



# HVTT14 - Future Pathways PROGRAM

The International Forum for Road Transport Technology (IFRTT) is proud to present the 14th International Symposium on Heavy Vehicle Transport Technology (HVTT14). This conference provides a unique forum for legislators, road administrators, academics, consultants, vehicle manufacturers and suppliers, transport organizations and transport operators to discuss and exchange ideas on ways to improve the safety, efficiency, productivity and sustainability of the road transport industry.

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## **Welcome to IHVTT14 in Rotorua**

The first of these international symposia was held in Kelowna, British Columbia in 1986. The conference was run by the Road Transport Association of Canada (RTAC) and was designed as an international forum to bring together representatives of all of the stakeholders in the road transport sector including regulators, policymakers, vehicle and component manufacturers, operators, researchers and consultants to talk about the way forward in heavy vehicle size and weight regulation. The primary motivation for having the symposium was completion of a substantial Vehicle Weights and Dimensions Study that RTAC had recently completed and the symposium was only intended to a one-off event.

However, because it was so successful, a second symposium was held at Kelowna three years later to see what progress had been achieved in implementing the ideas and concepts that had been presented at the first symposium. The delegates at this second symposium decided that these meetings were extremely worthwhile and that they should continue. Professor David Cebon, who is attending here, then offered to host the third symposium at Cambridge and, at that conference he initiated the establishment of the International Forum for Road Transport Technology (IFRTT) to promote the exchange of ideas between stakeholders and to organise future symposia on a regular basis. All delegates to these symposia automatically become members of IFRTT for the period until the next symposium.

Although the initial symposia focussed on size and weight issues, it soon became clear that creating a heavy vehicle transport system that is safe, productive, efficient and sustainable is about more than simply making trucks bigger and so the name of the conference was changed from the International Heavy Vehicle Weights and Dimensions Symposium to International Heavy Vehicle Transport Technology to better reflect the actual content.

Initially the membership of IFRTT and the delegates to the conferences were primarily from North America, Europe and Australasia. IFRTT has always been keen to widen its global coverage and gradually this has been achieved. Previous symposia were held in Canada, USA, UK, Netherlands, Australia, France and Sweden but more recently also in South Africa and Argentina. At IHVTT14 we have delegates attending from every continent on the planet.

New Zealand has been an active participant in these symposia from the very beginning. There have been delegates and papers from New Zealand at every conference and we have been early adopters of a number of the ideas put forward. The road transport

system in New Zealand is regulated from central government with no provincial or state governments involved and we have no land borders with any other jurisdiction. This gives us an ability to implement change relatively quickly. Ideas from these conferences have influenced all aspects of heavy vehicle regulation in New Zealand since the 1980s.

We are very pleased to welcome all delegates but especially those from overseas to HVTT14 in New Zealand. In terms of population we are the smallest country to host an HVTT symposium. The Institute of Road Transport Engineers of New Zealand (IRTEENZ) has taken up the challenge of running the event and IFRTT are very grateful to them for their contribution in doing this.

For the overseas visitors, you will notice significant differences between the vehicle configurations that we use in New Zealand and those that are popular in your home countries. In every country the vehicle configurations that you see represent what operators consider to be the best solution to the regulatory environment, the infrastructure, the topography and the freight task requirements. The best solution in New Zealand is probably not the best solution elsewhere. Nevertheless it can be very enlightening to find out why things are done the way they are elsewhere and this can lead you to new approaches.

On this point it is interesting to note that many industries worldwide have already been dramatically changed by digitisation and technological innovation. Transportation is now entering a new phase where technology will profoundly change the way freight and people are moved about. Future Pathways speaks to this approaching paradigm shift. More than ever technology is delivering transport solutions which are making the transportation industry safer, more efficient and sustainable.

I hope that you all enjoy your stay in New Zealand and that we all learn from each other over the three days of the conference.

**John de Pont**  
President, IFRTT  
Chair HVTT14 Scientific Committee.



## DAY 1 Tuesday 15th November

Chair	Author	Paper Title	
8.30am to 11.00am	John de Pont	PLENARY SESSION 1	
		<b>Opening</b> <b>Peter Mersi, CEO Ministry of Transport</b>	
		Panel discussion on Heavy Vehicle Regulatory Reform Thomas Asp –Sweden/ Nordic countries, John Woodrooffe – North America, Alejandra Efron – South America Paul Nordengen – South Africa, Dong Jinsong – China, Les Bruzsa – Australia, David Silvester – New Zealand	
11.00 to 11.30 BREAK			
11.30am to 12.30pm	Session 1a Mats Harborn	Joop Pauwelussen, Ben Kraaijenhagen, Igo Besselink, Pilipp Hartmann, Karel Kural Stef Weijers and Thorsten Poellath.	A Field Research On The Need Of High Capacity Vehicles To CO2 Reduce Emission And Improve Profitability
	Session 1b Loes Arrts	Thomas Asp and Anders Berndtsson.	HCT (High Capacity Transports) And Ers (Electric Road Systems) - Swedish Steps Toward A More Efficient And Climate Neutral Transport System
		Dom Kalasih and John Doesburg.	Behavioural Change Through A Fuel Efficiency Programme
		Scott Grossbauer and Hayden Schulz	Clean Fuel - Keep Running
12.30 to 1.30 LUNCH			
1.30pm to 3.00pm	Session 2a Dom Kalasih	Zhang Hongwei and Dong Jinsong	GB1589-2016 Promoting the Modernization Development of China's Road Transport Vehicles
		Rob Di Cristoforo and Les Bruzsa.	Growing Pains: Challenges For Australia'S PBS Scheme
		Kim Hassall.	Do 'Safe Rates' Actually Produce Safety Outcomes? A Decade Of Experience From Australia
	Session 2b Seamus Parker	Bruno Augusto, Peter Nilsson, Leo Laine, Jesper Sandin and Niklas Fröjd.	Using Large Moving Base Simulators As Tools When Designing Future Automated Functionality For Commercial Heavy Vehicles: A Case Study Of Highway Auto-Piloting For High Capacity Transport
		Maliheh Sadeghi Kati, Hakan K'oro'glu and Jonas Fredriksson.	Robust Control Of An A-Double With Active Dolly Based On Static Output Feedback And Dynamic Feed-Forward
		Christopher Charles de Saxe and David Cebon	Visual Odometry For Trailer Eff-Stacking rstimation
3.00 to 3.30 BREAK			
3.30pm to 5.00pm	Session 3a Bob Pearson	Alejandra Efron and Graciela Corvalan.	From Paper To Road- And Back Again: A Comparison Of The Implementation Of High Capacity Vehicles In Latin American Countries
		David Silvester.	A Transformation In Freight Productivity - A Case Study Of High Productivity Motor Vehicles In NZ
		Jesper Sandin.	Effects Of Higher Capacity Vehicles On Traffic Safety In Sweden
	Session 3b Rob di Cristoforo	Adam Ritzinger, Rob Di Cristoforo and Daniel Nolan.	The Effects Of Safety Chains On The Dynamics Of Truck And Dog Trailer Combinations In The Event Of A Coupling Failure
		Bolecnarth Svensson, Joergen Nilsson and Niklas Froejd.	Clevis Couplings In Multi-Vehicle Combinations
		Leon Henderson, David Cebon and Leo Laine.	Brake System Design For Future Heavy Goods Vehicles

**7.30pm INFORMAL DINNER - TRADITIONAL MAORI HANGI**

## DAY 2 Wednesday 16th November

Chair	Author	Paper Title	
<b>PLENARY SESSION 2</b>			
9.00am to 10.30am	Paul Nordengen	John Woodrooffe.	Performance Based Standards: Future Considerations
		Loes Aarts.	A Flexible Regulatory Framework for Trucks
		Jerker Sjögren and Thomas Asp.	OECD Working Group On High Capacity Transports (HCT) - Background, Aim, Activities And Expected Outcome
<b>10.30 to 11.00 BREAK</b>			
11.00am to 12.30pm	Session 4a Rob di Cristoforo	Michael Hofmann, Sebastian Franz, Mohammad Manjurul Islam and Leo Laine	Development And Evaluation Of An Experimental Platform For Steered Axles Of Long Combination Vehicles
		Robert Berman, Richardt Benade, Paul Nordengen and Benjamin Rosman.	Hyperformance: Predicting High-Speed Performance Of A B-Double
		Frank Kienhofer, Robert Berman, Jarryd Deiss and Paul Nordengen.	Maximum Of Difference Assessment Of Typical Semitrailers: A Global Study
	Session 4b David Cebon	Johan Granlund and Per Thomson.	Traffic Safety Risks With EU Tractor-Semitrailer Rigs On Slippery Roads
		Sogol Kharrazi.	Performance Of High Capacity Vehicles In Winter Versus Summer
		Lena Larsson, Emil Pettersson and Lennart Cider.	Co-Optimizing Multi Vehicle Combinations Energy Consumption & Traction In Slippery Conditions
<b>12.30 to 1.30 LUNCH</b>			
1.30pm to 3.00pm	Session 5a Bernard Jacob	Gunnar Svenson, Patrik Flisberg and Mikael Rönqvist.	Development And Implementation Of New Features In A Route Selection And Distance Measurement System
		Gavin Hill and Chris Koniditsiotis.	On-Board Mass Monitoring For Commercial And Regulatory Purposes In Australia: Operational Learnings From The Interim OBM Solution
		Matt Elischer, Aaron Percy and Simon Buxton.	Access Management Framework For Oversize-Overmass (OSOM) Vehicles In Tasmania
	Session 5b Adam Ritzinger	Kristoffer Tagesson, Jochen Pohl, Bengt Jacobson, Björn Eriksson, Johan Hultén and Leo Laine.	Improving Directional Stability Control In A Heavy Truck By Combining Braking And Steering Action
		Mohamed Bouteldja and Véronique Cerezo.	Tractor Semi-Trailer Side-Slip And Articulation Angle Estimation: Numerical And Experimental Result
		Graeme Morrison and David Cebon.	Assessment Of A Control Strategy For Combined Emergency Braking And Turning Of Articulated Heavy Vehicles
<b>3.00 to 3.30 BREAK</b>			
3.30pm to 4.30pm	Session 6a Alejandra Eifron	Tang Hui and Gu Jingyan.	Supporting "The Belt and Road" Initiatives: Build Up An Interconnected Transport And Logistics System
		Alexia Fenollar Solvay, Max Haberstroh, Tobias Meisen and Sabina Jeschke.	Decision Criteria For Introducing New Intermodal Transport Concepts In The European Market
	Session 6b Joop Pauwelussen	Loes Aarts and Gerben Feddes	European Truck Platooning Challenge
		Bernard Jacob and Franziska Schmidt.	Truck Platooning: Potential Benefits And Impact On Bridges

