31st Road Pavements Forum,
Africanos Country Estate, Addo
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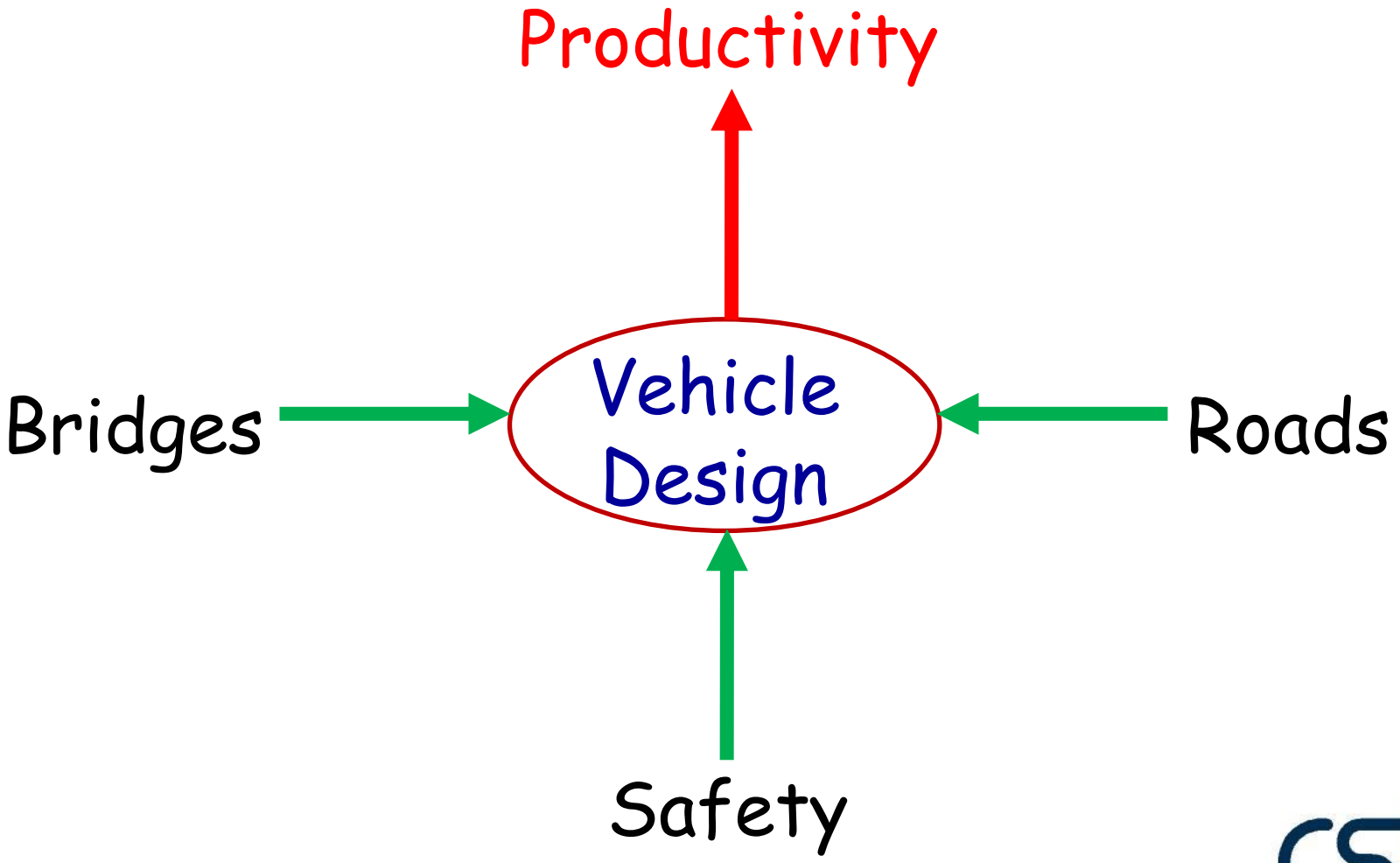
Update on the Smart Truck project: A Performance-Based Standards (PBS) approach to heavy vehicle design

Dr Paul Nordengen
Vice-President: IFRTT
Past President: SA Road Federation
Research Group Leader, CSIR Built Environment

