



eltic-Plus⁺

Smart Connected World

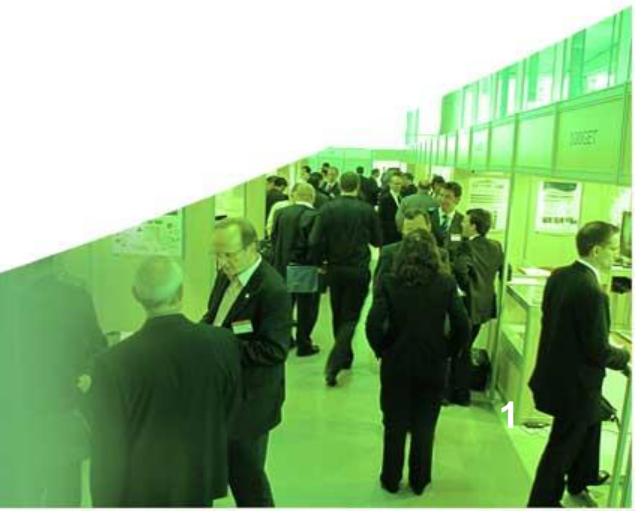


Celtic-Plus Proposers Day
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Preventive Maintenance in Automotive Powertrain (PRE-EMPT)

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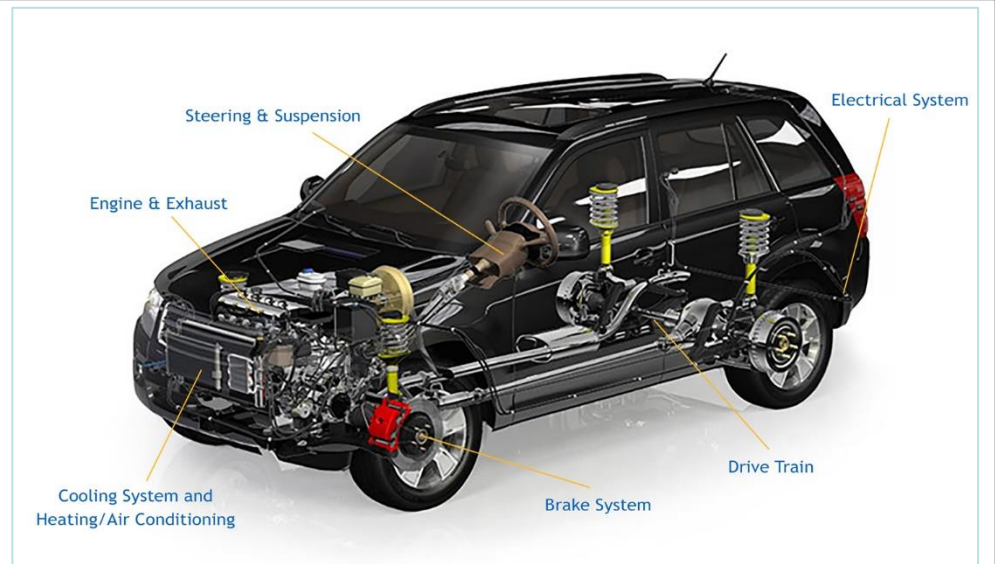
ENFORMA



Internet integration changing the car ownership model, bringing in connectedness more and more:

- ✓ creating a new platform for consumers to access content,
- ✓ leading to fully autonomous vehicles,
- ✓ reducing carbon emissions via innovative methods that rely on analysing data, and hence;
- ✓ revolutionising the auto industry.

Part of 'connectedness' inherently relates to the use of data processing techniques in maintenance.



Given data streamed from a vehicle—such as diagnostic trouble codes (DTCs) and other vehicle parameters at the time of occurrence of the trouble codes (e.g., odometer reading, vehicle speed, engine temperature, torque, etc.), can we predict an ensuing repair or a maintenance job on the vehicle?

VIN	Timestamp	DTC Code	Odometer	Speed	Engine temperature	Engine torque	Acceleration
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Celtic-Plus

Around 3400 DTCs...



Related to: Fuel and Air Metering P0309 Cylinder 9 Misfire Detected Circuit Low Input "B" Malfunction
 P0001 Fuel Volume Regulator Control Circuit/Open P0310 Cylinder 10 Misfire Detected P0503 Vehicle Speed Sensor Intermittent/Erratic/High P0620 Generator Control Circuit Malfunction
 ...57 more... P0505 Idle Control System ...6 more...

