the palm area. This provides good grip of the wheel, the ability to absorb large volumes of perspiration and a modicum of flame protection. However, several incidents highlighted that natural leather shrinks, and driver's hand were pulled into useless claws when exposed to flames, resulting in some severe burn injuries for drivers unable to release the safety harness.

The new standard specifies limits on how much leather can be used, and breaks the leather into smaller regions with standard Nomex in between. This provides most of the benefits of leather, but without the serious drawbacks.

CURRENT INITIATIVES OF THE FIA INSTITUTE CLOSED CAR WORKING GROUP

RICHARD HOLLWAY - AIMSS RESEARCH ADVISORY GROUP

The four Research and Working Groups for the FIA Institute for Motor Sport Safety are:

- Open Cockpit Research Group – supervises research into safety issues relating to open cockpit racing cars
- Closed Car Research Group – supervises research into safety issues relating to closed cockpit racing cars
- Karting Research Group – supervises research into safety issues relating to karts
- Safety Training Working Group – supervises research into safety training issues

WORKING GROUP PROCESS

Each working group follows a similar pattern as follows:

- Identify a need
- Review accident kinematics
- Agree the research strategy
- Conduct research and development
- Develop production prototypes for testing
- Hold discussions with stakeholders
- Propose specifications (performance or design)
- FIA publishes regulations

FIA INSTITUTE CLOSED CAR RESEARCH GROUP

CAMS and TEGA have supported my involvement in this group and, although my primary area of involvement in Australia is with V8 Supercars, the major development area for the FIA Institute Closed Car Working Group at present is into advanced side impact systems for rally cars.

Although it can be argued that current WRC cares are very safe, the question under review is “how can we make them safer?”

Given the nature of rally, as discussed in a separate paper later in this seminar, the terrain is such that intrusion cannot be prevented completely but we can manage the energy between the occupants and the object struck. There are seven steps which can be taken to make the cars safer.

SEVEN STEPS TO A SAFER CAR

1. Increase space to maximise energy attenuation between the driver and the target
2. Have a strong supportive seat to maintain the relativity of the head, shoulders, pelvis and thighs
3. Mount the seat on strong seat rails to support the loads
4. Spread the load of impact through door caging
5. Energy absorbing device fitted to the shoulder point of the seat.
6. Use nets to help control the drivers head in oblique impacts and to support the head and shoulder areas of the seat
7. Use optimised belt anchorage points - for better control of the driver’s body, in particular the pelvis

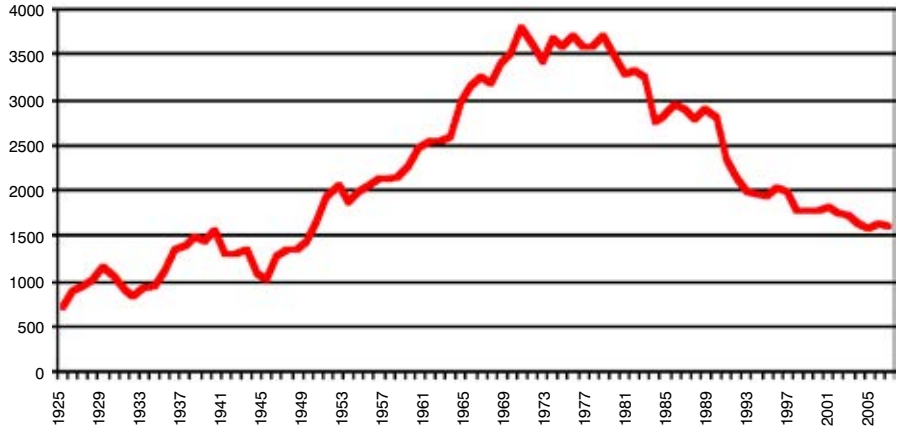
These are not necessarily new concepts but each needs to be explored against issues of access, weight and cost in order to optimise the possibilities of survival in the event of a crash.

THE RELATIONSHIP BETWEEN MOTOR SPORT SAFETY AND ROAD SAFETY

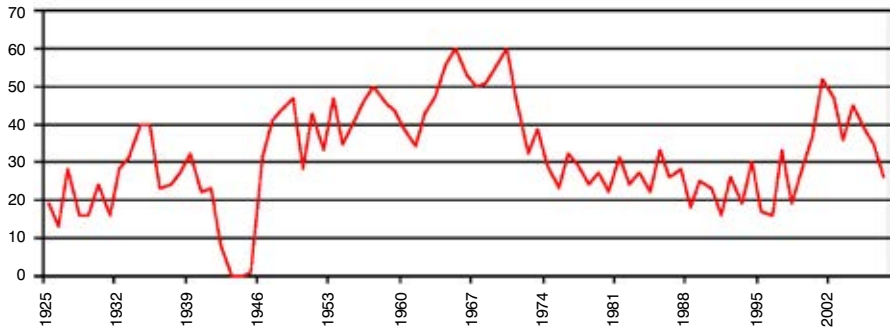
MICHAEL HENDERSON – CHAIRMAN, AIMSS

The introduction of motor sport safety measures was in many ways in advance of, and had many lessons for, the rapid improvements in road safety seen in the last two decades.

ROAD DEATHS, AUSTRALIA



MOTOR SPORT DEATHS, WORLDWIDE



The graph at top shows how annual road deaths in Australia were climbing steadily to a peak in the mid-seventies, before being brought under control and later reducing. There is a very similar shape to a graph of total deaths in motor sport world-wide, as shown in the lower graph.

However, what is apparent is that the turnaround in the seventies occurred earlier for deaths in motor sport, and the subsequent decline was steeper. Also apparent is a recent increase in annual world-wide deaths in motor sport, which is closely associated with a surge in developing countries and in unconventional categories of the sport, where the application of safety measures is lagging (for instance) contemporary circuit racing.

In other respects, why are graphs so similar?

A fundamental influence on the reversal of trends some 30 years ago was the application of science to problems that were previously attributed to bad fortune or simply human error. An early example of how science could be applied to race car – and later, road car – safety was the Pininfarina/Ferrari safety concept racing car, the Sigma Grand Prix. This was based on a 1967 Ferrari Formula One chassis and demonstrated the following safety features:

- Comprehensive restraint system with load absorbing mountings
- Head and neck restraint for rear and forward impacts
- Survival cell surrounded by crushable structures
- Collapsible steering column and dash panel
- Accident data recording

Few if any of these safety features were at that time yet to be seen in production road cars.