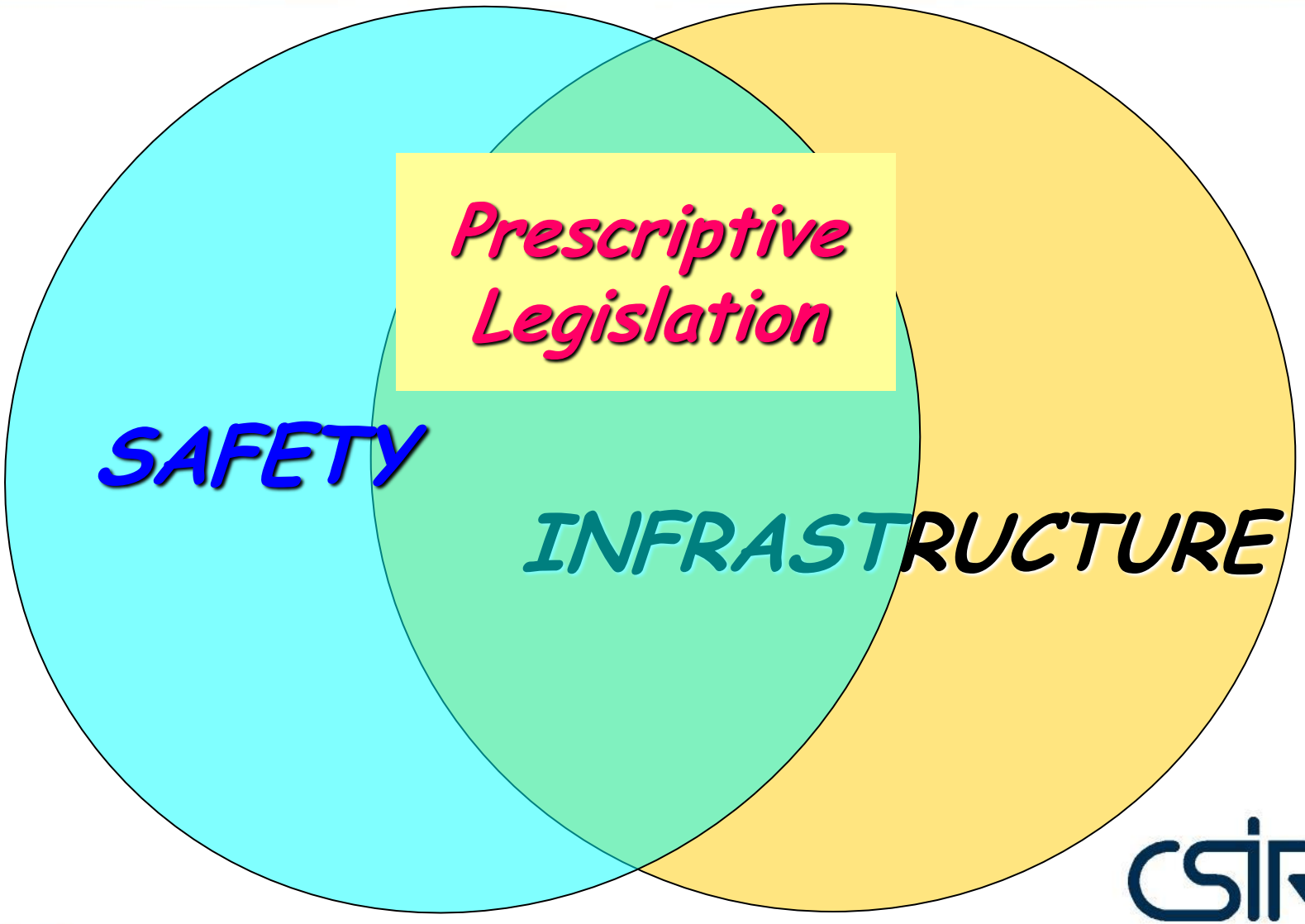
Performance-Based Standards

Performance-Based Standards

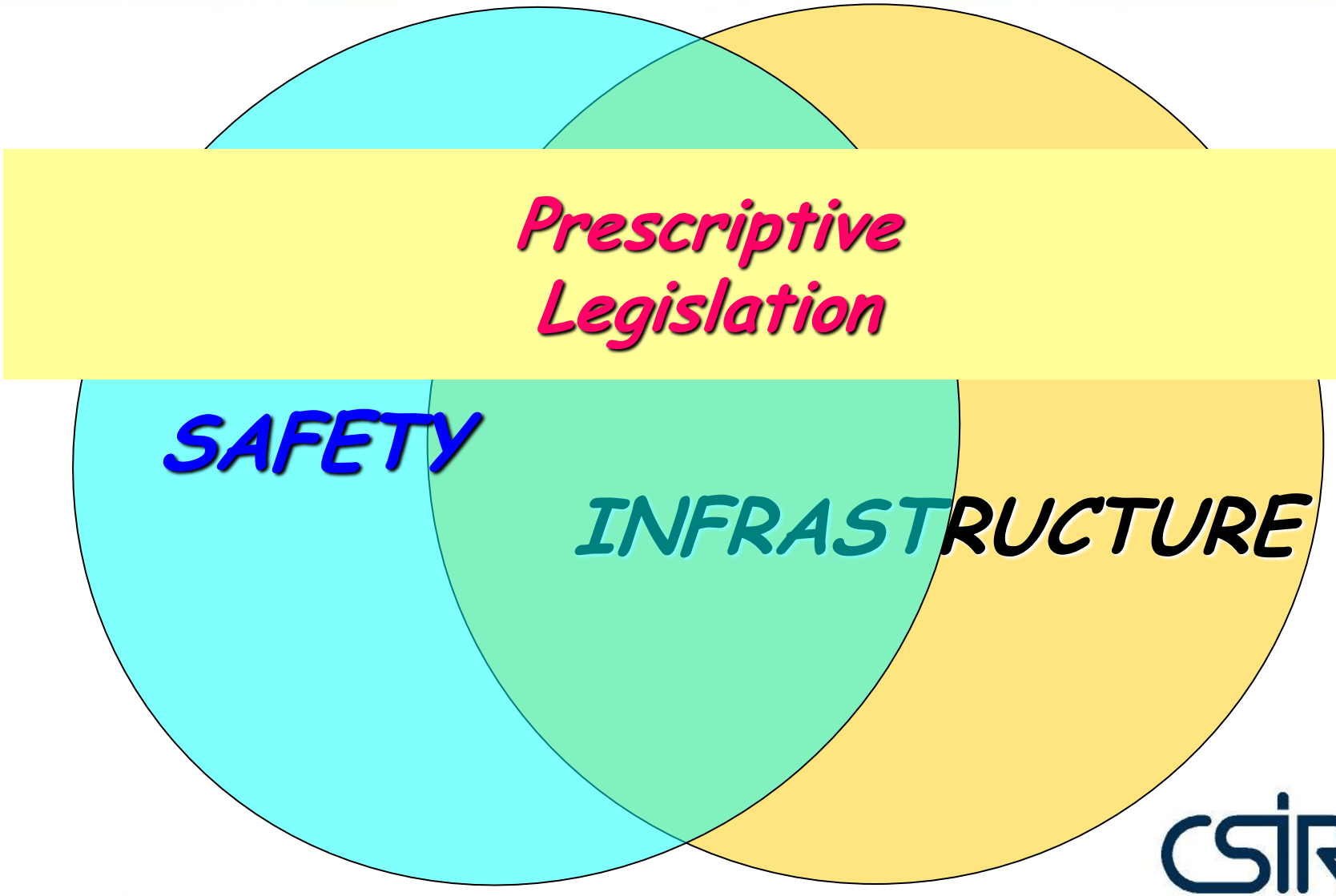
Conflicting Size & Weight Issues



Vehicle Design Constraints

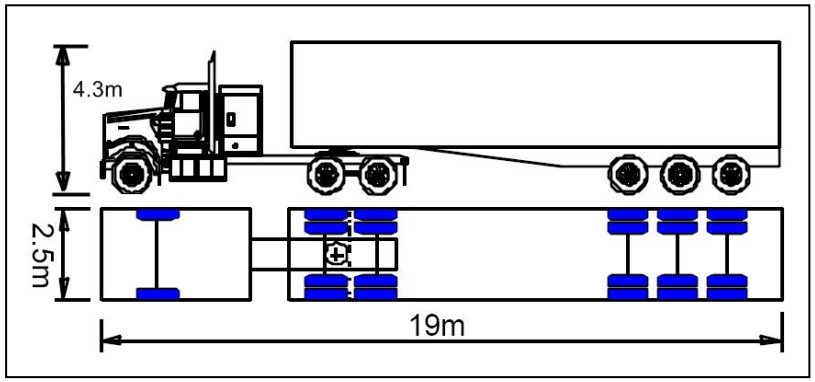


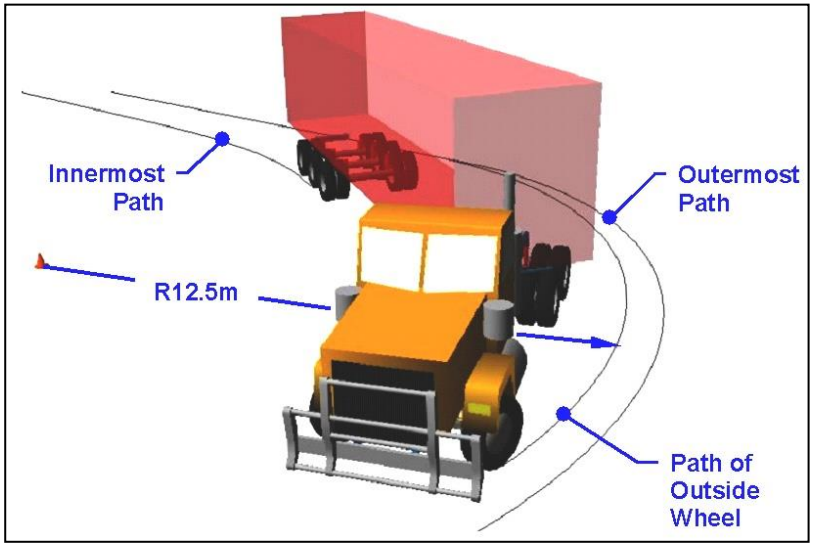
Vehicle Design Constraints



Performance-Based Standards

Prescriptive Standards	Performance-Based Standards

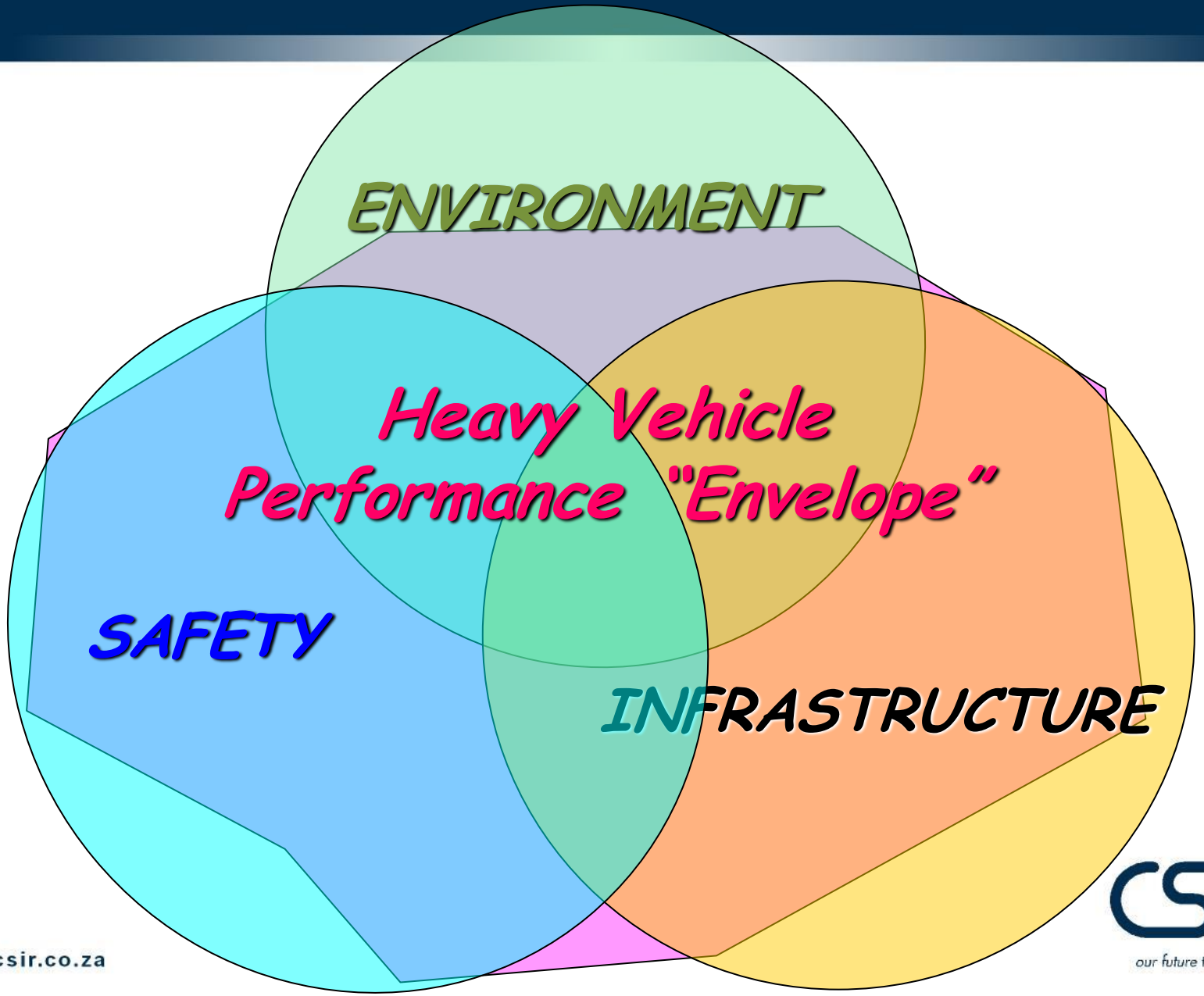




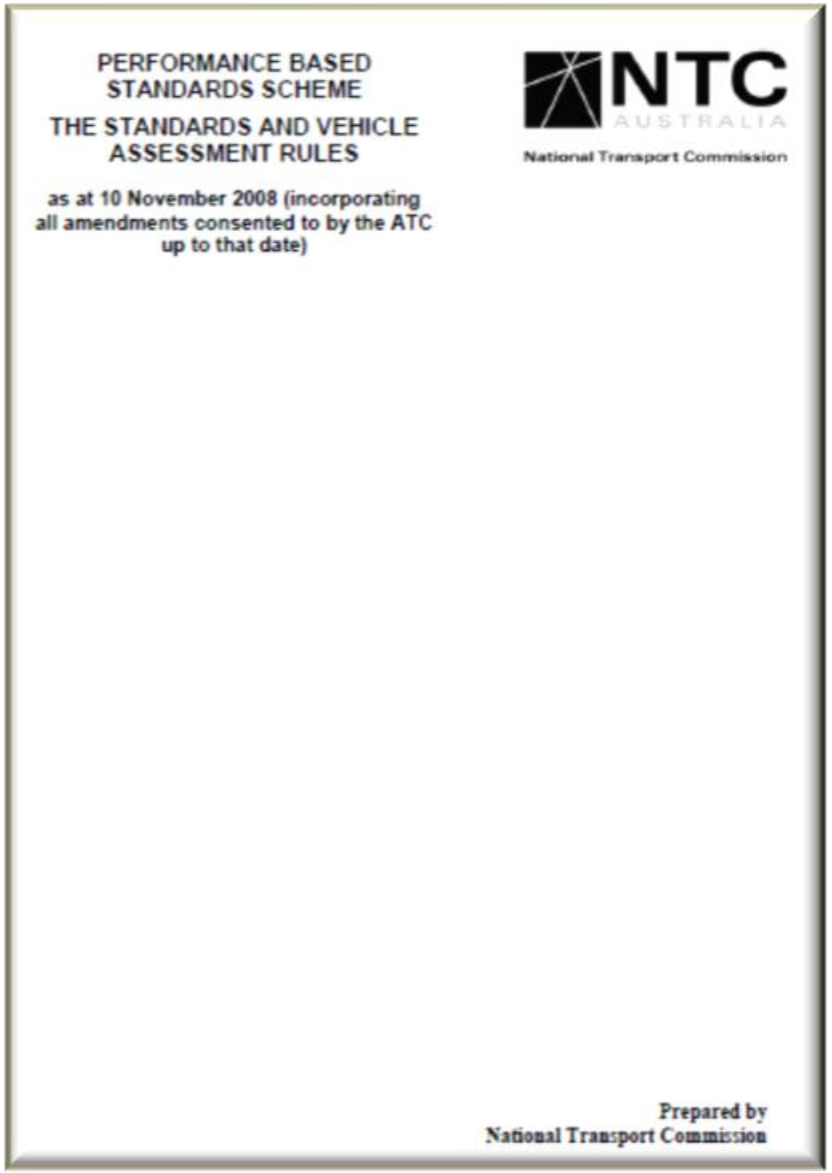
What the vehicle looks like	**What the vehicle can do**
Governs **mass and dimensions**	Governs actual **on-road performance**
Constrains productivity	Allows **heavier and/or larger** vehicles
Constrains innovation	Promotes **innovation**

Images courtesy of the Australian National Transport Commission

Performance Based Standards



Australian Performance Standards for heavy vehicles



PERFORMANCE BASED
STANDARDS SCHEME

THE STANDARDS AND VEHICLE
ASSESSMENT RULES

as at 10 November 2008 (incorporating
all amendments consented to by the ATC
up to that date)

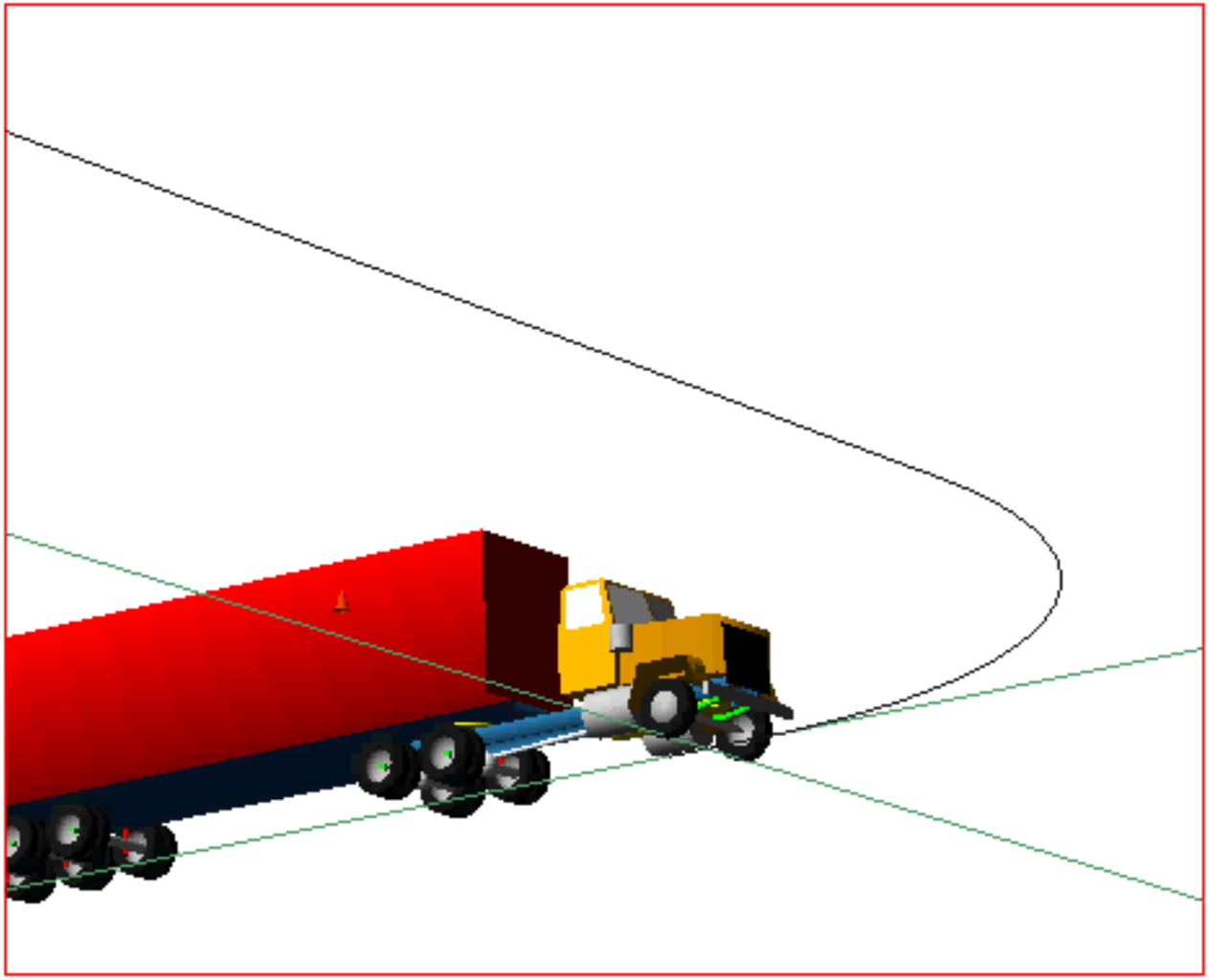
NTC
AUSTRALIA
National Transport Commission

