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TRUCK TECHNOLOGY

The Amazon Effect On Trucking

Using IoT To Make Better Engines & Trucks

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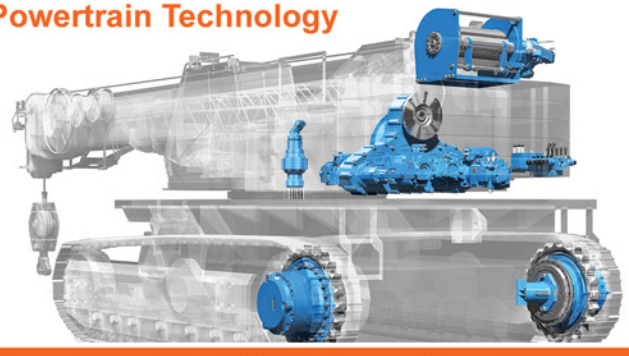

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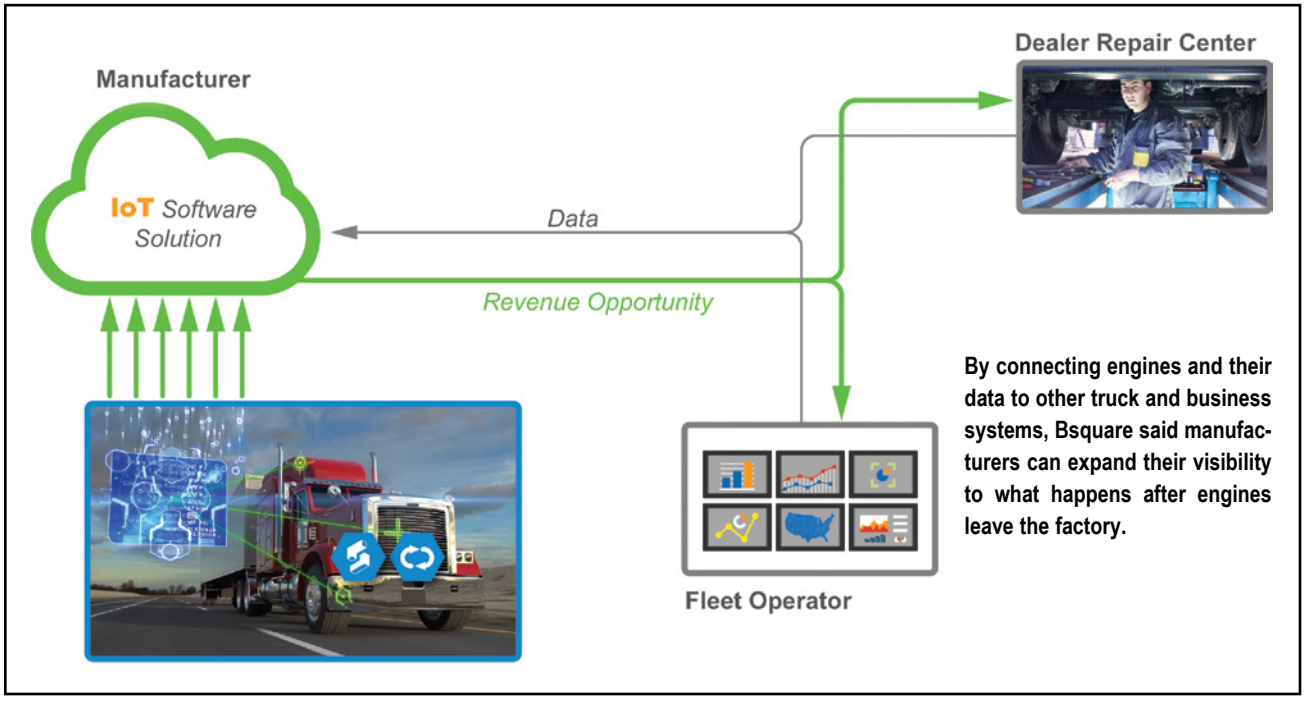

USING IOT TO IMPROVE ENGINE, TRUCK DESIGN

Collected data can provide valuable insight for diesel engine and vehicle designers as well as trucking fleets

Engineers who develop heavy-duty truck engines are faced with complex challenges. Designing the most efficient, most reliable product is a top priority, whether working on dynamic tuning for better fuel economy or understanding maintenance requirements to create engines with million-mile-plus life expectancies. Engine designers also develop electronic control module (ECM) firmware and updates that set thresholds for error conditions and other functions.

"Identifying these thresholds is an ongoing challenge to correctly signal error conditions to make sure trucks are brought in for service before a serious failure occurs," said Dave McCarthy, senior director of products, Bsquare Corp. Based in Bellevue, Wash., Bsquare is a provider of systems and software products designed to create Internet of Things (IoT) platforms that can effectively monitor device data, automate processes, predict events and improve business operations.

"All too often, when an error code is triggered and the truck brought in for service no problem is found," McCarthy said. "These false positives cost money for manufacturers, who have to pay warranty service claims, fleet operators, whose revenue hinges on truck uptime and drivers, whose income is often based on miles driven."

On the other hand, if thresholds are set too high and error conditions are not flagged, trucks may experience failures that result in expensive emergency repairs in addition to unplanned downtime. Issuing multiple running calibrations in an effort to more accurately establish error code thresholds is an expense for manufacturers and an inconvenience for owners and operators as they may need to take the truck into a service center to receive updates.

