

# Report on HVTT11 International heavy vehicle symposium

14-17 March 2010, Melbourne, Australia

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Research Report ARR 376





Research Report  
**ARR 376**

Report on HVT11 International heavy vehicle symposium



Research Report ARR 376  
ISBN 1 876592 61 3  
ISSN 0158-0728

## Information Retrieval

The aim of this report is to describe the structure and to summarise the results of the 11th Heavy Vehicle Transport Technology (HVTT) Symposium. The Symposium was held in Melbourne from 14-17 March 2010.

HVTT11 featured over 70 technical papers focusing on the key drivers of change and how these can influence future developments and government policy formulation relating to heavy vehicles. More than 160 international experts attended.

Key areas of HVTT11 included environment and energy, vehicle technology and design, safety, infrastructure design and operation, standards and regulations, compliance, community issues, logistics issues, productivity, heavy vehicle transport policy and freight volumes and trends.

ARR 376  
May 2010

ISBN 1 876592 61 3  
ISSN 0158-0728

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Anthony Germanchev leads the Heavy Vehicles team at ARRB which aims to improve the safety and efficiency of road going heavy vehicles performing Australia's freight task. Anthony specialises in the testing and simulation of the dynamic performance of multi-combination vehicles. He has taken on key roles in research activities including road train tests of national significance for development of heavy vehicle regulation. His experience includes improvement of productivity and safety in the mining and resources sector and rollover investigation and reconstruction. The findings from the work undertaken by the Heavy Vehicles team aim to improve understanding of the performance of high productivity freight vehicles.

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## SUMMARY

Prof. David Cebon and Dr. Peter Sweatman provided a summary of the conference at the concluding plenary. Peter Sweatman discussed the pressures to innovate or not to innovate. Freight growth, safety, environment, energy and climate change were encouraging innovation whereas public perception and funding were factors seen to be inhibiting innovation. Topics and issues raised during the conference were mapped projecting the path forward for heavy vehicle innovation.

The need to increase productivity was evident and the benefits of longer vehicles are compelling with a presentation from Bob Pearson providing statistics on B-doubles in Australia: 11 million tonne of GHG saved, \$12b reduction in transport costs, two fatalities for B-doubles compared with 329 associated with tractor semi-trailers. The University of Manitoba provided statistics on the innovative vehicles operating in Canada indicating that they had lower crash rates and 99% were compliant with weight limits and network restrictions. There was a notable absence of field operation trials and statistics on the high productivity freight vehicles currently operating in Australia. Statistical information is expected to only strengthen the case for innovative and high productivity freight vehicles.

The environment, energy and climate change were areas in which high performance freight vehicles were shown to offer quantifiable benefits. Reductions in fuel use and emissions were likely to flow from improved engine and drive-train efficiencies, reduced aerodynamic drag and use of regenerative braking (hybrids). Major gains in fuel consumption (up to 35%) could be achieved by changing logistic patterns i.e. using a tractor-semi-trailer instead of two rigids or using longer vehicles. Trailer axle steering provides the increase in manoeuvrability needed for long vehicles in urban areas). The greatest efficiency gains were identified in reducing traffic congestion resulting in fuel savings (and CO<sub>2</sub>) of up to 50% by:

- using higher capacity vehicles for the same freight task
- eliminating night-time curfews on freight deliveries
- optimising traffic control
- reducing accidents and delays due to road maintenance.

Active steering systems and electronic braking systems were the two vehicle technologies taking precedence at the conference. The OECD heavy vehicle performance benchmarking study conducted by ARRB showed that many higher capacity vehicles have equivalent or even better intrinsic safety characteristics in some respects than most common workhorse trucks, but that low speed manoeuvrability would prevent these typically longer vehicles from accessing the entire road network.

Trials conducted by the Cambridge Vehicle Dynamics Consortium (CVDC) showed that an innovative steering system for trailers can provide a solution to this problem by improving the manoeuvrability of semi-trailers and B-doubles. The NTC is investigating the productivity benefits available through the introduction of electronic braking and stability control and recommended this as an alternative to the existing static rollover threshold. David Cebon raised strong concerns that this may result in poorly designed and inherently unsafe vehicles fitted with the latest technology as compensation. John Woodroffe highlighted the great benefits available from roll stability and electronic stability technologies in terms of thousands of fatalities saved

Peter Hart's work to develop the Australian Brake Balance Code of Practice presented the challenge of 16 different levels of brake technologies that have to be made compatible and the huge difficulty of harmonisation in one relatively small area, where the technical issues are comparatively clear.

Other issues raised included:

- the importance of talking to the public and avoiding irrational dialogue that 'poisons the well'. This was emphasised by Paul Nordengen as a key factor in the successful implementation of PBS trials in South Africa
- the challenges facing the implementation of PBS and the uptake of HPFVs worldwide including the limitations of the current scheme
- the complex technical, policy and approvals framework In place with only 90 PBS vehicles on the road in Australia to date which is leading to unintentional and undesired inefficiencies and exclusivity.

Suggestions for improving the uptake of PBS were to:

- approve vehicles for general use
- approve modular systems of components instead of just single vehicles
- classify the road network or have a better system for route assessment approvals (e.g. a national bridge database and calculation system including access to databases, tools and nationally consistent information).

The difficulties of gaining public support were highlighted repeatedly through the conference. This is not a technical problem. – The engineering issues are largely solved with percentage benefits evident. However, this message is failing to reach the public either because the general public does not understand or does not appreciate the benefits. The lobbyist approach against HPFVs is typically a carefully orchestrated campaign, exploiting the press, playing on public emotion, with little concern about the facts. To address this problem a public relations champion is required to promote the benefits of HPFVs, to educate the public and ensure that road freight efficiencies are realised with the benefits reaching the end user.

## 1 Introduction

The aim of this report is to describe the structure and to summarise the results of the 11th Heavy Vehicle Transport Technology (HVTT) Symposium. The Symposium was held in Melbourne from 14-17 March 2010. It was opened by Anders Lundstrom, President of the International Forum for Road Transport Technology.

In introducing the Symposium, Anders pointed out that the global economy makes good freight systems a necessity. Problems are common in many jurisdictions and HVTT11 was an excellent forum for discussing these issues and identifying ways forward.

HVTT11 featured over 70 technical papers focusing on the key drivers of change and how these can influence future developments and government policy formulation relating to heavy vehicles. More than 160 international experts attended.

Key areas of HVTT11 included environment and energy, vehicle technology and design, safety, infrastructure design and operation, standards and regulations, compliance, community issues, logistics issues, productivity, heavy vehicle transport policy and freight volumes and trends.

The IFRTT Scientific Committee is chaired by Professor David Cebon, Director, Cambridge Vehicle Dynamics Consortium and Head of Cambridge University Engineering Department's Transport Research Group. The Committee was responsible for reviewing papers and developing the Symposium program. The members of the Committee are listed in Appendix 1 together with the members of the Organising Committee.

## **2 Background**

The International Forum for Road Transport Technology (IFRTT) was formed after the first Heavy Vehicle Weights and Dimensions symposium run by the Roads and Transport Association of Canada in 1986. The purpose of IFRTT is to:

Advance the agenda on heavy vehicle transport issues through the sharing of knowledge and exchange of views between researchers, policy makers, regulators, road agencies and the transport industry.

There have been 10 IFRTT hosted symposia held at various international locations since 1986. Known as the Heavy Vehicle Transport Technology symposia or HVTT, the 11th event was the first time that the Symposium had been held in Australia.

Over the last 20 years there has been a vast amount of international research co-operation generated by the OECD (DIVINE Project), European Commission COST projects and NAFTA activities in North America as well as Performance Based Standards (PBS) development in Australia. The IFRTT has played a role in publicising and presenting the results from these international activities through its HVTT symposia and provides an on-going opportunity for the international networks developed in these projects to continue and flourish.

### 3 The Program

The Symposium brought together some of the best technical, policy, safety and environmental experts from around the world. It spanned the range between transport technology and transport policy and demonstrate the role of technology in shaping future policy.