Prepared by
National Transport Commission

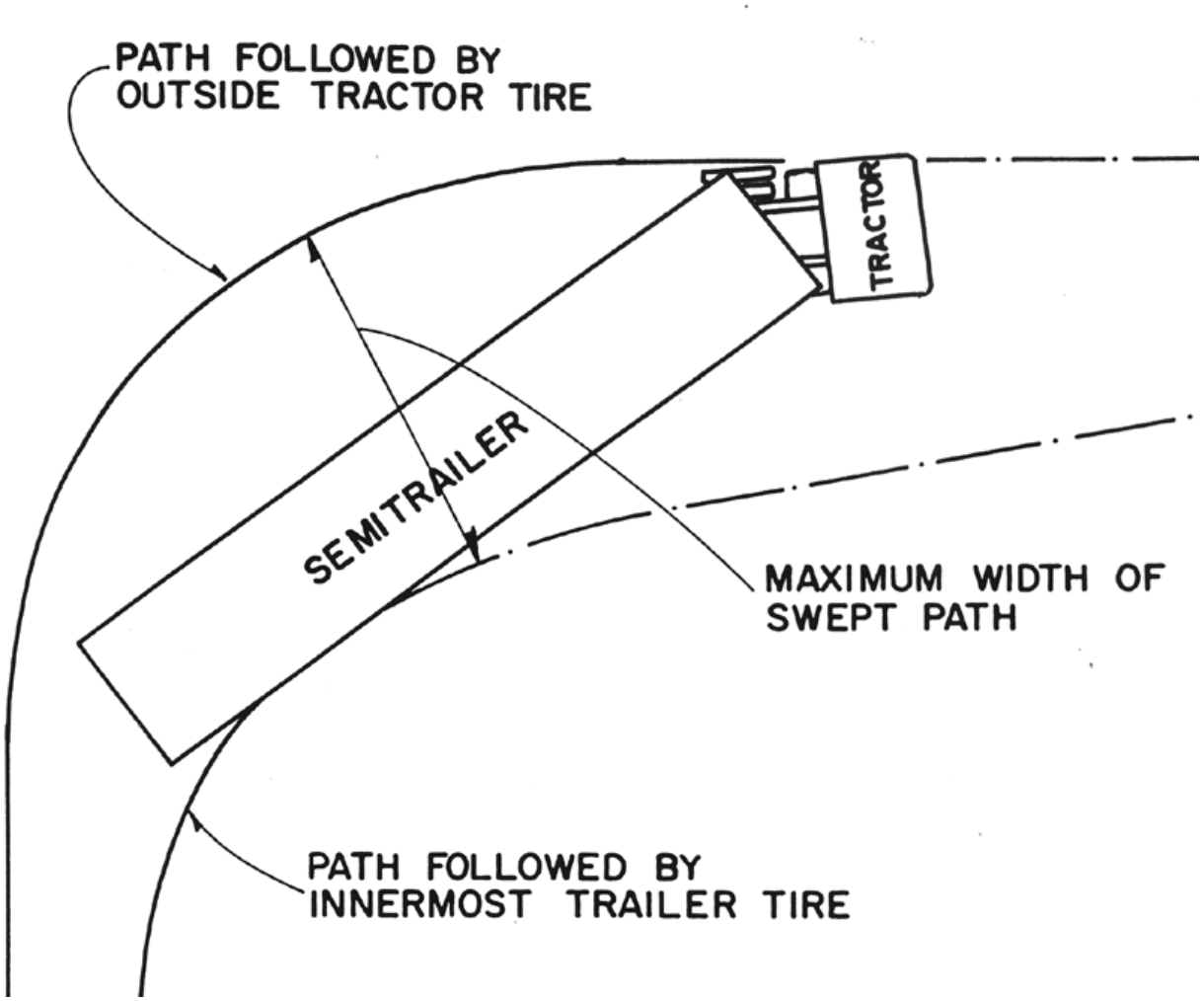
Performance-Based Standards: Safety

Manoeuvre/Test	Performance Standard
Low-speed 90° turn (5 km/h)	Low-speed swept path Tail swing Frontal swing Steer-tyre friction demand
High-speed lane-change (80 km/h)	Rearward amplification High-speed transient offtracking
Rollover	Static rollover threshold
High-speed pulse steer (80 km/h)	Yaw damping coefficient
High-speed on uneven road (90 km/h)	Tracking ability on a straight path
Various (driveability standards)	Startability Gradeability A Gradeability B Acceleration Capability

Low-Speed Offtracking

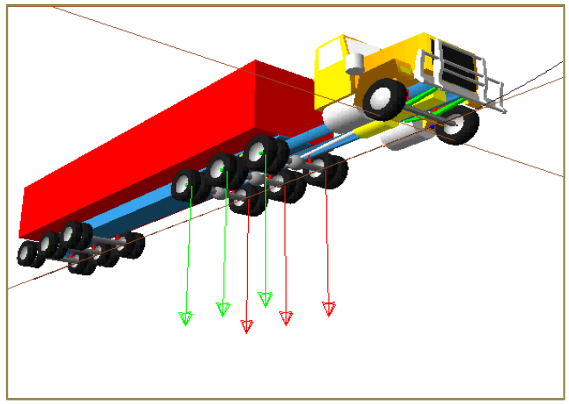


Low-Speed Offtracking



PBS in Africa ??? ....

Performance-Based Standards: Infrastructure



Infrastructure

Pavements

Bridges

Pavement Vertical Loading
Pavement Horizontal Loading
Tyre Contact Pressure Distribution

Bridge Loading

Road Wear Performance Standard

Pavement A: ES100

	Poisson's Ratio	Elastic Moduli (MPa)		
		Phase I	Phase II	Phase III
50 AG*	0.44	2000	2000	1500
150 G1*	0.35	450	450	350
150 C3*	0.35	2000	2000	500
150 C3	0.35	1500	550	250
SUBGRADE	0.35	180	180	180

Pavement B: ES100

	Poisson's Ratio	Elastic Moduli (MPa)		
		Phase I	Phase II	Phase III
50 AG*	0.44	2000	1800	1500
150 G1*	0.35	250	250	240
150 C3*	0.35	2000	1700	160
150 C3	0.35	1500	120	110
SUBGRADE	0.35	90	90	90

Pavement C: ES0.1

	Poisson's Ratio	Elastic Moduli (MPa)	
		Phase I	Phase II
S*	0.44	1000	1000
100 G4*	0.35	300	225
125 C4*	0.35	1000	200
SUBGRADE	0.35	140	140
-	-	-	-

Pavement D: ES0.1

	Poisson's Ratio	Elastic Moduli (MPa)	
		Phase I	Phase II
S*	0.44	1000	1000
100 G4*	0.35	200	180
125 C4*	0.35	1000	120
SUBGRADE	0.35	70	70
-	-	-	-

Pavement E: ES30/ES50

	Poisson's Ratio	Elastic Moduli (MPa)		
		Phase I	Phase II	Phase III
40 AG*	0.44	2500	2500	1600
120 BC*	0.44	3500	3500	1500
450 C3*	0.35	2200	1000	300
200 G7*	0.35	300	300	200
SUBGRADE	0.35	150	150	140

Pavement F: ES1.0

	Poisson's Ratio	Elastic Moduli (MPa)	
		Phase I	Phase II
S*	0.44	2000	1600
80 BC*	0.44	2000	1600
150 C4*	0.35	1000	300
SUBGRADE	0.35	140	140
-	-	-	-

Pavement G: ES10

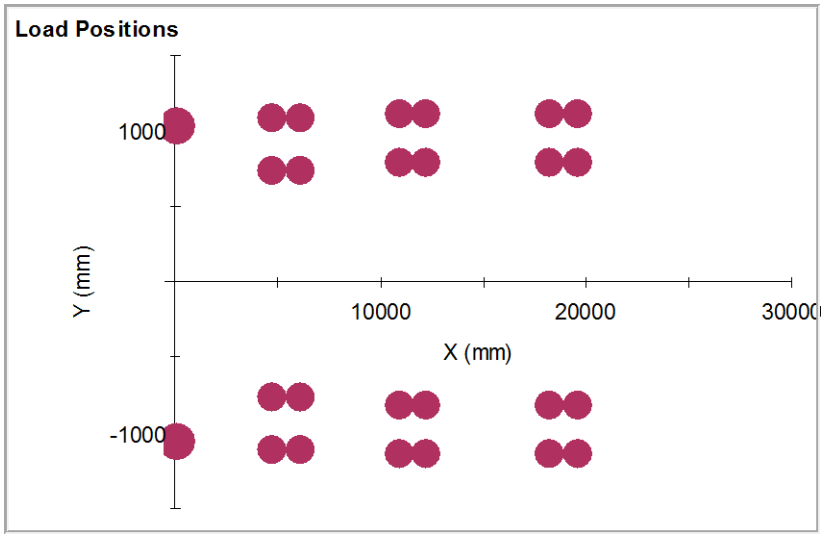
	Poisson's Ratio	Elastic Moduli (MPa)		
		Phase I	Phase II	Phase III
30 AG*	0.44	2400	2000	1600
150 C3*	0.35	2000	1800	250
300 C4*	0.35	1000	300	100
SUBGRADE	0.35	180	140	100
-	-	-	-	-

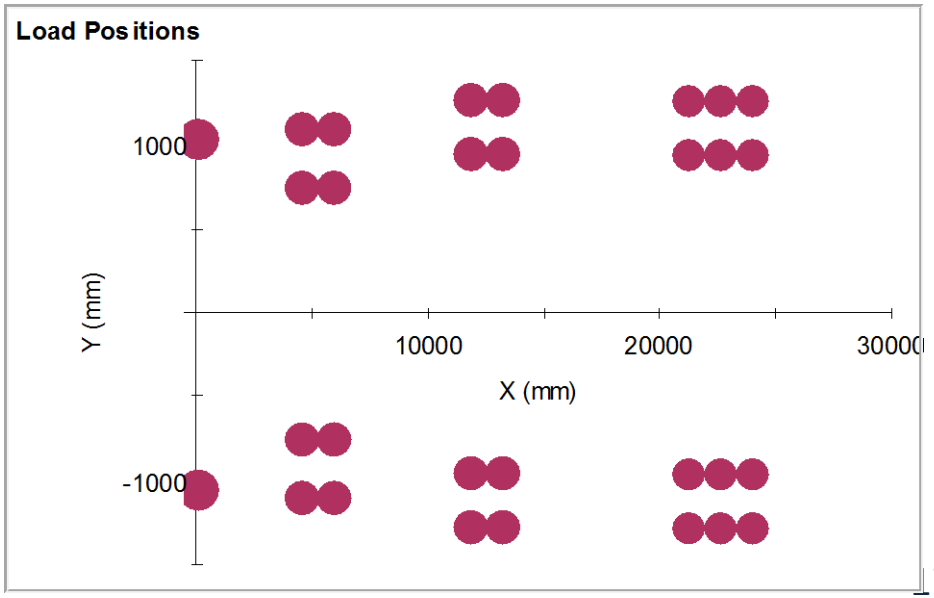
Pavement H: ES0.3

	Poisson's Ratio	Elastic Moduli (MPa)		
		Phase I	Phase II	Phase III
S1*	0.44	2000	1000	200
100 C4*	0.35	2000	1500	100
100 C4*	0.35	1000	300	100
SUBGRADE	0.35	140	140	100
-	-	-	-	-

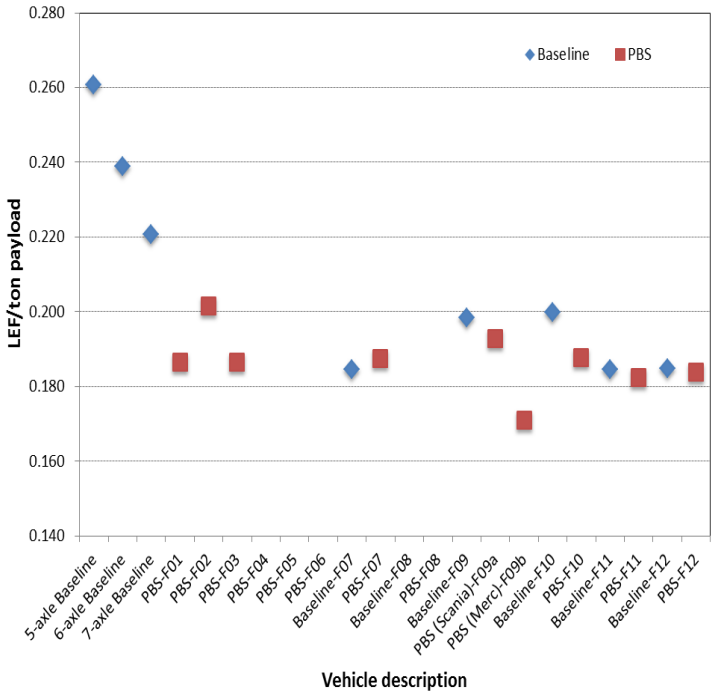
*** Classification according to TRH 14 (CSRA, 1985)**

