Braking and Stability Technology

Peter Hart

Director, Hartwood Consulting Pty Ltd

BULK TANKER EMERGENCY RESPONSE

sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Hosts

afac
Australasian Fire and Emergency Service Authorities Council

NBTA
National Bulk Tanker Association

The Scene

- Revolutionary changes are occurring with braking and stability technologies.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

The Scene

- Revolutionary changes are occurring with braking and stability technologies.
- There are significant technology differences between North American and European vehicles.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

The Scene

- Revolutionary changes are occurring with braking and stability technologies.
- There are significant technology differences between North American and European vehicles.
- Significant challenges arise when substantially different braking technologies are mixed on combinations.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Fundamental Questions

- Does the application of electronic technology always improve braking and stability performance?

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Fundamental Questions

- Does the application of electronic technology always improve braking and stability performance?
- Can disk and drum brakes be successfully mixed?

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

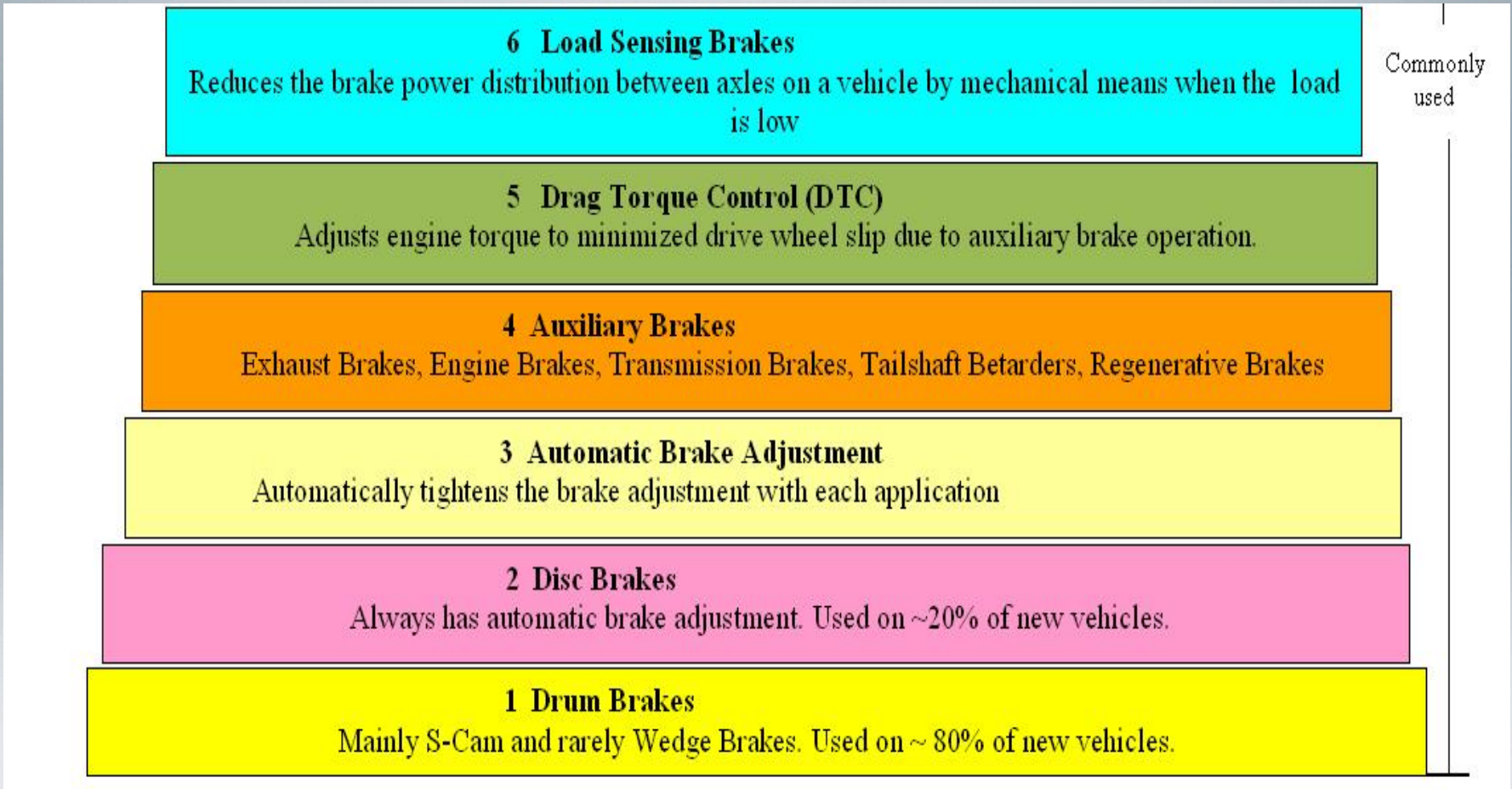
Fundamental Questions

- Does the application of electronic technology always improve braking and stability performance?
- Can disk and drum brakes be successfully mixed?
- Can ‘smart’ with ‘dumb’ be successfully mixed?

Hartwood

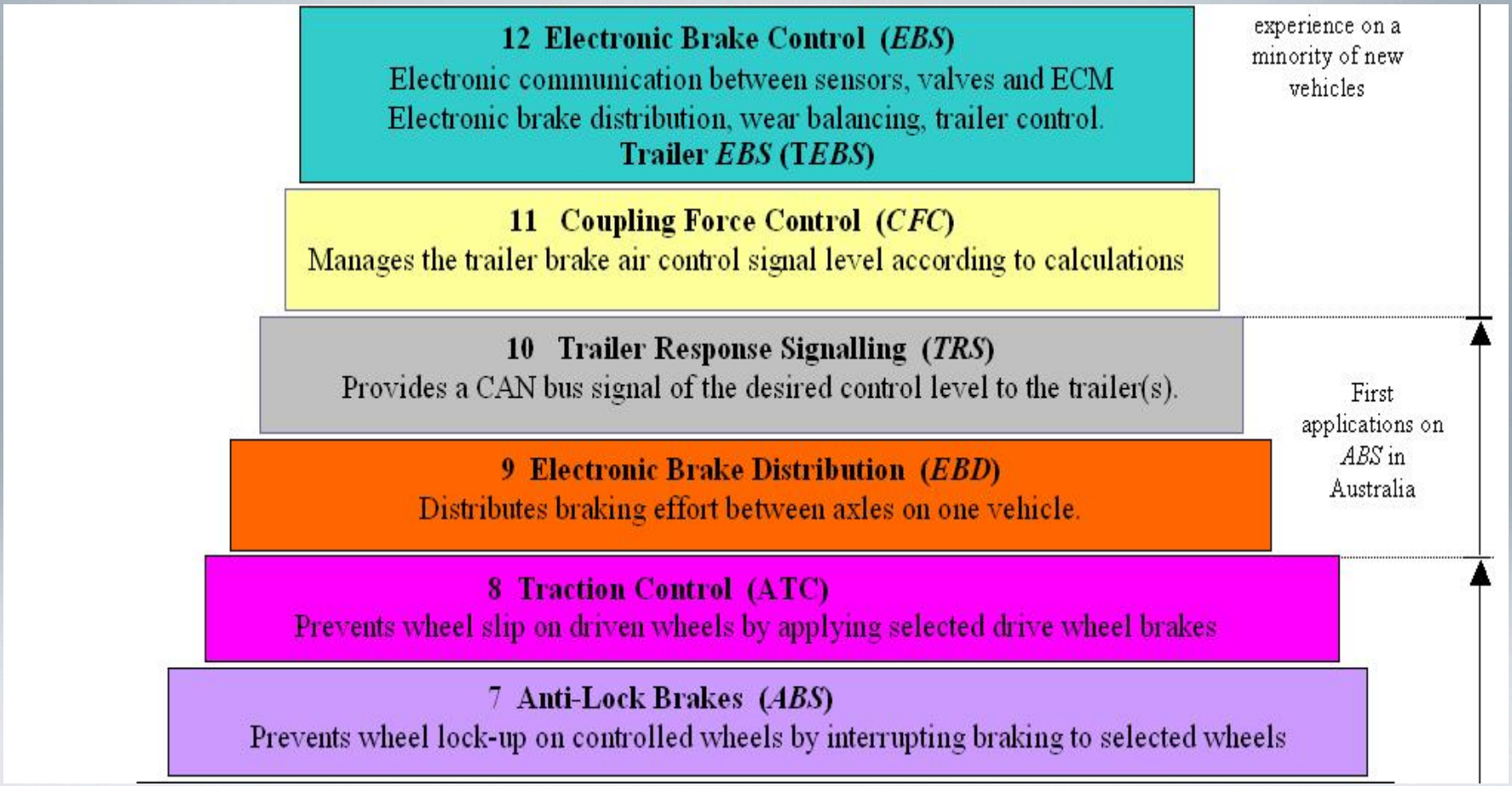
BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Technology Review