P0002 Fuel Volume Regulator Control Circuit Range/Performance
 P0003 Fuel Volume Regulator Control Circuit Low
 P0004 Fuel Volume Regulator Control Circuit High
Related to: Auxilliary Emission Controls. EGR, EVAP etc.
 P0506 Idle Control System RPM Lower Than Expected
Other:

Top 10 trouble codes from one empirical test

- P0420 - Catalyst System Low Efficiency - 13.2%
- P0171 - Fuel Trim System Lean Bank 1 - 10.4%
- P0401 - Exhaust Gas Recirculation (EGR) Flow Insufficient - 8.4%
- P0174 - Fuel Trim System Lean Bank 2 - 6.8%
- P0442 - Evaporative Emission (EVAP) System Small Leak Detected - 6.7%
- P0300 - Engine Misfire Detected (random misfire) - 6.4%
- P0455 - Evaporative Emission (EVAP) System Leak Detected (large) - 6.2%
- P0440 - Evaporative Emission (EVAP) System Leak Detected (small) - 5.5%
- P0141 - Oxygen Sensor Heater (H02S) Performance Bank 1 Sensor 2 - 5.1%
- P0430 - Catalyst System Low Efficiency Bank 2 - 3.2%

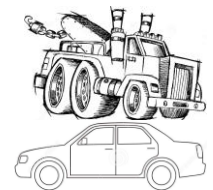
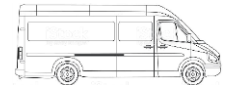
Related to: Ignition System and Detonation
 P0302 Cylinder 2 Misfire Detected
 P0303 Cylinder 3 Misfire Detected
 P0304 Cylinder 4 Misfire Detected
 P0305 Cylinder 5 Misfire Detected
 P0306 Cylinder 6 Misfire Detected
 P0307 Cylinder 7 Misfire Detected
 P0308 Cylinder 8 Misfire Detected
Related to: Vehicle Speed, Idle Control, and Auxiliary Inputs
 P0500 Vehicle Speed Sensor Malfunction
 P0501 Vehicle Speed Sensor Range/Performance
 P0502 Vehicle Speed Sensor
 P0600 Serial Communication Link
 P0601 Internal Control Module Check Sum Error
 P0602 Control Module Internal Control Module
 P0603 Internal Control Module Memory (KAM) Error
 P0604 Internal Control Module RAM Error
 P0605 Internal Control Module ROM Error (Module Identification Defined by SAE J1979)
 P0606 PCM Processor Fault
 P0608 Control Module VSS Output "A" Malfunction
 P0609 Control Module VSS Output
 P0701 Transmission Control System Range/Performance
 P0702 Transmission Control System Electrical
 P0703 Torque Converter Switch B Circuit Malfunction
 P0704 Clutch Switch Circuit Malfunction
 P0706 Transmission Control System Circuit Range/Performance
 P0708 Transmission Control System Circuit High Input
 P0710 Transmission Fluid Temperature Sensor Circuit Malfunction
 ...2904 more...

Key Selling Points

Methods to be applied for when the car is out in the field. Benefits:

- ✓ **Increase customer satisfaction:** Fewer defects, better scheduled maintenance (not just due to odometer reading), less time in the shop.
- ✓ **Avoid a recall or initiate it sooner:** Data from connected vehicles, service records, test data on parts that have been replaced, and even social media fed into predictive maintenance model. Problems identified and solved faster.
- ✓ **Optimise service delivery:** Service appointments more predictable. Volume of planned and scheduled work increased. Technician provided with a “guided repair” approach. More even workforce scheduling, reduced idle time, and more cost-effective usage of service facilities.
- ✓ **Optimise the supply chain:** Predicting required maintenance parts → better supply chain management. No longer keeping cars overnight waiting for parts; better scheduling; space freed-up; increasing satisfaction.
- ✓ **Reduce fleet downtime:** A fleet of hundreds or thousands of vehicles experiences real productivity gains, increasing OEM’s value.

- **Partners already involved**
 - ENFORMA
 - AVL Turkey
 - OKAN Univ – Automotive Engineering Dept
 - A light commercial vehicle manufacturer
- **Missing partners / expertise**
 - To complement data set, improve analysis and models, and increase overall impact;
 - EU heavy-duty truck manufacturer
 - EU passenger car manufacturer
 - Company specialising on CAN-BUS data capture
 - University or research institute with specialisation in optimisation in automotive applications



Contact Info

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