For both road and race safety, the importance of a systems approach to road safety became clearly apparent. The system – which can be applied to any safety issue – may be demonstrated in the case of road/race safety as follows:

	HUMAN	VEHICLE	ENVIRONMENT
CRASH PREVENTION	Behaviour Performance Training	Braking Handling Maintenance Driver aids	Road surfaces Road and track layout Signalling and warning
INJURY PREVENTION	Restraint system use Choice and use of helmets, apparel	Restraint system installation Supplementary restraints Stiff cockpit with crushable surrounds	Roadside and trackside design and installations Spectator/pedestrian protection
AFTER THE CRASH	Physical fitness Recovery from injury Access and egress	Fuel system integrity Fire extinguishing	Ambulance and rescue: access, efficiency, speed Trauma services and care

At the highest levels, motor sport safety developments have shown that death and injury in very severe crashes can be reduced to minimal levels, a principle underlying road safety's "vision zero". This holds that the inevitable crashes that do occur should not expose road users to impact loadings in excess of human injury tolerance levels.

To quote Michael Schumacher (The Guardian, 23 April 2007):

"In my racing career, I survived some very high-speed impacts. I am still alive today because the sport's governing body designed a system where safety is the prime consideration, where the car, the track and the rules work together to try to ensure that the inevitable crashes will not be fatal. This "Vision Zero" approach may sound like science fiction, but increasingly it guides the policies of those countries with the most effective road safety performance in the world."

Motor sport safety research has already led to a greater understanding of human tolerance levels for high-speed impact, and has demonstrated that survival in high-speed, high-deceleration crashes can be ensured by the application of known safety measures.

However, there is a field of research where road safety research now leads motor sport safety research. This is in the gathering and use of statistical data and large-scale crash analysis. It is important for motor sport that data collection and crash analysis is improved for all levels of the sport and for non-fatal injury.

There remain several challenges for the future in both road and motor sport safety. There is evidence that in for both fields, serious injury is becoming relatively common in newly-emerging and unconventional modes of vehicle use. This requires a reorientation of approaches for each case, especially in developing countries.

The high profile of motor sport and its participants can be used to heighten awareness of road safety in the community and thus, it may be hoped, an improvement in road user behaviour and an acceptance by governments of the need for investment in safer roads and infrastructure.

SAFETY ISSUES IN HISTORIC MOTOR SPORT

TONY CALDERSMITH - AIMSS RESEARCH ADVISORY GROUP

With over 1,700 cars dating from the 1920s to 1980s and typical race meetings having from 250 to over 500 entries, historic motor sport in Australia continues to grow and that popularity brings with it a number of challenges. The primary challenge is to retain the best possible authenticity, while at the same time try to adopt as many modern safety standards as possible.

The Historic Commission has an ongoing responsibility to review safety standards and competitor behavior to both protect the future of this popular sport and its participants and has adopted a three pronged approach under the headings of (i) Safety Equipment, (ii) Ageing Structures, Materials and Components and (iii) Competition Behaviour.

(i) Safety Equipment

To raise the bar on equipment safety, accidents are reviewed and analysed, and competitors are encouraged to install or enhance roll over protection in cars, together with adopting current safety harness standards, helmets, fire extinguishing methods, fuel equipment and seats.

(ii) Ageing Structures, Materials and Components

Given the age of the structural components of historic cars, there has to be a general recognition that over time some original components may need to be replaced. As well, there also needs to be a regime of inspection and adherence to sound maintenance schedules. Where component failures occur, they are recorded and bulletins are issued to warn other competitors of specific problems which have arisen and which may require attention.

(iii) Competitor Behaviour

The Historic Commission has established a code of driving behaviour designed to provide the pleasure of competing in historic vehicles in a safe and practical environment.

Historic race meetings now have Driving Behaviour Observers to observe the competition, assist new competitors and where appropriate to take action where inappropriate driving occurs. A particular areas addressed has been ensuring that overtaking is conducted safely and a rule developed to prevent cars competing for position taking advantage whilst overtaking of slower cars.

POTENTIAL HISTORIC RESEARCH AND EDUCATION PROGRAMS FOR AIMSS

Specific programs which might be addressed by AIMSS are research and education into the following:

- Ageing driver capability
- Magnesium castings; aging v. strength, crack detection and repair methods
- Composite ageing and the detection and evaluation of repairs
- Rollover potential from modern tyre and track surface adhesion coefficients

PATIENT EXTRICATION: THE ISSUE FACING RALLYING

GEOFF BECKER - MANAGER, MOTOR SPORT SAFETY RESCUE

Extrication from the rally car has become more difficult over the past ten years due to a combination of factors, including the design features of our modern day motor car.

A BRIEF HISTORY

- The first alert that a potential problem existed came in Australia approximately 10 years ago when the Tasmanian Ambulance Service Rescue Equipment struggled to gain entry into a Subaru Rally Car involved in a double fatal crash on a special stage in Rally Tasmania. The scenario was that the car hit a large tree on a corner at high speed. It was a difficult extrication with the rescue crew being unable to cut the “B” pillar even though the equipment complied with the specifications at that time
- From then it has proved important to source basic information in relation to some of the changes we are seeing in motor vehicle design and the effect that is having on rescue services. Subaru Australia had Fuji Industries supply technical information and the drawing of the “B” pillar was provided to the manufacturer of the Rescue Tool who advised that what was it was being asked to cut was well above the machine’s capacity
- Additionally, whilst there was an awareness of the problem, by 2004 there had been little consideration of the effect of the roll cage on extrication but one manufacturer team had Motor Sport Rescue undertake tests to ensure that the roll cage material could be cut by the equipment carried before using it in their cars and extrication teams were briefed on the problem
- A crash in 2004 highlighted the problem, as two occupants of the car had to be airlifted to hospital but only after an extended period of time as the local extrication team could not open the car
- At that time information was beginning to circulate on the internet on the difficulties of extrication from modern cars and a respected rescue site in the United States contained an article on the difficulties with Subaru vehicles
- Subaru Australia raised the issue with Fuji Industries whom supplied the latest drawings of their vehicles, including the recommended cut points on both the “A” & “B” pillars
- A growing awareness was being created by Rescue Tool Manufacturers whom as part of their research and development began working with vehicle manufacturers regarding the structural integrity of our modern motor cars

ROAD CRASH RESCUE

The major challenge for vehicle manufactures is to make the vehicle as safe as possible for its occupants, whilst retaining fuel efficiencies – this has brought about the use of high strength low alloy metals (stronger yet lighter than its predecessors), including Boron Steel, which require larger capacity cutting equipment.