The four days featured technical sessions on braking, road wear relationships and the performance of trailer steering systems. Others discussed heavy vehicle compliance including electronic log books, electronic route compliance and operator accreditation to ensure vehicle condition and compliance with mass regulations. Policy sessions included discussion of the link between growth in road transport and GDP growth.

Plenary sessions focused on key policy issues including:

- Balancing competing needs.
- Outcomes of the OECD/ International Transport Forum Working Group on Heavy Vehicles: Regulatory, Operational and Productivity Improvements.
- The PBS experience in Australia.
- Getting innovative vehicles on the road – experience around the world.
- Energy and the environment - driving heavy vehicle design, policy and operations.
- Tradeoffs – how to balance community, safety and environmental imperatives alongside the need for improved productivity and access for freight movement.

Immediately following the Symposium, delegates were invited to attend the International Truck Trailer and Equipment Show running from 18-20 March 2010. Over 350 exhibitors including all major truck and trailer manufacturers were on show in Melbourne, with delegates able to speak directly with the designers, innovators and engineers that produce cutting edge technology for the ever changing needs of the Australian transport market. Manufacturers/operators speaking at HVTT11 were able to display their innovative designs at this event.

The detailed program is listed in Appendix 2.

## 4 Program Report

### Session 1: Plenary 1 - Balancing Competing Needs

**Alan McKinnon**, Heriot-Watt University, UK spoke on 'Defining a sustainable balance for freight in the community'. The demand for transport continues to increase which is likely to result in ever-growing levels of green-house gas emissions if no action is taken. There is a need to break the link between the economy and transport demand. Possible ways of doing this include improved fuel efficiency, alternative energy use, longer heavier vehicles, shift to other modes and land-use planning. There is a need to define the cost-effectiveness of each option.

**Philip Lovel**, Victorian Transport Association provided a perspective on 'What do freight owners want?' A case study was described which was aimed at identifying barriers to wider acceptance of new freight technologies by the wider community and the media. Trial visits and demonstrations were used to show that positive benefits were likely to flow from increased use of more productive freight vehicles.

**Peter Sweatman**, University of Michigan Transportation Research Institute reported on 'Freight issues in developed countries'. Some of the issues mentioned included congestion, energy, climate, environment, demand for mobility, increased freight task, lack of finance for maintenance and construction, and emergencies. Over 90% of truck crashes are due to poor recognition of hazards and decision-making by drivers. Some research thrusts and innovations aimed at tackling these safety problems were outlined.

**Paul Nordengen**, CSIR, South Africa reported on 'Freight issues in other regions'. There are many issues impacting freight transport in developing countries such as lack of investment, corruption, cross-border delays, inadequate enforcement, lack of political will, other priorities, overloading, declining road and rail infrastructure, lack of expertise, systems and data, poor fuels and importation of aged second-hand vehicles. There is a need to leap to new technologies which are efficient and low cost

Issues raised during discussion included:

- connectivity is the next key technological advance
- the need for guidance, information and resources for regulators and councils
- heavy vehicle crash rate trends in developing countries.

### Session 2A: Higher Capacity Vehicles 1

**Bob Pearson** (Australia) outlined the factors that have led to the increase in numbers of B-doubles in Australia from less than 100 to more than 10,000 in only 18 years, including industry innovations and government responses. Now at a maximum length of 26 metres and gross combination mass of 68 tonnes, the B-double is used extensively in Australia in both urban and non-urban applications and is close to replacing the tractor-semitrailer as the 'workhorse' heavy freight vehicle. The paper also outlined performance measures relating to the use of B-doubles in Australia, comparing the present position with the case that would have existed if B-doubles had not been permitted.

In order to address problems of manoeuvrability, both in the forward and reverse direction, and the issue of high speed stability, the use of active trailer steering systems has been proposed. **David Cebon** reported on research by the Cambridge Vehicle Dynamics Consortium on the use of active rear steering hardware fitted to multiple trailer LCVs. A fully-steered B-double has been built with new steering hardware fitted to five axles on its two trailers. Each axle is independently steerable 'by wire' using a special-purpose hydraulic steering actuator.

**Paul Nordengen** from CSIR presented the monitoring and evaluation results of two PBS demonstration vehicles that commenced operation in 2007, in the forestry industry in KwaZulu-Natal, South Africa, until July 2008. Initial findings in terms of road wear, safety, emissions and productivity were positive and a number of recommendations were made concerning demonstration projects and future research for the further development of PBS in South Africa.

Issues raised during discussion included:

- capturing data on the safety of B-doubles and storing this information (particularly in Australia)
- use of path tracking cameras to follow white lines
- matching drivers to vehicles
- the effect of steerable axles on slip angles and reducing tyre forces
- the improved accessibility arising from steered trailers.

## **Session 2B: Safety 1**

**Deborah Freund** from the US Federal Motor Carrier Safety Administration summarised key laws and regulations concerning new and in-use equipment requirements for vehicles, heavy-goods-vehicle drivers, and motor carriers in the United States. In addition to describing the circumstances under which those laws and regulations were developed and the specific safety gaps they were intended to address, the paper also discussed contemporaneous political and business cycle influences. It provided a view toward the next evolutionary stages in commercial vehicle safety technologies and commercial vehicle safety regulation.

**Peter Hart** from the Australian Road Transport Suppliers Association discussed the crash forces that could occur in truck-to-truck crashes. There are clear trends for Australian (combination) trucks to become heavier and for the front of trucks and rear of trailers to become stiffer as a result of under-run protection being used. Consequently crash forces in nose-tail truck crashes are tending to increase. The paper discussed issues such as design rules for cabin attachment, mechanical coupling strength and seat strength and seatbelt anchor strength and the need for a safety factor in heavy vehicle design.

**Sean Carlson** from Engistics Australia provided a case study for the development and implementation of improved safety systems for a Performance Based Standards (PBS) vehicle in Newcastle Australia. The mechanisms that contribute to improved vehicle safety were summarised both above and below the deck, with emphasis on the load restraint system development and performance. The paper demonstrated the capacity for high productivity vehicles to provide a measurable increase in safety and environmental benefits for the community. Conclusions were provided on the opportunity provided by PBS vehicles to implement improved safety systems above the deck and provide quantifiable gains in transport safety.

## Session 3A: Policy

**Loes Aarts** from the Netherlands Centre for Transport and Navigation discussed 'Where does the growth of road freight transport end and what can policy makers do about it?' The main purpose of the paper was to take a logistics view of the possibilities which policy makers have to improve efficiency. The side effect of public interventions to improve the quality of life, reduce emissions or congestion can be an increase in road freight transport. Understanding logistics processes is therefore necessary to develop effective policies. Some key issues in transport policy are whether road freight demand will 'decouple' from economic growth and how road freight can be managed to achieve societal outcomes.

**Gerwin Zomer** presented the paper of Kees Verweij and Igor Davydenko from TNO in the Netherlands which described an assessment of the impact of long and heavy vehicles on future European transport demand and modal split. On the basis of the authors' calculations, harmonisation of European policies to allow LHVs to operate borderless in Europe was recommended. The rail and inland waterways sectors will not suffer much from LHV use, however LHVs would apply some extra competitive pressure on these sectors. The societal benefits of LHV include price decreases for road transport, fewer heavy vehicles on the roads and less congestion, less energy consumption and emissions.

Road freight growth in New Zealand is regarded as unsustainable due to impacts on congestion, energy usage, air quality and CO<sub>2</sub> emissions. **John de Pont** from TERNZ reported on development of a complex modelling framework that describes the relationships between economic growth and freight growth. Data have been collected for the existing patterns of freight movements and these are being used to calibrate the modelling framework both at the national economy level and for several major industry sectors. The models predict total freight demand and the allocation of that demand to the different transport modes is done on the basis that users choose the mode with the greatest utility. To be able to use these models for developing strategies for achieving sustainable levels of freight demand, the relationships between the key economic drivers and the model parameter values that they influence are being determined.

Issues raised during discussion included:

- derivation of tonne-km from vehicle-km
- causes decoupling of heavy vehicle growth from economic trends
- likelihood of harmonisation throughout Europe.