**7.30pm GALA DINNER**

## DAY 3 Thursday 17th November

Chair	Author	Paper Title	
9.00am to 10.30am	Chris Walker	PLENARY SESSION 3	
		Tim Breemersch and Kris Vanherle.	An Integrated Approach To Road Freight Transport CO2 Reduction In Europe
		Jacques Marmy and Marten Johansson.	International Guidelines On Safer Goods Reception For Road Transport
		Veronika Pereseina.	Sustainable Business Models In Transportation – Experience From Swedish And Australian Long-Haulage Trucking Industry.
10.30 to 11.00 BREAK			
11.00am to 12.30pm	Session 7a Marten Johansson	Corinne Watson.	Creating Win-Win Solutions For The Network And Best Practice Operators
		Gavin Hill and Chris Koniditsiotis.	Implementing Electronic Work Diaries (EWD) For Regulatory Fatigue Management
		Anna Beesley.	Improving Safety And Compliance, And Simplifying Enforcement - Recent Reforms To Australia'S Heavy Vehicle Chain Of Responsibility Laws
	Session 7b Bruce Currie	Stefano Sedran, Fredrik Bruzelius, Sogol Kharrazi, Bengt Jacobsson and Nicola Amati.	A Heavy Vehicle Dynamics Model For Driving Simulators
		Gunnar Svenson and Dag Fjeld.	The Impact Of Road Geometry And Surface Roughness On Driving Speed For Swedish Logging Trucks
		Johan Granlund, Rob di Cristoforo, Rolf Mellum and Marius Hansen Raddum.	Investigating Heavy Vehicle Rollover Crashes And The Influence Of Road Design By Use Of Vehicle Simulations: A Case Study In Norway
12.30 to 1.30 LUNCH			
1.30pm to 3.00pm	Session 8a Les Bruza	Richardt Benade, Robert Berman, Frank Kienhofer and Paul Nordengen.	A Pro-Forma Approach To Car-Carrier Design
		Seamus Parker.	Investigation Of Longer Modular Concept Configurations For British Columbia
		Sri Kannan.	Allowing Truck And Trailer Combinations At PBS Mass Limits
	Session 8b Alexia Fenollar Solway	Frederic Domprobst.	Heavy Truck Vehicle Dynamics Model & Impact Of The Tire
		Fredrik Bruzelius, Sogol Kharrazi and Emil Pettersson.	Model And Road Surface Sensitivity Of Longitudinal Performance Based Standards
		Paul Nordengen and Anton Steenkamp.	A Methodology For Assessment Of Road Structures For The PBS Pilot Project In South Africa
3.00 to 3.30 BREAK			
3.30pm to 5.00pm	Session 9 John Woodroffe	John de Pont, Don Hutchinson and Graham Taylor.	Formalising The PBS System In New Zealand
		Karel Kural, Igo Besselink, Yiheng Xu, Abhishek Tomar and Henk Nijmeijer.	Driver Support System For Improved Maneuvering Of Articulated Vehicles Using Unmanned Aerial Vehicle
		Christopher Walker.	Improving Compliance And Enforcement Options Through International Policy Transfer And Collaboration. The Australian And Swedish Experience With Remote Vehicle Monitoring Under The Intelligent Access Project (IAP).
	Summary and Close of Technical sessions		

**EVENING FREE**



DAY 4 Friday 18th November

## TECHNICAL VISIT

Join us for a visit to one of New Zealand's largest forests to view some of our off-highway logging vehicles in their day-to-day activities.

Buses leave the hotel at 8.30 a.m. and return at 12.30 p.m. to the hotel. Please wear suitable, sturdy footwear and take a warm jacket, waterproof if possible.



# A FIELD RESEARCH ON THE NEED OF HIGH CAPACITY VEHICLES TO REDUCE CO2 AND IMPROVE PROFITABILITY



Ben Kraaijenhagen,  
Vice President  
Head of Central Division  
Foresight and Product  
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Karel Kural, MSc,  
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Stef Weijers, MSc,  
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Logistics and Alliances,  
at HAN University  
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Igo Besselink, MSc,  
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## Abstract

In order to reduce the current level CO<sub>2</sub> contribution by the global/western European road transport sector, there is a need for more efficient logistics including high capacity vehicles allowing multiples of loading units, fitting with current and future infrastructures. In addition, multimodality need to be explored due to its potential to increase transport efficiency and as a consequence reduce CO<sub>2</sub> emission levels. These explorations involve different stakeholders. To a certain extent they all have their own interests which we believe must be valued. But if we want to help to develop transport efficiency to a higher level, we should establish a common language and a clear structured framework. Such a framework is proposed in this paper, in terms of a questionnaire for further field survey; it helps to determine benefits of high capacity vehicles, creating a sound basis for potential business cases and optimized scenarios for the road transport industry. Creating a fit between new concept vehicles, new logistics concepts based on these vehicles, and infrastructure is important, requiring smart infrastructure access policies, with vehicle approval being based on vehicle performance. Based on that, a project FALCON is described, aiming for deriving these use cases.

Keywords: High Capacity Vehicles, multimodality, performance based standards



# HCT AND ERS IN SWEDEN



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THOMAS ASP  
STA / CLOSER  
Civil Engineer from Chalmers in Gothenburg. Now working both as a head of a section at Swedish Transport Administration (STA) and as a project leader for a research program around High Capacity Transport at CLOSER Lindholmen Science Park.



ANDERS BERNDTSSON,  
STA  
Prospecting geologist and journalist. Now chief strategist at Swedish Transport Administration, chairing the Swedish HCT-group and initiator of the Swedish pre commercial procurement of ERS demonstrators.

## Abstract

In this paper we describe which steps and measures we are taking to be able to introduce HCT in Sweden. We will describe how we in Sweden manage and collaborate on the issue of HCT-cooperation between industrial groups, agencies, academia and government. Which projects we have started and results from some completed projects. We describe the results from two assignments that we got from the Swedish government both about having HCT introduced at Swedish road network. This together have placed Sweden in the front of HCT research in Europe.

We will also briefly describe the process of developing and funding two demonstrators of ERS. The project is (what we know) one of the biggest pre commercial procurement carried out in Europe. It has engaged the Swedish heavy truck industry as well as providers of electrical road systems and other public authorities in Sweden.

Keywords: High Capacity Transport (HCT), Sweden, Freight transport, Heavy Vehicle

# BEHAVIOURAL CHANGE THROUGH A FUEL EFFICIENCY PROGRAMME



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DOM KALASIH, Z Energy



JOHN DOESBURG  
Energy Efficiency Conservation  
Authority

## Abstract

This paper shares the approach taken and progress of a New Zealand government led and subsidised heavy vehicle fuel efficiency programme (Programme). The key goal of the Programme was fuel saving however, a number of co-benefits to the transport operator businesses, tangible and intangible, also became evident. The co-benefits could be broadly categorised as financially benefiting the business or benefiting the behavioural aspects of how the business was operated. Tangible co-benefits include reduced downtime and cost savings associated with improved safety, reduced complaints from the public, less time spent at roadside with enforcement agencies and a reduction in repairs and maintenance. The intangible co-benefits include higher levels of staff engagement, personal growth, a shift to a more systemic approach with managing the business and improved discipline. For its 2015 financial year EECA estimated savings of 4.7 million litres could be achieved through its programme.

# CLEAN FUEL – KEEP RUNNING



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**SCOTT GROSSBAUER** works for Donaldson Company, a global manufacturer of filtration systems for a broad range of air and liquid markets. He earned his Bachelors of Science in Mechanical Engineering from Michigan Technological University and his MBA from the Carlson School of Management at the University of Minnesota. Currently Scott is the Director for Donaldson's Global Hydraulics business unit.



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**HAYDEN SCHULZ** works for Donaldson Company, a global manufacturer of filtration systems for a broad range of air and liquid markets. Hayden has worked in a variety of roles directly linked to the heavy diesel industry, including operations management of an interstate transport company, branch manager of a heavy diesel engine OEM, and operations manager of an independent heavy vehicle repairer. Currently Hayden is the Australian Manager of Donaldson's Clean solutions group

## Abstract

This paper is an opportunity to learn more about how evolving diesel engine technology is driving the need for cleaner fuel. While that may seem to be fairly straightforward, delivering clean and dry fuel consistently to your engine's fuel injection system can be a great challenge. We'll explore these challenges and how they can be overcome, with a large focus on handling fuel prior to being pumped into your vehicle. Written from the angle of a global filtration company, the focus will be on the role of filtration in achieving the necessary OEM specifications, but also included is important info on other topics like storage tanks, pumps, and engines. We will explore the challenges of keeping fuel clean and dry from the refinery all the way up to the point of injection on your engine, all with the end goal of keeping fleets running. Clean Fuel – Keep Running!