For example, a section of Boron Rod cut from a Peugeot 206CC using Lukas LS530EN Cutters, with the same results achieved with Lukas LS501/511EN Cutters, required up to 70 Tonne capacity.

The challenge for cutting equipment manufacturers is to stay abreast or ahead of new vehicle technology. This is primarily to ensure that the end users, emergency rescue services have the most efficient and effective rescue tools available to them.

SOME RECENT RESEARCH IN AUSTRALIA

- In 2006 a 2005 Subaru STI Spec C shell fitted with a Bond roll cage was provided by Les Walkden. Equipment for the test was provided by PT Rescue. Gauges were checked by engineers pre- and post-test
- The results of this test revealed that to cut through “B” pillar roll cage only was 31 Tonnes, and to cut through the side intrusion bar – roll cage took 27.9 Tonnes

SUMMARY

- Huge cutting forces are now being required to cut components of a rally car. Together with the car manufacturers’ use of stronger materials, the need for rescue services is to carry larger capacity equipment, up to 100 Tonne capacity
- Alternative methods are considerably slower with some unsuitable
- There is a need for more research and dissemination of information to local rescue services

ISSUES IN THE ADMINISTRATION OF SAFETY STANDARDS IN AUSTRALIAN MOTOR SPORT

BRUCE KEYS - CAMS MANAGER, SAFETY AND MEDICAL SERVICES

SAFETY DOES NOT WIN RACES

If safety shaved a half a second from their lap times, then motor racing would be the safest sport known to man. There would be a stampede to the local motor sport shop every time a new safety initiative was announced.

There is no component of safety which is measurable in an active competition sense – until something goes wrong. Then every ounce of engineering, design, fabrication and technology at our disposal is needed to produce a positive outcome, or perhaps that should be a less negative outcome, as there are not many positive outcomes in crashes. Sadly, for administrators and evangelists for the cause, safety does not win races.

WHY THEN DO COMPETITORS INSTAL SAFETY?

There is no doubt that a significant part of the reason why competitors instal safety items in their cars, such as multi-point attachment roll cages, 6-point seat belts, flame sensing fire extinguishers, rubber bladder cellular foam fuel tanks and even metal valve caps, is simply because CAMS regulations say they have to do it.

Some alternative sanctioning bodies, for some forms of motor sport which have traditionally been conducted under the sanction of CAMS, have attracted entries from competitors whose cars and drivers may not meet the current CAMS safety standards.

There are numerous instances of late where CAMS licensed drivers have put the issue of gaining a competitive edge over their fellow drivers before the consideration of basic safety. They sought to have the rules of safety changed so life could be easier or to make their cars go faster.

Until recently there has been a reluctance by CAMS Commissions, Panels, Committees and Boards to actively review and investigate incidents at motor sport events, quite possibly due to the fear of potentially embarrassing outcomes.

In 1997 the CAMS National Track Safety Committee instituted a process to obtain simple crash data statistics. The reluctance of many of the Track Operators to supply the required information was frustrating. Why? Perhaps there was a fear that it would clearly demonstrate that there was a need to institute safety controls at specific locations, thus denying the opportunity to argue against spending to provide a safe environment.

We all know that seat belts are a positive factor in saving lives and significantly reducing injuries in the vast majority of crashes. Yet there remains a small group who believe that the retention of originality of a vehicle is more important than providing a safer environment for the driver in cars which are raced. There is also a group who believe that the use of window nets deter the spectators from seeing the drivers and they have been allowed not to use the simple and basic protection offered by such devices, even though the majority of races at which they run attract less than 100 paying spectators.

SO, WHAT IS THE POINT?

Very simply, if people are willing to put the issue of competitiveness, cost, originality, facility for argument, personal comfort and ego ahead of their reasonable personal safety – in what can be argued is an environment where the uncontrolled risks are greater than any other sporting, workplace or entertainment environment on earth – then **the message that safety in motor sport is a good thing - has failed.**

A 'SILVER LINING' TO THIS CLOUD

That means that collectively, we have all failed in our primary mission. However, the proverb says "every cloud has a silver lining". One of the tasks for all of us is to change that culture of negativity and ensure that safety is seen not only as a good, healthy, positive practice, but one which can be openly and comfortably discussed by us all:

- Drivers should have no fear of being called "wooses" just because they want to stop their arms being crushed in a roll over
- Track Operators should be proud to display their new trackside installations
- Engineers should be able to gloat about the increase in torsional rigidity of their chassis design which allows the driver to survive an impact at 25 km/h higher speed as well as being 0.75 seconds per lap quicker around Bathurst
- Organisers should be encouraged to identify risk areas of their events and develop new, interesting and intelligent ways of controlling those risks within the given environment

OH&S – THE MOTOR SPORT WORKPLACE

In the past three years, we have had to introduce the notion that the motor sport environment is a workplace and thus is subject to the laws of Occupational Health and Safety. We have had to ensure we have processes for avoiding simple things like leaving electrical leads in puddles and conducting

site inductions so drivers know where flag points are before they go onto the circuit, rather than waiting until they get charged for passing under yellows.

If there is anyone who doubts that motor sport events are treated by the civil authorities as workplaces, CAMS received a fine from the NSW Industrial Relations Court for $80,000 as a result of a fine for being in breach of the NSW OH&S Act at a race meeting in 2004.

During the three years since the introduction of the CAMS OH&S and Risk Management Policy, it has become apparent that there is a positive reluctance by organisers, competitors and officials alike to consider that they have an obligation to the OH&S Laws, or that, in order to discharge that obligation, they need to consider what the dangers or hazards exist at their event or in their activities. They appear to be, quite simply, embarrassed to talk about safety. It is not the done thing. They don't want to think about what they are doing which could hurt someone.

DON'T KILL THE MESSENGER - CHANGE THE CULTURE AND 'GET EXCITED' SELLING THE MESSAGE!

The preceding provides an idea of some of the hurdles in the process of administering safety in today's motor sport environment. No one gives thanks for giving a hard time about being safe. And, no one will ever admit that they were wrong and the safe way was right.

There are hurdles to jump, costs to reduce, philosophies to challenge, cultures to change and positive messages to sell, and all within a hostile and ego sensitive environment.

The discussions in this seminar will stimulate a great deal of thought and hopefully produce some very positive results in months and years to come. Perhaps one way to change the perceptions to the issue of safety in motor sport can be achieved by putting excitement into motor sport safety. After all motor sport is, above all else, exciting – it was after all Big Kev who said "I'm excited" after being driven around Bathurst by Paul Morris some years ago.