## Session 3B: Brakes

**Peter Hart** from the Australian Road Transport Suppliers Association described the development of the Australian Brake Balance Code of Practice. Achievement of good brake balance on heavy combination vehicles is a challenging task because of the large number of axles involved and because axle weights change dramatically as the load is altered. It is a particular problem in Australia because of the wide range of vehicle models and braking systems that exist. The Code aims to provide guidance on:

- What is the likely brake performance of a proposed combination vehicle?
- What can be done to improve the brake balance performance of a problem vehicle?
- What approaches are available to set standards for brake balance performance?

**Maarten Johansson** from the Swedish Association of Road Haulage Companies reported on a move to harmonise brake testing on heavy commercial vehicles in Nordic countries. A future goal is for heavy vehicle checks carried out in one Nordic country to be accepted beyond its borders. This would involve:

- consistent Nordic inspection regulations and measuring practices
- specification of requirements for roller brake testers
- qualification requirements for inspection personnel.

**David Cebon** from Cambridge University discussed a research project to develop a practical wheel slip control system suitable for commercial use on articulated vehicles. Novel methods of actuation and advanced controller designs are being investigated. When testing on the full-scale vehicle, the slip controller will require knowledge of several states and parameters that are impractical to measure in commercial systems. Consequently, sliding mode observers and nonlinear regression techniques are being investigated to estimate these unmeasurable quantities in real-time under various road and vehicle conditions. The algorithms are being validated both in simulation and against data from experiments with the aforementioned experimental vehicle.

Issues raised during discussion included:

- the effect of ABS/EBS on safety and improved stopping distance
- the feasibility of fitting new braking systems to vehicles on the road.

#### **Session 4A: Higher Capacity Vehicles 2**

**John Billing** (Canada) outlined the process followed to introduce long combination vehicles in Ontario. This work has been multi-disciplinary, encompassing:

- planning and policy development
- assessment of dynamic performance of candidate combinations
- assessment of safety implications
- assessment of benefits
- extensive discussions with stakeholders.

The full paper provides details of all configurations considered, methods of analysis, details of results and findings, and experience from the first year of operation.

**Jeannette Montufar** from the University of Manitoba (Canada) presented a paper which used exposure-based evidence to assess compliance with safety regulations, weight restrictions and network-related operational conditions of productivity-permitted long trucks. The paper:

- presented a methodological framework for assessing long truck compliance using exposure-based evidence
- described regulations governing long truck operations in the Canadian Prairie Region
- provided examples of exposure-based evidence of long truck regulatory compliance in the Canadian Prairie Region with safety regulations, weight restrictions, and network-related operational conditions.

**Matthieu Bereni** of the Laboratoire Central des Ponts et Chaussées in Paris reported on the heavy goods vehicle (HGV) characteristics which have the most influence on pavement wear and bridge damage, as well as those governing other impacts, such as on safety equipment (safety

barriers), road and intermodal terminal operation. A series of truck silhouettes from the OECD member countries were benchmarked against their aggressiveness for pavements and for bridges. Recommendations were made on the design of longer and heavier commercial vehicles to reduce their aggressiveness for infrastructure. Finally some other impacts of heavy vehicles were investigated including impacts on bridge piers and safety barriers, impacts on road traffic operation, traffic lane management and congestion.

Issues raised during discussion included:

- prioritising infrastructure updates to cater for new vehicle designs
- comparing the performance of LCVs and as-of-right vehicles
- the influence of high productivity freight vehicles on bridge safety formulae.

## **Session 4B: Safety 2**

**Veronique Cerezo** from the Laboratoire Regional des Ponts et Chaussees de Lyon, France outlined an approach to modelling heavy vehicles to identify risk. The more complex the model, the more difficult it is to operate the model in real time. For this reason, an approach has been adopted which splits the vehicle trajectory into a range of simple models. It is possible to quickly swap between the models depending on the vehicle trajectory. The intention is to identify risky situations so that warning can be provided to the vehicle operator in time for action to be taken.

**Shaun Talko** from Transport Certification Australia (TCA) reported on the development of specifications and test protocols for an electronic diary supporting the heavy vehicle driver fatigue legislation in Australia. Following the completion of a testing and development program, TCA, an organisation established by Commonwealth and State Governments to administer the Intelligent Access Program, has produced an initial set of specifications and tests for an evidentiary application. The specifications will be fully aligned to the Heavy Vehicle Driver Fatigue Regulations which allow for the use of electronic record keeping devices (also known as electronic work diaries).

**Murray Johns** from Optalert Australia reported on the development of technology that measures the driver's level of drowsiness continuously and objectively. It uses a special pair of glasses frames that monitor eyelid movements unobtrusively, without interfering with the driving task. Drivers are warned with audible beeps and voice messages. The technology has been validated in laboratory experiments.

Issues raised during discussion included:

- usefulness of short breaks to reduce drowsiness
- the modelling of vehicles carrying liquids
- can electronic work diaries assist drivers to manage fatigue?

## **Session 5A: Pricing**

**Anders Lundstrom** presented a paper by Olavi Koskinen from the Ministry of Transport/Road Administration, Finland which described a method to analyse how well the increased fuel tax caused by traffic congestion compensates for the respective increased external social economic costs. The study found the collection of fuel tax is very efficient and cheap compared to the costs of the road pricing systems. These two charging collection procedures were compared, results presented and conclusions were made.

**Bernard Jacob** from the Laboratoire Central des Ponts et Chaussees in Paris described the new pay-per-kilometre trucks tax. It involves charging, through electronic toll collection techniques, trucks traveling the State Road Network (SRN). It aims to press the road freight industry for lower

and better use of roads, and to collect new resources for transport infrastructure developments, in a clear inter-modal strategy. The eco-tax will apply to about 10 to 15,000 km of roads, mostly SRN and around 2000 km of local government roads. All vehicles over 3.5t will be included i.e. the 600,000 domestic vehicles and about 200,000 foreign vehicles that use French roads.

**Matthew Clarke** from the NTC (Australia) described how ARRB, with Austroads and National Transport Commission funding, has undertaken estimates of the marginal cost of road wear covering six axle group types with loads ranging from axle group tare weight to well in excess of the current general mass limits (GML) regulatory framework for a range of sealed road types. Through the use of a well informed pricing system, based on these marginal road wear cost estimates, road freight operators should improve their freight productivity while road agencies would be appropriately compensated for the road wear costs. Prices, costs and revenues based on marginal road wear costs would also provide signals for effective management of their road networks in regard to the availability of targeted funds for maintaining road freight routes.

Issues raised during discussion included:

- costs of the French pay-per-km eco-tax scheme - about 15-20% of the returns
- the use of fuel tax as a means of charging for congestion
- the realism of the fourth power law
- how to get politicians and the public to support pricing schemes.

## **Session 5B: Compliance**

**Christopher Walker** of the University of New South Wales Australia, analysed the Australian experience with alternative regulatory accreditation and then examined the potential for a fundamental reform of the heavy vehicle regulatory framework by instituting a two track system. This consists of a high track that has greater policy flexibility and more onerous accountability requirements and a low track characterised by standard prescriptive limits and traditional deterrent-based enforcement.

**Chris Koniditsiotis** from Transport Certification Australia (TCA), reported on the progress of the Intelligent Access Program which utilises GPS technology to remotely monitor heavy vehicles against access conditions imposed on them by Australian governments. This program is administered by Transport Certification Australia (TCA). The IAP program is based on national legislation and open, performance based specifications. To date, the IAP program has certified service providers who install type-approved telematics units and a certified back office service that monitors heavy vehicles and notifies jurisdictions in the event of non-compliance to access conditions.

**Lloyd Davis** from Queensland University of Technology documented the challenges and some proposed solutions regarding the issue of tamper-evidence for on-board mass systems for heavy vehicles. It was found that dynamic data and its analysis is the key to detecting tamper-events. The analysis of dynamic data by the project team has indicated strongly that reliable tamper-evident metrics are available by using some simple algorithms. By incorporating these measures into the existing Intelligent Access Program specifications a very robust regulatory scheme for on-board mass for heavy vehicles should be able to be implemented in Australia.