# GB1589-2016 PROMOTING THE MODERNIZATION DEVELOPMENT OF CHINA'S ROAD TRANSPORT VEHICLES



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## Abstract

The compulsory standard “Limits of dimensions, axle load and masses for motor vehicles, trailers and combination vehicles” (GB 1589) is one of China’s basic technical standards for vehicle management, which regulated the vehicle’s dimensions, axle loads and mass limit. It is applicable to all motor vehicles, trailers and combination vehicles saled and used in China. In order to meet the development demand of domestic and international road freight transport market, promote the use of new structures and new technologies in vehicle production and speed up the pace of road transport equipments’ modernization development, China’s vehicle management and standardized management departments jointly carried out the technical amendment to GB1589 which issued and implemented in July 27, 2016. The revised version of GB 1589 added the type of center axle trailer. It perfected the length, axle load and total mass limit of the vehicle, and special requirements of special operation automobiles. This standard built China’s road freight vehicle modular system and solved the problems of low efficiency cargo loading-unloading, the inadaptability between vehicle width and pallet’s size, the mismatching between tractors and semi-trailers, etc. After this standard published, the Ministry of Transport has carried out a series of standards revision and vehicle management, which promoting the standardization process of China’s freight vehicle effectively and improving the incorporation degree with the international vehicle standards and regulations. This standard will benefit the healthy development of domestic and international road freight transportation industry, and open up a new market for international co-operation and trade.

# GROWING PAINS: CHALLENGES FOR AUSTRALIA'S PBS SCHEME



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## Abstract

The Australian PBS Scheme has been very successful in certain sectors of the road transport industry, with a large proportion of new vehicles entering service in those sectors now PBS-approved. In other sectors, however, the level of take-up by the industry has been much lower than expected. This is thought to be due to a number of policy and operational impediments, which are discussed in this paper. The key impediments are bridge load capacity, overall vehicle combination length and administrative processes. Together, the bridge load capacity and overall vehicle combination length issues effectively preclude any mass and dimension increases under the PBS Scheme unless operations are limited to a very small number of pre-approved roads where infrastructure capacity is known to be sufficient. The administrative process issues result in unduly long approval timeframes and constant uncertainty around the likelihood and level of road access for a PBS vehicle, seriously undermining industry confidence in the Scheme.

# DO 'SAFE RATES' ACTUALLY PRODUCE SAFETY OUTCOMES? A DECADE OF EXPERIENCE FROM AUSTRALIA



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## Abstract

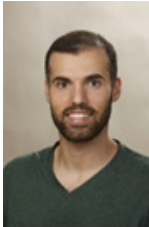
On 1 July 2014 the Australian government activated a body called the Road Safety Remuneration Tribunal. This tribunal would examine and legislate minimum rates of pay for owner drivers. This determination was based on the premise that there were strong links between truck crashes and driver remuneration. This perception has been held in Australia since the early 1990s. In April 2016 the Tribunal set an owner driver pay rate determination which precipitated industrial action. From 1991 to 2006 research had been undertaken into the safety of the 'hire and reward' sector, however, by 2016 perceptions about this sector were provably outdated. The expert findings in the National Transport Commission's report, (NTC, 2008) were weak. In 2013 new benchmarking of the 'hire and reward' versus the 'ancillary' segments' safety performance was undertaken with strong findings. This paper presents arguments from the most recent data and counters the industry remuneration/safety link.

Keywords: Truck Safety, truck crashes, heavy vehicle accidents, driver remuneration



# Using Large Moving Base Simulators As Tools When Designing Future Automated Functionality For Commercial Heavy Vehicles:

A Case Study Of Highway Auto-Piloting For High Capacity Transport



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MSc in Mechanical engineering at the Technical University of Lisbon (IST), 2009. Research assistance at Chalmers University of Technology (CTH) up to 2011. 2011, joined the Swedish National road and transport research institute (VTI).



PETER NILSSON, VGTT and CTH, Sweden  
MSc. from CTH, 2000. Joined VGTT in 2000 becoming a senior vehicle analyst with vehicle dynamics and noise/vibration isolation. Studies for Ph. D. degree at CTH applied mechanics undergoing since 2012.



LEO LAINE, VGTT and CTH, Sweden  
MSc. from CTH, 1996. Completed PhD within actuator coordination in 2007, CTH. Joined Volvo Group Trucks Technology (VGTT) in 2007, since 2013 Adj. Prof. at CTH, and since 2014 also Sr. tech. specialist.



NIKLAS FRÖJD, VGTT Sweden  
MSc. in mechanical engineering from CTH, 1989. Joined VGTT in 1995 where he currently works as technology specialist in vehicle dynamics.



JESPER SANDIN, VTI, Sweden  
Obtained a Ph.D. in Vehicle Safety from Chalmers University of Technology in 2008. Leads a programme that monitors the safety performance of HCTs in Sweden, and conducts research on driver support systems.

## Abstract

This work aimed at analysing the potential for the application of large driving simulators on the study of future automated driving functionality. The case study was centred on applications for heavy vehicles, focusing on lane-change manoeuvres and automated driving. A simulation environment was created which hosted a model of a real world road, motion emulation with high fidelity truck dynamics, controllable surrounding traffic and a driver assistance system including autonomous driving. Two types of heavy vehicles were selected for this study, an 80ton and 32m long A-Double combination vehicle and a 40ton and 20m tractor semi-trailer. The final experimental set-up was driven by a group of professional truck drivers. It was concluded that today's resources in terms of hardware, software and even knowledge base satisfy the requirements for testing such automated systems in a holistic way. Driving simulators are capable of providing much valued feedback as well as insight at early stages of function design which can effectively speed up, focus and streamline further development.

Keywords: High Capacity Transport, Driver Assistance, Driving Automation, Driving Simulation

# ROBUST CONTROL OF AN A-DOUBLE WITH ACTIVE DOLLY BASED ON STATIC OUTPUT FEEDBACK AND DYNAMIC FEED-FORWARD



MALIHEH SADEGHI KATI



HAKAN KÖROĞLU



JONAS FREDRIKSSON

## Abstract

A steering-based control is proposed for improving the lateral performance of an A-double combination with an active dolly. The controller is based on static output feedback combined with dynamic feed-forward and is designed to ensure an  $H^\infty$  performance objective in the face of parametric uncertainty. The synthesis is performed via linear matrix inequality (LMI) optimizations. Two feed-forward design methods are proposed and one of them is highlighted as the more rigorous approach for dealing with parametric uncertainty. The verification results confirm a significant reduction in rearward amplification of yaw rates and high speed transient off-tracking even when the dynamic feed-forward from the tractor steering angle accompanies the static feedback only from the articulation angles.

Keywords: Static output feedback, Dynamic feedforward,  $H^\infty$  synthesis , LMI based control, Rearward amplification, Active dolly

# VISUAL ODOMETRY FOR TRAILER OFF-TRACKING ESTIMATION



C.C. DE SAXE

Obtained BSc(Eng) and MSc(Eng) from Wits University in South Africa. Currently a Mechanical Engineer at the CSIR, South Africa, and pursuing a PhD in the Transportation Research Group at the University of Cambridge



D. CEBON

Obtained BE from the University of Melbourne and PhD from the University of Cambridge. Currently Professor of Mechanical Engineering at the University of Cambridge and Director of the Cambridge Vehicle Dynamics Consortium and Centre for Sustainable Road Freight.

## Abstract

Application of articulated and Long Combination Vehicles (LCVs) in challenging off-highway applications is possible with the use of path-following trailer steering. This requires an accurate estimate of trailer off-tracking, but it has been shown that existing methods for this are not applicable on roads with low friction or significant camber or grade. Here we propose an off-tracking measurement concept using stereo visual odometry which is applicable to off-highway environments. Simulation results demonstrate the theoretical accuracy of the system as well as the effects of camera placement and stereo baseline. Rearmounted cameras are shown to yield the best precision, with RMS off-tracking measurement errors of 7–36 mm, while side-mounted cameras offer practical benefits such as scope for multiple-trailer configurations. Integration drift errors were shown to be bounded in time due to the relative nature of the off-tracking measurement.

Keywords: Articulated HGVs; off-tracking; visual odometry; stereo vision; trailer steering

# FROM PAPER TO ROAD- AND BACK AGAIN: A COMPARISON OF THE IMPLEMENTATION OF HIGH CAPACITY VEHICLES IN LATIN AMERICAN COUNTRIES



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A EFRÓN

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G. CORVALAN

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Graduated in Social Sciences and Economics. Secretary of State of San Luis Logistics, she was the Minister of Infrastructure of the province of San Luis, responsible for building the highways and the international airport. Developed San Luis Logistics as its President.

## Abstract

Implementation of innovative freight transport policies face challenges regardless of geography or level of economic development. Financial concerns, social/cultural acceptability and perceived political returns have been identified as key barriers to successful implementation of transport policy, more so than institutional, technical, environmental and legal barriers or needs. This paper describes the successes, failures and current status of the implementation strategies for High Capacity Vehicles (HCV) in selected countries in Latin America. The paper concludes that virtually all implementation strategies for HCVs in the selected countries have encountered challenges where regulatory authorities have been lobbied by stakeholders, both for and against, with varied degrees of success. Implementation of new heavy vehicle technologies could be influenced by the different stakeholders' agendas, regardless of evidence. The authors hope that interested parties in countries in the region and elsewhere will draw lessons from the study, for the future implementation of policies associated with HCVs and other type of new vehicles and technologies.