We need to put excitement into motor sport safety - to stop it being a boring, closet subject which is only spoken about by men in dirty white dust coats with slide rules in their hands and reading glasses on the ends of their noses.

Maybe this seminar is our coming out party. So, lets all come out! Let's be excited by safety in motor sport. I am. It will be contagious - and I hope we will all be infected!

SELLING SAFETY – A RISKY BUSINESS!

PETER LAWRENCE – CAMS MANAGER, TECHNICAL SERVICES

WHY IS REDUCING THE RISK OF DEATH AND INJURY SO HARD?

Organisers and competitors have concerns because they recognise that what they do is risky. They accept that risk and want to minimise that risk but generally this comes with some issues:

- Cost: Competitors have limited funds to spend on 'fun' which they know money will buy and 'safety' which they hope they will never use. Therefore, there is a strong incentive not to spend money on safety that could be spent on FUN
- Inconvenience: Many safety requirements impose a deal of inconvenience and discomfort such as safety cages restricting entry, flame retardant overalls retain heat and head restraints restrict movement
- Philosophy: There are many competitors who hold the view that modern safety requirements reduce performance, don't give the thrill they want, don't look right, sanitise the sport and "It's not what they used to do."

To deal with these issues requires a qualification in Juggling 101. Motor sport regulators must balance desire to reduce risk, and need to obtain reasonable insurance, as well as meet legislative requirements against the possibility of driving people out of the sport or having them turn to a regulator with lesser requirements, or worst of all having them move to illegal motor sport.

WHAT STRATEGIES CAN BE USED?

These are the many and varied initiatives which have been raised at this seminar but essentially they revolve around two approaches:

- Education: Providing information to inform all participants about the best practice, and
- Attitude: Making organisers and competitors more receptive to safety - **This is the hard part!**

COMPETITION HARNESS FITTING AND LIFE

ROB CHADWICK – AIMSS RESEARCH ADVISORY GROUP
MICHAEL HENDERSON – AIMSS CHAIRMAN

Schedule I, under General Requirements for Automobiles in the CAMS Manual, provides excellent general advice on the fitting and recommended mounting points for safety harnesses. More detailed advice is provided in fitting instructions provided with motor sport harnesses made by major manufacturers with experience in safety.

Careful attention to these recommendations and requirements is essential. In a crash at about 38g, the occupant will move a surprising distance despite being restrained by a full six-point harness.

HARNESS FITTING

Critical to a good installation are the following:

- A clear path for all belt lengths
- Short belt lengths, adjusted tightly
- 75mm webbing to spread loads
- Twin crutch straps to minimise pelvic movement and stabilise the entire system

An example of the importance of attention to detail is shown by the crash resulting in the fatal injuries of Dale Earnhardt, where a lap belt breakage led to his head striking the steering wheel and a fractured base of skull.

In summary, there is no single measure more important for motor sport crash protection than the correct fitting and use of a safety harness.

An aspect of restraint harness use that has been taken up by AIMSS as a subject of study is the useful and effective life of a harness. Competition vehicles in Australia are fitted with a wide variety of harnesses. The more recent ones carry an expiry date of five years from the date of manufacture. This is based on an FIA ruling but the vast majority in competition vehicles carry no dates at all, either manufacture or expiry.

HARNESS LIFE

This raises the question, “What is the effective life of a competition harness?” or alternatively, “Is there an effective life of a competition harness?”

Currently no data exists to support or reject the notion of an expiry date on a competition harness. From research done on passenger-vehicle seat-belt life, the conclusion was that there was no limit to the effective life provided they were not subjected to mechanical damage.

The AIMSS Research Advisory Group proposal is to establish a testing protocol such as body block testing, and then subject a number of used competition harnesses, of varying ages, use and manufacture, to the test.

The analysis of the data would then establish if in fact there is the need to respect the expiry dates. Some initial investigation has been conducted and preliminary discussions held with one of the two test houses in Australia capable of conducting such testing. The next phase is to write the testing protocol, establish a testing program and source funding for the work.

SEAT STANDARDS AND MOUNTING

DAVID BLACK – MANAGING DIRECTOR, RACETECH MANUFACTURING LTD
PETER LAWRENCE – CAMS MANAGER, TECHNICAL SERVICES

SEAT STANDARDS

The First FIA seat standard was introduced into International Motorsport in 1992 with it becoming mandatory for WRC events in 1996. The current standard is FIA 8855-1999 seat standard and testing. The third FIA seat standard which is about to appear is being termed "for Advanced Racing Seats" and is intended for implementation for the WRC in 2008 and possibly other high level FIA sanctioned series.

The development process of the new standard has been between 2003 and 2007. The first part of the process was to recognise that there was a need, as deaths were occurring. It began by examining existing seats and their mountings. Tests of existing products have been done recording injuries along with tests of possible new direction seats and corresponding injuries. The findings were discussed with stakeholders, including the seat makers, teams and test houses which led to refinements, more testing to establish in both dynamic and static situations to establish final loads and deflections. From this the draft standard has been developed and is in final states of discussion with stakeholders prior to adoption and implementation.

The 'draft' new FIA Seat Standard responds to rearward and lateral loads, with forces based on true data from testing and actual accidents collected by crash recorders. It is far more detailed than before, specifying support to various parts of human body, energy absorbing foams and allowed deflections to take total simultaneous lateral load of 37.5kN applied to the head, shoulder and pelvis. Also, brackets and mountings have been included in testing and are part of the standard.

A LAYMAN'S VIEW

For the layman, the following would be of interest:

- Front and rear impacts rarely cause death now that we have head and neck restraint devices
- There are four critical parts of the body to support in a lateral impact - these being - head, shoulder, pelvis and thigh. If all keep in same relationship to each other the human body can handle huge "G" impacts
- A 100kg driver having a 50 "G" impact will cause approx a 5 Tonne spike load on the seat
- Lateral impacts of 81 "G" have been measured – with no injury
- Survivable impacts well over 100 "G" have been measured in actual motor sport crashes
- The body should be stopped at a rate as close to the chassis deceleration as possible
- Only 20% of body movement in a frontal deceleration is belt stretch – the balance is body reconfiguration.

Other issues to be considered in race seat design and usage:

- It is still up to the team owner/driver/engineer to choose the best product for the purpose and instal it correctly while understanding the true importance of a racing seat. This implies a need for education and delivery to the people who need it.
- The seat is only part of the total package and how seats are mounted is also of vital importance.

