



AI-TIRE: Intelligent Transformation in Tire Testing

AI-based early anomaly detection for tire endurance testing



 **smart**
advanced manufacturing

ORGANISATION PROFILE

Name: Prometeon Tyre Group – Türkiye (R&D and Manufacturing, Kocaeli, Türkiye)



Organisation: Prometeon Tyre Group is a global tyre manufacturer fully focused on the industrial segments (truck, bus, agricultural and OTR tyres), with headquarters in Milan and production plants in Türkiye, Egypt and Brazil. The Türkiye site combines a large-scale truck/bus tyre plant with an in-house R&D and indoor testing centre.

Products / Services / Technical areas: Truck and bus radial tyres; tyre structure development; indoor testing (high-speed, endurance, rolling resistance – ISO 28580, ECE R54 / R117 homologation); quality systems (FMEA, APQP, PPAP, SAP QM); process auditing and benchmark analysis.

PROPOSAL INTRODUCTION (I)

Vision: Transform destructive run-to-failure tyre endurance testing into an intelligent, AI-supervised process that detects hidden micro-failures early, halts the test before catastrophic disintegration, preserves intact root-cause evidence and standardises stop / continue decisions across operators.

Motivation: the paradox of destructive testing.

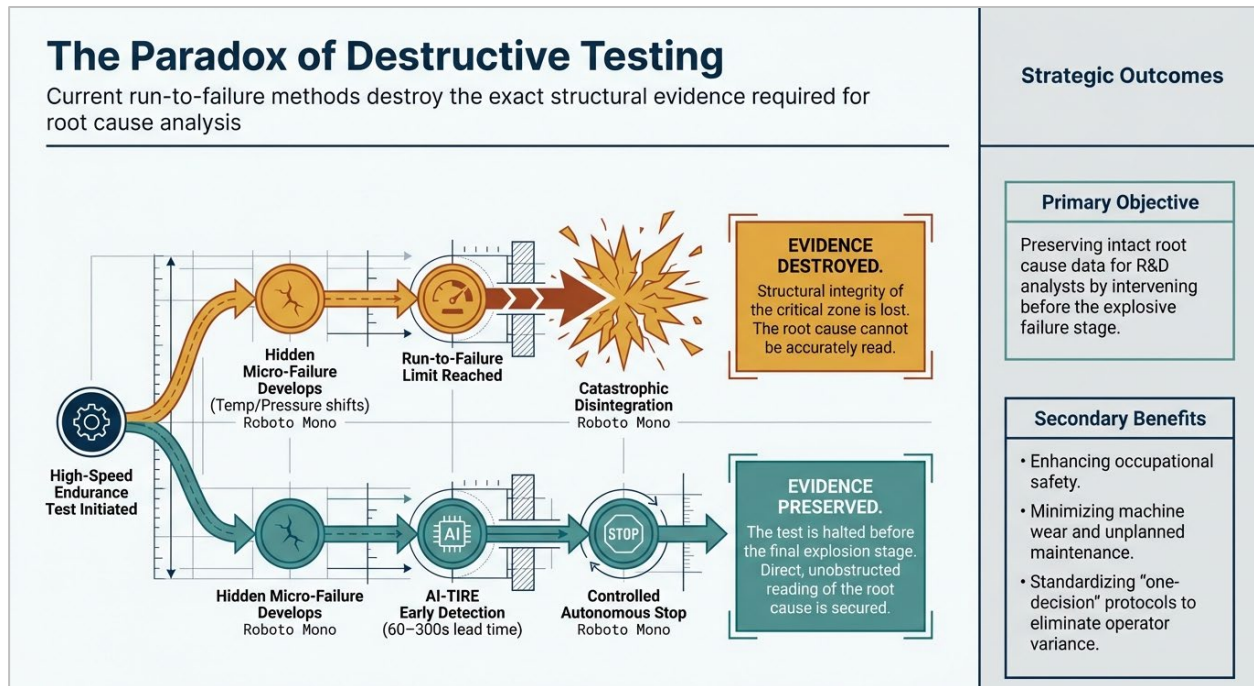
- Current run-to-failure methods destroy the exact structural evidence required for root-cause analysis: once the tyre disintegrates, the critical zone is lost and the failure origin cannot be read accurately.
- Hidden micro-failures (temperature / pressure shifts, acoustic and vibration signatures) develop long before the visible failure, but today no system detects and acts on them.
- Stop decisions depend on individual operator judgement, creating variance between technicians, shifts and plants.
- Catastrophic disintegration is an occupational-safety risk and causes drum wear and unplanned machine maintenance.

Content: developments to be made in the project.

- Multi-sensor fusion on the endurance test rig: image processing, thermal imaging, acoustic / noise, vibration, internal temperature / pressure and load / speed channels (1-minute sampling).
- Central analysis engine combining generative AI with deep-learning time-series models (LSTM, autoencoder) for anomaly detection.
- Explainable AI (XAI) output layer visualising exactly why an alert is triggered (thermal maps, noise spikes, anomaly score and confidence).
- Graduated system authority: 1. Shadow → 2. Advisory → 3. Decision Support → 4. Autonomous Stop, integrated with test-machine control.

