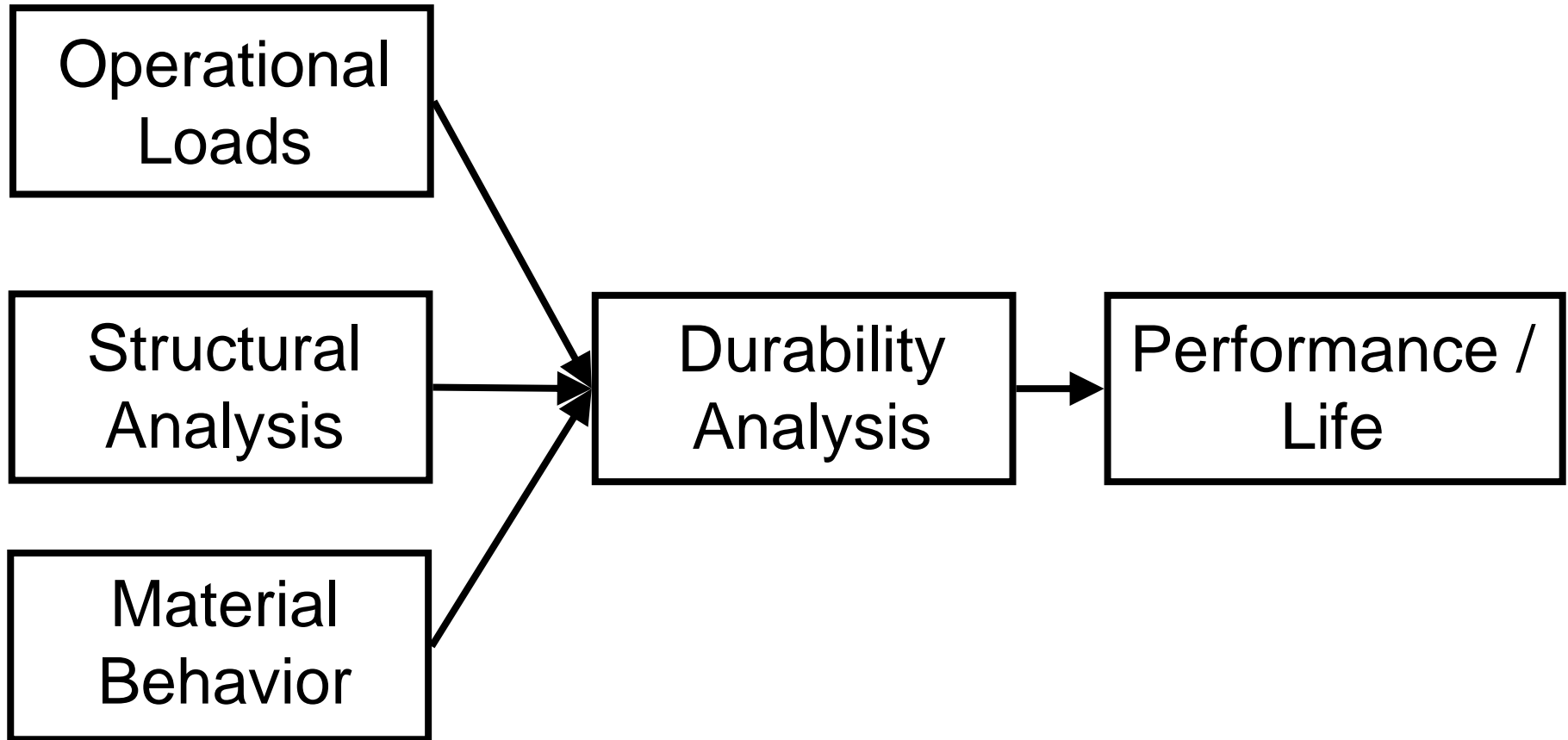