SEAT MOUNTING

The previous discussion centres on the seat and it is important to note that safety harnesses bear nearly all load in collisions up to 20 degrees either aside of straight ahead. As collision become more lateral, seat begins to bear a greater load, particularly at the shoulders and short shoulder harnesses can assist. In collisions from the rear the seat bears all the load.

Noted above is that the new seat standard will include the brackets and mounting. A great deal of emphasis is placed on the safety harness, with standards by SFI, FIA, ECE etc being tested to 25G and head restraints tested to 68G. The new NASCAR/FIA seat standards will produce extremely strong, rigid seats similar to that experienced by Formula 1 drivers and will place much more emphasis on seat mounts and the interface between mounts and automobile.

It will probably require six mounting points compared with the traditional four mounts on base or side plus. There will be a requirement of two or more mounts behind the shoulders, floor mounts on transverse tubes so that seat moves inboard with the sill in a side impact and the transmission tunnel crushes, and shoulder mountings attached to the safety cage. The new seats may have shoulder harnesses attached directly to the seat, with the seat attached to the cage. Structures in the car should then absorb impact energy.

SEAT MOUNTING - THINGS TO AVOID

Finally, from experience there are a number of no-nos in mounting seats, as follows:

- Longitudinal mounts
- Small washers
- Spacers
- Small mounts on seats not designed for back mounts
- Modified seat mount
- Safety harness mounted to seat mount.

HEAD AND NECK INJURY PROTECTION

TOM GIBSON – AIMSS RESEARCH ADVISORY GROUP

In Australia the only available wheeled motor sport injury data is from the AIHW (2006) report for hospitalised sports injury in Australia. The report indicates that 1.1 % of the Australian population (15 years and over) who were hospitalised had participated in wheeled motor sports in 2003 (n=2093 cases). 85% were motorcyclists, 6% go-karting, 3% ATVs and 2.5% motor car racing. For motor car racing trunk, head and neck injuries were predominant. The major injury (45%) type was fractures followed by intercranial injury (14.3%).

There is still a need to improve the level of protection given to the head and the neck in motor racing.

To understand the needs of a protection system requires us to understand the mechanisms of injury to the head and neck:

- Brain injury occurs when the brain is distorted, stretched or torn.
- Skull fracture occurs as a result of excessive deformation.
- Similar mechanisms cause injury to the neck.

The most common form of head protection is the helmet. The basic requirements of a protective helmet are:

- It must be worn.
- It must remain in place.
- It must be able to reduce the effect of the impact.

A typical motor sport helmet features systems to deal with each of these requirements. These include:

- Padding, communication equipment and ventilation for comfort and usability.
- An adjustable retention system and internal shape to ensure that the helmet is retained in place.
- Shell to spread the impact load and energy absorbent liner to absorb the energy of the impact.

Research has defined the requirements of a helmet to protect from head injury for a specific impact by defining allowable loading for a given risk of injury. Two criteria generally used for the purpose of designing helmets are:

- Wayne State University Concussion Tolerance Curve (WSTC), from SAE (1980), which is based on the translational acceleration of the head and
- Skull fracture risk curve for the adult population based on peak head acceleration, from Mertz et al (2003).

A helmet standard, such as AS/NZS 1698:2007: Helmets for Motorised Vehicle Users, sets down the test methods and requirements which have to be met by a helmet. Different standards are designed for protection under different situations.

The FIA lists approved helmets for FIA sanctioned events in Technical List 25 and include:

- FIA 8860-2004 (for Formula 1)
- Snell SA 2005
- Snell SA 2000
- SFI 31.1A
- SFI 31.2A
- BS6658-85 type A/FR and
- Snell M 2000
- Snell M 95

The equivalent list for CAMS is in Schedule D – Apparel. The main difference is that CAMS allows the use of the Australian AS/NZS 1698 which must be worn for any use on public roads, and European E22 helmets.

THE HANS DEVICE AND ALTERNATIVES

MICHAEL HENDERSON – AIMSS CHAIRMAN

Head and neck restraint has became a major issue in motor sport safety. Several international and major national categories, under both FIA and non-FIA regulations, have now mandated the use of such restraint.

The main issues facing a competitor or regulatory body in determining whether to use such restraint, and, if so, which model, are as follows:

- Potential benefits in injury reduction
- Acceptable standards
- Costs of fitting
- Device pricing
- Fitting and use difficulties
- Usage – voluntary and mandatory

The potential benefits of head and neck restraint are as follows:

- Limitation of potentially fatal neck loads – especially axial tension
- Limitation of potential head excursion and resulting head impact
- Limitation of "whiplash" and soft-tissue neck injury

In terms of injury risk, soft-tissue neck injury ("whiplash") is a common outcome of crashes both on the road and on the track. However, while catastrophic neck injury – involving damage to the skeletal structure of the neck and/or damage to the spinal cord – may be life-threatening, available statistics show that it is rarely sustained in motor sport. Probably the highest incidence is in US oval racing, where impact speeds are often exceptionally high, impacted surfaces are usually solid, and the vehicles have a very "stiff" response to impact.

There are two international standards for head and neck restraint devices.

One is the FIA 8852-2002 standard, which is specific to the HANS® system and cannot be applied to other devices. The standard requires a proof strength test, roughly equivalent to a crash generating 75Gg.

The other is the US-based SFI Specification 38.1, Head and Neck Restraint Systems which, unlike the FIA standard, is a performance-based standard. Using a crash sled test procedure at 68g frontal and 30 degrees angled impact, it specifies maximum allowable neck injury criteria.

To place such deceleration requirements in perspective, a selection of "typical" impact decelerations is as follows (1g is acceleration/deceleration at 9.8 metres/second/second):

Median road car crash	10G
Seat belt tests for road cars	30G
FIA dynamic harness test	32G
Risk of long-term "whiplash" disorder	40G
Earnhardt Daytona wall impact (NASCAR)	48G
SFI test level for race belts	50G
Mean peak level for impacts (Indy/Champ cars)	53G
SFI test level for head/neck restraints	68G
FIA equivalent for HANS	75G
Kubica wall impact (F1)	75G

It is clear that the static and performance requirements of the two standards represent very severe crashes indeed.

"Acceptable" standards for Australia (when head and neck restraint is required by CAMS or under category regulations) are likely to be both FIA 8852-2002 and SFI 38.1.