Issues raised during discussion included:

- crash rates of accredited vs non-accredited vehicles
- identification and enforcement of rules relating to tampering
- are the concessions significant enough to make an IAP scheme attractive?

## **Session 6: Plenary Session 2 - Moving Freight with Better Trucks - Improved Safety, Productivity and Sustainability – OECD/ITF Report**

The OECD and the International Transport Forum have combined to create the Working Group on Heavy Vehicles: Regulatory, Operational and Productivity Improvements led by **Jorgen Christensen** (Denmark). The Group's report was expected to be approved in the next few days. It was based on the work of 27 experts and took a short to medium term view of 10 years (to 2020). The following speakers all played key roles in supporting the production of the report.

**Jeff Potter** from the NTC (Australia) outlined the safety analysis which had been undertaken. Heavy vehicle safety performance had been compared across 22 OECD countries. Many differences had been identified e.g. the proportion of urban vs rural crashes, the relative role of causative factors and the proportions of single truck crashes. Hazard recognition and decision making by heavy vehicle drivers appear to be more than for car drivers. A key constraint on the analysis was a lack of detailed data to enable differentiation amongst the different types of HVs.

**Anthony Germanchev** from ARRB Group (Australia) described a benchmarking exercise of 40 HVs from 10 countries. The vehicles were assessed against 7 PBS measures using simulation and relative rankings derived. In general the larger HVs performed well but were not able to meet manoeuvrability criteria. This will limit access to many urban roads unless new technologies are implemented.

**John Woodrooffe** from UMTRI (USA) described a comparison of HVs against criteria such as road wear, impact on structures, safety, productivity and the environment. Larger vehicles were found to have positive benefits e.g. they were more productive per unit of energy used.

**Barry Moore** (Australia) stated that to get more productive vehicles on the road, there was a need to package up the benefits and get the community, media and political system on board. New technology is making the clear benefits of a PBS approach easier to achieve e.g. WIM and ITS. There is a growing preference to take a chain of responsibility approach now rather than tackling operators on the road.

**Jorgen Christensen** then read each of the 16 key messages from the OECD/ITF report.

During the ensuing panel session, the key issues raised related to:

- the evidence supporting a link between PBS standards and road safety effects
- means of convincing the political system and the community about the benefits of high productivity vehicles
- the possible role of involving experts in community engagement and communicating with the different levels of government
- making better use of existing spare capacity
- the need to upgrade driver skills to match the introduction of the high productivity vehicles
- the diversity of the certification schemes and local needs and capacities.

## **Session 7: Plenary Session 3 - PBS Experience in Australia**

**David Anderson**, Independent Chair of Australia's PBS Review Panel, spoke about putting PBS into practice. There is a clash of cultures between long-standing experience and new analytical tools. There is a need to work with communities (especially in cities) which are wary of large vehicles. Any lack of commitment needs to be dealt with where it exists and the 'us vs them' mentality must be eliminated.

**Mark Johnson** from Haulmark Trailers (Australia) provided a manufacturer's viewpoint. Indecision especially on route assessments in urban areas was a big problem. Each state and territory needs a specialised heavy vehicle productivity assessment group.

**Tony Miller** from Fonterra (Australia) provided a customer's view. He reported on a new design for a milk tanker. It is flexible, is safer and has better braking performance than B-doubles and causes less road damage. The vehicle is still having some approval problems and is not able to be used on some desired routes which are approved for B-doubles. In Victoria it cannot be run at capacity even though PBS says it can. The bridge assessment standards were also queried.

**Steve Warrell** from the RTA NSW (Australia) provided a road agency view. He said that there are 35 PBS vehicles operating in NSW. The application of the PBS scheme in NSW was described. The process needs to be streamlined especially assisting councils to undertake route assessments. He said that PBS did not really address infrastructure issues e.g. there are 177 timber bridges awaiting replacement by local government.

Issues raised during discussion included:

- VicRoads had improved bridge capacity and allowed heavier trucks where possible
- bridge engineers were considered to be too conservative
- improving efficiency of the assessment process
- need for a national bridge register.

## **Session 8A: Vehicle Productivity 1**

**Luke Callaway** from ARRB Group outlined the findings from a large scale simulation-based investigation into the forces generated at the tyre/road interface of the drive tyres of tri-drive heavy vehicles while turning relatively tight turns at low speed, climbing grades at steady speed and during start-up. Vehicles ranging from a rigid concrete agitator to AAB-quad road train combinations were simulated with most vehicles being simulated in both a tandem-drive and tri-drive configuration. Specific reference to the tri-drive prime mover policy in Queensland was made with the study being intended to be used as a key input into the review of this policy.

**Damian Walsh** presented a paper by Mark Brown of CRC Forestry Ltd./ University of Melbourne, Australia which described a planned trial of two new high productivity vehicles for transporting woodchips - a quad-B-double and steerable wheel semi-trailers. The potential of these two configurations will be explored for their potential impact on transport cost, fuel use and related emissions as well as the logistics of the operations and compared against preliminary results from field trials to be started in early 2010.

**Thomas Dessen** of the University of Witwatersrand in South Africa reported on a new performance based vehicle to transport steel pipes. As part of the strategy to implement Performance Based Standards (PBS) in South Africa (SA), a demonstration vehicle is to be developed for the transportation of large-bore welded steel pipes. The motivation for the research is to provide recommendations towards a suitable PBS framework for SA. The productivity and safety of the PBS demonstration vehicle will be compared with vehicles designed to comply with the current prescriptive legislation. The safety performance evaluation of the proposed demonstration vehicle makes extensive use of the Australian PBS legislation.

Issues raised during discussion included:

- relationship between horizontal loads and road damage
- efficiency of steerable wheel trailers compared to B-doubles

- establishment of skills and knowledge to perform vehicle assessments.

## **Session 8B: Pavements 1**

The paper by **Omar Khemoudj** from the Laboratoire Central des Ponts et Chaussées (LCPC) - France reported on a project which has the aim of developing smart systems to estimate the impacts of heavy vehicles on pavements and to develop active control strategies to reduce the maximum dynamic effects. The author proposed a practical solution easy to implement on modern trucks and to be coupled with active control systems. This method uses an optimised sensor configuration, but for real-time operating conditions the matrix inversion can saturate the CPU. Therefore an alternative method is proposed to directly estimate the forces by using a modified state space model formulation. The forces can then be estimated by classical robust states observers.

**William Goodrum** from Cambridge University presented a paper titled 'Whole-life pavement performance modelling of full-depth asphalt pavements'. Higher Mass Limits (HML) are weight concessions for vehicles equipped with 'road-friendly' air suspensions that operate in certain states in Australia. However, if air suspensions have ineffective or poorly maintained hydraulic dampers, their dynamic tyre forces can increase significantly – making air suspended vehicles less 'road friendly' than vehicles with conventional leaf spring suspensions. The objective of this study is to use whole-life pavement performance modelling to improve understanding of the effects of HML and suspension condition on the performance and maintenance costs of heavily trafficked, full-depth asphalt pavements. The methodology has been tested on datasets from Australia and the United States.

**Hocine Imine** from the Laboratoire Central des Ponts et Chaussées proposed a new method to estimate the unknown inputs of heavy vehicles. These inputs represent road profile which is used to estimate the vertical forces acting on wheels. These unknown inputs are reconstructed by using higher order sliding mode observers. First, speeds and accelerations of heavy vehicle are measured in finite time. The validation process uses an instrumented heavy vehicle and road profile is measured with a Longitudinal Profile Analyser. The estimations allow reconstruction of the vertical forces which are very important for calculating road damage or for evaluating the risk of rollover of the heavy vehicle using the Load Transfer Ratio.