Keywords: Implementation strategies, legislation, High Capacity Vehicles, innovation, Freight technology, Latin America.

# A TRANSFORMATION IN FREIGHT PRODUCTIVITY – A CASE STUDY OF HIGH PRODUCTIVITY MOTOR VEHICLES IN NEW ZEALAND



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DAVID SILVESTER  
Freight Portfolio Director  
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David is a senior manager with the NZ Transport Agency, with over 35 years' experience in integrated transport planning, programming and investment. An experienced professional engineer in the transport sector, he has a leading role in the provision of planning services, including resource, urban, transport and traffic planning. Another responsibility is the development of clear national level planning and investment signals to local and regional councils and the Transport Agency's Highways & Network Operations group for developing and managing the NZ\$4.5 billion per year National Land Transport Programme. David undertakes a variety of programme lead roles within the Transport Agency including Regional Economic Development, Electric Vehicles and from July 2016, the Freight Portfolio.

## Abstract

This paper outlines the introduction of High Productivity Motor Vehicles (HPMV) into New Zealand. The background through to the implementation of the HPMV programme will be examined from a policy and regulatory perspective primarily, with some mention and referencing of the key technical elements. Challenges will be outlined and the solutions will be identified with a view to highlighting the factors that were critical to making it attractive for the industry to invest in HPMVs. The paper will conclude with a look at the programme as it stands in mid-2016.

Keywords: High Productivity Motor Vehicle, Heavy Truck, Freight, Productivity, New Zealand, Government, Infrastructure, Road Transport, Regulation, Policy, Efficiency, Safety, Stakeholders, Economy.

# EFFECTS OF HIGH CAPACITY VEHICLES ON TRAFFIC SAFETY IN SWEDEN



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## Abstract

In July 2016, there were 38 Higher Capacity Vehicles (HCVs) active in Swedish trial operations. Between 2010 and July 2016, in total 24 accidents had occurred with HCVs involved. Nine of the accidents involved HCVs with an allowed GVW up to 74tonnes. A further 13 rollover accidents had occurred with 90tonne HCVs used for iron-ore transport. Lastly, two accidents involved HCVs longer than 25.25m. Due to the small sample it was not found reasonable to calculate crash risk. Interviewed HCV drivers were overall positive to the vehicles. Compared to conventional HGVs, both the heavier and longer HCVs require more planning when decelerating and accelerating. International experiences of HCVs show that the traffic safety performance of HCVs are as good or better as conventional heavy vehicles. The reason for this is a systematic framework for HCVs involving a match of PBS-approved vehicles and road networks, vehicle monitoring, and qualified drivers. This approach is and should be adopted in order to keep a high level of traffic safety in Sweden.

Keywords: High Capacity Transport, HCT, High Productivity Vehicles, HPV, Long Combination Vehicles, LCV, Articulated vehicles, Overtaking, Passing maneuvers, Lane change crashes, Merging crashes



# THE EFFECTS OF SAFETY CHAINS ON THE DYNAMICS OF TRUCK AND DOG TRAILER COMBINATIONS IN THE EVENT OF A COUPLING FAILURE



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## Abstract

This paper describes an investigation of the effects of safety chains on the dynamics of truck and dog trailer combinations in the event of catastrophic failure of the primary pin coupling. Safety chains on drawbar couplings are not mandatory in Australia for such combinations, but are recognised as having the potential to reduce crash risk and severity of crash outcomes. Some industry stakeholders, predominantly drivers, have expressed safety concerns regarding potential unintended effects of the chains on the dynamics of the hauling unit in the event of a coupling failure. The on-road dynamics of truck and dog trailer combinations connected only by safety chains was assessed via field tests, in which dynamic performance data was recorded using a data logging system. Through analysis of the recorded data and observations made by the driver of the vehicle and other observers, it was found that neither the truck nor the trailer demonstrated unsafe behaviour in any of the tested manoeuvres. It was determined that a truck-trailer combination can be brought safely to a stop in the event of a primary connection failure, up to the highest tested speed of 80 km/h. These findings strongly indicate that there is little potential for safety concerns to arise as the result of the fitment of safety chains to drawbar couplings of these truck configurations.

Keywords: Truck, Trailer, Safety, Chain, Dynamic, Stability, Coupling, Failure

# CLEVIS COUPLINGS IN MULTI VEHICLE COMBINATIONS



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## Abstract

This article addresses the issue of dimensioning the coupling equipment in multi vehicle combinations. Extensive measurements have been performed. The measurements are made on the clevis couplings in the combinations. Measurements are made on highways, rural forest roads as well as on test tracks.

A filtering concept that enables the separation of effects from different force generating mechanisms has been developed. Based on observation from the analyses qualitative models are set up for the force generating mechanisms.

The results show that the margin between the measured force magnitudes and the requirements calculated using the Australian rules is wide.

Further results show that there is a strong relation between speed and forces generated in the couplings. In particular this holds true for forces generated by the interaction between the longitudinal unevenness and the geometrical layout of the vehicle combination.

Keywords: Clevis Coupling, Coupling Forces, Measurements, Filtering

# BRAKE SYSTEM DESIGN FOR FUTURE HEAVY GOODS VEHICLES



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## Abstract

A fast-acting pneumatic braking system developed by Cambridge University and Haldex AB has been shown to reduce the stopping distance of a tractor-semitrailer combination by 17% on a low friction surface, compared to existing heavy vehicle brake systems. The high control bandwidth of the new braking system allows brake torque to be accurately controlled, independently, at each wheel station. This functionality complements a new control allocation based motion management system, which aims to optimally control individual wheel brake torques in combination with other actuator demands on the vehicle (e.g. steering, engine, diff-locks, etc.). In order to fully integrate the braking system with an optimal motion management system, brake torque capability information (including available friction) will need to be communicated from each wheel station to the motion management controller. This information is also essential for highly automated vehicles, which (as stated in SAE standard J3106) must be able to identify changes in operating environment.

Keywords: Anti-lock braking system, EBS, ABS, slip control braking, pneumatic braking systems, pneumatic actuators, brake system design, automated braking

# PERFORMANCE BASED STANDARDS ENABLING TRANSPORT DECARBONISATION



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## Abstract

This paper contemplates next generation performance based standards (PBS) designed to measure and quantify the impact of road freight transport vehicles on society and the environment. Presently there is a lack of standard objective measures that inform the public and policy makers on the impact of high capacity vehicles (HCV) with respect to societal benefits including fuel consumption, CO<sub>2</sub> emissions, safety, public health, traffic congestion, mobility etc. The paper discusses the concept of next generation PBS, including, parameters requiring consideration, how the metrics could be defined and puts forward the concept of a sustainability index for freight transport. The paper concludes with some examples of next generation PBS metrics that can be used to measure transport sustainability and societal impact of both the vehicle and transport system.

Keywords: Trucks, heavy vehicle, freight transport efficiency, high capacity vehicles, performance based standards, safety, sustainability, sustainability index, societal impact, decarbonisation, CO<sub>2</sub>, greenhouse gas.

# A FLEXIBLE REGULATORY FRAMEWORK FOR TRUCKS



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## **Abstract**

No abstract provided

# ITF/OECD WORKING GROUP ON HIGH CAPACITY TRANSPORTS (HCT) – BACKGROUND, AIM, ACTIVITIES AND EXPECTED OUTCOME



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## Abstract

The paper presents the new ITF/OECD working group on High Capacity Transports (HCT). The working group is result of a Swedish initiative and a number of countries have decided to join. A kick off was held in February 2016. Focus areas for the WG will be: Market and Impact Assessment, Modal Shift, PBS, Infrastructure, Safety and Compliance.

The study will pay special attention to the potential for HCT in China and Africa, due to the expected strong growth in trade and land based transportation.

The final report will conclude with a package for policy makers - guidance and recommendations for a balanced implementation of HCT in order to achieve an efficient and sustainable transport system.

Keywords: HCT, HPV, freight, ITS, market potential, policy makers, safety, sustainable transport, guidance, road network, working group



# DEVELOPMENT AND EVALUATION OF AN EXPERIMENTAL PLATFORM FOR STEERED AXLES OF LONG COMBINATION VEHICLES



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## Abstract

Long Combination Vehicles (LCVs) can benefit from advanced strategies in controlling lateral dynamics of the combinations to ensure optimal motion by the trailers. Steering more than the towing units first axle has been developed in previous works and now needs to be verified in real vehicle tests. This work thus developed an experimentation platform incorporating a rapid prototyping system to provide the possibility of evaluating these algorithms on vehicle level. In this paper the solution is detailed as a Hardware-in-the- Loop (HiL)-platform linking a vehicle dynamics frame-work with two steered axles. In accordance with the V-model development process, this allows to safely verify the functioning of both software and hardware before performing track-tests of the fully integrated system with all units of a LCV. This paper outlines the development and capabilities of the resulting experimental platform and gives a short example of its performance in a standard-maneuver, which is also used to proof the validity between simulation and HiL-environment enabling full system testing on vehicle level.

Keywords: Long Combination Vehicle, Active Steering System, Hardware-in-the-loop testing, Truck dynamics, Rapid-Prototyping

# HYPERFORMANCE: PREDICTING HIGH-SPEED PERFORMANCE OF A B-DOUBLE



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## Abstract

This paper presents a data driven approach to develop a prediction model for the PBS performance of heavy vehicles. A gap exists between trailer manufacturers who create PBS vehicle designs and the PBS assessors who evaluate the performance of the vehicles. The prediction model bridges that gap in the form of a light-weight methodology to predict the PBS performance of a new vehicle design given a set of vehicle input data. Such a model was developed for typical South African 9-axle B-double PBS combinations. The model considers vehicle geometry, suspension parameters and payload properties as variable inputs and is able to predict the high-speed PBS performance with an average error of less than 1% for four of the five standards and less than 5% for the fifth, yaw damping. The model we present can be used as a standalone application for vehicle designers to develop PBS designs, or by transport regulators to verify or validate the results of a proposed vehicle. In addition to this, the model can be used in an optimisation regime to determine the optimal set of vehicle parameters for a given goal, such as maximum payload mass or volume.