Head and neck restraints complying with SFI 38.1 specification are as follows:

- Hubbard-Downing HANS device (also complies with FIA 8852-2002)
- Leatt Brace Moto-R Sport device
- LFT Technologies R3 device
- Safety Solutions Hutchens-II device
- Safety Solutions Hutchens Hybrid device
- Safety Solutions Hybrid X device

The main advantages of the HANS device are as follows:

- High level of protection in frontal and near-frontal crashes
- FIA and SFI compliant
- Very widely used and is compulsory for many international categories
- Solid research basis supported by objective published data
- Compact and simple once installation and fit are satisfactory

It also has some disadvantages:

- Critically dependent on installation and fit

- Usually requires changes in shoulder belt installation and routing to avoid the shoulder belt slipping off the device
- Possibly not as effective in side impacts as some alternatives
- Some problems with vehicle egress and comfort

The Leatt Brace, which has SFI certification, clips around the neck and is held in position by the restraint harness and bars down the front and back of the upper torso. It acts as a solid form of the "horse collar" and has reportedly shown good test results in all impact directions. It does not require any modifications to the helmet. However, because of the interaction of the brace and the helmet – especially in a full-face configuration – it may not be suitable for use in formula cars with a reclined seating position.

The LFT "R3" head and neck restraint has SFI 38.1 certification. Its frontal crash performance matches HANS, and its performance in a side impact is reported to be much better. It uses a fairly simple body harness, and is popular in drag racing and speedway in USA.

The Hutchens II Pro has SFI 38.1 certification. It matches the HANS in frontal impacts, and its manufacturers claim effectiveness in side impacts. It represents the latest evolution of the strap system with a body harness. The earlier version of the Hutchens device has long been popular in speedway racing.

The Hutchens Hybrid also has SFI 38.1 certification, and test results published by the manufacturers indicate frontal crash performance at least equivalent to the HANS device and better performance in all non-frontal impacts.

The demanding performance requirements of approved head and neck restraint devices make them expensive by amateur motor sport budget standards. Approximate prices for currently available devices are as follows.

FIA approved:

Hubbard-Downing HANS®	$1,499 to $2,300 AUD

SFI specification:

HANS®	$1,499 to $2,300 AUD
Leatt Brace	$1,100 to $1,380 AUD
LFT Technologies R3	$1,500 AUD
Hutchens II: about	$750 USD
Hutchens Hybrid: about	$1,100 USD

Non-approved (a selection only):

Hutchens device (harness and tethers)	$550
D-Cel (harness and tethers)	$695

CONCLUDING COMMENT

Mandating, choosing and using a head and neck restraint means balancing risks, benefits and costs. Competitors need extensive prior education in order to make informed choices, particularly in an environment where there is a continuing and rapid evolution of these systems.

However, head and neck restraint may in principle be confidently recommended for all categories of racing, and education and encouragement should be emphasised. Probably the single most important advice to be offered is that any device purchased should be tried in the seat of the vehicle in which it is to be used before such purchase is finalised, or a firm commitment be obtained from the retailer that it may be returned or replaced by an alternative model if it is shown to be unsuited to the competitor's specific circumstances.

INNOVATIONS IN DRIVER HEAT STRESS MANAGEMENT

GEOFF BECKER – MANAGER, MOTORSPORT SAFETY RESCUE

This presentation discusses the methodology used to treat rally crews in preventing heat stress and also treating heat stress.

Motorsport Safety & Rescue Pty Ltd has provided team support to the Subaru team competing in the Asia-Pacific Rally Championship over the past two years and has worked with Subaru Motorsport, Motor Image Group and Arctic Heat in researching and developing cooling vests and how best to utilise them. A specific product is the subject of this presentation.

THE PRODUCT

- The Cooling Vest is manufactured from scientifically tested proven body cooling materials Sportwool (Woolmark & CSIRO) and pockets of gel which are designed to hold the temperature for extended periods
- The outer layer uses Nomex which is fire resistant and Sportswool which is a composite of Merino Wool with other fibres which allows the fabric to take advantage of wool's unique benefits of feeling cooler and reduced sweating, creating a natural climate control reducing chill and breathing naturally
- The vest is activated by placing in water for up to ten minutes until the crystals turn into a gel and then swell. The vest is then dried and then frozen for the optimal result of cooling for up to two hours and after freezing the vest is ready for use.

SCIENTIFIC DATA

- The vest can lower skin temp by up to 17 degrees Celsius and can be worn over clothing and still record up to 12 degrees Celsius reduction in skin temperature
- Less total cardiac output is directed towards skin allowing more blood for active muscle
- Reduction in sweat loss, thus reducing dehydration

CASE STUDIES

Tests of the cooling vests were conducted on a rally stage in Indonesia in 2006 where in-car temperature reached 50-55 degrees Celsius. Using the vest, the driver's core temperature increased only one degree over the stage and the co-driver recorded no significant increase. The conclusions reached were:

- Body cooling vests used with a hydration strategy of water with an electrolyte drink provides the best results with a definite improvement in driver performance
- The vests were tested and successfully met FIA Standard 8856:2000 (Underwear), to ISO 15025 (Limited Flame Spread Test), ISO 9151 – 1995 (Evaporation Test)

Tests of a "medical cooling kit" for re-hydration were also conducted in Indonesia. The kit consisted of groin/axilla Pads, a hat and a blanket. The pre-disposing factors were extreme ambient heat and additional heat from inside the vehicles, lack of hydration during event, no cooling systems, failure to recognise heat stress and dehydration, and re-hydration after event.

Two case studies were observed:

- With the re-hydration strategy using the medical cooling kit, an exhausted older driver, who would not have been able to go further without re-hydration, recovered to complete the event
- A younger driver, who displayed the early effects of heat stress and dehydration, presented with a rapid heart rate and feeling very unwell. Treated using the medical cooling kit, oral fluid (consisting of water and an electrolyte replacement) and the blanket maintained for the entire 20 minutes of a service break, his heat rate returned to normal and, although feeling tired, he was able to continue in the rally

CRASH DATA AND ANALYSIS

TOM GIBSON – AIMSS RESEARCH ADVISORY GROUP

Worldwide there are limited studies of motor sport crash fatalities and injuries but three recent ones of note were:

- Chesser et al (1999)

  A five-year study (n=521) of medical centre attendances at Castle Combe circuit in the UK with "major trauma" to 20 drivers identified three deaths, six multiple rib fractures, five pelvic fractures, two intra-abdominal haemorrhages and two spinal injuries.

- Leonard et al (2005)

  A follow-up to the Chesser et al (1999) study, it included "severe" (hospitalised) injury to 11 drivers, one with a head injury and three with what were described as "multiple injuries". The study assessed the difference in safety due to the addition of the two chicanes.