## **Session 9A: Environment 1**

**Bram van der Schaar** from Hino Motor Sales reported on hybrid truck experience in Australia. Hybrid vehicles were introduced into the Australian market by Hino and have been used by several significant national fleets. The operational experience, environmental outcomes and also the financial outcomes of this experience were highlighted, including the sectors where hybrids are best suited in Australia. The paper reviewed overseas developments and the future potential for hybrids in Australia. It discussed the opportunities for hybrids to develop a significant market share in Australia and the factors needed to bring this about.

**Neil Wong** from the National Transport Commission, Australia reported on an extensive research program to provide a robust, scientific foundation for the development of actions to address the annoyance from engine brake noise. This research included:

- identifying what is it about engine brake noise that makes it so annoying to the community
- identifying a suitable noise descriptor
- roadside testing
- muffler trials
- an independent analysis of the potential safety impacts
- an independent analysis of the costs and benefits of the proposal.

This research was used to develop a proposed in-service standard which two jurisdictions are now considering adopting.

**Panu Sainio** of Aalto University presented a paper by Olavi Koskinen of the Ministry of Transport/Road Administration (Finland) on the impact of increased vehicle size on fuel and transport economy, emission reduction and road wear. A computer simulation system, based on vehicle dynamics, engine maps of fuel and pollutant emissions, other technical characteristics of vehicles and roads as well as driving technique (target speed/gear shift strategy) has been developed and validated by field measurements on roads. Fuel consumption and emissions are very sensitive to the road topography and speed, and therefore several road types and target speeds were included in the final model. It was found that all parameters reached better values, when the vehicle size was increased.

**Lydie Nouveliere** of the University of Evry in France described the development of an advisory system which provides advice to drivers on preferred gears and speed profiles with the aim of lowering fuel consumption. A driver training program has also been developed to promote more economical driving. Trials are currently underway.

**Joop Pauwelussen** from the HAN University of Applied Sciences in the Netherlands discussed the impact of heavy vehicle weight on fuel consumption. Lower weight means a higher payload for the same fuel costs, which contributes to the global reduction of CO<sub>2</sub>, and which offers both the transport company and the vehicle manufacturer a competitive edge. Reducing the semi-trailer mass requires a detailed understanding of the design and vehicle structure, of the use of (less conventional) materials such as composites with special emphasis on strength and fatigue, of the production process, and of specific assembly techniques. The project FORWARD aims at making tools available for the vehicle manufacturer that will help in designing semi-trailers with lower weight.

Issues raised during discussion included:

- the availability of hybrid designs on larger vehicles
- expected rate of compliance with proposed brake noise standard
- varying levels of acceptance of larger vehicles across different countries.

## **Session 9B: Vehicle Design and Technology 1**

**Marcus Coleman** from the NTC (Australia) assessed whether or not the Australian Performance Based Standards are still relevant in light of emerging active safety technologies. It included a review of the various technologies available, how they affect PBS performance, the tensions between delivering safety and productivity and an evaluation of alternative regulatory mechanisms, in particular the ECE R13 braking standard. A review of approved PBS designs evaluates how the standards have influenced vehicle design. Physical testing will compare the PBS performance of a vehicle fitted with and without a commercially available electronic vehicle stability system.

**John Woodrooffe** from UMTRI (USA) summarised a study conducted by UMTRI which examined the performance of electronic stability control systems (ESC), and roll stability control systems (RSC) for heavy truck tractor semitrailers. The study was based on the analysis of independent crash datasets using engineering and statistical techniques to estimate the probable safety benefits of stability control technologies for 5-axle tractor semitrailer vehicles. A novel method of examining the potential benefits of these systems was used. Crash scenarios that could likely benefit from the technologies were selected from national crash databases and the probable effectiveness of each technology was estimated.

**Seamus Parker** of FPInnovations (Canada) described an investigation of potential methods of improving the dynamic performance of truck/full trailers. The goals of this research have been to improve the safety of these configurations and to allow full trailers to carry full axle capacity thereby improving productivity. Roll-coupling hardware is the only option that will enable the performance criteria to be achieved under current dimensional allowances in Canada that will also facilitate straightforward regulation enforcement. Therefore, FPInnovations has developed roll-coupling hardware for a truck/full trailer and which is to be subjected to a comprehensive test program.

**Vincent Rouillard** of Victoria University (Australia) proposed a method which considers the non-stationary character of vehicle vibrations as the main cause of its overall non-Gaussian nature. The proposed vibration synthesis is based on previous research that shows that wheeled vehicle vibrations can be represented as a sequence of Gaussian segments of arbitrary length and rms levels. This approach has been found to be accurate as it accounts for the inherent non-stationarities that are characteristic to random vehicle vibrations. This resulted in a mathematical model that was found capable of describing the statistical distribution of stationary vibration segment lengths.

Issues raised during discussion included:

- the effect of mixing components with and without active vehicle stability systems
- application of new stability control systems to B-doubles and other more complex vehicles
- accuracy of vehicle vibration models in predicting road damage rates.

#### **Session 10: Plenary Session 4 - Getting Innovative Vehicles on the Road - experience from Round the World**

**John Woodroffe** from UMTRI (USA) reported that in the US, there were some high performance vehicles on state roads but these were not allowed on the interstates. There have been no changes to load and length limits since 1992. Public pressure against the introduction of longer, heavier vehicles was so strong that it was considered unlikely these vehicles would be more widely adopted in the short term in the US. This contrasted with the situation in Canada where there have been many advances. Varying rules initially existed across provinces so a weights and dimensions study was implemented to produce an MOU to encourage implementation of the results. The approach was also taken to limit the PBS system to specialised vehicles which are less than 5% of all heavy vehicles. In Alberta, these vehicles have been shown to be safer, consume less fuel, emit less CO<sub>2</sub> and NO<sub>x</sub>, consume less roads and decrease VKT.

**John Billing** from NRCC (Canada) provided a history of bridge and road construction in Canada and its influence on vehicle regulations. Since the 1980s, Canada has led in the operation of higher capacity vehicles such as Turnpike Doubles, Rocky Mountain Doubles and Triples. Early mistakes were made which led to major infrastructure costs and which have been extremely expensive and time consuming to overcome. It is much easier to extend existing rules – ‘taking back’ is much harder.

**Martin Salet** from Rijkswaterstaat (Netherlands) reported on the European PBS experience. Road transport in Europe is perceived negatively and the possibilities for widespread innovation are considered to be limited. Few countries allow longer heavier vehicles or are trialling or considering their use. This is not the case in the Netherlands where a major trial is underway. It involves assessment of the safety of the new design vehicles, a survey of the attitudes of drivers of other vehicles, the identification of an approved network, and assessment of impacts on infrastructure.

**Paul Freestone** of Freestones Transport (Australia) provided an operator’s view and raised a number of issues. Driver comfort has been ignored - an example was provided of a PBS vehicle that was too hard to drive and uncomfortable. Tri-drives and low profile tyres are damaging and uncomfortable respectively. The roads are not good enough – taxes on operators are too high. Consideration should be given to making trucks travel slower than cars.

During the panel discussion, the following issues were raised:

- what are innovative vehicles?
- the need to change roads as heavy vehicles change
- the importance of driver training.

### **Session 11A: Environment 2**

**Marten Johansson** presented the paper by Jacques Marmy of the International Road Transport Union entitled 'Sustainable road transport: a key component of the global economy'. The paper discussed:

- the modular concept and co-modality to promote better rather than more road transport
- emission standards to ensure greener road transport
- Intelligent Transport System (ITS) applications to increase road transport efficiency and safety.

The paper concluded that road transport in a globalised economy has become an efficient and unique production tool. As such, its progress goes hand in hand with new technologies, tools, methods and systems to make it the most flexible and accessible transport mode available to everyone everywhere. In this framework, the difficulty is thus to prevent misusing these tools and keep their use voluntary to all road transport stakeholders.

To investigate the effects of introducing LHVs in the EU, the European Commission's Directorate General for Transport and Energy ordered a consortium to provide an insight on six issues: meeting demand, co-modality, safety, infrastructure, energy efficiency and noxious emissions. The paper by **Tim Breemersch** of Transport & Mobility Leuven described the methodology followed to assess the following two scenarios:

- 'Corridor': LHVs of 25.25 m and 60 t are allowed to cross borders, a corridor of countries (Finland, Sweden, Denmark, Germany, the Netherlands and Belgium) allow them;
- 'Compromise': LHVs of up to 20.75 m - 44 t are allowed on the entire primary road network within the EU.

