Living the **dream**

Predictive maintenance is something of a dream for fleet engineers – knowing exactly when a vehicle might need servicing. But is it practical, or even possible? And if not, what can be done using today's telematics? By Toby Clark

As Scott Hutchins, VP of sales at telematics firm Teletrac Navman, puts it: "In our sector people talk about mileage or operating hours, and we can very accurately measure those. Mileage is a given, and feeds directly into maintenance schedules. If a vehicle is doing 600 miles a week, then obviously you can very easily predict when it needs a service.

"We have plant and machinery firms that use operating hours as a trigger," he adds, because "you can invalidate the warranty if you don't have pretty good visibility of operating hours". This sort of scheme might be better called proactive servicing – it doesn't actually predict any sort of failure or problem.

"I think the terminology is a little ambiguous," says Hutchins. "Predictive maintenance in industry – as opposed to telematics – is much more developed." In plant maintenance, particularly in production line or process manufacturing, it is possible to have an element of predictive maintenance. Industries such as food manufacturing employ a combination of preventive maintenance, ongoing inspection and continuous reporting sometimes known as reliability-centred maintenance (RCM).

In computing, too, the life of critical and vulnerable items such as hard drives can be estimated; the usual term is mean time to failure (MTTF) or, for repairable items, mean time between failures (MTBF). But calculating and using these numbers relies on a relatively predictable environment – stable temperatures and consistent operating speeds, for instance – and on statistical information from a large sample of items.

Also, these processes rarely depend on operator skill or experience, whereas in reality a truck driver is potentially the biggest factor in vehicle wear. Even with advanced driver assistance systems, driving is the very opposite of a steady-state industrial process. And it affects every component, not just the engine.

Says Hutchins: "The utopia would be to have a particular type of van or truck analysing the driving style, taking everything into consideration, and to use some kind of algorithm and AI [artificial intelligence] to predict when it next needs servicing. But we don't really go that far at the moment."

FIRST STEPS

So, how can a fleet engineer add at least an element of predictive maintenance? A full-blown telematics or fleet management solution can give a lot of CAN-Bus-derived data, so exception reporting is key, he states. "We can look at oil and water temperature and the like, and raise alerts if it goes out of specification. The FMS gateway presents that kind of data," says Hutchins (see also box).

Telematics also gives information

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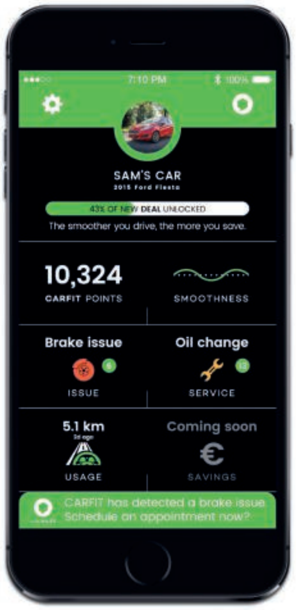

on driving style, of course, but Hutchins reckons that it is not consistently able to help with predicting component life: "We can output the data of how each vehicle is being driven, but we can't compare with a baseline."

Driving data can be extracted from the CAN-Bus easily using a device which plugs into the vehicle's diagnostic port. One of the neatest examples, though not yet for sale in the UK, is Cummins' Inline Mini device, compatible with most Cummins engines built since 2007. This plugs directly into the 9-pin (SAE J1939-13) diagnostic socket, and communicates with a phone, tablet or laptop via Bluetooth. The Inline Mini ($390 in the US, price to be decided here) links to a smartphone app called Guidanz; this is part of the firm's 'Connected Solutions portfolio', which offers additional services for a monthly fee. Cummins describes Guidanz as having "algorithm-driven automation and data analytics" and offering "quicker, more accurate service".

One of the few products that does claim to offer true predictive maintenance is Stratio. This Portuguese firm is marketing itself at both vehicle manufacturers and operators; for them, it says it "collects and extracts insights from your vehicle's data in real time, communicating failures before they happen". It describes its system in three stages: acquire, analyse and alert.

Data is acquired and streamed to Stratio using the firm's Databox, a typical wireless-equipped CAN-Bus interface.

This data is "continuously analysed by Stratio's proprietary machine-learning algorithms, and according to fault detection rules created by automotive engineers". The algorithms "continuously learn from new incoming data and extracted insights", identifying faults in real time. Finally, the operator is alerted via the web, email or SMS.

Similarly, California- and Paris-based start-up Carfit (pictured, inset) aims to use machine learning and aggregated data to derive predictive maintenance instructions from the noise, vibration and harshness (NVH) signature of components; this data comes from vibration sensors installed in components or retrofitted to the vehicle. Carfit is also targeting end-users, with a €50 device called Carfit PULS; this is simply attached (with adhesive) to the steering wheel. The firm says its approach complements CAN-Bus-based systems, and "can be used to gain concrete insights into the parts of the vehicle that aren't currently monitored by an on-board computer – the tyres, wheels, shocks and brakes". The intention is to give the user suggestions about component replacement and driving behaviour.

Stratio and Carfit are evidently at an early stage, but Stratio alone claims to have recorded almost 2 trillion data points from vehicles; at some point this sort of 'big data' could become very useful for operators and OEMs. TE

CAN-BUS DATA COMPATIBILITY AND THE FMS STANDARD

There is a worldwide standard for communication in cars and trucks, known as SAE J1939 (named for the US-based Society of Automotive Engineers) or, more usually in Europe, ISO 11898. This covers cabling and network standards (SAE J1939/21) as well as messages and protocol handling (SAE J1939/71), dealing with external communication with the CAN-Bus control system.

Some manufacturers issue dire warnings to customers regarding connections to the CAN-Bus; for instance, DAF says: "Direct connection to CAN-Bus system for the purpose of retrieving operating data or with other purposes is not allowed... In case of a direct connection, DAF reserves the right to withdraw any warranty on the product or to consider it null and void".

However, OEMs' rules for themselves are different. In 2001 the European truck and bus manufacturers announced a development known as FMS (Fleet Management System) standard, by which they would use a common data protocol. In fact, it took a while for this to be integrated with digital tachograph data. Truck and bus standards, initially different, became harmonised with the adoption of FMS Standard 3.0 in 2012.

FMS Standard 3.0 includes items such as:

- **Engine – percent torque**
- **Engine speed**
- **Engine total hours of operation**
- **High resolution total vehicle distance**
- **Vehicle motion**
- **Vehicle overspeed**
- **Engine coolant temperature**
- **Ambient air temperature**
- **Service brake air pressure (circuit 1 and 2)**
- **Aftertreatment diesel exhaust fluid tank level**
- **Cruise control active**
- **PTO state**
- **Accelerator pedal position**
- **Axle location**
- **Axle weight**
- **Gross combination vehicle weight**
- **Retarder - percent torque**