- Minoyama and Tsuchida (2004)

  Studied 112 recorded injuries in professional racing 1996-2000 in Japan. The study found that injuries in motor sport were poorly documented and compared injury patterns between formula and closed cars. There were three cases of concussion and one death from head injury from contact with a trackside object.

In Australia the only available motor sport injury data are from an Australian Institute of Health and Welfare report by Flood and Harrison (2006). The report indicates that, for hospitalised sports injury in Australia, 1.1% of the Australian population (15 years and over) who were hospitalised had participated in motor sports in 2003 (n=53) of whom 85% were motorcyclists. But beyond that is a dearth of information in this area. As seen below some statistics are collected but little analysis is completed and yet it is important.

WHY IS CRASH DATA COLLECTION AND ANALYSIS IMPORTANT?

A number of reasons can be advanced for collection and analysis as follows:

- It allows continuing monitoring of the safety systems
- It allows management of the risk for participants and insurance
- The data is not available from elsewhere
- It acts as the first stage of an in-depth accident system

CURRENT COLLECTION OF CRASH DATA IN CAMS EVENTS

Crash and injury data is already being collected for CAMS-authorised events. Accident Report Forms are completed for every incident (i) with injury or (ii) where a vehicle sustains damage preventing further participation in meeting. For vehicles, basic details are noted on damage and an assessment by the Stewards is included in the form.

For competitors or officials, an Injury Report Form is required for any injury or medical treatment at a meeting. These completed forms are forwarded to CAMS and there may be up to 20 to 30 accident reports a week but there may sometimes be more for a single major event. But no on-going collation or analysis of the data has been made until now.

PILOT STUDY

AIMSS has set up a pilot study of data from 2006 based on CAMS reporting of incidents based on the CAMS Accident Report Form and CAMS Injury Report Form from all events. The aims of the pilot study are to demonstrate the usefulness of the data, to look at the sufficiency and the accuracy of the collected data, and to give an indication of cost and time required for systematic data collection and analysis.

SUMMARY

The Pilot Study has developed a coding system adapted to the available CAMS incident reports. It has demonstrated the usefulness of on-going data coding and analysis. It will be useful as an addition for the in-depth accident investigation. The concept has been supported by the FIA as a potential model for international adoption and, therefore, AIMSS will continue to the next stage.

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IN-DEPTH CRASH INVESTIGATION

ROBERT CHADWICK AND MICHAEL HENDERSON - AIMSS RESEARCH ADVISORY GROUP

Unlike the Original Equipment Manufacturers of motor vehicles, where there is a well prescribed and developed protocol of design, testing and validation of the crash worthiness of motor vehicles, the majority of competition vehicles are one off builds. Without the ability, or the volume, to amortise the resources required to conduct computer analysis, prototype testing and complete vehicle testing, competition vehicles, in the main, move directly from rudimentary design work, directly to manufacture.

The first time that the design and safety systems on a competition vehicle are truly tested, is in the first incident in which the vehicle is involved. The behaviour of the competition vehicle, in these real world incidents, can provide extremely useful feedback to the designers and rule makers.

Providing the resources to investigate every incident in motor sport is impractical in terms of cost and time. Being trained and equipped to recover the significant data to be obtained from major incidents, however, is a feasible and practically manageable program.

For the purpose of this study, a major incident will be defined as follows:

Incidents in which there are either:

- High levels of deceleration
- High levels of deformation
- Injury to occupants or other participants

The systems within a competition vehicle which are of significance and therefore of interest are:

- Seats and their mounts
- Harnesses and their mounts
- ROP systems and their mounts
- Energy absorption systems
- Interior hardware

Being able to record and recover the important information, in a format and clarity that is useful for later analysis, is often difficult in the heat of the moment at a major incident.

From several CAMS investigations of major incidents, it has been observed that, whilst efforts are made to capture and record data, often the detail of what is captured does not totally record all the required data.

Training of key staff is recommended to ensure that the following processes are followed:

- Analysis of the scene
- Photographic and video evidence
- Impact marks, internal (occupant) and external (environment)
- Tyre marks
- Analysis of the vehicle(s)
- Photography
- Structural deformation and crush
- Data from crash recording electronic equipment
- Biomechanical analysis
- Injury data
- Autopsy data
- Design, fitting and use of personal protective equipment
- Crash reconstruction
- Physical
- Numerical
- Computer modelling

This is a relatively comprehensive list of tasks to be undertaken but the real benefits of full and accurate recording and reporting are that the causes and effects are able to be captured accurately and used for future developmental purposes.

SAFETY ISSUES IN RALLYING

COL TRINDER - ACTING CHAIRMAN, AUSTRALIAN RALLY COMMISSION

This presentation covers the following:

- The key features of rallying
- Safety systems that exist
- Issues with safety
- Technology
- What might AIMSS focus be

THE KEY FEATURES OF RALLYING

Rallying differs from other forms of motor sport, such as motor racing, in a number of defined ways. The central component is that there are two people in a competition car with one driving and the other giving directions and there is only one car on course (or a section of the course) at a time competing against the clock. Therefore, overtaking is rare.

Most competitions are on public roads, not on purpose-built race circuits. The surfaces are gravel or tarmac, with different risk profiles. The courses contain unforgiving roadside scenery in the form of trees, rocks and street furniture. There is significant diversity of competition vehicles and levels of preparation. In order to be socially responsible, there are a range of complex primary and secondary safety protocols and rules to mitigate the inherent levels of risk.

SAFETY SYSTEMS AND PROTOCOLS

To ensure that appropriate levels of safety are taken in any event, systems and protocols are established for the vehicles, competition course and event organisation:

- **In the vehicle**

  There are FIA and CAMS mandated safety items such as roll over protection, fire extinguishers, safety items and the crew wear fire resistant clothing. The crew also have responsibilities to look out for other vehicles that may have crashed and in that event must execute certain safety protocols such as the display of safety triangles and respond with SOS or OK systems as well as being required to administer emergency first aid.

- **On the course**

  Instructions warn of hazards and warning signage may be posted. There are a large number of officials closing roads, controlling the event and implementing safety protocols. SOS emergency communications points are established at regular intervals for relaying messages and there must be an FIV and Ambulance presence.

- **In the event organisation**

  In the lead up to the event, the proposed course is scrutinised from a safety perspective by several experience officials. Emergency safety plans are developed and communications networks established for event control, safety and positive vehicle tracking. Competitors are made aware of their part in executing safety protocols. On the day of the event, a variety of course clearing vehicles check and re-check route safety and instructions.