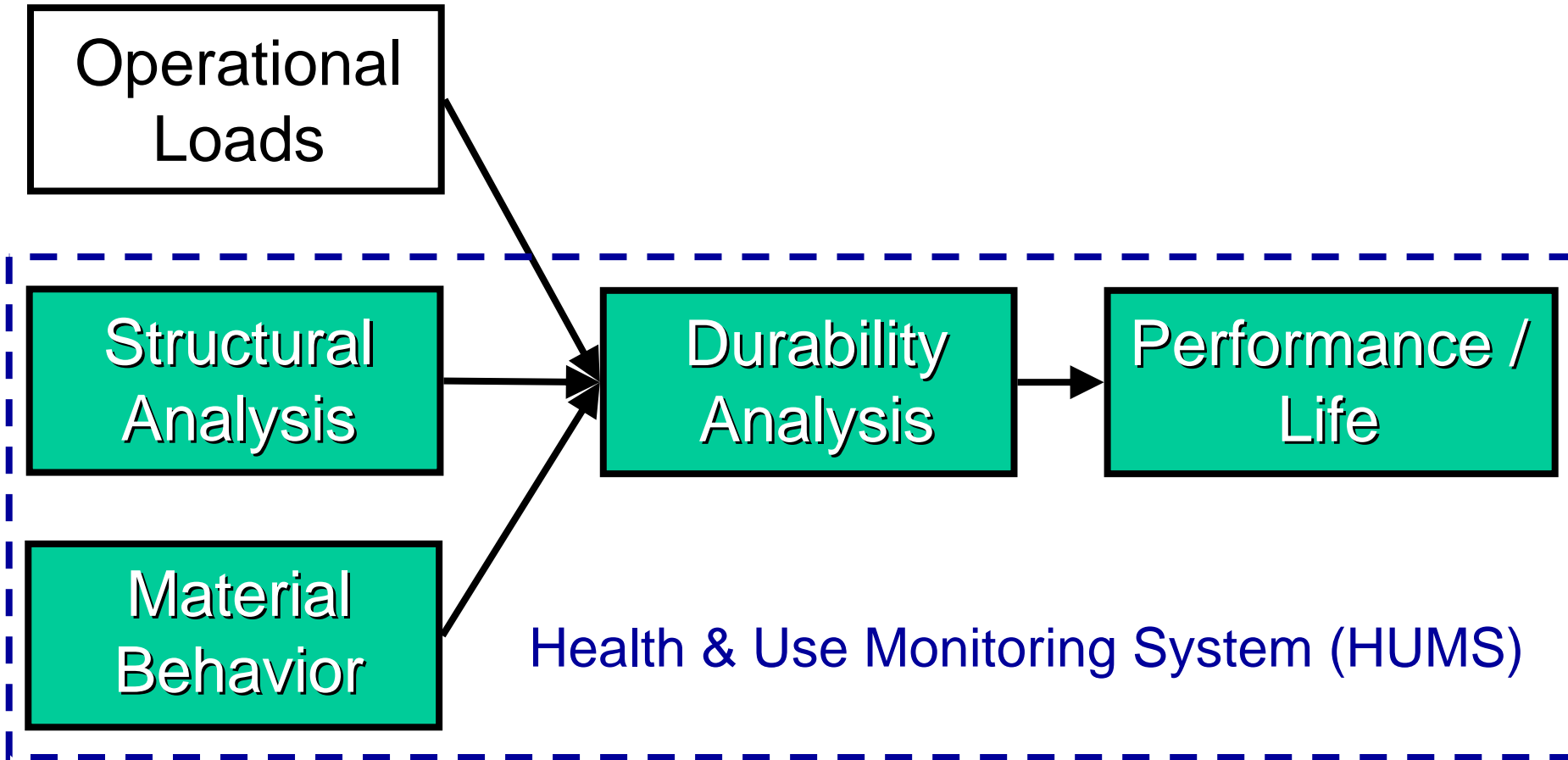