**Peter Hart** from the Australian Road Transport Suppliers Association outlined a method for estimating truck drag forces. The method uses the speed against time record from a roll-down test, which is obtained when the truck rolls to a stop from a high initial speed  $V_0$ . The performance is measured with the vehicle in various conditions (laden, unladen, engine engaged etc.) so that the relative contribution of aerodynamic forces, tyre drag forces, engine retardation etc. can be inferred. Characterisation of the drag forces on trucks provides an important tool for research into the effectiveness of fuel efficiency enhancements such as aerodynamic aids and low-loss tyres. The paper presented results for roll-down testing on several different sized medium and heavy vehicles and reviews the various drag loss mechanisms on vehicles and describes their likely variation with speed.

Issues raised during discussion included:

- the effect of long vehicle length on drag results
- techniques for improving aerodynamics
- the scope for further engine improvements.

## **Session 11B: Vehicle Design and Technology 2**

**John Billing** from the Centre for Surface Transportation Technology, National Research Council of Canada described an approach to assessment of the handling performance of straight trucks. Handling describes the response of a vehicle to steering. The CCMTA/RTAC Vehicle Weights and Dimensions Study developed a handling performance measure. However, it was never adopted as handling is a rather 'soft' area, was not a significant issue for the tandem drive tractors being considered, and was difficult to relate objectively to highway safety. NRC-CSTT recently evaluated the dynamic performance of 13 straight truck configurations. Some of these had a self-steering axle as the rearmost axle, and it was evident they might become oversteer. It was therefore necessary to devise a simple and practical approach to assess handling performance.

**Panu Sainio** from Finland presented a paper on research which aimed to cut the aerodynamic coefficient of heavy road vehicles in half. There were two target vehicles, a long distance bus and a vehicle combination of 25.25 meters and 60 ton. The main objectives were to raise discussion about the potential of aerodynamics in the case of heavy road vehicles in Finland and to test one technical solution to improve the aerodynamic performance of the end of the trailer. This solution is called a virtual boat end and it is based on flow of pressurised air from the trailing edges of the trailer.

The paper by **Johan Granlund** from Vectura Consulting AB (Sweden) presented several methods to measure pavement damage that can bring health and safety risks. These methods can be used in new approaches to reduce risks on low-volume roads. Many professional truck drivers are exposed to unacceptable human whole-body vibration and suffer unacceptably high risk for work-related musculoskeletal and cardiovascular diseases. Pavement condition and truck ride vibration was used to predict compression stress in drivers' spines and a new pavement condition parameter was validated. It described undesired variance in cross slope (causing a ride where high vehicles were rolling from side to side), and a relevant limit value for this 'roll indicator' was drafted.

## **Session 12A: Vehicle Productivity 2**

**Adam Ritzinger** of ARRB Group (Australia) reported on a performance assessment and sensitivity analysis of a range of innovative quad-trailer combinations via computer simulation using PBS. The computer based vehicle simulations considered all PBS measures designed to address the safety of the vehicle in on-road scenarios and the impact of the vehicle on road infrastructure. The simulation results showed considerable differences in the high speed dynamic stability of the configurations. These results were supplemented by a field test program conducted using two quad-road train combinations in Darwin, Australia.

**John de Pont** of Transport Engineering Research New Zealand described research to improve the performance of New Zealand's heavy vehicle fleet in protecting the road and bridge infrastructure, improving safety, reducing environmental impact and reducing congestion. To achieve this aim, typical vehicles used in six transport tasks in New Zealand (NZ) were benchmarked against vehicles undertaking those same tasks in Australia (Au), Canada (Ca), Southeast Asia (SEA), and in the United Kingdom (UK). The six transport tasks analysed were passenger coach transport, bulk liquids and materials transport, 40 foot ISO intermodal container transport, and livestock and refrigerated goods transport. Four aspects of heavy vehicle performance: pavement wear, bridge wear, road width occupancy and safety were considered.

**Erik Dahlberg** from Scania compared different approaches on specifying heavy trucks. The actual performance and operating economy was compared for vehicles specified using three different methods. The first vehicle was based on market standards, the second was optimised based on operational factors given by the customer while the third was optimised using detailed operational statistics read out from vehicles in operation. Trucks often use less than full loading capacity. In optimising for the real need, there is a large saving potential indicating both lighter and more fuel efficient trucks, e.g. with down-sized engines. By utilising vehicle operational statistics and an

optimisation program, truck specifications better adjusted to the transportation task can be offered to the customer.

## **Session 12B: Pavements 2**

**Karim Chatti** from the Michigan State University (USA) presented on the 'Identification of localized roughness features and their impact on vehicle durability and damage to goods'. The first research objective was to identify and implement tools to extract information on distress features such as faults, breaks, slab curling and potholes through the use of raw profile data. The implemented tools detect, locate and identify the level of surface irregularities; however, they do not in themselves provide guidance on acceptable roughness levels to limit user costs. Therefore, there is a need to develop a methodology to determine such roughness thresholds.

**Klaus-Peter Glaeser** from BASt (Germany) reported on the 'Performance of articulated vehicles and road trains concerning road damage and load capacity'. From extensive rutting tests performed in different European countries with different tyres, tyre configurations, axle loads, inflation pressures etc., a tyre configuration factor (TCF) was defined. The TCF value relates the pavement wear of a given tyre to the pavement wear of a reference tyre. Within different axle categories (steered, driven or towed axle) there is a wide range of TCF values. Tyre assembly (single/dual), tyre width and tyre diameter are the most important factors which influence the TCF. Axle wear factors and vehicle wear factors and the relationship with pavement wear was also discussed.

**Lars Persson** of the Swedish Road Administration presented results from 5 years of Swedish measurements with bridge WIM system during 2004 - 2008. The conclusions so far are that there is a considerable problem with overloading, in terms of both gross weight and axle weights. There has been an increase in heavy traffic and at the same time the amount of overloading has decreased. Data from the measurements gives an important input to new design models for road construction. Results from the measurements can be a good base for discussions with the transport industry about how to solve the problems with overloading.

Issues raised during discussion included:

- the need to identify local roughness events
- simulator testing and the power relationship
- the accuracy of the bridge WIM system.

## **Session 13: Plenary Session 5 - Energy and Environment - Driving Heavy Vehicle Policy, Design and Operations**

**Anders Lundstrom** from Scania (Sweden) presented on the challenges to motor vehicles. The demand is for more mobility for goods and people with no increase in willingness to pay. Other factors need to be reduced such as crashes and emissions. Some argue that in the future peak oil and gas will lead to a reduction in emissions. Average heavy vehicle fuel consumption has decreased by more than 30% from the 1970s but has been stable for the last 20 years. A side-skirt to improve aerodynamics may reduce fuel consumption by 0.6%. Other innovations include a system which optimises gear changes, a driver support system which provides feedback during and at the end of a trip world-wide labeling for fuel efficiency and CO<sub>2</sub>.

Anders considered that improvements to the vehicles by themselves cannot reach fuel and CO<sub>2</sub> targets and action in other areas (such as reducing congestion, improving rolling resistance and upgrading driver skills) will be needed.

**David Cebon** from Cambridge University (UK) described some vehicle modeling of fuel consumption using a range of vehicles and trip cycles. Congested motorways were found to double fuel use compared with free-running motorways. The effect was also present in urban areas but was not as strong. To harness the energy lost in braking a heavy vehicle, regenerative braking systems have significant potential for fuel efficiencies. David argued that effort should be directed to those measures with the most potential cost-effective impact such as:

- reducing traffic congestion (use HCVs, eliminate night-time curfews, optimize traffic control, reduce crashes and delays) - up to 50% reductions
- change logistic patterns (use semi-trailers instead of rigids, use longer vehicles) - 10-35% reductions
- regenerative braking - 25% reductions
- improve engine/drive train, rolling resistance - 5-10%.

