Southern African Transport Conference 2025

International Workshop on Weigh-In-Motion
for Direct Weight Enforcement

# Challenges for Direct WIM Enforcement (WIMe) in South Africa

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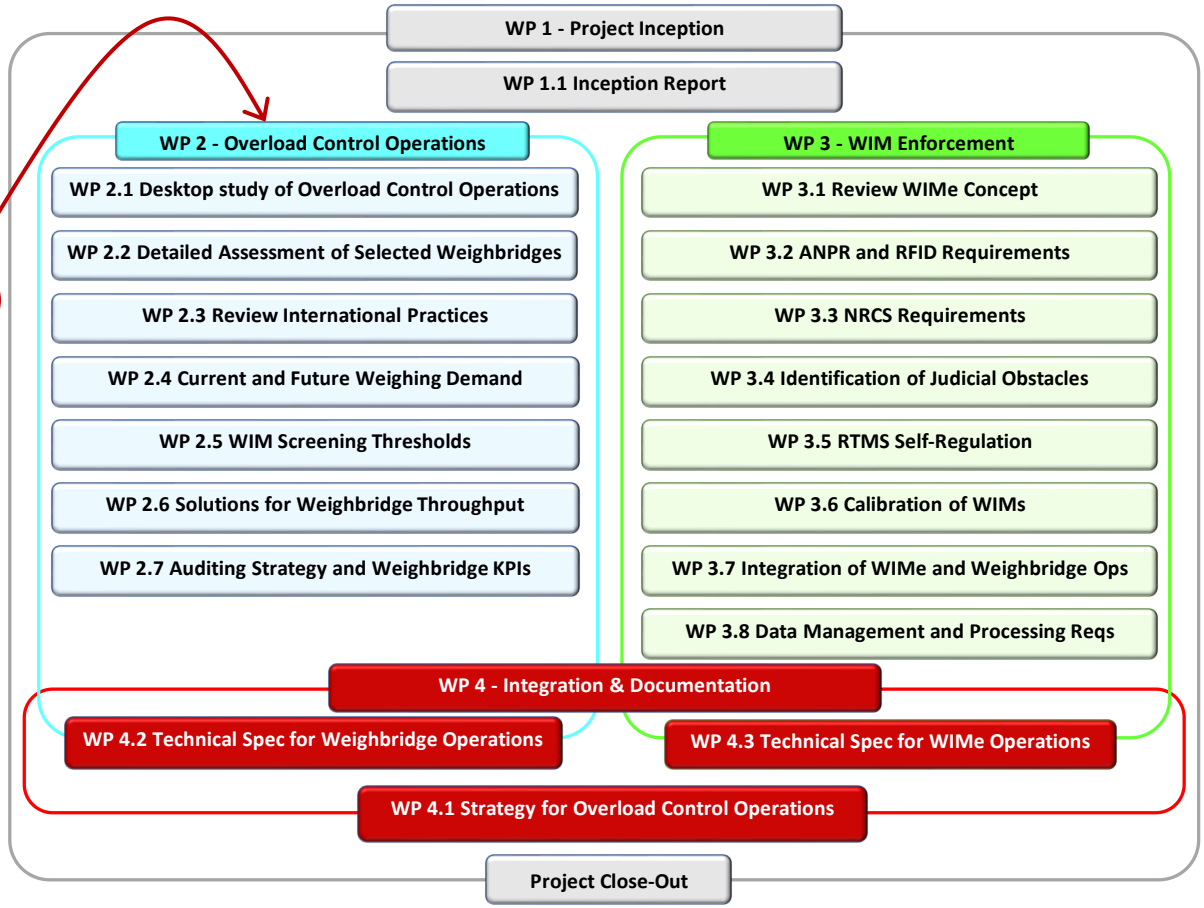
# Introduction - Background

- Current Overload Control in South Africa
  - Static Weighbridges at Traffic Control Centres (TCCs)
  - Several Weighbridges have already or will soon reach capacity, contributing to delays and traffic safety concerns.
  - Law Enforcement using Static Scales impedes Freight Mobility
  - “Tug of war” between freight mobility and asset preservation

# Introduction - Research

- SANRAL Research Project (2021-2023)
  - WIM Enforcement
  - Weighbridge Optimisation
  - Holistic Integration
- Testing and Implementation **2025**



# Introduction – ~~Challenges~~ Opportunities

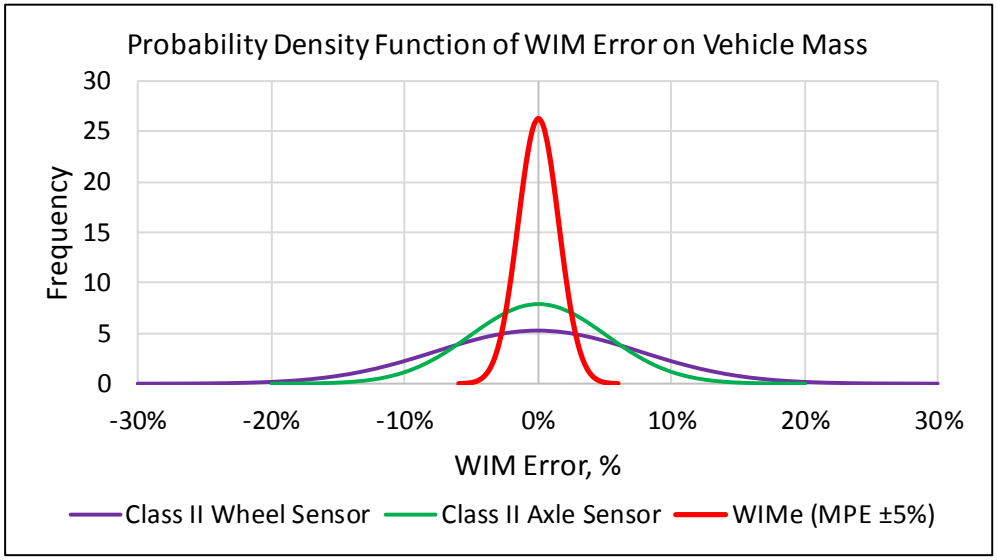
"In the middle of every difficulty lies opportunity”