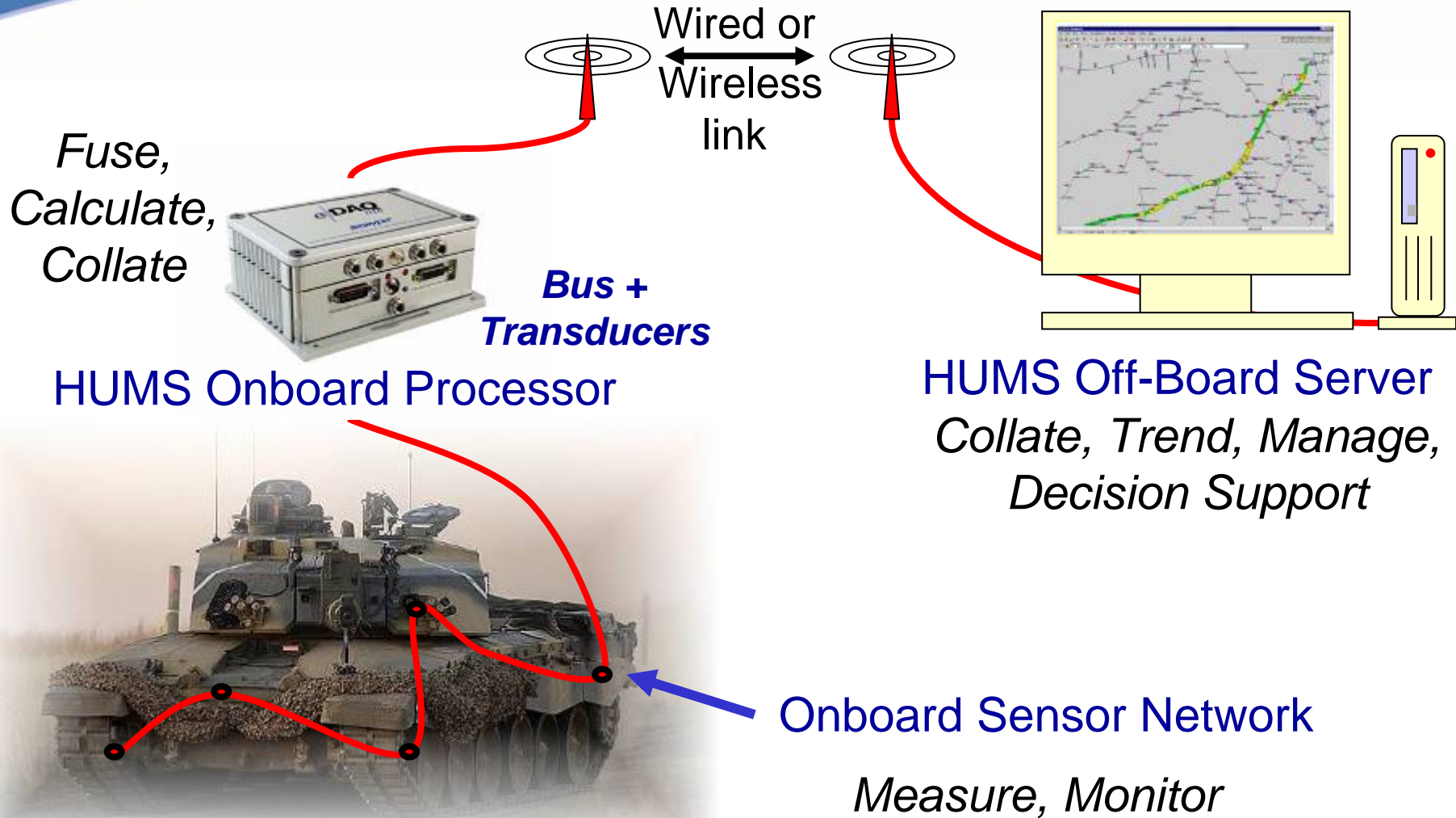
Durability Performance Process



Durability in Operation - HUMS



Health & Use Monitoring Systems (HUMS)