**Alan McKinnon** from Heriot-Watt University (UK) presented a wider logistical perspective. One study has found a huge variation in the cost of pallets carried per distance travelled. Some companies were fuel efficient but were poorly loading their goods. Others made their decisions for quite justifiable reasons. Advance warning would enable more effective vehicle use. Another study found that once all the constraints were taken into account, the scope for load matching/back-loading was a lot smaller than is often claimed. Also it should not be forgotten that congestion can also occur at factories, warehouses and shops. In fact, some would have to be re-engineered if night-time curfews were lifted.

The Freight Best Practice program in the UK has been influential in leading to adoption of fuel efficient practices by participating companies. However in many industries CO<sub>2</sub> is a small part of the costs and therefore it is difficult to convince CEOs that action needs to be taken.

**Pieter Wouters** from KiM Institute for Transport Policy Analysis presented a perspective from the Netherlands. He suggested that companies can take actions now but because many do not, government has to step in. Improvements in areas such as technology, driver behaviour and biofuels are not likely to meet government targets. So a study was initiated to look at a range of policy initiatives including km and CO<sub>2</sub> levies, emissions and fuel consumption standards, lower rolling resistance tyres and incentives. The most effective was judged to be an emissions trading scheme, some were more efficient and others had poor efficiency.

During the panel session, discussion addressed:

- the potential effects for alternative fuels
- the effects of using different drive cycles in the models
- placement of a labeling model in the public domain for users to check the efficiency of their vehicles
- buying on-line vs in person.

**Tony McMullin**, CEO of Australia's Truck Industry Council discussed a project which involved interviews with 1000 drivers. The feedback was that trucks were accepted, new trucks were assumed to be greener and safer but the drivers wanted to know in what way were the trucks better.

## **Session 14: Plenary Session 6 - Balancing Competing Needs - the Findings**

Three experts were the Conference rapporteurs.

**Peter Sweatman** from UMTRI (USA) discussed:

- reasons to innovate (such as safety and emissions) or not (such as (funding levels and public perceptions)
- a range of quotable quotes from the presentations
- what innovations have been achieved to date and what innovations look the most promising/imminent.

**Alan McKinnon** from Heriot-Watt University (UK) thought that it was an excellent Conference but it was disappointing so few operators had attended. It appeared that there had been a lot of technically focused research but little coming from the logistics end. Community engagement was clearly a big need. Care needs to be taken when extrapolating between countries. There are many reasons why results may not be applicable elsewhere. There is a strong need for better data but in the past, it has been difficult to get industry to fill out questionnaires.

**David Cebon** from Cambridge University (UK) considered that there had been many papers which had reported interesting findings or had identified promising new avenues to pursue further. In terms of PBS in Australia, it was expanding slowly and steadily but appeared to be too restrictive and exclusive with high risk regarding return for investment in its current form. A number of suggestions were made to improve the scheme. The benefits from use of larger vehicles have been well documented but public response has been negative. If we are to provide a stronger message, the approaches used by lobbyists need to be adopted.

## **5 Next Symposium**

HVTT12 will be held in the Stockholm area in Sweden in 2012.

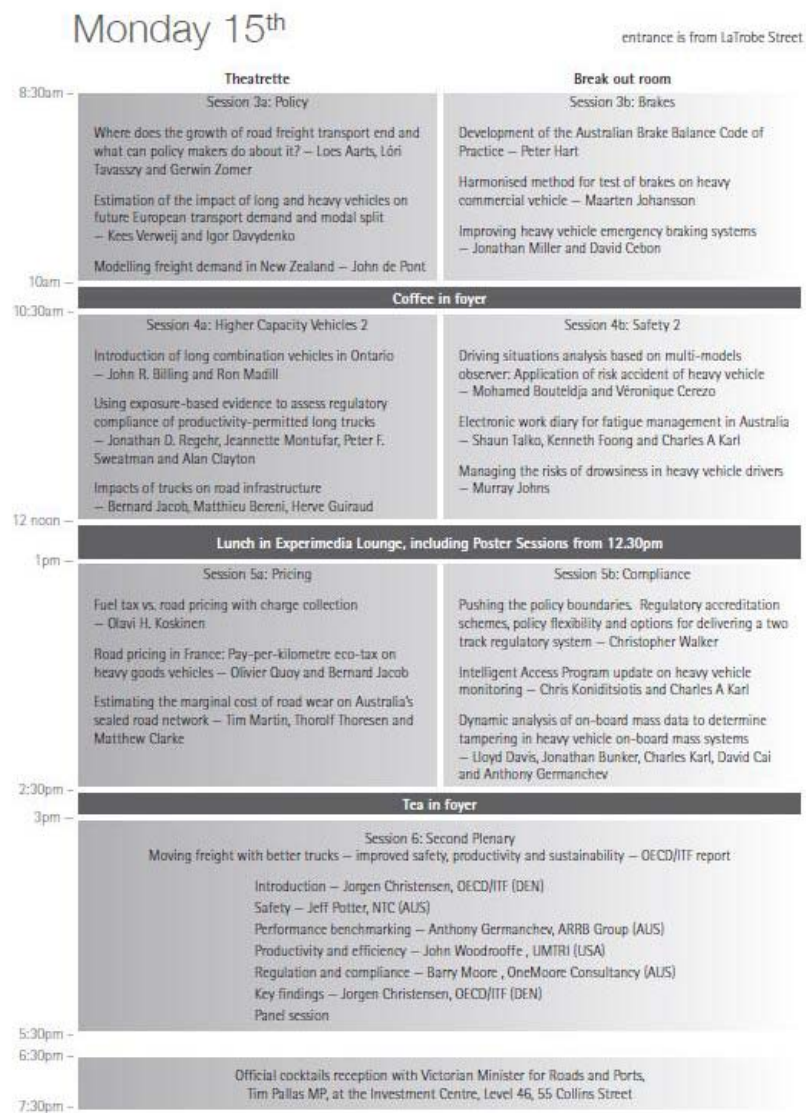
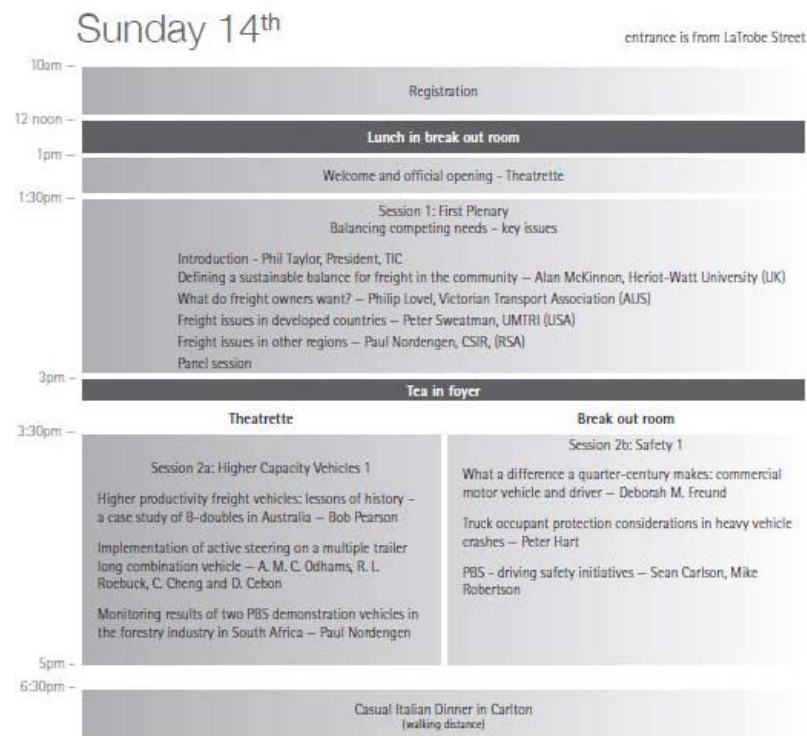
**Appendix 1: Members of the Scientific Committee include:**