– *Albert Einstein*

**Challenge = Opportunity**

# WIM Accuracy

- Most common International reference: OIML R134 – Automatic instruments for weighing road vehicles in motion and measuring axle loads.
- South African Standard produced by National Regulator for Compulsory Specifications (NRCS), based on OIML 134.
- WIMe will have to be about 3 times more accurate than current screening WIMs used in South Africa – **MPE of ±5% for Total Vehicle Mass**




**Already Available!**
**(but not yet in South Africa)**

| WIM Type | 95th Percentile WIM Error | Max Permissible Error (MPE) |
|---|---|---|
| Class II Wheel Sensor | **±15%** | |
| Class II Axle Sensor | **±10%** | |
| WIMe | *±3.0%* | **±5%** |

Note: MPE interpreted here as the 99.9% confidence interval

# Accuracy Verification using Test Trucks

- Typical Metrological Requirement: Test Vehicles for Accuracy Verification (Full Traceability to reference mass)
- Challenges:
  - Finding suitable test vehicles
  - Representativeness of test vehicles
  - Re-loading and redetermining reference loads
  - Making U-turns for repeated passes
  - Time and Cost
  - Achieving minimum sample sizes is hard work!

# Accuracy Verification using Test Trucks

- …but maybe the sample sizes are still too small…?
- Maximum Permissible Error (MPE) = Most Challenging Statistical Test
- Practical Limitation on sample size and representativeness of test trucks
  - Example:
    - WIM commits 1/1000 excessive errors (i.e. exceeds MPE)
    - The WIM fails the MPE criterion, BUT
    - Using a sample of 100 measurements, it would on average pass the Verification 9/10 times

# Vehicle Identification

- Vehicle identification is paramount.
- Automated Number Plate Recognition (ANPR) success rate at Screening WIMs is below 65%.
- ANPR success rate on Gauteng eToll system was about 80% for small trucks and approximately 60-70% for large trucks.
- Alternative/supplementary vehicle identification would be required for WIMe.

No Identification = No Prosecution

# Strike Rates

- Prosecution grace must be set such that the risk of unfair prosecution is negligible. For example, for GVM transgressions:

$$Grace_{WIME} = Grace_{standard} + Buffer_{scat}$$
$$= 2\% + 5\%$$
$$= 7\%$$

- Because of the high grace percentage, simulations showed that only about 5% of transgressors are expected to be prosecuted by WIMe (low “Strike Rate”).

# Payment of Fines

*"It is not the Severity of Punishment, but the Certainty of Punishment that changes behaviour"*

| Weighbridge | Percentage of Fines Paid | |
|---|---|---|
| | 2021 | 2022 |
| N4 East | 10,04% | 10,27% |
| Heidelberg | 22,30% | 14,78% |
| Bapong | 17,03% | 11,68% |
| Mantsole | 32,14% | 22,08% |
| Zebedela | 20,78% | 20,15% |
| Polokwane | 24,33% | 8,77% |
| Beitbridge | 40,16% | 11,96% |
| **Average** | **23,83%** | **14,24%** |

| Description | 2006 | 2023 |
|---|---|---|
| Class 4 Toll Fee, Johannesburg-Durban | R 440 | R 1130 |
| Average Fine for Overloading at Heidelberg TCC | R 1100 | **R 1050** |
| Ratio | 2.5 | 0.93 |

In terms of Fines, both the Certainty and Severity of Punishment are Low

# Payment of Fines

- Load Correction considered to be a more successful deterrent than issuing of fines to combat overloading.
  - ✓ On-site – difficult to escape from holding yard
  - ✓ The “Hassle Factor”
  - ✓ Costs money (often more than the fine)
  - ✓ Wastes TIME → TIME = MONEY
- What happens if we replace static weighbridges with WIMe?

  No load correction, no time penalty, compromised vehicle safety!

# Way Forward

| Challenges | Opportunities |
|---|---|
| ❖ WIM Accuracy | ➢ Draw from International Experience<br>➢ Technology Trials on Home Soil |
| ❖ Accuracy Verification using Test Trucks | ➢ Respect and enhance metrological processes<br>➢ Supplement with statistical Quality Management processes |
| ❖ Vehicle Identification | ➢ Combine ANPR with Tags<br>➢ Incentivise participation in Self-Regulation |
| ❖ Strike Rates | ➢ Prosecute excessive overloads<br>➢ Monitor self-regulation |
| ❖ Payment of Fines | ➢ More Carrot, less Stick |

# Questions

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