HUMS – What to Measure

Bottom-up Approach

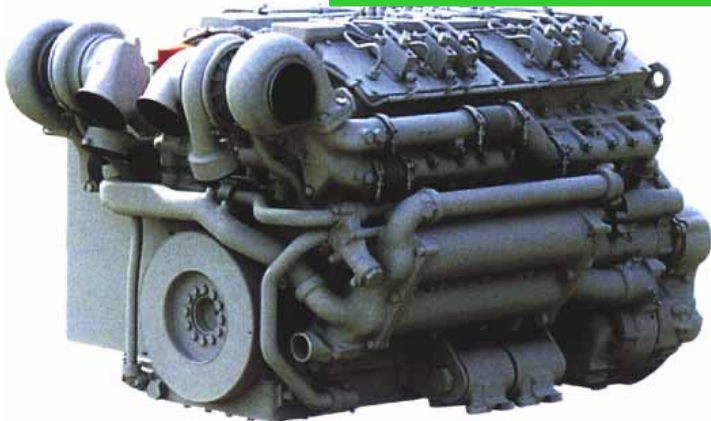
- Look at what can be measured and log everything that looks relevant

- Crankshaft speed / position sensor
- Camshaft position
- Acceleration
- Turbocharger speed
- Air temperature
- Air mass
- Coolant temperature

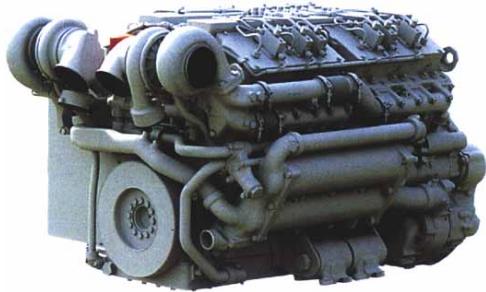
• Present the right information to the right person at the right time!

• Improved Operational Effectiveness (Use Cases)

- Identify stakeholders (field commander, O&S, driver, etc.)
- What information is needed and how urgent is it?
- Measure / transmit only information needed at that time

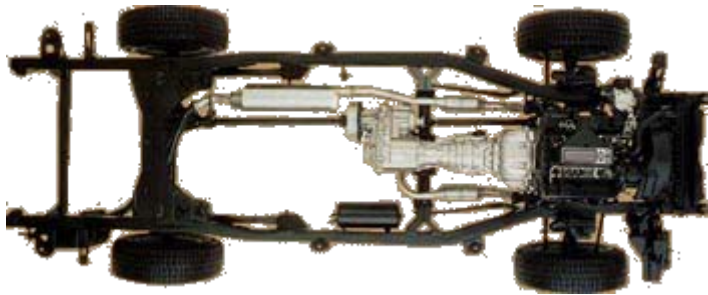


HUMS – Component Analysis



- Powertrain
 - Engine
 - Transmission

Diagnostics based on CAN data



- Structural
 - Chassis
 - Steering
 - Suspension

Prognostics based on measured / calculated strains



- Body Mounted
 - Weapons
 - ECUs
 - Radios
 - Brackets
 - Etc.

Prognostics based on measured acceleration
(Shock Dosage and Damage Dosage)