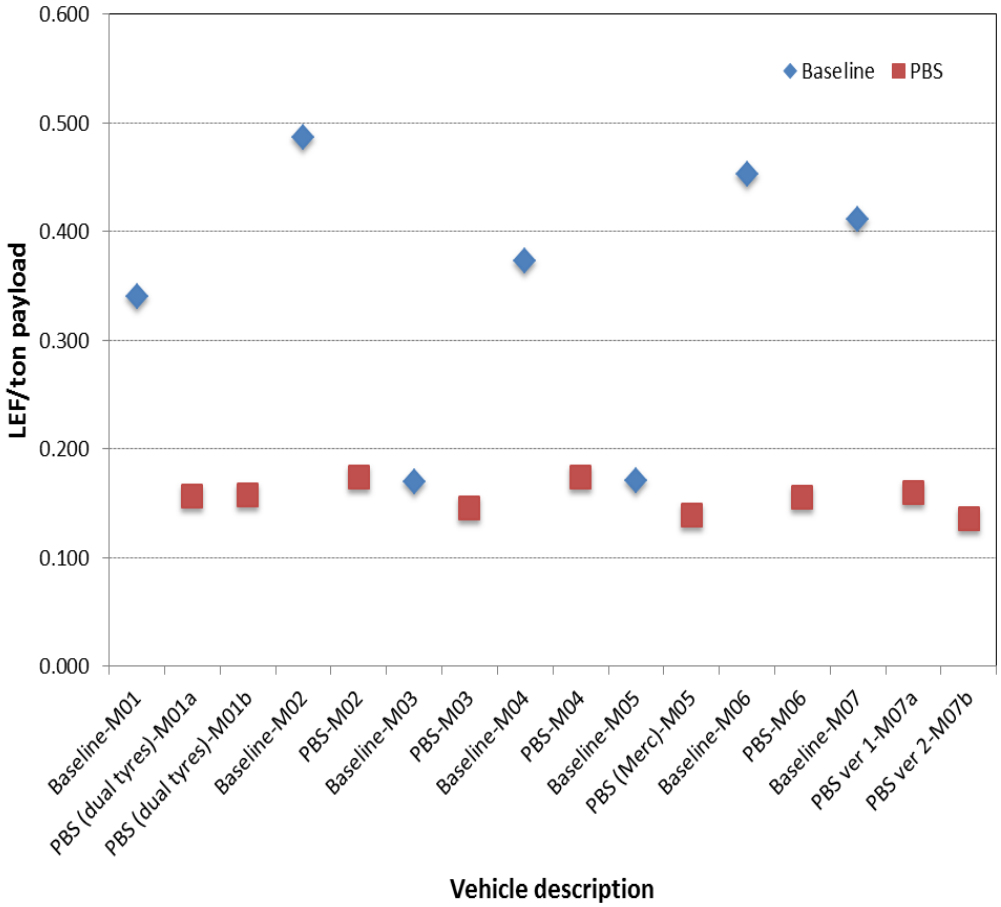
8 Pavement Structures-1.ppt



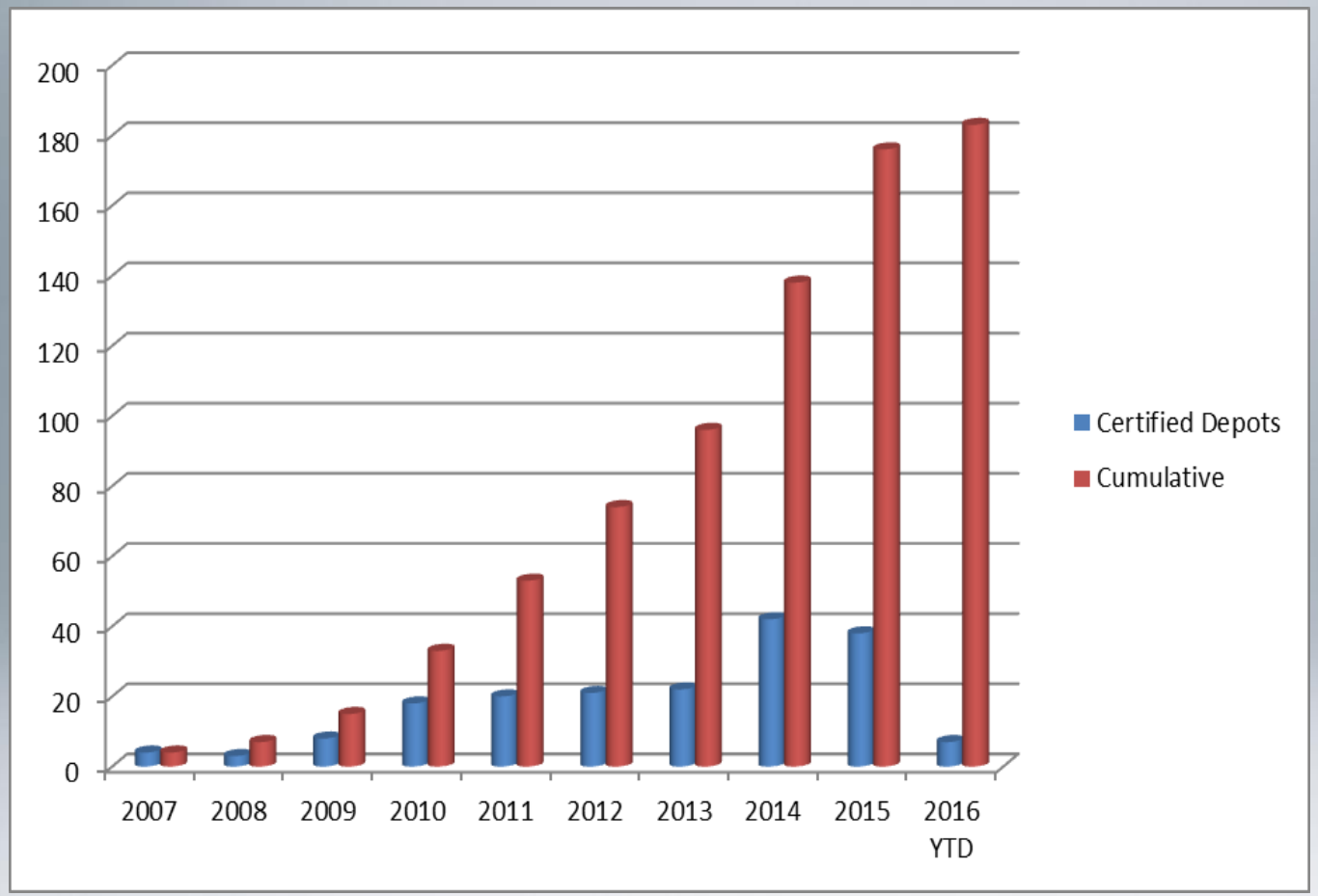


Road Wear Performance Standard





Growth of the RTMS in SA



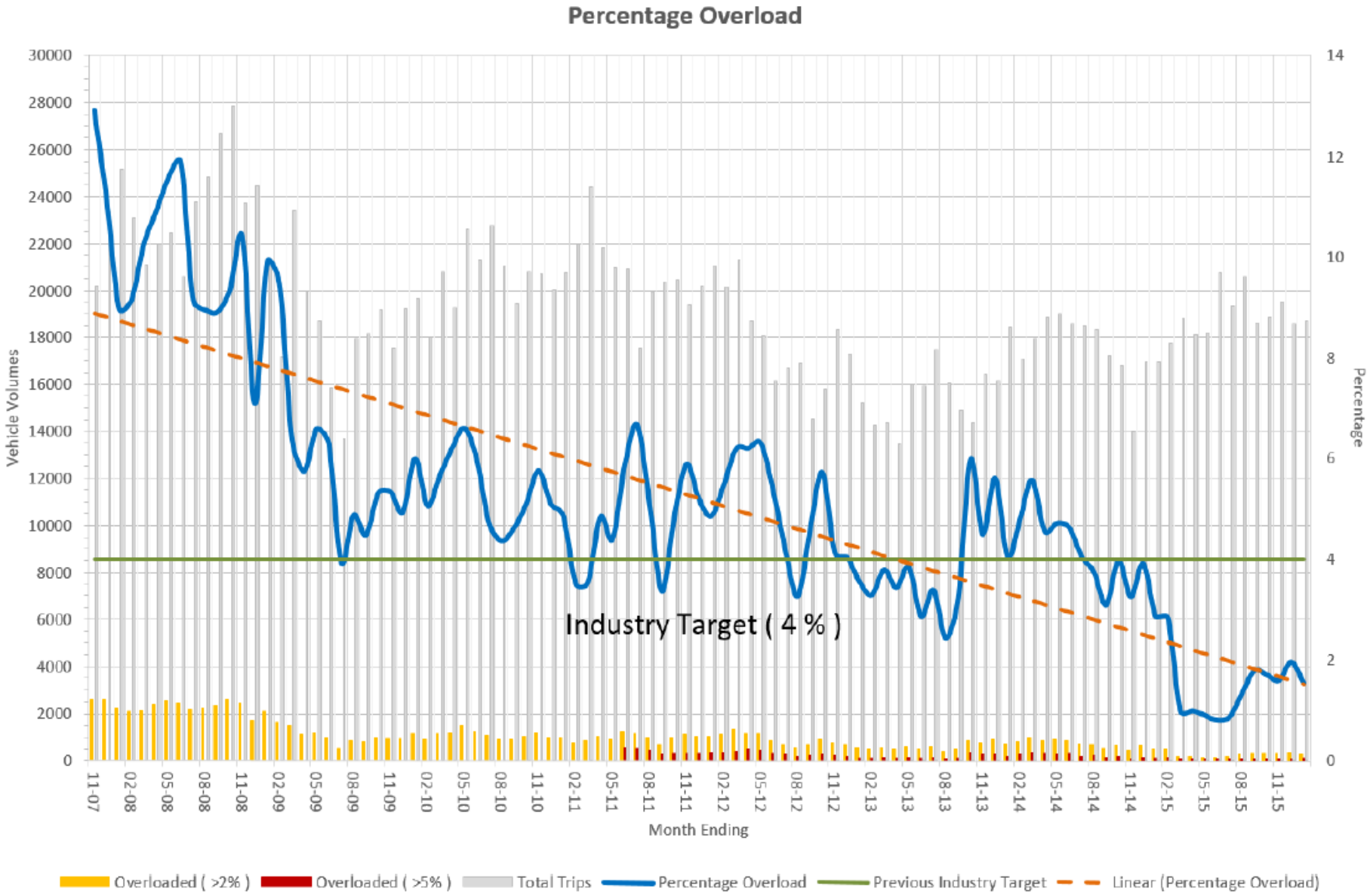
185 fleets representing over 9 300 trucks & buses (In 2007 their were 74 certified vehicles)

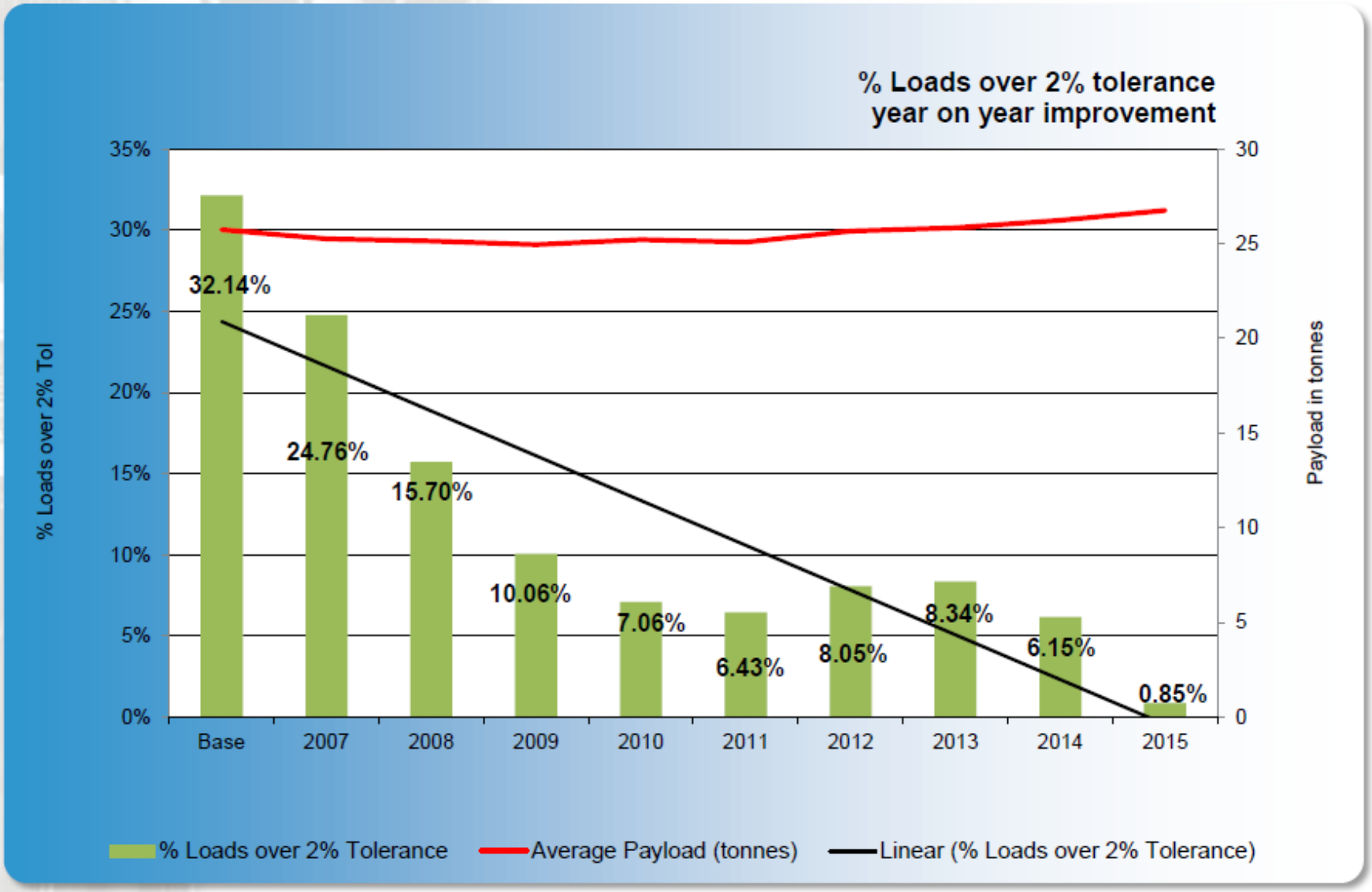
Four bus operators:

- Buscor 404 buses
- Intercape 152 coaches
- GABS Over 1000 buses
- Intestate (Bloem)

24 abnormal load operators:

- 258 vehicles
- Plant hire, construction, engineering, mobile cranes
- 2 commercial A/L operators (108 vehicles)





Road Transport Management System
RTMS
Driver Wellness • Safety • Loading • Productivity