ISSUES WITH SAFETY

There are a number of significant safety issues for rallying:

- High speeds attained and sustained, particularly in tarmac rallying. There is a serious accident rate in tarmac rallying which is unacceptably high and needs to be addressed
- Both people and property are at risk, including spectators, although Australian practices with spectator control are more robust than overseas
- There is a range of contributing factors which can increase risk, including the geography of Australia being flat and dry with suitable roads being few and far between. Also, there is a strong demand for 4WD turbo which increases speeds and can test crew experience, particularly as there is a limited knowledge of the co-driver role

There is not just one treatment for risks. A multi-pronged approach is needed required.

TECHNICAL AND SPORTING FIXES?

There are a number of technical and sporting steps which could be adopted to reduce risks. These include the use of limiters, cut outs, crew warning systems and remote trackers to reduce top end sustained speed. The rules could be changed to penalise sustained very high speed driving. Consideration could be given to moderating tyre adhesion to reduce traction and therefore speed. Also, steps could be taken to improve extraction technology.

A significant improvement would be the adoption of automated systems to track vehicles such as the WRC vehicle tracking system using an airborne repeater, interfaced with GIS mapping at HQ (with back ups using conventional tracking systems) to trips emergency response if a vehicle stops >30 seconds. Also, within the affected sectors there could be a system of 'Yellow Flag' to alert following vehicles.

WHERE MIGHT AIMSS CONTRIBUTE?

Some suggested ways in which AIMSS might be able to assist are as follows:

1. Provide a forum for sharing ideas across disciplines, such as extrication methodology, as there are common issues
2. Foster research into cross-discipline technical issues, and to follow the same example to work together to improve extrication technology
3. Investigate issues associated with tyre adhesion and safety in a motor sport sense. For example, would reducing adhesion through compound manipulation reduce straight line or cornering speeds? What would be the effect? Can it be done in a way that won't compromise safety?

PRINCIPLES AND PRACTICE OF TRACK SAFETY

BRIAN SHEAD – CHAIRMAN, CAMS NATIONAL TRACK SAFETY COMMITTEE
BRUCE KEYS – MANAGER, SAFETY AND MEDICAL SERVICES

Track safety is about managing risk at motor race circuits with the aim of decreasing the risk of serious injury by assessing potential hazards for likelihood of occurrence against the consequence of occurrence. In an environment where circuits are responsible for the safety of competitors and the public, improvements are prioritised by the level of risk.

RISK EVALUATION

Risks are evaluated regularly by the CAMS National Track Safety Committee (NTSC) on the basis of AS4360 taking into account stakeholder consultation, engineering principles, incident data and experience.

CONSIDERATION OF WHAT IS ACHIEVEABLE

The NTSC uses FIA Guidelines, its own Track Operators Safety Guide and evaluation of the individual circumstances of a track in assessing a circuit. What is able to be achieved reasonably at one track may not be the same for another. There are significant differences in dealing with Mt Panorama as against Queensland Raceway. Financial issues, the status of events and the cars to be used are all taken into consideration.

WHAT CAN GO WRONG?

Whilst drivers are assumed to have established safe operating speeds which are roughly the same, small variations in speeds lead to the need for more accurate determination of safety features in a given area. Drivers make two basic errors, incorrect estimation of the braking or cornering ability of a car and doing the unexpected. Both events can end up in car to barrier contact.

HIERARCHY OF PROTECTION

To provide protection, there is an established hierarchy of protection:

- First line – immovable barrier next to track to stop car getting to spectator
- Second Line – strong and high mesh barrier to prevent debris from cars getting into spectator areas
- Third line – delineation between area reserved for marshals and spectators

BARRIERS AND RUN-OFF AREAS

We place barriers on straights, curves and put lane and other protection systems include run-off areas provided for drivers who underestimate speed and run off the outside of a turn. These may be clear space in the form of grass, gravel or bitumen. Barriers may be made of concrete, guardrail, tyre barriers with or without conveyor belt facing.

PROTECTION SYSTEMS

The type of installation used is dependant upon available space, likely impact angle and a variety of alternative ideas. Significant examples of different approaches include:

- The Morgan Park model
- The Collie model
- Caltex Chase at Mt Panorama
- Street circuit protection panels
- Guardrail at Turn 8 Adelaide

CAMS NATIONAL TRACK SAFETY COMMITTEE ROLE AT THE AUSTRALIAN GRAND PRIX

BRIAN SHEAD - CHAIRMAN, CAMS NATIONAL TRACK SAFETY COMMITTEE

The role of the CAMS National Track Safety Committee at the Australian Grand Prix begins shortly after the completion of the event each year and follows a pattern along these lines:

APRIL/MAY

A full debriefing is undertaken shortly after the event to establish future requirements and activities for the following year. In particular, an action list is drawn up and this forms an important part of the agenda for Engineering Group Meetings.

APRIL / FEBRUARY

Regular meetings of the Engineering Group are held throughout the year involving key AGPC personnel, the contracted engineering firm KBR and CAMS representatives to monitor progress of action items and works required.

FEBRUARY / MARCH

Prior to the event when the circuit is under construction, random visits to site to check on construction progress on:

- Block location
- Barrier assembly
- Identified issues

ONE WEEK PRIOR TO EVENT

This is the start of full time attendance on site to monitor the final build process to:

- Ensure the circuit engineering is seen through the eyes of a motor sport expert rather than a construction contractor
- Provide opportunity for other officials to offer input into areas of concern

SUNDAY TO WEDNESDAY

This is a critical period immediately prior to on-track activity which begins on the Thursday and during this time it is important to:

- Check all aspects of track related construction
- Ensure that there are no minor variations in concrete block placement which may have serious safety consequences even though there is a great deal of documentation available
- Keep a watching brief for last minute advertising and television installations
- Liaise with CAMS personnel carrying out marshal zone OHS inspections to ensure no overlap of activities
- Conduct twice daily inspections to produce Track Condition Reports which are passed to KBR for action and rectification. These reports are produced from a database which has the capability to provide the order of input, track location, priority of response, who is responsible, completion date, and description of problem

WEDNESDAY

On the day before track activity begins the NTSC participates in the FIA International track inspection and coordinates actions emanating from the inspection.

THURSDAY TO SUNDAY

During the event NTSC personnel are on standby to deal with unforeseen problems or issues arising from on track incidents. They collect and collate reports from Sector Marshals and liaise with KBR engineers to rectify problems.

MONDAY

The process starts all over again!

CONTACTS

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