Operational Usage

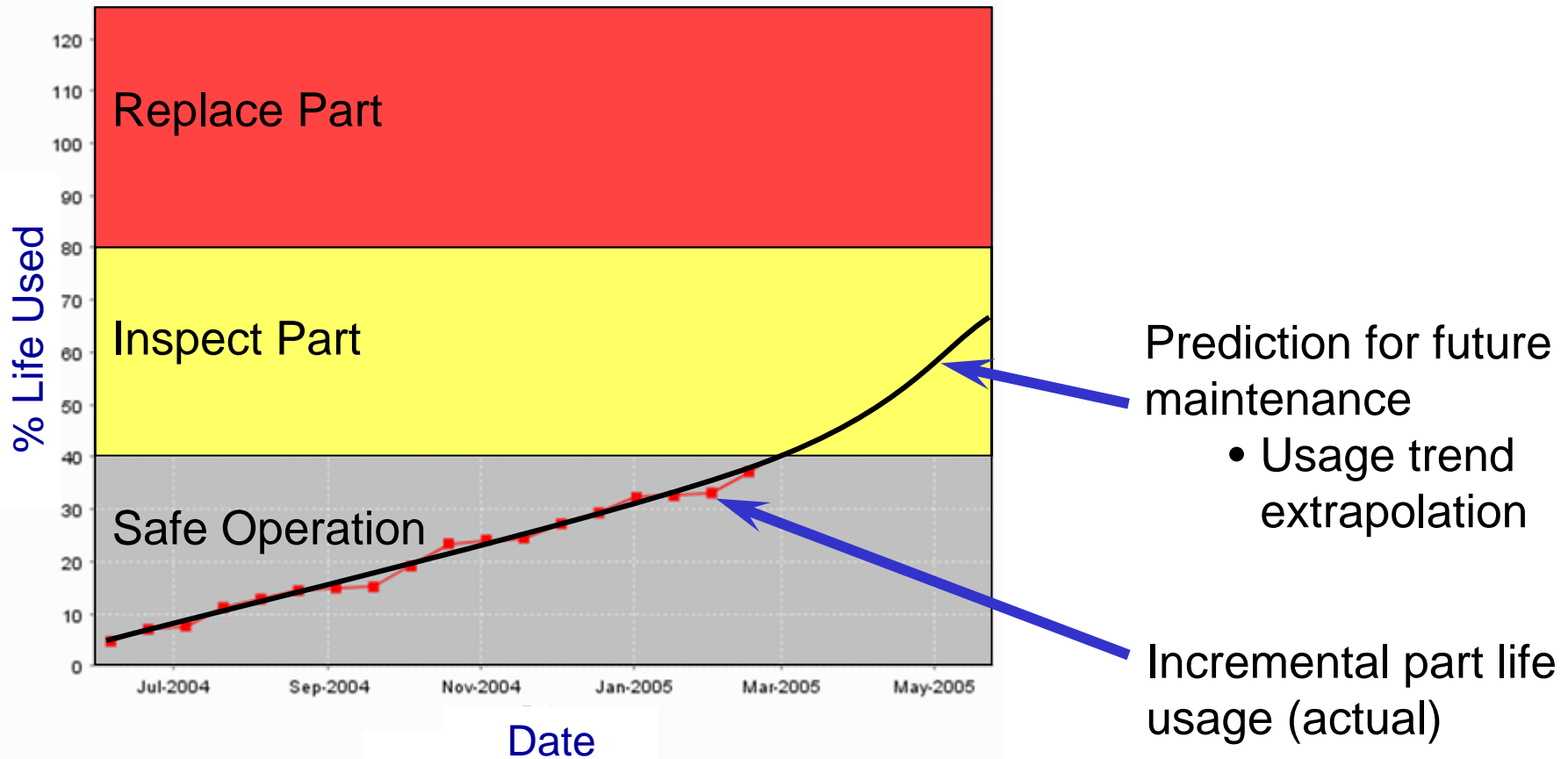
Example engine usage analysis

Actual usage 23% beyond design limits

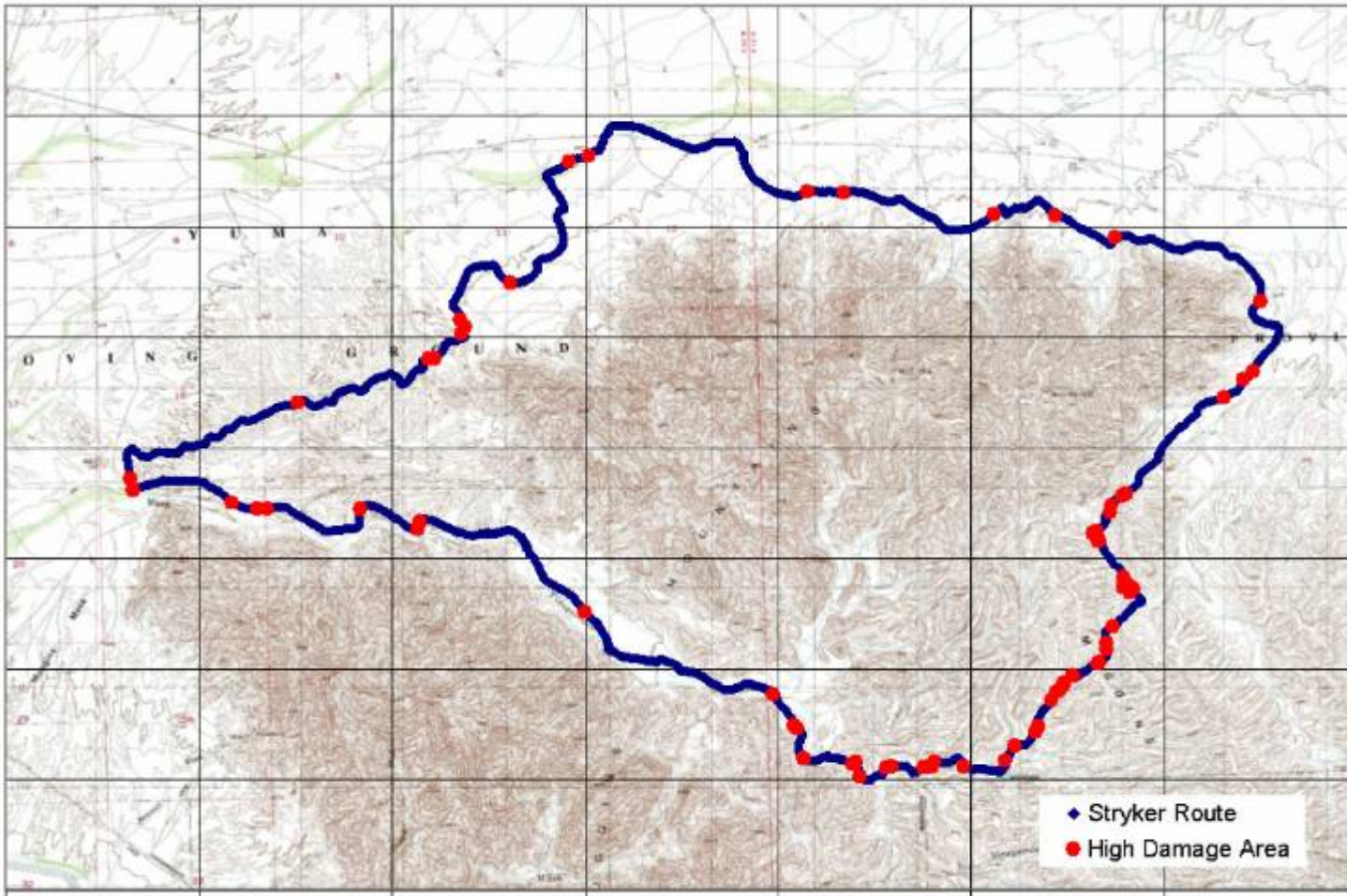


Maintenance Prediction

Age as Percentage of Transmission Life



Damage Mapping



HUMS - Benefits

Base

- Prioritise Deployment Based on Condition / Usage
- Condition Based Maintenance
- Balanced Fleet Life Consumption



Reduced Life
Cycle Costs

Operations

- Avoid Front-line Failures
- Improve Availability and Confidence
- Reduced Logistics Footprint
- Reduced Down-time



Enhanced Operational
Effectiveness



9'9"