**Keywords:** Performance-based standards, B-Double, pro-forma designs, data driven, performance prediction, high-speed stability

# MAXIMUM OF DIFFERENCE ASSESSMENT OF TYPICAL SEMITRAILERS: A GLOBAL STUDY



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## Abstract

Tractor semitrailer car-carrier designs operating in South Africa are required to demonstrate Level 1 compliance as legislated by the Australian PBS in order to be granted productivity concessions. A stumbling block in demonstrating compliance has been the Maximum of Difference (MoD) performance measure, which must be no greater than 0.40 m. The MoD performance of 480 tractor semitrailer combinations were analysed. The study compared the MoD performance of semitrailers specified to have the maximum allowable width and frontal overhang as stipulated by legislation from Australia, the European Union, Canada, the United States and South Africa. The majority of the Australian, EU and Canadian semitrailer combinations and all of the South African semitrailer combinations analysed did not demonstrate performance within the MoD limit of 0.4 m set by the Australian performance based standards. This would suggest that the MoD limit of 0.4 m is overly strict. An MoD limit of 0.6 m is suggested as an appropriate limit to be implemented in South Africa.

Keywords: Performance-Based Standards, Car-Carrier, Maximum of Difference, Frontal Overhang

# TRAFFIC SAFETY RISKS WITH EU TRACTOR-SEMITRAILER RIGS ON SLIPPERY ROADS



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## Abstract

Heavy goods vehicles (HGV) for long haulage within the EU Nordic countries have due to regional evolution mostly been straight trucks with drawbar trailers. In the past decade, there has been a significant increase in articulated EU tractor/semitrailer rigs within the Nordic countries, a trend driven by lower freight costs when using low paid drivers from Eastern Europe. Heavy trucks are often involved in crashes and traffic jams on ice-slippery winter roads. An ever-increasing number of voices are stating that the articulated vehicles present disproportionate high traffic safety risks on icy winter roads. This paper discusses some regulatory & design factors that partially explain why EU semitrailer rigs are particularly associated with jamming long steep icy upgrades, and with loss-of-control crashes such as jackknifing and trailer swing. A novel analysis was made with TruckSim software. Preliminary results support the opinion that EU semitrailer rigs are an unsafe vehicle combination on slippery roads. This finding calls for deeper research about the winter road safety risks with the EU tractor/semitrailer vehicle combination, as well as on how to mitigate its safety risks. Results from such research are likely to be useful arguments for modifying the EU directive 96/53/EC, so that tractor units with longer wheelbase can be used without conflict on trailer length and payload volume.

Keywords: Winter Road Condition, Road Slipperiness, Traffic Jamming, Upgrades, Loss-of-Control Crashes, Adverse Cambered Curves, Vehicle Dynamics, Commercial Motor Vehicle, Articulated Vehicle, Truck, Prime Mover, Tractor, Semitrailer, 5th Wheel Friction.

# PERFORMANCE OF HIGH CAPACITY VEHICLES WINTER VERSUS SUMMER



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## Abstract

The transport sector is facing a major challenge to reduce energy consumption and limit environmental impact; therefore, there is a great interest in increasing the efficiency of the transport system in Sweden, which makes the High Capacity Vehicles (HCVs) an attractive solution. In order to introduce HCVs in Sweden, the existing regulations should be modified; one approach is to use performance based standards (PBS) as in e.g. Australia and Canada. However, it is very important that the winter road conditions in Sweden is considered and a PBS system suitable for Swedish condition is developed. In this paper performance of a selection of HCVs are compared for both summer and winter condition, which shows a strong correlation between the two.

Keywords: High Capacity Vehicles, Performance Based Standards, Low Friction, Rearward Amplification, Offtracking, Yaw Damping, Load Transfer Ratio

# CO-OPTIMIZING MULTI VEHICLE COMBINATIONS FUEL CONSUMPTION & TRACTION IN SLIPPERY CONDITIONS



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## Abstract

Northern Sweden gives challenges such as temperatures above 30°C in the summers with 24 hour of daylight to well below -30°C with darkness, ice and snow during the winters. The main winter problems are start ability and low speed grading & maneuvering.

Co-optimizing means that fuel consumption, loading capacity, start ability and low speed grading & maneuvering are taken into consideration both in loaded and unloaded conditions.

Traction and start ability when unloaded was solved by declutching and lifting the second driven axle at the same time dumping the air on the 1st dolly axle and lifting 4 trailer axles. At the same time this gave an 8% fuel reduction when unloaded. On a transport cycle 160 km loaded and 160 km unloaded this traction aid feature gave a fuel saving of 3%.

Further optimizations of aerodynamics (lower driving height on main roads) and driveline gave an improvement of 9% of the whole transport cycle. Mainly improve when driving loaded.

Keywords: High Capacity Transport, Sweden, Traction, Fuel consumption, Heavy Vehicle Truck/transport Technology

# DEVELOPMENT AND IMPLEMENTATION OF NEW FEATURES IN A ROUTE SELECTION AND DISTANCE MEASUREMENT SYSTEM



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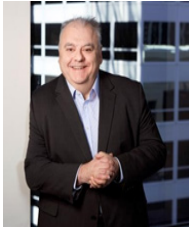
## Abstract

In Sweden, road transport payments in the forestry sector are based on the distance driven. Since 2010, the Calibrated Route Finder system has been in practice, a system developed jointly within the forestry sector. A number of road features and weights for road attributes are used to establish the preferred route and distance between landings in the forest and mills or terminals. To find accurate weights, between forest and haulage companies, best practice 'key-routes' are used as the optimal solutions to define an inverse optimisation problem where the unknown weights are variables. The system uses road data from the Swedish national road data base.

Deviation reports over time from forest and haulage companies have indicated certain areas that need improvement. Examples are curvature, topography, and stop and start in junctions, all of which increase both time and fuel consumption. Other problems that arise are geometrically impossible or illegal turns in the network. Improving the system is essential for accurate distance measurement and for the credibility of the system.

Keywords: Calibrated Route Finder, Key Routes, Forest Road Transport, Optimisation, Road Feature, NVDB, Curvature, Topography, Junction

# ON-BOARD MASS MONITORING FOR COMMERCIAL AND REGULATORY PURPOSES IN AUSTRALIA: OPERATIONAL LEARNINGS FROM THE INTERIM OBM SOLUTION



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Chris was appointed inaugural CEO of Transport Certification Australia (TCA) in 2005. Chris has successfully established TCA and made operational a number of national telematics programs, including the Intelligent Access Program, the first land-based voluntary, regulatory telematics program in Australia. With more than 30 years' experience, Chris has held senior executive positions nationally and internationally, in both public and private sector organisations. Chris has Bachelor and Masters Degrees in Engineering. He and is a Member of the Australian Institute of Company Directors, and a Board Member of the International Society of Weigh-in Motion, and of Intelligent Transport Systems Australia.



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Gavin has a diverse background in the area of road transport regulation and national reform, and addresses public policy needs through the use of telematics and other intelligent technologies. Gavin has managed the implementation of national regulatory and non-regulatory telematics and ITS programs, and led national and state-based reform to deliver public purpose outcomes.

## Abstract

In Australia, On-Board Mass (OBM) systems are applied to measure and record the mass of heavy vehicles and are implemented in conjunction with the Intelligent Access Program (IAP), using a combination of telematics technologies and mass sensor units (MSUs) fitted to the vehicles' axles. With both the mass and location of enrolled vehicles monitored for compliance with access arrangements, Road Managers obtain stronger assurances that the conditions of access are being met. For Transport Operators, better access in exchange for monitoring offers productivity, efficiency and environmental outcomes – greater loads, fewer trips and greenhouse gas emissions, and more direct routes. This paper presents an overview of the OBM program currently operating in Australia, its broader context within the heavy vehicle landscape, and some of the key insights and operational learnings that are progressing the program to its next stage.

Keywords: On-Board Mass (OBM) monitoring, In-vehicle technology, Regulatory telematics



# ACCESS MANAGEMENT FRAMEWORK FOR OVERSIZE-OVERMASS (OSOM) VEHICLES IN TASMANIA



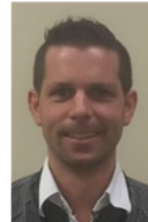
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Simon commenced his career in the roads and bridges industry in 1982 and has worked in both the UK and Australia. Simon has been with the Department since 2003 and presently works in the capacity of Project Manager



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Aaron worked as a consulting engineer at Pitt & Sherry for nine years where he gained an understanding of bridge design, inspection and assessment. Aaron has been with the Department since 2014 in his role as a bridge asset engineer and led the technical aspect of this project.

## Abstract

This paper outlines the development and implementation of a risk and evidence-based access management framework for Oversize-Overmass (OSOM) heavy vehicles (referred to as abnormal loads in Europe). The framework improves safety and productivity both through industry having increased levels of access certainty, efficiency, transparency and flexibility when planning their operations; and road managers having increased control and greater consistency over infrastructure management.

Australia commenced its new Heavy Vehicle National Law (HVNL) in February 2014 which provided, for the first time, clear legal accountabilities and responsibilities for all road managers, including local governments, to manage heavy vehicle access to their roads.