Hartwood

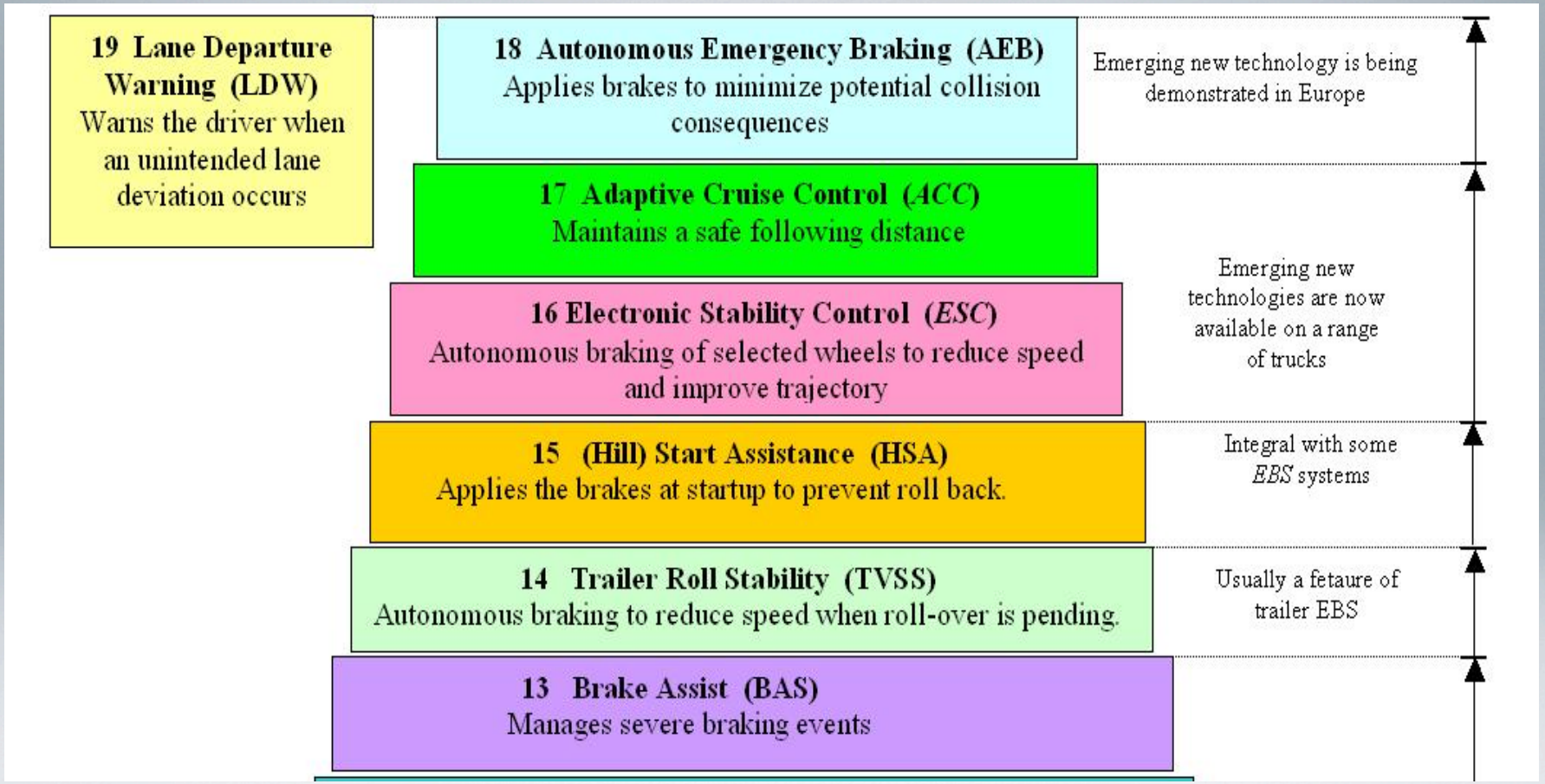
Technology Review



Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Technology Review



Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Basics

Braking effort on an axle should be in proportion to the load carried.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Basics

Braking effort on an axle should be in proportion to the load carried.

Balancing threshold (onset braking) pressure is important for wear balance.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Basics

Braking effort on an axle should be in proportion to the load carried.

Balancing threshold (onset braking) pressure is important for wear balance.

The faster the response the better.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Basics

Braking effort on an axle should be in proportion to the load carried.

Balancing threshold (onset braking) pressure is important for wear balance.

The faster the response the better.

It is preferable to have the same brake technologies on all vehicle parts.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Potential for Improvement

1 The potential deceleration performance of a combination vehicle is ~ 0.7g from 60 km/h on a dry sealed road - about double what a typical unladen vehicle is expected to achieve.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Potential for Improvement

1 The potential deceleration performance of a combination vehicle is ~ 0.7g from 60 km/h on a dry sealed road - about double what a typical unladen vehicle is expected to achieve.

Advanced electronic braking controls can deliver this if adjusted correctly and appropriately coupled.

Hartwood

Potential for Improvement

2 Good brake balance delivers short stopping distances and directionally stable vehicles.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Potential for Improvement

