IoT and Predictive Maintenance

I've often wondered why I need to change my automobile's motor oil every 3,500 miles or 3 months, whichever comes first. Maybe I'm one of the few people left in the world who still enjoys changing his own oil. But it's often concerned me that maybe a mileage- or time-based maintenance schedule wastes lots of valuable resources like oil; aluminium and metals for fabricating the new oil filter; plastic for making the new jug of oil; and energy for the recycling facility that takes my dirty motor oil, strips all the impurities from it and recycles it.

Maybe I don't really need to change the oil that often. Maybe the metrics which determine when I should change the oil – in this case either vehicle mileage or time – aren't the best predictors of my car's optimal maintenance schedule. What if there were sensors on my red 1966 Ford Mustang convertible (V8, 289 cubic inch engine, 2-barrel carburettor, for those curious) that would tell me when I need to change the oil. And what if those sensors were collecting data from the oil filter, the valves, the pistons and the exhaust to find anomalies that are better predictors of when I should change my oil to prevent deterioration of my car.

Predictive maintenance is one such IoT/M2M solution that helps lower operating and capital costs by facilitating proactive servicing and repair of assets, while allowing the more efficient use of repair resources – both human labor and replacement products. See Fig. 1.
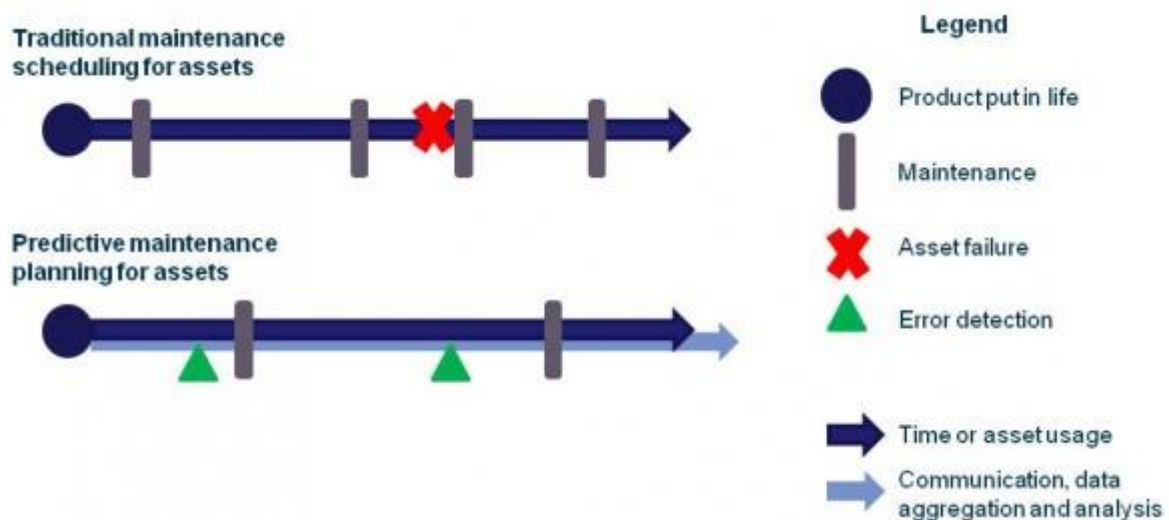

Figure 1: Traditional maintenance scheduling versus predictive maintenance for assets
[Source: Analysys Mason, 2013]

Predictive maintenance is enabled by a **three major solution enhancement** over a traditional maintenance schedule.

1. **Capturing Sensor Data** – There are sensors on the asset being monitored. These assets provide a constant flow of data – most of which are all within standard ranges of tolerance and trigger no alert or error. However, a very small percentage of those data falls outside standard ranges and trigger alerts that might indicate a reason to undertake maintenance.
2. **Facilitating data communications –** The data flowing off these sensors are connected to a central processing facility using some WAN- or LAN-based connectivity platform. The choice of connectivity technology is dependent on several factors including security requirements, level of asset mobility and expected integrations with other assets.
3. **Making predictions –** The captured data is continuously evaluated – for example, in a business intelligence system – based on expert knowledge or data from past events. The application relies on a series of rules that are based on expected and observed data associated with the

assets being monitored. If the application can make better predictions, it can suggest a maintenance schedule which better matches the progressive deterioration of the asset. An enterprise need not over-invest in maintenance labor and parts. Predictive maintenance allows an enterprise to match its cash outlay with actual prevention of asset wear-and-tear.

Data aggregation and analysis is a key piece of a predictive maintenance solution. We wrote about data aggregation and analysis in "M2M management software: supplier and product review" and my previous blog posting on Systems management for the IoT and M2M world. Predictive maintenance requires the collecting and systematic analyzing of large quantities of data to help predict faults and errors outside the normal tolerance range. These anomalies could be symptoms of larger problems with the asset and might trigger a maintenance response.

As a result, predictive maintenance can:

- Lower maintenance costs by matching a maintenance activity with actual symptoms of future asset failures
- Save vital resources by reducing the need to purchase replacement parts for asset components before they fail
- Reduce out-of-service time for an asset by determining when maintenance must be completed in order to minimize asset failure

Predictive maintenance allows for more services
In addition, predictive maintenance allows enterprises to innovate through new revenue streams including enhanced warranty and maintenance services and also strengthen their competitive advantage through a differentiated offering. And last but not least, using predictive maintenance will help manufacturers to increase customer satisfaction from fewer warranty claims.

Share your thoughts about predictive maintenance for proactive servicing and repair. Is this a valuable solution? What other applicability can we find for predictive maintenance?