CLEANAWAY
Waste Services

Thank You

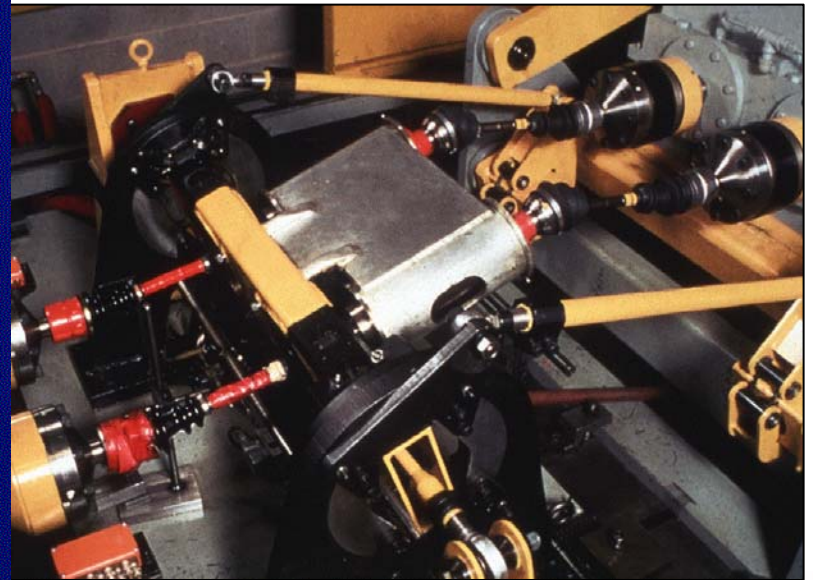
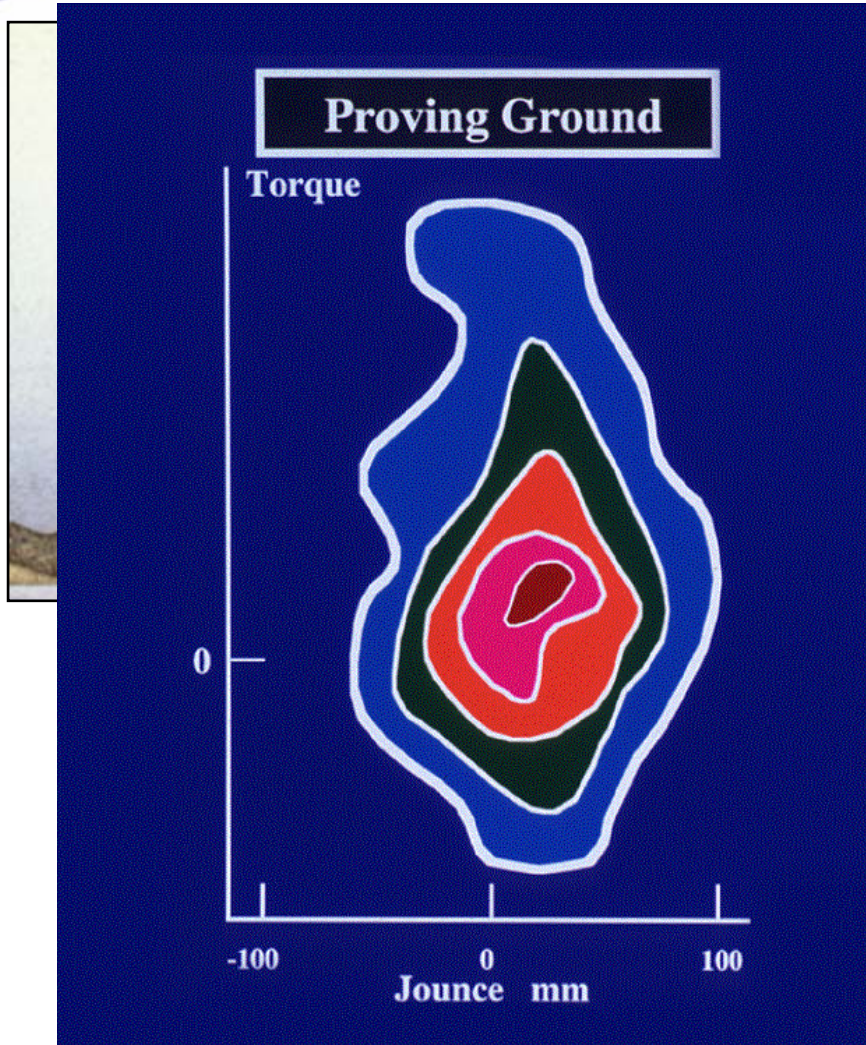


Durability Process – Add Product Value



- Propeller shaft yokes failed
 - No time to re-test – durability prediction used
 - Most critical load occurred during assembly
 - 5,000 vehicles re-called
 - Improved next 20,000 units

CV Joint – Test Process



CV Joint – Test Process