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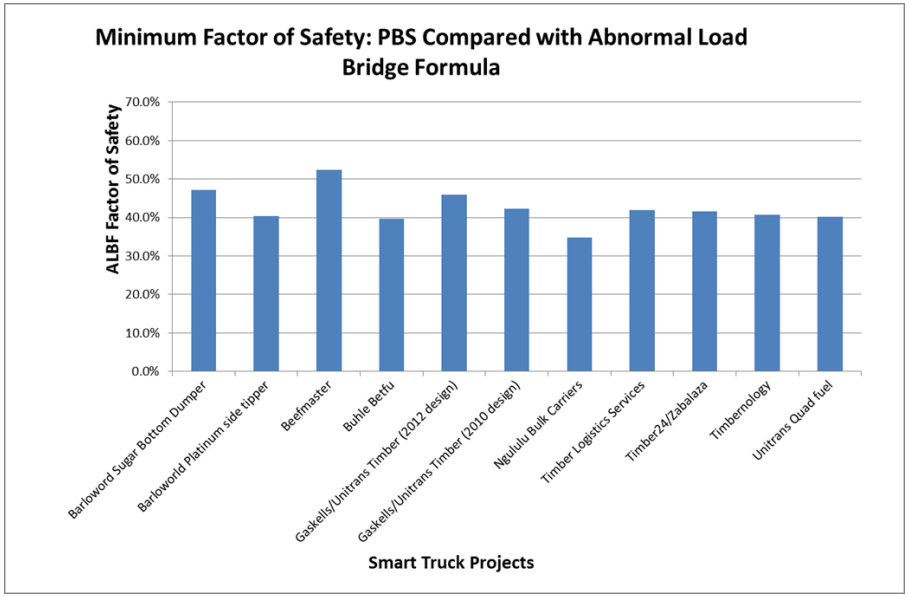
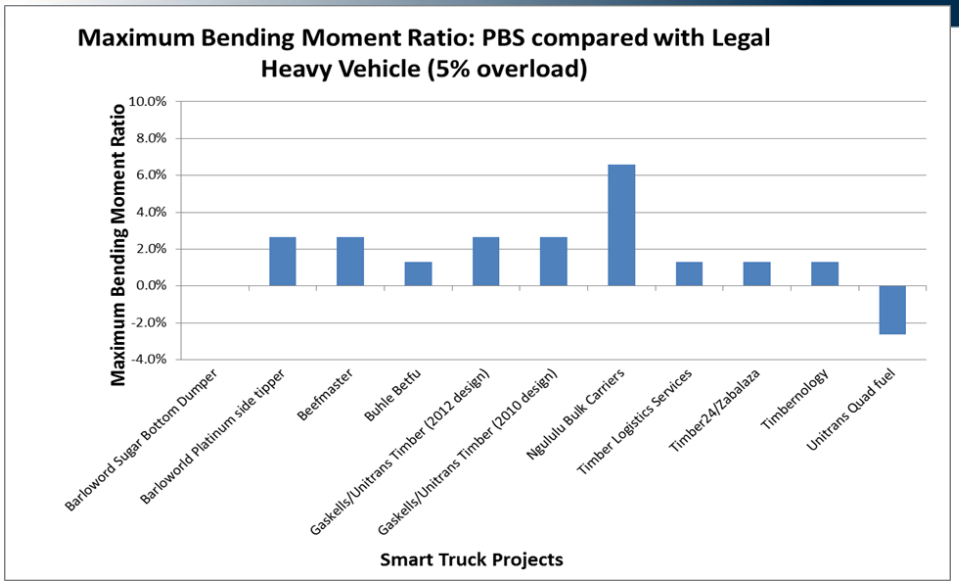
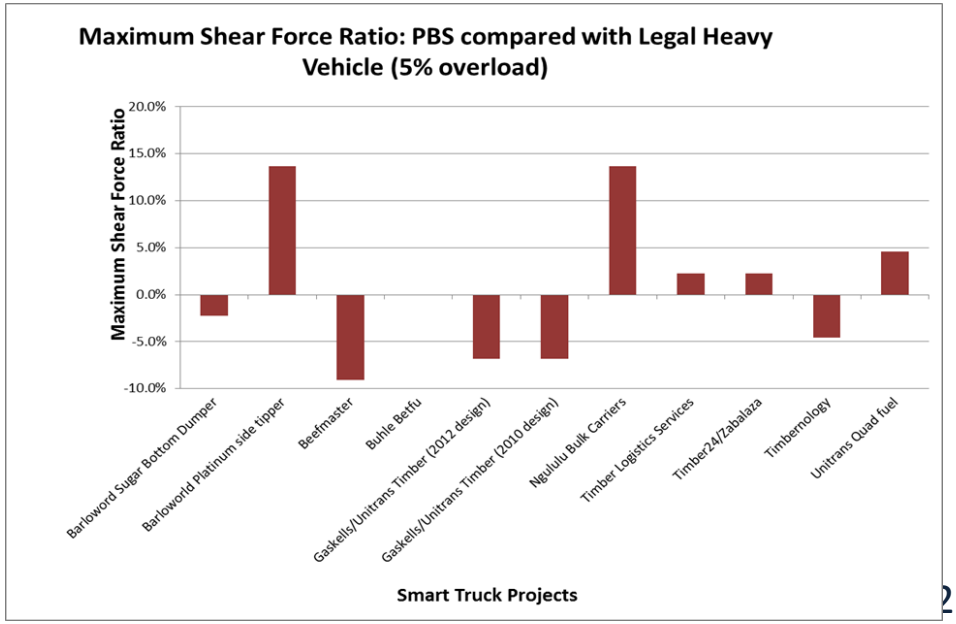
Structures Performance Standard







PBS Pilot Project in South Africa

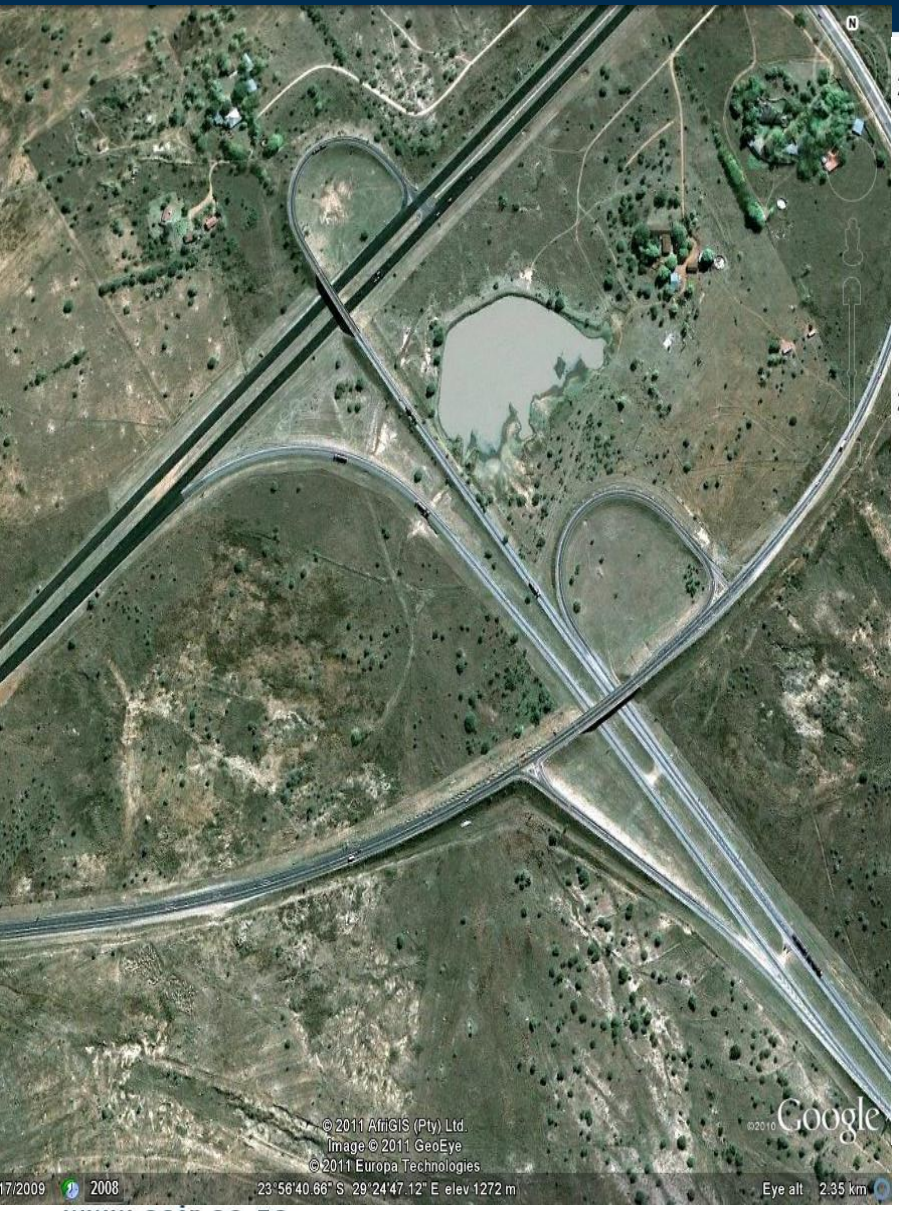
Target kms: 100 million Kms travelled to date: 69 million (end-April 2016)

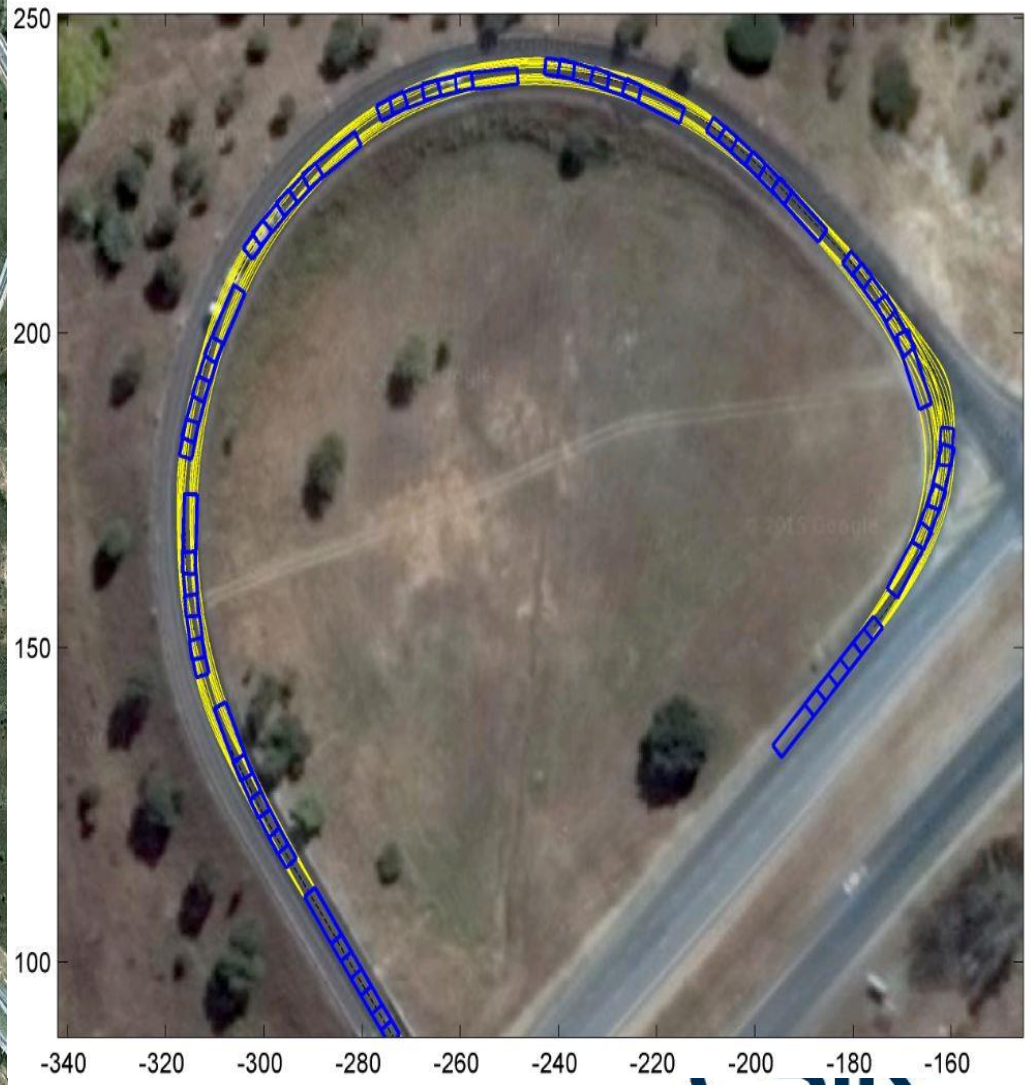
No. of Smart Trucks per Province: April 2016										
Commodity/ Industry	**E. Cape**	**W. Cape**	**N. Cape**	**Mpum.**	**Gauteng**	**Limpopo**	**KZN**	**Free State**	**N. West**	**Total**
Timber	0	0	0	30	0	0	53	0	0	**83**
Mining	0	5	2	12*	0	36*	11	0	0	**54**
Processed Sugar	0	0	0	0	0	0	9	0	0	**9**
Fuel	0	0	0	0	0	0	5	0	0	**5**
Beef cattle	0	0	2*	0	0	0	0	0	2*	**2**
Beer	0	0	0	0	0	0	2	0	0	**2**
Buses	0	0	0	12	0	0	0	0	0	**12**
Total	**0**	**5**	**4**	**54**	**0**	**36**	**80**	**0**	**2**	**167**

*Note: 12 mining PBS vehicles operating in both Mpumalanga and Limpopo;
2 beef cattle PBS vehicles operating in Northern Cape and North West