Tasmania has developed an extensive and sophisticated access management framework for OSOM vehicles (up to 103t GCM, 5.5m wide, 5.0m high and 30m long) including a vehicle classification framework, standardised and optimised structural assessments, and harmonised operating conditions.

Keywords: Heavy Vehicles, Oversize Overmass, OSOM, access management

# IMPROVING DIRECTIONAL STABILITY CONTROL IN A HEAVY TRUCK BY COMBINING BRAKING AND STEERING ACTION



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## Abstract

The introduction of electronics in heavy vehicle steering systems has enabled active steering torque support. As steering is an effective way of escaping directional instability and brakes are fast and decoupled from the driver a combination of controlled steering and braking would be beneficial when performing directional stability control. A method is therefore proposed for this, based on control allocation. The method is unique in that it uses combined quadratic lateral and longitudinal tyre constraints computed in real-time, which has the potential of producing a higher corrective yaw moment than the commonly used approach with linear constraints, and that it can be adapted to any heavy vehicle combination. The method has been tested and compared to a standard stability control system in three different manoeuvres using a heavy solo tractor unit on a frozen lake. The measured deviation from the intended path was observed to reduce up to several meters with the new method. Also driver rating improved.

Keywords: Heavy Vehicles, Electronic Stability Control, Braking, Steering, Control Allocation

# TRACTOR SEMI-TRAILER SIDE-SLIP & ARTICULATION ANGLE ESTIMATION: NUMERICAL & EXPERIMENTAL RESULTS



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## Abstract

No abstract supplied

# ASSESSMENT OF A CONTROL STRATEGY FOR COMBINED EMERGENCY BRAKING AND TURNING OF ARTICULATED HEAVY VEHICLES



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## Abstract

“Slip control” (SC) braking has been demonstrated to reduce the straight line emergency stopping distances of heavy goods vehicles by up to 19%. However, this may be to the detriment of the vehicle’s lateral dynamics. In a previous paper the authors proposed an “attenuated slip demand” (ASD) controller to overcome this, restoring the vehicle’s directional performance while retaining a stopping distance advantage relative to a conventional electronic braking system (EBS). This paper describes recent full-scale vehicle tests on a tractor-semitrailer, comparing back-to-back, the combined emergency braking and cornering performance with conventional EBS, SC and ASD systems. Whereas SC is shown to have a negative impact on the vehicle’s lateral performance, ASD successfully improves on the conventional EBS with respect to both stopping distance and directional dynamics in the combined braking and steering manoeuvre. A substantial reduction in steering effort, greatly improved lane-keeping ability and a reduced risk of jack-knife are all observed with the ASD controller.

Keywords: Anti-lock braking system, EBS, ABS, slip control braking, attenuated slip demand, ASD, articulated vehicle stability, combined braking and steering

# SUPPORTING “THE BELT AND ROAD” INITIATIVES: BUILD UP AN INTER-CONNECTED TRANSPORT AND LOGISTICS SYSTEM



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## Abstract

“Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road” has been published by China government, dedicated to promote the openness and co-operation between countries and regions, and improve infrastructure connectivity and transport effective and efficiency. This paper describe how the national and local transport department to make plans and launch related initiatives to prepare for implementation of B&R in Infrastructure interconnection, Information exchange, and transport facilitation. The paper try to make common understanding the possible way and strategies to build up an interconnected and high efficient transport and logistics system between countries in Asia and Europe

Keywords: Belt and Road (B&R), infrastructure, transport service, logistics, Neal-Net, interconnected, efficiency, Information exchange

# IMPLEMENTATION OF A NEW INTERMODAL TRANSPORT CONCEPT – FROM PROOF OF CONCEPT TO DECISION CRITERIA FOR MARKET INTRODUCTION



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## Abstract

Over the course of three years the EU Project TelliSys developed a market-oriented intermodal transport technology concept opening new opportunities for intermodal transport in Europe and abroad. The capabilities of the system have been proven during an extensive evaluation phase, including a profitability analysis, life-cycle assessment and test runs throughout European transport networks. This paper describes in detail the proof of concept of the new intermodal transport system and discusses the lessons learned from the evaluation phase. Derived from this evaluation, the decision criteria for choosing or avoiding intermodal transport from forwarder's and customer's perspectives are presented, taking into account the requirements for the implementation of different use cases. The results show that the new transport system addresses current market necessities, opening new possibilities for the intermodal transport due to the enhanced competitiveness compared to road transport.

**Keywords:** freight transport, logistic, intermodal loading unit, decision criteria, market requirements.

# EUROPEAN TRUCK PLATOONING CHALLENGE



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Senior Advisor Intelligent Mobility at the Netherlands vehicle authority RDW, Ministry of Infrastructure and Environment. 'Founding father' of the ITS exemption process, and the stepped admission process to get ITS systems on the public roads. Worked for both profit and non-profit, and developed a keen eye for everything that has to do with business. Innovation, development and promotion suites him well.

## Abstract

This paper will report on the experiences and results of the first cross border truck platooning initiative in the world: The European Truck Platooning Challenge. In this showcase six truck platoons departed from different locations in Europe to arrive on the 6th of April 2016 in the Port of Rotterdam. The truck platoons mainly drove at daytime in a normal traffic situation. During the Challenge, each European truck manufacturer had one truck platoon in operation: DAF, Daimler, IVECO, MAN, Scania and Volvo. There was no competition between the OEMs on a technical level. The European Truck Platooning Challenge was much more a challenge in the sense of harmonization test procedures between authorities of the countries involved: Sweden, Denmark, Germany, Belgium and The Netherlands. The ultimate ambition is to create cross border corridors over Europe where truck platooning is allowed and facilitated by 2020. The research results (benchmark of test procedures, aerial film recordings) and experiences (interviews with truck platoon drivers and stakeholders consultation) are used to come to recommendations for the further process of harmonization and deployment of truck platooning.

**Keywords:** Autonomous Vehicles, Vehicle-to-vehicle Communication, Field Operational Tests, Trials and Testing, Logistics Optimization.

# TRUCK PLATOONING: POTENTIAL BENEFITS AND IMPACT ON BRIDGES



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## Abstract

Automation of road vehicles is a major challenge. Heavy good vehicles are also concerned and the platooning concept, i.e. a short series of trucks traveling at short or very short spacing, is among the solutions to improve the efficiency of road freight transport and to reduce its environmental impacts. Platooning may significantly improve the road capacity and thus reduce the congestions and avoid expensive and energy and material consuming investments in new infrastructures. It may reduce the drag forces, improve the vehicle aerodynamics and thus reduce the GNG emissions and fuel consumption. But the most promising benefit could result of a better logistics planning and more productivity of the drivers. After a short literature review reporting the past studies and experiences, some perspectives about the development of platooning in the EU and the potential benefits will be proposed, with a special focus on the potential impact on bridges reliability and lifetime, and on bridge loading codes.

Keywords: Heavy Vehicles, Trucks, Platooning, Road Freight Transport, Bridges, Traffic Loads, Bridge Design Codes.



# AN INTEGRATED APPROACH TO ROAD FREIGHT TRANSPORT CO<sub>2</sub> REDUCTION IN EUROPE



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Kris Vanherle is a biochemical engineer and holds a master degree in environmental sciences. A researcher working for TML, his key expertise is the quantification of emissions emitted by the various transport modes.

## Abstract

We review and verify studies investigating CO<sub>2</sub> emissions reduction potential of road freight vehicles through a comparative literature study and a survey with the 6 largest European manufacturers of heavy duty vehicles: DAF, Daimler, IVECO, MAN, Scania and Volvo, with the support of ACEA. The aim of this study is to consolidate the collective knowledge of manufacturers and frame it in the context of an integrated approach to reduce CO<sub>2</sub> emissions from the road freight sector, by combining vehicle modifications of a technical nature with measures to be taken by other actors in the field, like tyre manufacturers, fuel producers, transport service suppliers, road infrastructure managers and legislators.

Keywords: road freight vehicles, CO<sub>2</sub> emissions, emission reduction technologies, integrated analysis

# INTERNATIONAL GUIDELINES ON SAFE AND EFFICIENT GOODS RECEPTION FOR ROAD FREIGHT



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## Abstract

The International guidelines on safe and efficient goods reception for road freight provides information, rules and recommendations for different goods reception areas, taking into consideration safety, environment and cost effectiveness measures, enabling users to select the best solution based on its specific requirements. The guidelines include general information on goods reception areas intended to facilitate the loading and unloading of goods and aim to contribute to an efficient and safe working environment for all new and existing reception areas. The guidelines are also meant to help architects and warehouse companies take the right decisions when building or renovation goods reception areas. Commercial vehicle drivers, depot workers and many other stakeholders, including shop staff, cleaners and other employees, work on a daily basis in goods reception areas. Many injuries are reported every year of people collecting or delivering goods. Some accidents or incidents could have been prevented if all stakeholders involved (consignors, carriers, consignees) had cooperated and coordinated their work in a better way.

Keywords: Loading docks, safety, working environment, liability, responsibility, types of goods, types of heavy goods vehicles, load/unloading equipments.

# SUSTAINABLE BUSINESS MODELS IN ROAD TRANSPORTATION

EXPERIENCE FROM SWEDISH AND AUSTRALIAN LONG-HAULAGE TRUCKING INDUSTRY. SOCIAL NETWORK PERSPECTIVE



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## Abstract

The increased focus of today's businesses is to operate in a more sustainable way in order to create value for numerous stakeholders. This is also valid in the transportation industry due to the multiple negative environmental impacts of this industry, and of road transportation in particular. Within the road transport industry, trucks remain to be the main mode of transportation for long-haulage deliveries, including the countries such as Sweden and Australia. Therefore, with the current focus of high-end truck manufacturers to provide sustainable transport solutions, the question arises: what is a sustainable business model in road transport supply chains?