2 Good brake balance delivers short stopping distances and directionally stable vehicles.

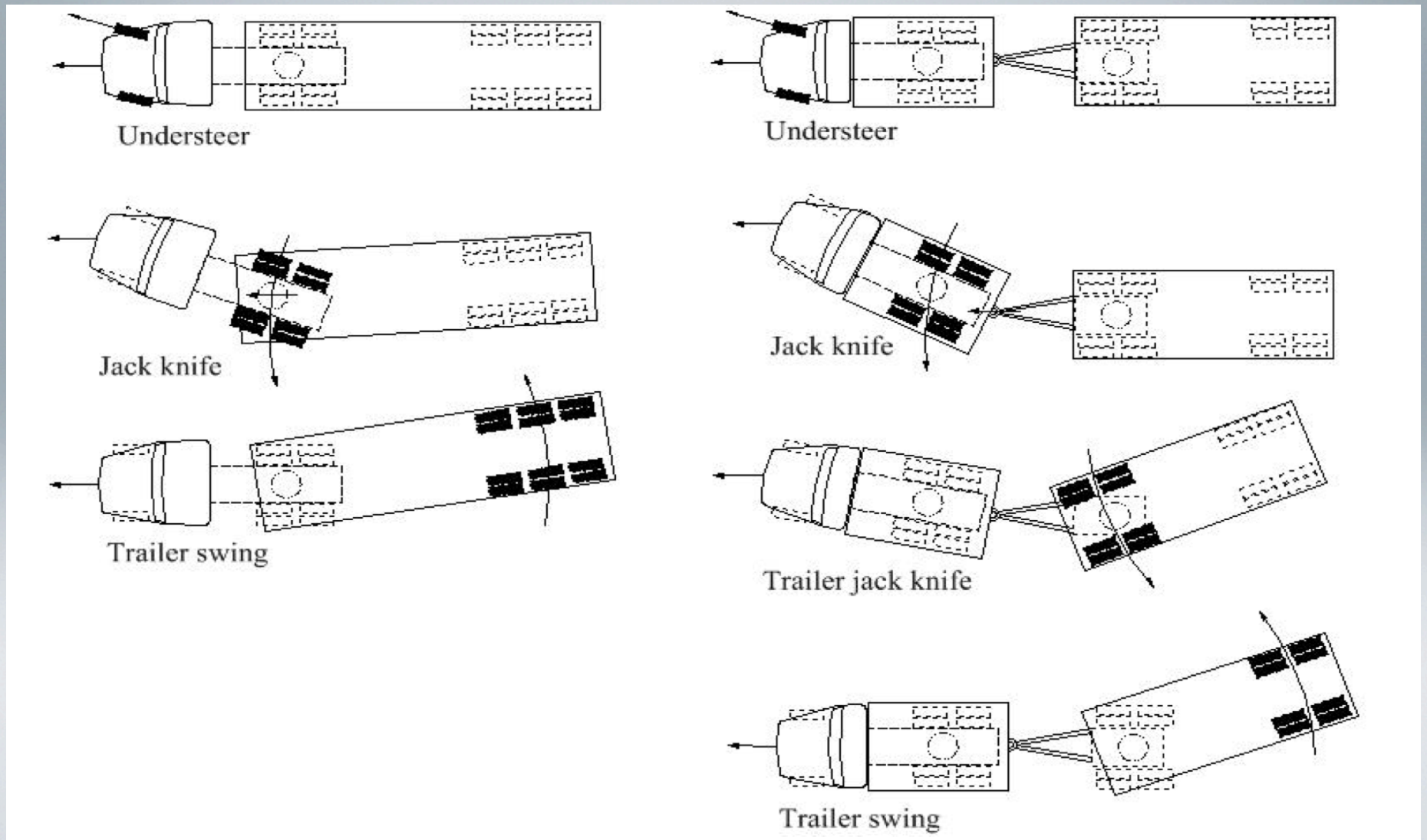
Advanced brake technologies can adapt to changed loading, road conditions and driver actions to achieve this.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Potential for Improvement



Potential for Improvement

3 A vehicle with good brake balance feels good to drive, because it behaves predictably and stops straight.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Potential for Improvement

3 A vehicle with good brake balance feels good to drive, because it behaves predictably and stops straight.

But

Drivers might choose to drive an ‘advanced truck’ harder.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Potential for Improvement

4 Whilst particular vehicles can usually be set-up to be compatible, uncontrolled mixing of technologies will be unsuccessful.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Potential for Improvement

4 Whilst particular vehicles can usually be set-up to be compatible, uncontrolled mixing of technologies will be unsuccessful.

The vehicle suppliers should provide guidance.

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Potential for Improvement

So the potential for improvement is plausible.

Does real-world experience confirm this?

Hartwood

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Effectiveness of safety technology

Rob Di Cristoforo

Director, Advantia Transport Consulting Pty Ltd

BULK TANKER EMERGENCY RESPONSE

sharing lessons and improving outcomes

20th October
Melbourne Park Function Centre

Hosts

afac
Australasian Fire and Emergency Service Authorities Council

NBTA
National Bulk Tanker Association

The big questions

- Is technology actually effective in reducing crashes?
- Does it work as well in normal operations as it does in staged demonstrations?
- Is the benefit-cost ratio favourable?

advantia
transport consulting

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Additional technologies

Not just brakes:

- Forward collision warning (or avoidance)
- Lane departure warning
- Intelligent speed adaptation
- Adaptive cruise control
- Fatigue management (eye monitoring)

advantia
transport consulting

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Literature review

No.	Primary author	Sponsor	Title	Year
1	Anderson	QDTMR, DITRDLG, TCA and VicRoads	Analysis of crash data to estimate the benefits of emerging vehicle technology	2010
2	Cairney	Austroads	Reviewing ITS technologies and road safety opportunities	2010
3	Latto	Austroads	Future trends in heavy vehicle design	2004
4	Lehmer	USDOT (NHTSA)	Volvo Trucks Field Operational Test: Evaluation of advanced safety systems for heavy trucks	2007
5	Murray	USDOT (FMCSA)	Analysis of benefits and costs of roll stability control systems for the trucking industry	2009
6	Regan	Austroads	A review of literature and trials of intelligent speed adaptation devices for light and heavy vehicles	2003
7	Woodrooffe	USDOT (NHTSA)	Safety benefits of stability control systems for tractor-semitrailers	2009

Estimated crash reductions (Anderson)

Technology	Estimated annual crash reductions in Australia (combined for cars, trucks and motorcycles)		Estimated benefit-cost ratio for trucks
	Fatality	Non-fatal injury	
Forward collision avoidance (all speeds)	227 (16%)	54,305	1.8
Forward collision avoidance (80+ km/h)	127 (9%)	8,204	1.1
Fatigue management	150 (10%)	9,233	2.9
Lane departure warning	100 (7%)	4,177	2.2
Lane change warning	14 (1%)	5,031	0.7
Truck stability	20 (1%)	1,130	1.5

advantia
transport consulting

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

Estimated crash reductions (Cairney)

Technology	Estimated range of the number of crashes avoided		Cost per vehicle	Benefit-cost ratio
	Fatal	Serious injury		
Drowsiness alerting	32 - 95	225 - 674	$1,375	0.06 - 0.22
Intelligent speed adaptation (advisory)	Not advised	185 - 4,985	$550	0.09 - 2.49
Intelligent speed adaptation (supportive)	53 - 108	374 - 765	$2,030	0.07 - 0.17
Intelligent speed adaptation (mandatory)	522	2,636	$2,872	0.57 - 0.66
Collision warning	107 - 179	1,478 - 3,767	$463 - $1,250	Not advised
Lane departure warning	2 - 56	56 - 187	$514	0.03 - 0.23
Road departure warning	90 - 301	622 - 2,077	$514	0.47 - 1.8
Brake assistance	100 - 315	475 - 1,986	$1,000	0.22 - 0.92
Adaptive cruise control	7 - 24	227 - 757	$1,400	0.05 - 0.17

Volvo trucks FOT

Severity	Rear-end collision reduction by safety technology (95% confidence interval)		
	Collision warning system	Active cruise control and disc brake EBS	Collision warning system, active cruise control and disc brake EBS
Conservative	-1.9 ± 20.8%	9.4 ± 12.4%	7.2 ± 16.8%
Medium	20.7 ± 24.2%	12.0 ± 28.4%	**28.1 ± 21.0%**
Aggressive	25.3 ± 44.0%	9.8 ± 53.6%	29.9 ± 39.6%

B/C up to 3.6

advantia
transport consulting

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

ESC and RSC (Woodrooffe)

Measure	Total considered to be relevant to ESC or RSC annually	Number (or percentage) that could have been prevented:	
		by ESC	by RSC
Number of crashes	11,224	4,659 (42%)	3,489 (31%)
Number of deaths	255	126 (49%)	106 (42%)
Number of injuries	14,233	5,909 (42%)	4,384 (31%)

advantia
transport consulting

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre

RSC business case in the USA (Murray)

- 37-53% reduction in rollovers
- US$197k per property damage crash
- US$462k per injury crash
- US$1.14M per fatality crash
- 6-30 month ROI

advantia
transport consulting

BULK TANKER EMERGENCY RESPONSE
sharing lessons and improving outcomes
20th October
Melbourne Park Function Centre