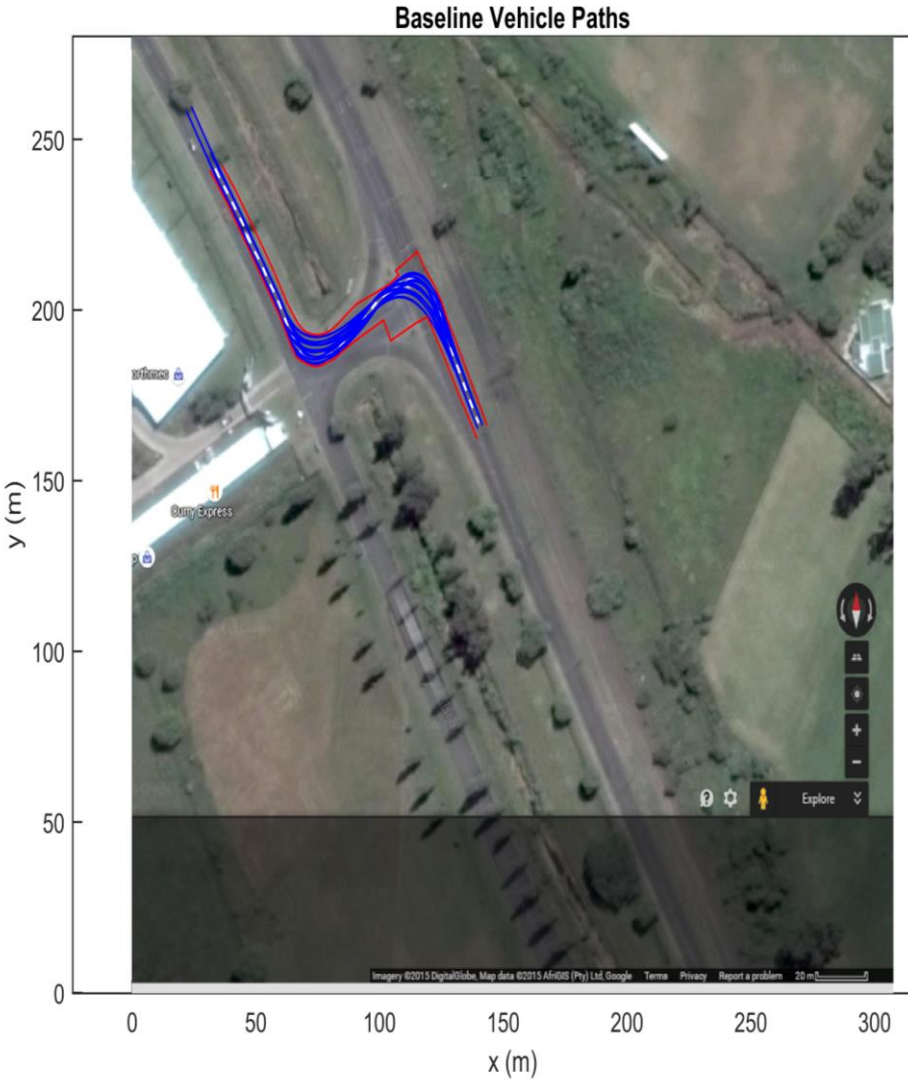
Current projects: Containers, tomatoes, paper reels, coal, general freight

Access: Route assessments





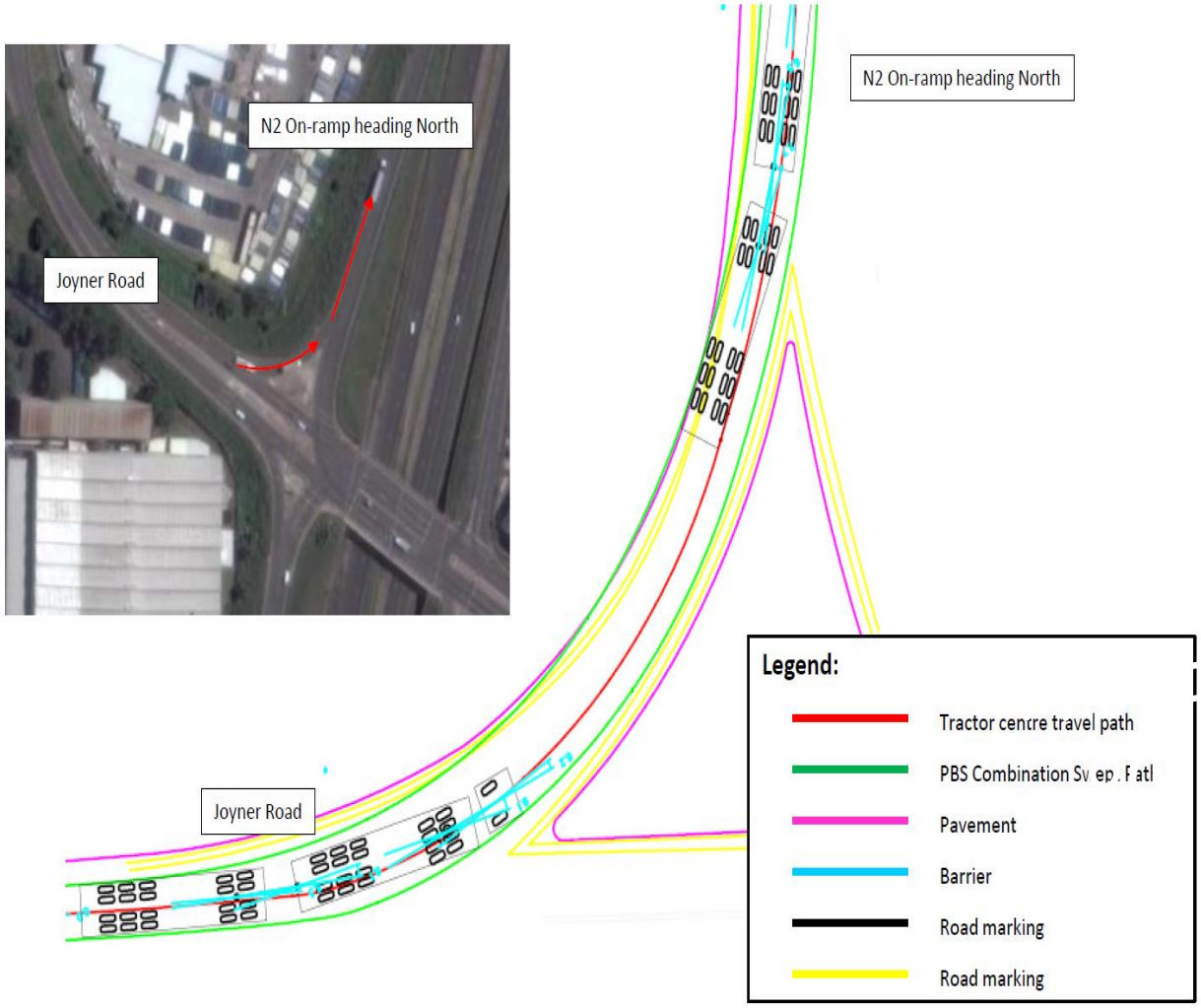
Access: Route assessments



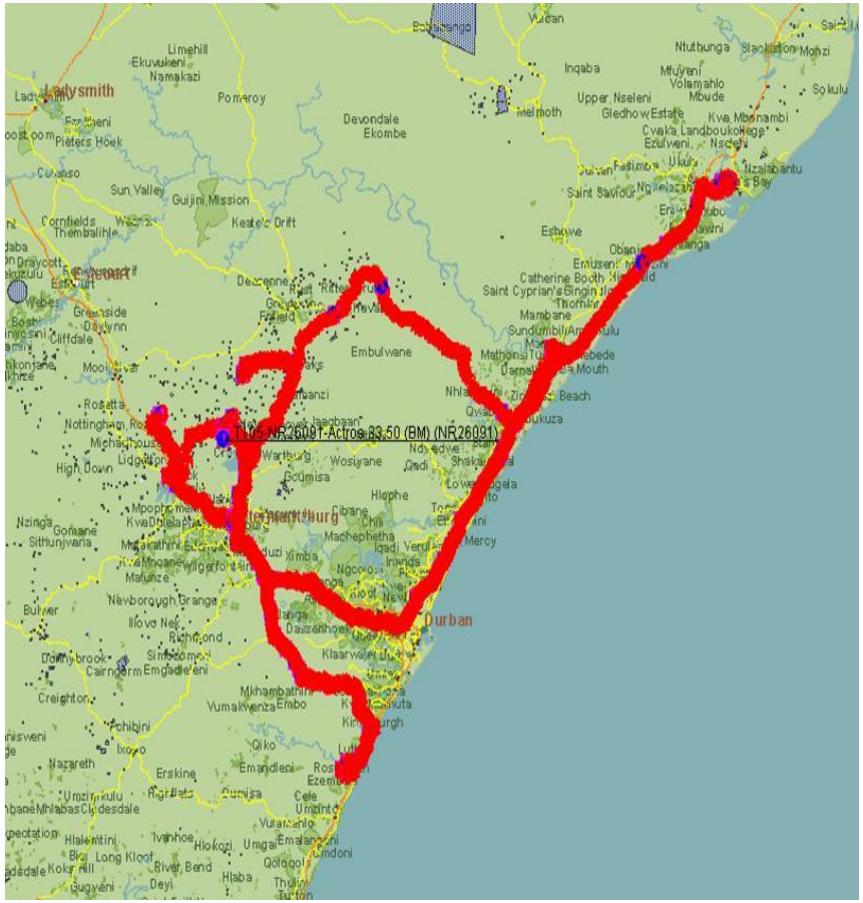
Access: Route assessments

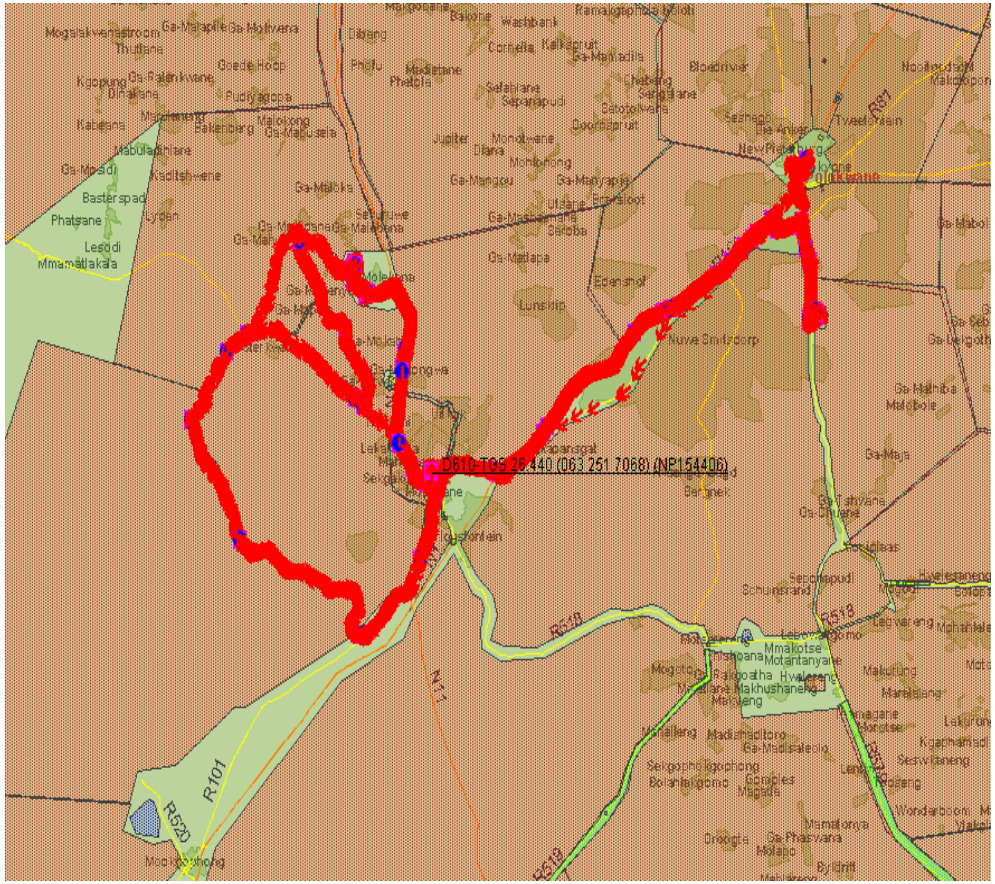
SAB Prospecton Depot to SAB Springfield Depot:

Joyner Road onto N2 on-ramp

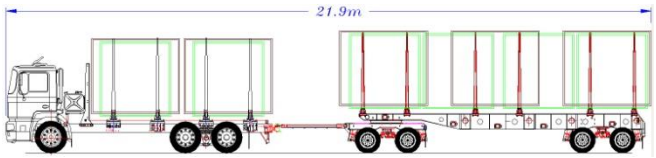


Access: Route compliance

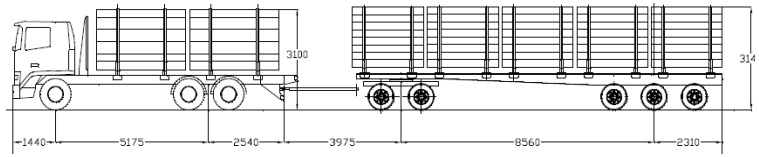




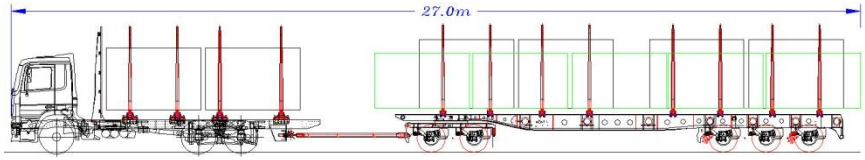
Forestry baseline and PBS vehicles



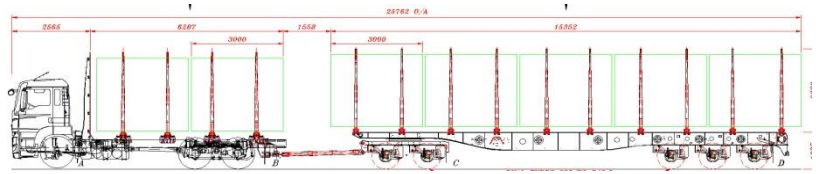
22,0 m, 56.0 tons



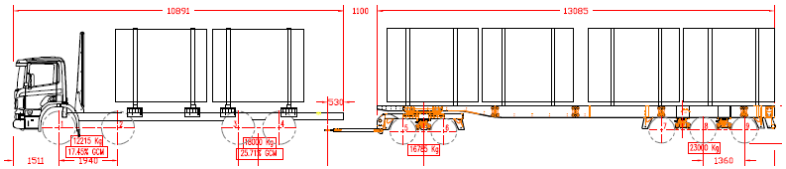
24.0 m, 64.1 tons



27.0 m. 67.5 tons



25.8 m, 67.5 tons



25.0 m, 70.0 tons

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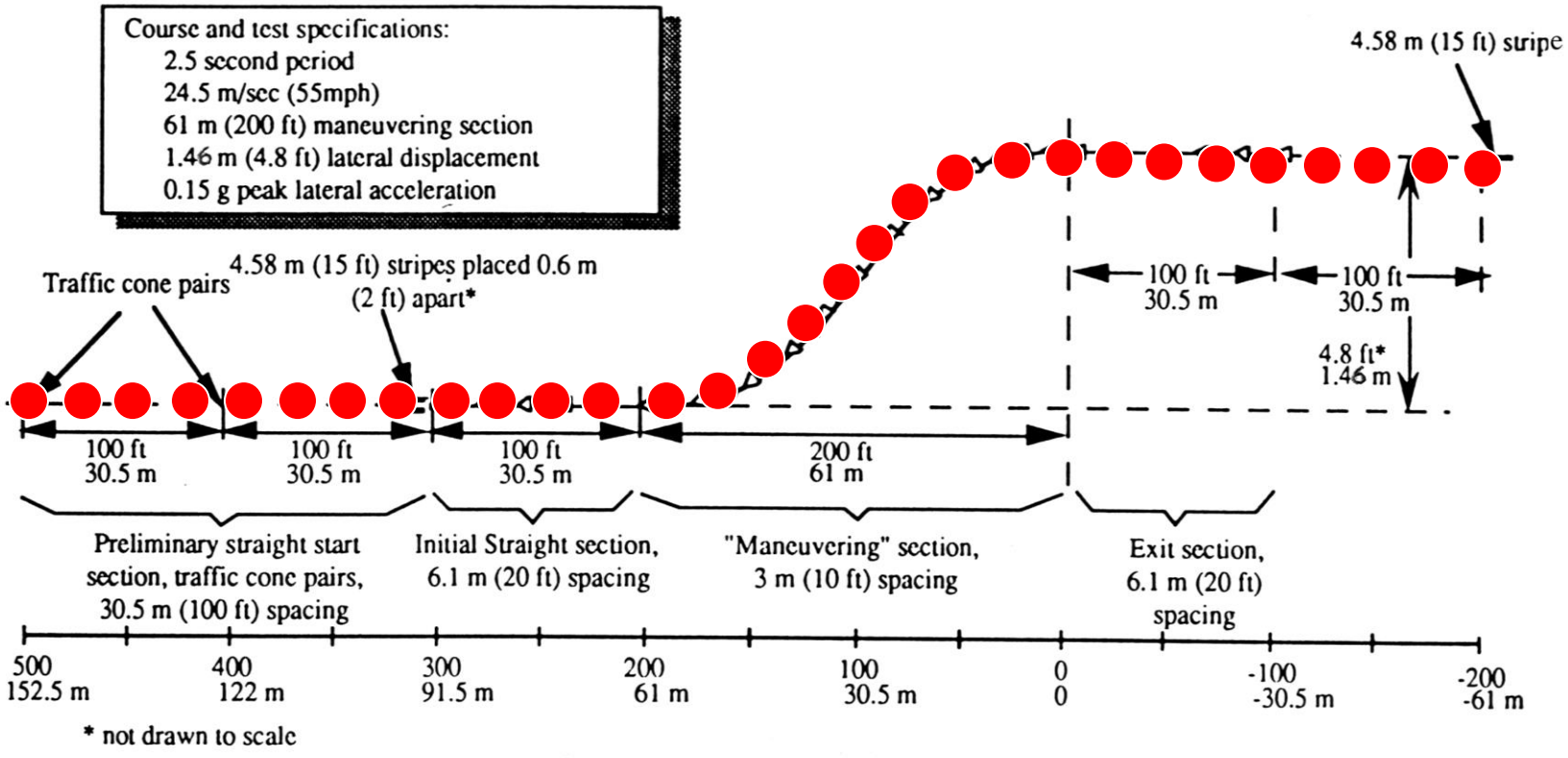
SMART TRUCK
TIMBERNOLOGY
SCANIA
TRUCK OF THE YEAR
S02
R500
ABNORMAL
NRB 61311
SMART TRUCK
TIMBERNOLOGY
SCANIA
TRUCK OF THE YEAR
R500
ABNORMAL

High Speed Transient Offtracking

PBS Lane Change Manoeuvre (SAE J2179)



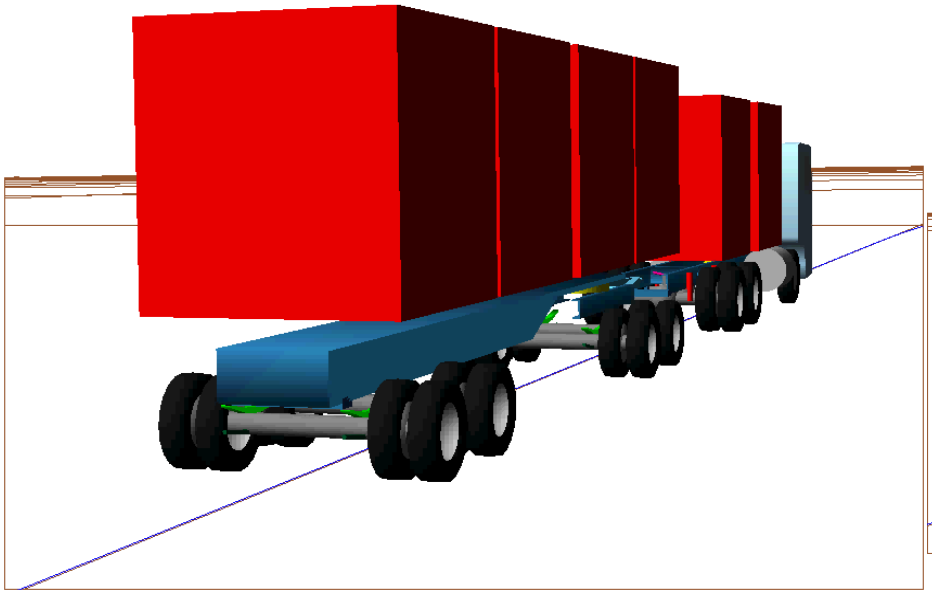
High Speed Transient Offtracking

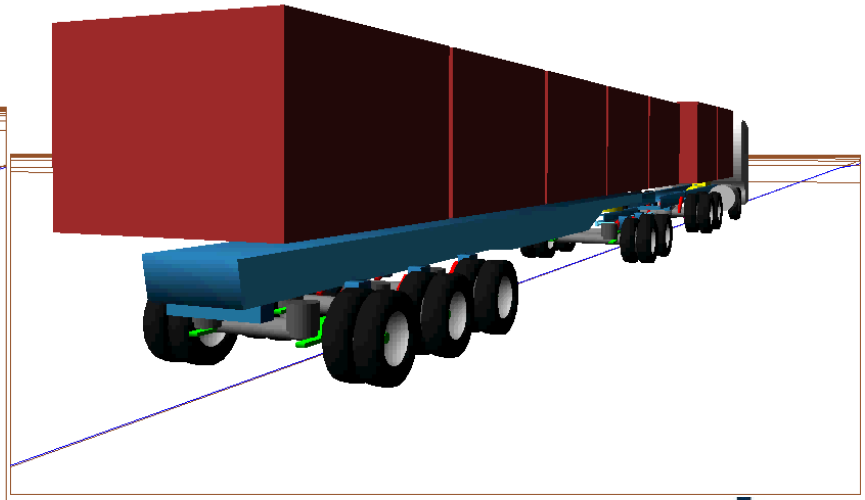
baseline

Last_Run Time= 2.4000 Frame=50

PBS

Last_Run Time= 2.4000 Frame=50



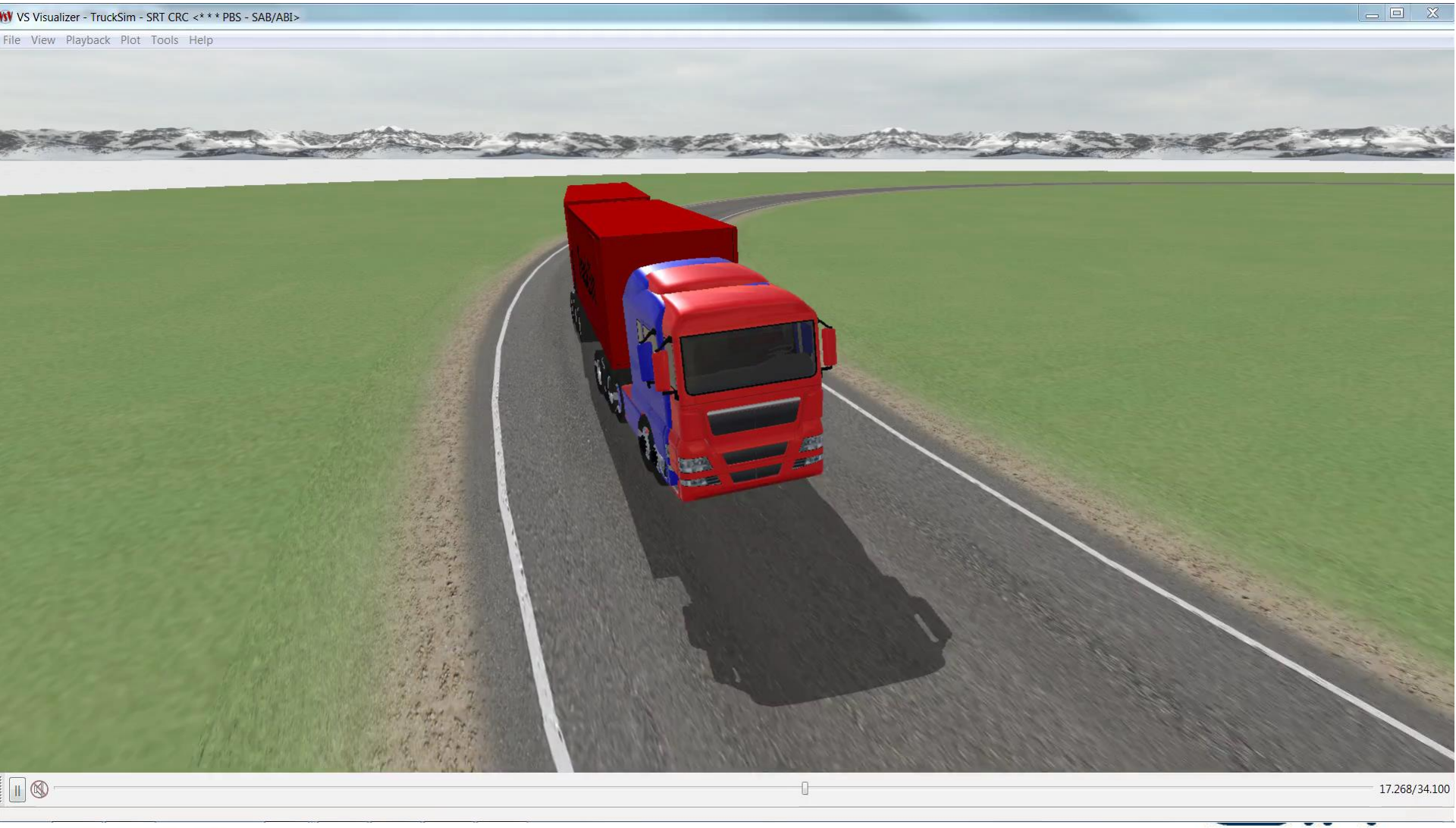


Mining Road Train: Rearward Amplification

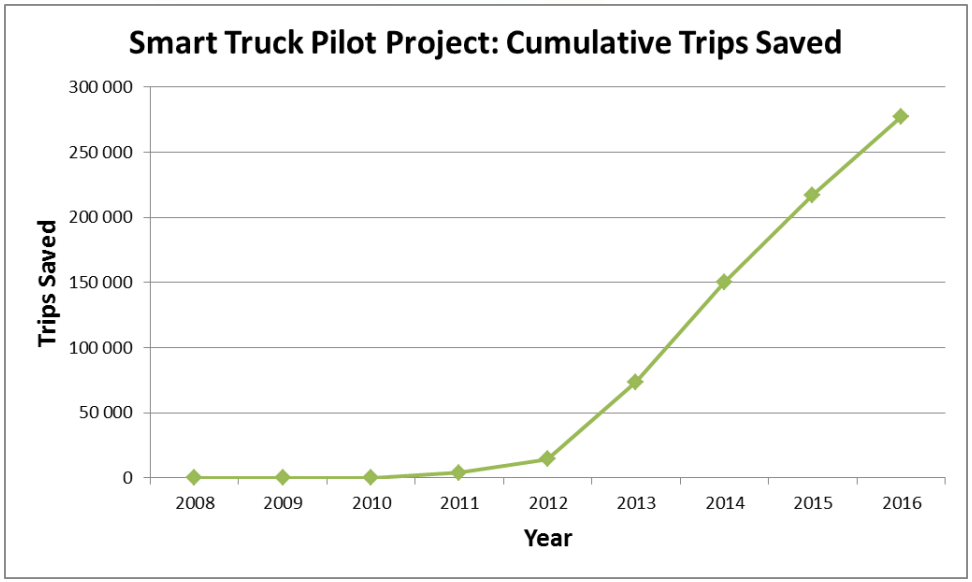
SA Breweries baseline: SRT (Rollover)