The empirical base is a multiple case study focused on high-end truck manufacturers and their downstream networks in Sweden and Australia. The results show that the high-end heavy-vehicle manufacturers who are to offer sustainable transport solutions do not only talk about recent technologies and green production processes, but are also focusing on the propositions of sustainable business solutions. The expected results are to show and advise various stakeholders of long-haulage transport supply chains about sustainable business models and its components in the industry.

Key words: sustainable solution, business model, long haulage trucks, road transport

# CREATING WIN-WIN SOLUTIONS FOR THE NETWORK AND BEST PRACTICE OPERATORS



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Managing Director  
CCS Innovation in Logistics Ltd

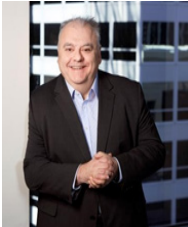
cwatson@ccslogistics.co.nz Corinne Watson has a BSc (Hons) degree in Transport Management and a Diploma in Industrial Studies from Loughborough University, UK. She has been employed in both Operations and Project Management roles in large corporate fleets in UK. In 2003 she moved to NZ and has spent 11 years as Managing Director of CCS Logistics – an independent fleet performance support office. Initially working as a consultant, Corinne has developed a subscription programme to provide continuous improvement programme support to fleets. Her passion is facilitating best practice by leveraging GPS data to effect cultural and behavioural change in heavy transport fleets.

## Abstract

NZTA has a goal of a safe, productive and efficient network. A key constraint is in their confidence in operators to comply with access restrictions. This paper addresses how fleets can demonstrate best practice without publishing detailed operational statistics – and how this can be used to benefit the economy, network productivity and the industry. Using examples to show how fleets can demonstrate compliance with a performance standard, it is possible for a fleet to earn the right to greater flexibility which enhances network efficiency and productivity whilst providing an economic benefit to the operator and a safer environment for the community.

Keywords: Network efficiency, Best practice, Rewarding achievement, Economic benefit Performance Based Standards, Operator Rating System, Telematics, Environmental

# IMPLEMENTING ELECTRONIC WORK DIARIES (EWD): SAFETY, PRODUCTIVITY, EFFICIENCY



CHRIS KONIDITSIOTIS

Chris was appointed inaugural CEO of Transport Certification Australia (TCA) in 2005. Chris has successfully established TCA and made operational a number of national telematics programs, including the Intelligent Access Program, the first land-based voluntary, regulatory telematics program in Australia. With more than 30 years' experience, Chris has held senior executive positions nationally and internationally, in both public and private sector organisations. Chris has Bachelor and Masters Degrees in Engineering. He and is a Member of the Australian Institute of Company Directors, and a Board Member of the International Society of Weigh-in Motion, and of Intelligent Transport Systems Australia.



GAVIN HILL

Transport Certification Australia

Gavin has a diverse background in the area of road transport regulation and national reform, and addresses public policy needs through the use of telematics and other intelligent technologies. Gavin has managed the implementation of national regulatory and non-regulatory telematics and ITS programs, and led national and state-based reform to deliver public purpose outcomes.

## Abstract

For the purposes of fatigue management, drivers of fatigue-regulated heavy vehicles in most Australian jurisdictions must comply with national laws and regulations that require them to record their work and mandatory rest times in a standardised, hard copy National Driver Work Diary.

Although Electronic Work Diaries (EWD) have been recognised in regulations since 1999 and their benefits have been long identified, questions remained. Following an Operational Pilot in 2011, the development of an EWD Functional and Technical Specification, and amendments to national laws in 2015, work is now underway to implement EWDs as a voluntary alternative to written work diaries. Regulated EWDs will be type-approved, and available through certified Service Providers.

This paper provides a technical and operational overview of EWDs, their benefits, and focuses on the work currently underway to implement the EWD.

Keywords: Automation, Telematics, Fatigue Management

# IMPROVING SAFETY AND COMPLIANCE, SIMPLIFYING ENFORCEMENT

## RECENT REFORMS TO AUSTRALIA'S HEAVY VEHICLE CHAIN OF RESPONSIBILITY LAWS



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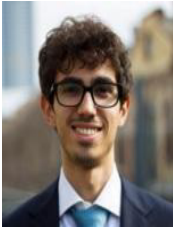
Obtained a B.A. and an L.L.B. (Hons) from the University of Melbourne and a M.H.Sc. (Public Health Law) from Latrobe University. Admitted to practice as barrister and solicitor of the Supreme Court of Victoria and the High Court of Australia. Currently Manager Legislative Policy, Heavy Vehicle Compliance.

### Abstract

In November 2015 Australia's federal, state and territory transport ministers agreed a significant package of reforms to the chain of responsibility obligations of the Heavy Vehicle National Law. These reforms substantially improve the law for both industry and regulators by reducing complexity, improving consistency and clarifying obligations. These reforms also better align the law with Australia's other national safety laws. The aim of these reforms is to create a proactive culture of heavy vehicle road safety and enforcement, improving safety for the whole community. This paper examines Australia's unique approach to heavy vehicle road safety through chain of responsibility, and the need for law reform, before then detailing the reforms to be implemented and the anticipated outcomes of these reforms.

Keywords: Chain of Responsibility, CoR, Heavy Vehicle National Law, HVNL, primary duties, executive officers, heavy vehicle, road safety, compliance, enforcement, Australia, Heavy Vehicles, Freight Transport, Symposium

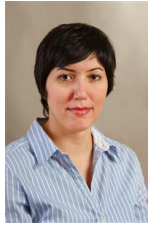
# A HEAVY VEHICLE DYNAMICS MODEL FOR DRIVING SIMULATORS



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## Abstract

The aim of the present paper was to develop and validate a heavy vehicle dynamics model for driving simulators. The model was thought to be open, with a high level of readability and flexibility for future understanding, modification and use. A stepwise increment of the model complexity was utilized to understand the most contributing factors and to obtain a model capable of running in real-time. The model has been validated objectively using a previously validated model and through subjective evaluation in a driving simulator.

**Keywords:** Truck dynamics modeling, model complexity analysis, driving simulators

# THE IMPACT OF ROAD GEOMETRY AND SURFACE ROUGHNESS ON DRIVING SPEED FOR SWEDISH LOGGING TRUCKS



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## Abstract

Transport accounts for more than 25% of the Swedish forest industries' roundwood procurement cost at mill gate (exclusive stumpage). Wages accounted for 34.2 % of truck transport costs, so in order to further reduce transport costs and increase productivity it is important to better understand the impact of the transport environment on truck speed. This study quantified the impact of curvature, road surface roughness, gradient, integrated gradient and truck weight on driving speed. The study was done with a conventional 60 ton logging truck in an area which captured high variation in the studied variables.

The results quantified the correlation between driving speed and the independent variables curvature, road surface roughness and functional road class. Functional road class was also found to partially capture variation in curvature, integrated gradient and road surface roughness. Further analysis of the data will focus on developing a complete empirical model for improving forestry transport planning and costing of logging truck transport as well as the further refinement of the route selection system Calibrated Route Finder.

Keywords: Speed, Logging Truck, Curvature, Surface Roughness, Gradient, Integrated Gradient, Vehicle Weight, Gravel Road, Functional Road Class



# INVESTIGATING HEAVY VEHICLE ROLLOVER CRASHES AND THE INFLUENCE OF ROAD DESIGN BY USE OF VEHICLE SIMULATIONS – A CASE STUDY IN NORWAY



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## Abstract

A heavy goods vehicle (HGV) overturned at an entry ramp to the E6 freeway in Norway. The 24 m long vehicle combination was a heavy truck & drawbar trailer, legally loaded with timber logs into 57 ton gross vehicle weight. The crash investigation showed that the HGV was stable and that the driver had adjusted the speed in order to merge with the E6 traffic. Simulations were made of the crashed vehicle's dynamics when driving a 3D model of the entry ramp. The results showed that the entry ramp had a very unfortunate geometry. The crash came as result of a failure in the interaction between the driver and the heavy goods vehicle's performance in relation to the condition and function of the road. The investigation found that the Norwegian Public Road Administration (NPRA) requirements of the design and of construction of entry ramps do not take adequate account of the road's function, i.e. that large heavy vehicles will use the entry ramp. The Accident Investigation Board Norway recommended that the NPRA revise its requirements for design and execution of entry ramps. This case is an example of the large potential for benefits from simulations of vehicle dynamics in crash investigations. A future application may also be validation of safety for road designs. Traditionally road design codes are dealing with one factor at a time. Simulations make it possible to verify safe road designs in 3D, such as crossfall/curvature in combination with downhill grade. Furthermore, vehicle simulations can provide accurate input to projects that identify hazardous existing curves and make decisions on enhanced speed & attention management.

Keywords: Heavy Vehicle Dynamics, Rollover Crashes, Vehicle Simulations, Geometric Design of Roads, Crash Investigation, Curve Speed and Attention Management.

# A PRO-FORMA APPROACH TO CAR-CARRIER DESIGN



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Mechanical Engineering graduate of The University of Pretoria, 2013. Completed a master's degree under the supervision of Prof. F. Kienhöfer in 2015. Research involves developing pro-forma approaches to PBS and streamlining the assessment processes for car-carriers in South Africa.



**DR P.A. NORDEGEN**  
Council for Scientific and Industrial Research. Principal Researcher at the CSIR. He obtained his PhD in the area of PBS for heavy vehicles in 2013. He has been involved in the development of bridge, overload control and abnormal load management systems in various countries in Africa.