Once an engine leaves the factory, the engine manufacturer historically has had little idea how it is being used until it is brought in for service. The addition of telematics and onboard diagnostic systems has helped provide engineers with information that can help enhance products and design for manufacturing. However, there may still be times when an engineer may have an idea for an improvement but doesn't have the right data to determine whether the approach will work.

"For engineering, this where the Internet of Things can have value in equipment design," McCarthy said. "Imagine if engineers could look at a digital representation of the engine that combines telematics and diagnostic data with other sources of information that paint a more detailed picture of the engine's operating environment, historical failures and likelihood of future problems. They could use this digital twin to model design changes and

Kenworth has adopted IoT to help improve truck uptime and reliability, using it to bring together multiple data sources along with real-time engine data. By using predictive failure capabilities, the company has been able to more quickly and accurately identify the root cause of failures and predict future failures, meaning trucks can be serviced before serious damage occurs.

observe their impact on other systems, engine longevity and other scenarios."

In commercial trucks, connected technologies can deliver a wide range of benefits, including the ability to predict failures to reduce unplanned downtime.

According to McCarthy, manufacturers have adopted telematics and onboard diagnostics systems to help achieve these goals but are often disappointed that the expected benefits do not materialize. There are, he said, several reasons for this.

One, the vast amount of data generated by diesel engines can quickly overwhelm monitoring systems manned by humans and transmitting and storing the data can be expensive. As a result, a significant portion of data is not used which can lower the accuracy of an analysis.

Two, the information provided by these systems tend to provide a singular and rather simplistic view. They may accurately report on specific conditions such as the engine coolant temperature is high. But many faults are the result of cascading failures — what is causing the coolant temperature to rise?

A broken drive belt can be the culprit behind an elevated coolant temperature. Information from the HVAC system can help pinpoint the cause, said McCarthy. If the AC compressor for the HVAC system isn't turning, the drive belt is the likely point of failure.

"A well-planned IoT system can bring engine data together with disparate current and historical data sources such as other vehicle systems, environmental conditions, repair histories and others to create a much bigger, more accurate view of engine condition and health," McCarthy said. "By analyzing multiple data points, the IoT system can perform complex event processing that more accurately predicts potential failures.

"By connecting engines and their data to other truck and business systems like warranty and repair, manufacturers can greatly expand their visibility into what happens after engines leave the factory. Combining the resulting rich set of data with historical information provides even greater insight and allows the system to become more intelligent over time."

According to Bsquare, Kenworth has adopted IoT to help improve truck uptime and reliability. The manufacturer started with a telematics system but when that did not deliver the desired results it used IoT to bring together multiple data sources along with real-time engine data. By using predictive failure capabilities, Kenworth was able to more quickly and accurately identify the root cause of failures and predict future failures, meaning trucks can be serviced before serious damage occurs, the company said.

When failures do occur, adaptive diagnostics help get trucks back on the road by providing Kenworth service centers and technicians with detailed information about the failure before the truck arrives, along with repair instructions and parts lists. As repairs are made, the diagnostics can be updated with any improvements to repair processes, allowing for greater efficiency over time. The result is faster mean time to repair (MTTR), greater uptime, and improved reliability, McCarthy said.

"IoT can also help keep trucks on the road and extend engine life through condition-based maintenance, which establishes maintenance schedules that are based on actual operating conditions and their effects on the engine, rather than arbitrary time- or mileage-based schedules," he said. "By examining real-world operating environments, operators and manufacturers can manage maintenance schedules and understand performance degradation that may not be critical but needs attention soon."

Manufacturers and fleet operators can also use IoT capabilities to more effectively manage and understand fleets, from learning how they are being used on the road to optimizing the performance of underperforming trucks

based on information learned from the best performers in the population.

Bsquare said manufacturers would be happy to see the business outcomes that IoT can provide, but many do not know how or where to begin.

"Experience has shown that successful IoT projects occur in stages," McCarthy said. "Connecting engines and collecting data is the beginning, followed by monitoring and visualizing the data.

"By this point, however, companies often find themselves drowning in data. This is where data analytics and complex event processing can help parse the flood of noise without losing valuable information. Subject matter experts within the organization help create and evaluate rules and models that drive analytics capabilities — for example, to recognize the correlation between two data points moving in the same direction that may just be a coincidence versus two related data points that are causing a problem."

Once a system to effectively analyze the data is in place, automation can be applied to orchestrate complex actions across the organization, such as in the Kenworth example of diagnostic and repair processes. Updates can be managed and performed automatically without needing trucks to visit a service center. At this stage, the system becomes more intelligent as it learns from evolving analysis and becomes more effective at business goals such as condition-based maintenance and asset utilization.

The final stage of IoT, said McCarthy, is to make these capabilities available to trucks that are not actively connected to a network. "Most modern engines are already outfitted with onboard computing capabilities," he said. "By enhancing those systems, analysis and action can be taken immediately even if the truck is offline.

"This distributed intelligence — processing data at the edge of the network — allows all the data from the truck to be evaluated without worrying about network or storage overhead, for much greater accuracy. Actions can be taken such as automatically shutting down the engine when safety or catastrophic failures are threatened."

IoT can also give design engineers a greater understanding of how their products are being used and how they can be improved. Engineers can use digital twins of engines to simulate capabilities, features and changes to individual engines or across entire fleets.

"As more manufacturers realize the benefits of IoT, engineers can make significant progress towards designing even more reliable, efficient, and full-featured engines that will help them become the preferred choice for OEMs, fleet operators, and truck owners," McCarthy said." dp

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