- Professor Sean Brennan, Penn State University, USA
- Mr Les Bruzsa, Principal Engineer, TMR, Australia
- Professor Karim Chatti
- Professor Andrew Collop
- Dr Erik Dahlberg, Head, Field Analysis, Scania, Sweden
- Dr John De Pont, Director, TERNZ, New Zealand
- Mr Rob Di Cristoforo, Consultant, Advantia, Australia
- Dr Klaus-Peter Glaeser, Head Vehicle Pavement Interaction, BASt, Germany
- M. Bernard Jacob, LCPC, France
- Mr Dom Kalasih, Fleet Manager, Shell, New Zealand
- Mr Anders Lundstrom, Senior Advisor, Scania, Sweden
- M. Jacques Marmy, Head, Technical Affairs, IRU, Switzerland
- Mr Paul Nordengen, Research Group Leader, CSIR, South Africa
- Dr Laszlo Palkovics, Director, Advanced Engineering, Knorr Bremse, Hungary
- Mr Seamus Parker, Senior Researcher, FERIC, Canada
- Mr Christophe Penant, Industry Standards, Michelin, France
- Dr Hans Prem, Senior Consultant, MSD, Australia
- Mr David Rolland, Senior Consultant, GHD, Australia
- Dr Peter Sweatman, Director, UMTRI, USA
- Professor John Widmer, Professor of Transport Engineering, University of Sao Paulo, Brazil
- Mr John Woodrooffe, Head of Safety Research, UMTRI, USA

## Members of the Organising Committee included:

- Nick Dimopoulos, CEO, National Transport Commission and Chairman of HVTT11 Organising Committee
- Les Bruzsa, Principal Engineer, TMR, Queensland
- Don Hogben, Acting Executive Director - Road Safety & Network Access, VicRoads
- Gary Liddle, Chief Executive, VicRoads
- Philip Lovel, AM, CEO, Victorian Transport Association
- Graeme Miller, National Manager, Technical Support, Scania Australia
- Terry Pennington, Chief Technical Officer, Truck Industry Council
- Rob Perkins, Director Projects, Victorian Transport Association and Secretary for HVTT11.

## Appendix 2 The HVTT Symposium Program



Tuesday 16<sup>th</sup>

entrance is from LaTrobe Street

	Theatrette	Break out room
8:30am –	<b>Session 7: Third Plenary</b> The PBS experience in Australia The PBS model in Australia – Paul Sullivan, NTC (AUS) Putting PBS into practice – David Anderson, PRP (AUS) Manufacturers experience – Mark Johnston, Haulmark Trailers (AUS) Customers experience – Tony Miller, Fonterra (AUS) Road agency experience – Steve Warrell, RTA NSW (AUS) Panel session	
10am –	<b>Coffee in foyer</b>	
10:30am –	<b>Session 8a: Vehicle productivity 1</b> Tri-drive prime movers and tyre forces – Nick Trevorrow and Luke Callaway The impact of new high productivity vehicles on the wood chip transport task in the Green Triangle region of Australia – Mark Brown A South African Performance Based vehicle to transport steel pipes – Thomas Desein, Frank Kienhofer and Paul Nordengen	<b>Session 8b: Pavements 1</b> Control theory approach for on-board estimation and monitoring of heavy vehicle dynamical tyre forces – Omar Khemoudj, Hocine Imine, Mohamed Djamaï and Bernard Jacob Whole-life pavement performance modelling of full-depth asphalt pavements – William Goodrum and David Cebon Experimental validation of unknown inputs estimation via high order sliding mode observer – Hocine Imine, Aziz Benallegue and Leonid Fridman
12 noon –	<b>Lunch in Experimedia Lounge, including Poster Sessions from 12.30pm</b>	
1pm –	<b>Session 9a: Environment 1</b> Hybrid Truck Experience in Australia – Bram van der Schaar World-first standard for engine brake noise – Neil Wong Nordic vehicle configuration from the viewpoint of fuel and transport economy, emission reduction and road wear impact – Olavi H. Koskinen Driving assistance system for low fuel consumption of a heavy truck: advisor system – Lydie Nouveliere, Fabien-Romain Duval, Vincent Demeules, Fabrice Accary and Bernard Jacob FORWARD: Fuel Optimised trailer Referring to Well Assessed Realistic Design loads – Joop P. Pauwelussen, Jeroen Visscher, Menno Merts and Rens Horn	<b>Session 9b: Vehicle design and technology 1</b> Performance Based Standards and active vehicle stability systems – Marcus Coleman Analysis of stability control systems for tractor-semitrailers – John Woodroffe, Danial Blower and Paul E. Green Synthesizing nonstationary, non-gaussian wheeled vehicle vibrations – Vincent Rouillard and Michael A. Sck Development of a roll-coupled hitch for truck/full-trailers – Seamus PS Parker and James L. Sinnett
3pm –	<b>Tea in foyer</b>	
3:30pm –	<b>Session 10: Fourth Plenary</b> Getting innovative vehicles on the road – experience from around the world Canada and the US – John Woodroffe, UMTRI (USA) Ontario experience – John Billing, NRC (CAN) European experience – Martin Salet, Rijkswaterstaat (NL) Australian operators view – Paul Freestone, Freestones Transport (AUS) Panel session	
5pm –	<b>IFRTT General Assembly</b>	
5:30pm –	<b>HVT11 Dinner</b>	
7pm –	<b>Queens Hall, State Library of Victoria - entrance is via Swanson Street</b>	
11:30pm –		

Wednesday 17<sup>th</sup>

entrance is from LaTrobe Street

	Theatrette	Break out room
8:30am –	<b>Session 11a: Environment 2</b> Sustainable road transport: a key component of the global economy – Jacques Marmy Contribution of LHVs to EU environmental policy as calculated with COPERT IV – Tim Breemersch Estimation of truck drag forces in roll-down testing – Peter Hart	<b>Session 11b: Vehicle design and technology 2</b> An approach to assessment of the handling performance of straight trucks – John R. Billing and J. D. Patten Aerodynamic possibilities for heavy road vehicles – virtual boat tail – Panu Sainio, Kimmo Killström and Matti Juhala Reducing health and safety risks on poorly maintained rural roads – Johan Granlund
10am –	<b>Coffee in foyer</b>	
10:30am –	<b>Session 12a: Vehicle productivity 2</b> Comparative performance of innovative quad-trailer combinations – Adam Ritzinger Optimisation of New Zealand's heavy vehicle fleet – Neon Taramoera and John de Pont Minimizing operating costs by specifying trucks based on operational statistics – Johan Wängdahl and Erik Dahlberg	<b>Session 12b: Pavements 2</b> Identification of localized roughness features and their impact on vehicle durability and damage to goods – Imen Zaabar and Karim Chatti Performance of articulated vehicles and road trains concerning road damage and load capacity – Klaus-Peter Glaeser Results from 5 years of Swedish measurements with bridge WIM system during 2004 - 2008 – Lars Persson and Tomas Winnerholt
12 noon –	<b>Lunch in Experimedia Lounge</b>	
1pm –	<b>Session 13: Fifth Plenary</b> Energy and environment – driving heavy vehicle policy, design and operations The challenges for heavy vehicles – Anders Lundstrom, Scania (SWE) Meeting the challenge: heavy vehicle options – David Cebon, Cambridge University (UK) The wider logistical perspective – Alan McKinnon, Heriot-Watt University (UK) Policy options for carbon efficient heavy vehicles – Pieter Wouters, KIM (NL) Panel session	
2:30pm –	<b>Tea in foyer</b>	
3pm –	<b>Session 14: Concluding plenary</b> Balancing competing needs – the findings Leading participants from the four days of the symposium will be chosen to sum up how to balance competing needs in heavy vehicle transport technology	
4:30pm –	<b>Closing address</b>	
5pm –		



Research Report  
**ARR 376**

Report on HVT11 International heavy vehicle symposium



Research Report ARR 376  
ISBN 1 876592 61 3  
ISSN 0158-0728