## Abstract

In this work a pro-forma approach is developed for assessing truck and centre-axle tag-trailer or 50/50 car-carrier designs in terms of their compliance with the South African Performance-Based Standards (PBS) pilot project requirements. First, the low-speed performance standards were considered using a low-speed pro-forma design developed by deriving equations for frontal swing, tail swing and low speed swept path. Thereafter, the remaining performance standards were considered, incorporating additional checks to be performed when evaluating a potential vehicle. It was found necessary to specify a minimum drive axle load in order to meet the startability, gradeability and acceleration capability standards. The required drive axle load was determined as 19.3% of the GCM. It was confirmed that the static rollover threshold performance can accurately be predicted by means of the applicable New Zealand Land Transport Rule method. This simplified approach can significantly benefit the PBS pilot project by offering a cost effective method to investigate the PBS conformance of proposed car-carriers.

**Keywords:** Performance-Based Standards, Pro-Forma, Blueprint, Heavy Vehicles, Car-Carrier

# INVESTIGATION OF LONGER MODULAR CONCEPT CONFIGURATIONS FOR BRITISH COLUMBIA



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## Abstract

This paper gives an overview of preliminary evaluations undertaken for two potential configurations which are capable of hauling two modular containers thereby improving hauling efficiency. Steerable trailer axles were utilized so that acceptable low-speed tracking performance could be achieved for these long configurations. Simulations indicate that acceptable performance can be achieved with forced steer axles using steering control strategies which are speed dependent. Further research and optimization will be required to improve the 9-axle (tandem drive version) configuration's performance, but the 11-axle (tridem drive version) configuration's performance was satisfactory for immediate implementation.

Keywords: High Productivity Vehicles, Modelling, Trailer Steering System, Performance Based Standards.

# ALLOWING TRUCK TRAILERS AT PBS MASS LIMITS



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## Abstract

The National Transport Commission recently completed a project that investigated whether certain truck and trailer combinations that meet specific requirements could enjoy the productivity benefits of the Performance Based Standards (PBS) scheme, without having to endure the costs and time delays associated with the formal PBS assessment and approval process. Popular truck and trailer combinations, such as the six and seven axle combinations, account for approximately 60 percent of all PBS applications approved between 2008 and 2013. Based on the available data, it is clear that these vehicle combinations are safe to operate at increased mass limits on specific freight routes and a popular choice of combination with heavy vehicle operators. Migrating approved PBS designs into regulations is in line with the original policy of the PBS scheme which envisaged allowing innovative heavy vehicle combinations to operate in a controlled environment before including them as part of prescriptive access arrangements. This paper outlines the recommended approach to be followed by relevant authorities to allow specific PBS style specification envelopes to be included in regulations.

Keywords: Truck, trailer, dog, PBS, Performance Based Standards, productivity, safety, envelope, specifications, regulations

# HEAVY TRUCK VEHICLE DYNAMICS MODEL & IMPACT OF THE TIRE



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## Abstract

This paper aims at sharing the work that has been done at Michelin to better understand the impact of the tire on the truck convoys handling performance and safety for heavy loaded usage. It describes a measurement campaign that has been done on track with dynamometric wheel and additional sensors to carry out a correlation study with a vehicle model that has been designed with Trucksim software from Mechanical Simulation Corporation. As a good tire model correlation with tests was observed, a tire cornering stiffness effect has been simulated and tested. It shows that the tire has a significant impact on the performance and that a Performance Based Standard criterion should be described in the future to master this point as the current criteria don't take into account all aspects of the tire impact.

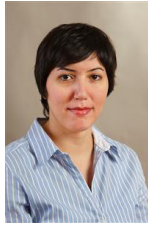
Keywords: Heavy vehicles dynamics, vehicle model, tire model, handling performance, Performance Based Standards.

# MODEL AND ROAD SURFACE SENSITIVITY OF LONGITUDINAL PERFORMANCE BASED STANDARDS



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Professor in Vehicle Dynamics at Chalmers University of Technology – Department of Applied mechanics MSc in Automotive Engineering from Chalmers university of Technology. Design Engineer Advance Engineer HCT-projects

## Abstract

Performance-based standards (PBS) is a regulation policy to address the complexity of variations in vehicle combinations. It enables a direct way of addressing certain requirements associated with the safety, environment and road network and their implications to the vehicle specific quantities without stipulating vehicle properties.

Computer-based simulations may be an efficient tool to assess the performance measures. However, using simulations through models in a legislation raise questions of model accuracy and model complexity. What is a required level of modelling details to be used to assess a PBS measure?

In this paper, we investigate three level of complexity of models and the impact this have on three longitudinal performance measures; Startability, Gradeability and Acceleration Capability. Simulations for 10 vehicle combinations are compared with two different engine alternatives. For Nordic countries, slippery road conditions are common during winter conditions. Hence, low friction is included in the comparison.

The comparison suggested that the complexity could potentially be kept really low, without major loss of accuracy. However, for slippery conditions, a higher levels of complexity might be required.

Keywords: Longitudinal performance based standards, Models complexity, Road surface sensitivity

# A METHODOLOGY FOR ASSESSMENT OF ROAD STRUCTURES FOR THE PBS PILOT PROJECT IN SOUTH AFRICA



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## Abstract

This paper describes the methodology that is being used for the performance assessment of PBS vehicles in terms of road structures as part of the PBS pilot project in South Africa. The assessment approach has evolved from the standard “bridge formula” contained in the National Road Traffic Regulations that is applicable to legal heavy vehicles, to the less conservative “Abnormal Load” bridge formula that is used to evaluate permit applications for the movement of indivisible loads with a total combination mass of up to 125 tonnes. Since 2012, a more performance-based approach has been adopted, which involved the comparison of maximum bending moment (BM) and shear forces (SF) generated by the proposed PBS vehicle with a reference bridge design load (NA and NB30 from the South African bridge design code). Span lengths assessed range from a 5m simply-supported span to 2- and 3-span continuous structures up to 120m. The requirement for the PBS pilot project is that the maximum BM or SF generated by the PBS vehicle may not exceed 85% of the corresponding effects generated by the reference design load. The paper shows the results of a number of the current PBS vehicles and compares the BM and SF effects with a range of legal heavy vehicles. This assessment methodology could form the basis of a performance standard for road structures should the PBS approach for heavy vehicles be adopted in South Africa.

Keywords: Performance-based standards, Smart Trucks, heavy vehicles, road structures, bridge design loading

# FORMALISING THE PBS SYSTEM IN NEW ZEALAND



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## Abstract

Traditionally size and weight regulation has been based primarily on prescriptive limits. Since the 1980s there has been increasing interest in using Performance-Based Standards (PBS) as a mechanism for regulating size and weight. New Zealand was an early adopter of the PBS approach and performance assessment has been used extensively both to inform the development of the prescriptive limit regime and to evaluate over-dimension and over-weight vehicles for permit operations. The performance measures and standards used in New Zealand for these purposes have primarily been those developed originally for the Road Transport Association of Canada (RTAC) study in the 1980s and more recently those developed for the Australian PBS system. These performance standards reflect the conditions and requirements of the jurisdictions in which they were developed and are not necessarily appropriate in New Zealand. This paper presents the development of a set of performance standards that reflect the New Zealand situation.

Keywords: Performance Based Standards, Heavy Vehicles, Productivity, Size and Weight, Regulation, Freight Efficiency.



# A DRIVER SUPPORT SYSTEM FOR IMPROVED MANEUVERING OF ARTICULATED VEHICLES USING AN UNMANNED AERIAL VEHICLE



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## Abstract

This paper proposes a new concept for a driver support system to assist low speed maneuvering of articulated commercial vehicles. The functionality of a system is based on previously published research and extensive measurements with a number of drivers, who have identified the lack of visibility from the vehicle cabin as a primary problem for the driver when maneuvering and reversing at low speed. As a solution an unmanned aerial vehicle (UAV) is proposed, responsible for providing visual top view of the vehicle and its surroundings through a portable screen (tablet) in the cabin. Furthermore the UAV is capable of image processing, and identifying mutual position between the vehicle and the destination point. Subsequently suitable path which the vehicle is able to follow, while respecting the kinematic constraints and environment limitations can be provided to the driver. Besides the path, the driver may be supported while driving with steering instructions to achieve proposed path such as calculated by steering controller. This feature aims to improve driver performance during reversing and docking of vehicle combinations at distributions centers. The concept is intended to be tested on scaled test setup.

Keywords: Intelligent transport systems, Low speed maneuvering, Articulated Vehicles, Driver support system, UAV , Autonomous Vehicles

# IMPROVING REGULATORY AND COMPLIANCE OPTIONS THROUGH INTERNATIONAL POLICY TRANSFER AND COLLABORATION. THE AUSTRALIAN AND SWEDISH EXPERIENCE WITH REMOTE VEHICLE MONITORING UNDER THE INTELLIGENT ACCESS PROGRAM (IAP).



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## Abstract

This article will present the key findings of a research project examining the international transfer of the Intelligent Access Program (IAP) from Australia to Sweden. The IAP is a compliance tool that uses GNSS technology to accurately monitor the activity of heavy vehicles relating to speed, mass, location and vehicle type. This study focuses on the transfer of the IAP to Sweden in the form of a trial. This trial is taking place within the context of more broader heavy vehicle regulatory reform considerations in Sweden. Different factors that influence the transfer process as well as elements that may represent obstacles to the adoption of the IAP are examined. This study looks at ways in which international collaborations provide opportunities to learn lessons from innovations that may not have been produced or observed in a domestic setting. Finally, this paper considers whether the IAP has a broader international application for heavy vehicle compliance.

Keywords: Intelligent Access Program (IAP), regulatory reform, international policy transfer, policy studies, industry self-regulation, heavy vehicle safety, international collaboration, Intelligent Transport Systems (ITS), policy innovation.

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