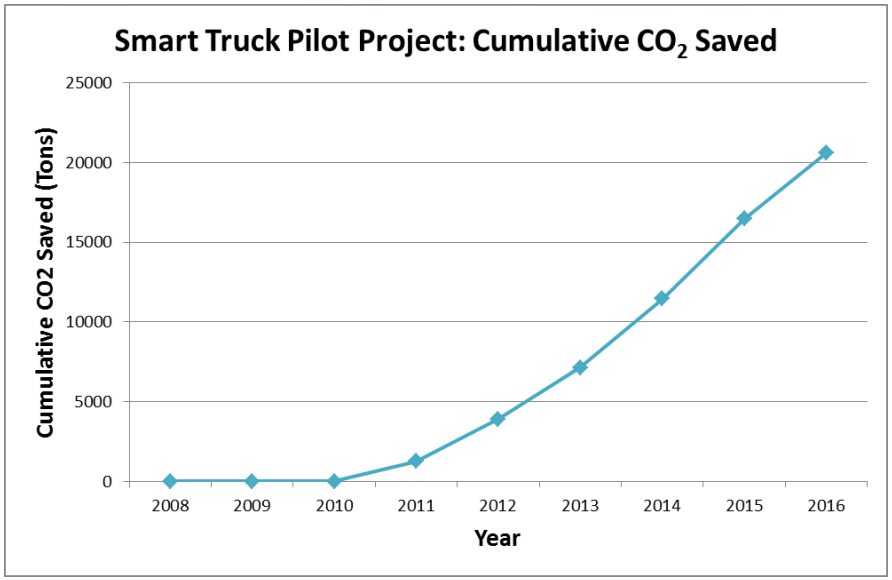
SA Breweries PBS combination

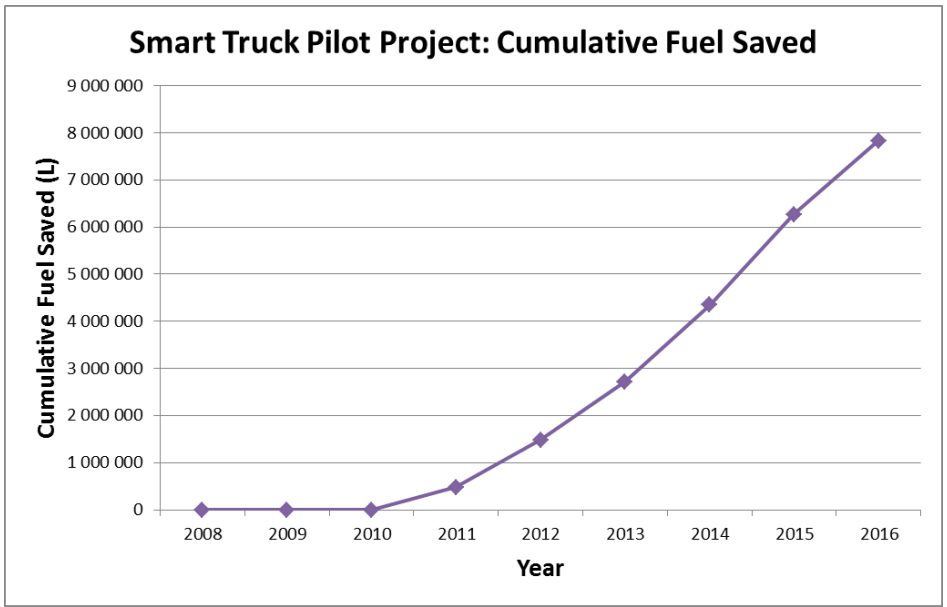
Rollover stability: Baseline (legal) vs PBS



Smart Truck monitoring: Productivity & Environmental Impacts

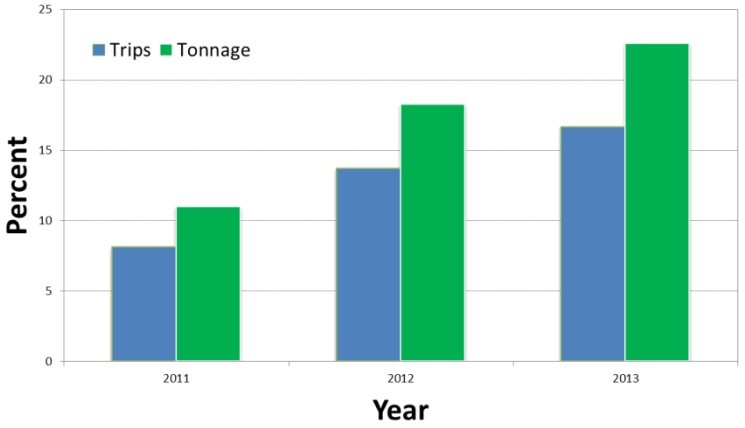


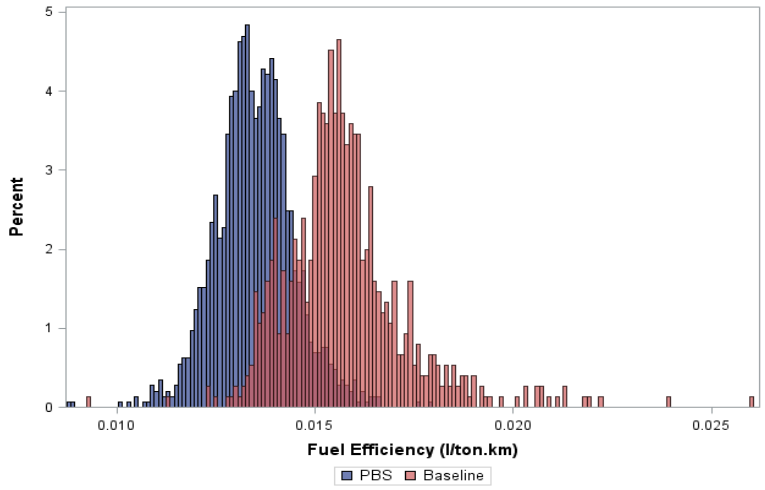




Smart Truck (PBS) project

- 106 demonstration projects operational during 2014
- 130 car carriers plus 100 others in design phase
- 75 700 trips saved, 1.23 million litres of fuel, 3 390 tons of CO_2
- Approx. 22% of pulp timber transported by Smart Trucks in 2013
- On average 14% fuel savings in forestry industry





2013
- Fuel savings: 1.24 million litres
- Emissions: 3 250 tons CO_2
- Road freight in SA (2012): 303 billion ton.km
  Assuming 10% are PBS vehicles would result in a reduction of 188 million tons CO_2 p.a.

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Smart Truck Safety Performance Results: Jan 2008 – Feb 2016

		Timber Logistics Services	Unitrans Timber	Buhle Betfu	Timber24	Total
No of Crashes	Smart Trucks	30	8	9	3	86
	Baseline	101	2	27	52	494
	Total	131	10	36	55	580
Total Kilometres	Smart Trucks	16 554 920	4 698 908	5 019 000	3 378 162	62 778 000
	Baseline	23 490 641	1 183 134	9 212 970	21 981 042	211 794 000
	Total	39 409 884	5 882 042	14 231 970	24 654 106	272 863 000
Crashes per million kms	Smart Trucks	1.80	1.70	1.80	0.90	1.37
	Baseline	4.30	1.70	2.90	2.40	2.33
	Total	3.30	1.70	2.50	2.20	2.13
Caused by Third Parties and Pedestrians (included in figures above)						
No of Crashes	Smart Trucks	11	3	0	0	50
	Baseline	44	13	0	0	264
	Total	55	16	0	0	315
% of Total	Smart Trucks	91.7%	33.3%	0.0%	0.0%	58.1%
	Baseline	51.2%	650.0%	0.0%	0.0%	53.4%
	Total	56.1%	145.5%	0.0%	0.0%	54.3%

Crash rate ratio:
Smart Truck : Baseline 1:1.70

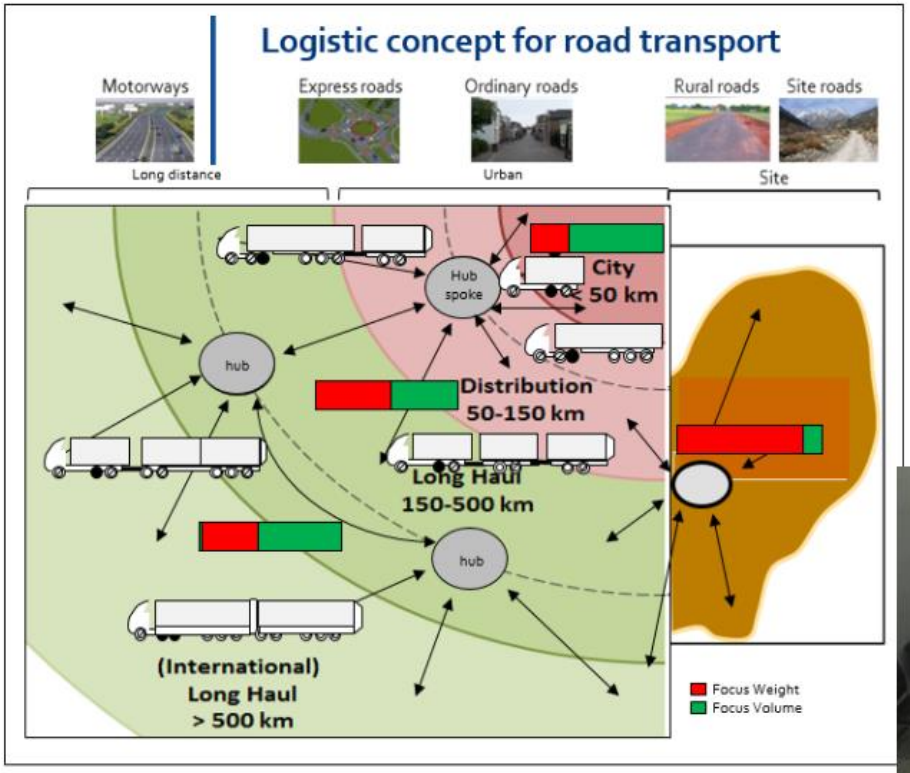
MAIN RESULTS OF HCV WORKSHOPS

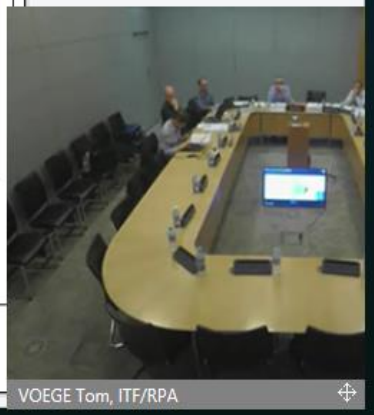
- **Overall approach:**
  - Common understanding of the definition of HCV.
  - Mutual agreement that HCV have high potential to reduce emissions, improve road transport efficiency and maintain road safety.
  - Contribution to the TML CO_2 report 2030, in which will be addressed the opportunities of using HCV concepts in Europe.
  - Together with other organisations like ITF/OECD: Definition of a roadmap with clear identified milestones how to have HCV in Europe.
  - Common understanding of Performance-Based Standards: PBS is a set of Performance Based Standards for the vehicle ensuring safe use and avoidance of road wear and tear and good manoeuvrability within the existing infrastructure.
  - PBS and increased efficiency in logistics including the CO_2 reduction from road freight are base for acceptance of HCV.

- **Strategy:**
  - Continue the activities (included working packages)
  - Exchange and cooperation with ITF/OECD
  - Reflection about H2020 call "GV-09-2017: Aerodynamic and flexible trucks".

CONCEPTUAL APPROACH

- **Cross boarder transport along the main European corridors:**
  - Transport of **mode compatible loading units** in line with a legal PBS framework
  - Complementary to urban freight, node/spoke for consolidated transport
- **Regional and industrial specific transport along defined routes:**
  - Transport of specific freight in line with the legal PBS framework.





RESULTING NEXT STEPS (1/2)

6 work packages to be further investigated

1) Developing a set of uniform Performance-Based Standards

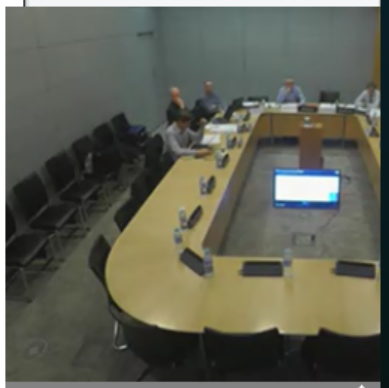
2) Define positive mapping and corridors where HCV will drive

3) Effects on fuel efficiency, CO_2 reduction and safety of different penetration rates of different HCV combinations in the EU member states

4) Guidelines where and when to use HCV along the supply chain

5) Drivetrain technology (related to the 25% rule)

6) Aerodynamic improvements in addition to the front and the end of vehicle combinations



VOEGE Tom, ITF/RPA

Smart Trucks: Potential Gains

- Reduced vehicle trips i.e.
  - Reduced congestion
  - Reduced safety exposure risk
- Improved safety performance
- Improved transport productivity
- Reduced road wear (per ton.km)
- Reduced emissions (per ton.km)
- Improved performance of the SA heavy vehicle fleet


Thank you