PROBLEM STATEMENT

The paradox of destructive testing: AI-TIRE early detection halts the test before the explosion stage, so the root cause can be read directly instead of being destroyed.



PROPOSAL INTRODUCTION (II)

Expected outcome: results to be obtained in the project.

- A validated AI-TIRE early-detection system running on high-speed / endurance drum test rigs, with a 60–300 s lead time before failure.
- A reference dataset of normal test behaviour (target ≥ 400 h) and labelled anomaly cases for model training and benchmarking.
- An XAI dashboard for technicians, and a controlled autonomous-stop function triggered only at high-risk safety thresholds.
- A standardised “one-decision” stop / continue protocol applicable across operators and test sites.

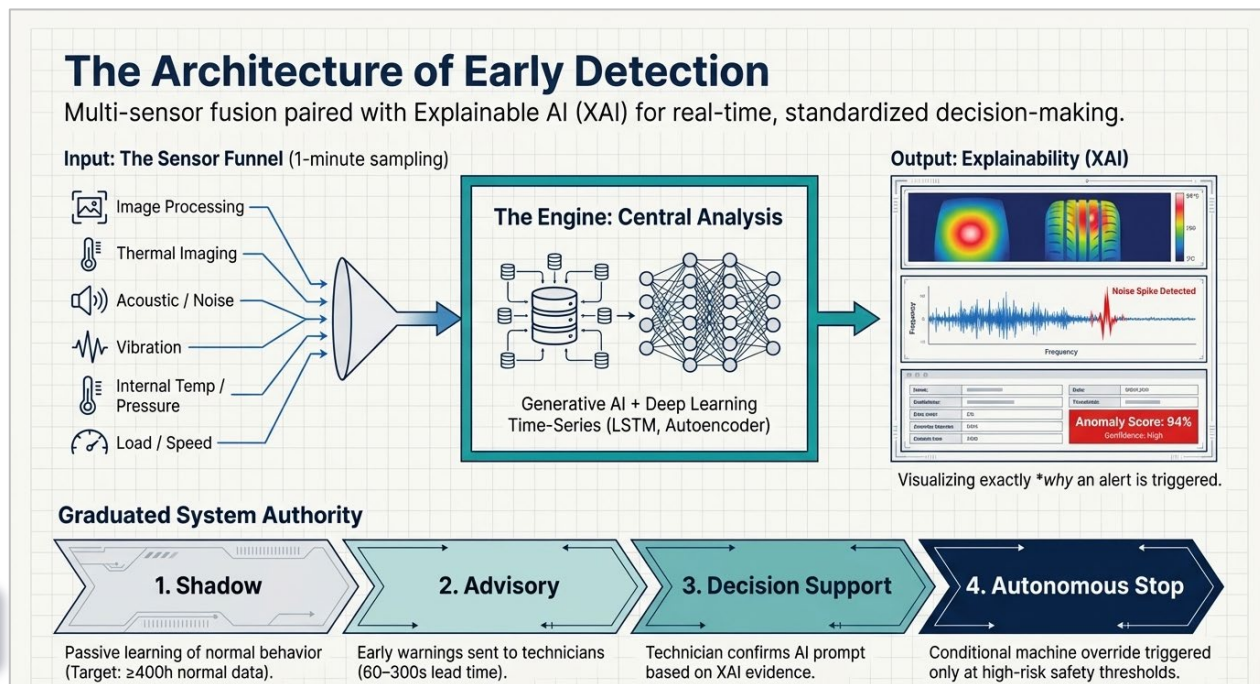
Impacts: expected market and operational impact.

- Intact root-cause evidence for R&D analysts → faster and more reliable design iterations and shorter development cycles.
- Enhanced occupational safety; minimised machine wear and unplanned maintenance on test equipment.
- Elimination of operator variance in test decisions; transferable methodology for other destructive test domains in the automotive sector.

Schedule: indicative duration 24–36 months. Phase 1 Shadow (data collection & passive learning) → Phase 2 Advisory (early warnings to technicians) → Phase 3 Decision Support (technician confirms AI prompt on XAI evidence) → Phase 4 Autonomous Stop (conditional machine override).

TECHNICAL CONCEPT

Architecture of early detection: multi-sensor fusion paired with Explainable AI (XAI) for real-time, standardised decision-making.



PARTNERS

Current Consortium:

- Prometeon Tyre Group – Türkiye (Kocaeli): partner and industrial end-user; provides endurance test facilities, tyre samples, domain expertise and test data.

Partner search: type of partner searched and countries of origin.

- AI / machine-learning software company with experience in industrial time-series anomaly detection and Explainable AI.
- Sensor and data-acquisition integrator (acoustic arrays, infrared thermal cameras, accelerometers, in-tyre temperature / pressure sensing).
- Test-machine manufacturer or industrial automation company for controlled-stop integration with drum test rigs.
- Research institute or university for model validation and tyre failure-mechanism analysis.
- Countries: any SMART / Eureka member country; [insert preferred countries if any].

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