Construction Equipment Telematics

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Abstract: Over the past 10–15 years, equipment manufacturers have addressed the issues related to the use of *telematics* for construction equipment, trying to provide both the customer and themselves with relevant data to improve the functionality, operation, maintenance, and management of this equipment. Each manufacturer approached this task independently with varying ideas on how to best accomplish this.
DOI: 10.1061/(ASCE)CO.1943-7862.0000281.

CE Database subject headings: Construction equipment; Construction industry.

Author keywords: Construction equipment; Telematics.

What Are Telematics?

Construction equipment telematics are divided into four components with the following principal functions:

- Collect and Buffer: to collect the outputs from the sensors (including the GPS antennae) and store and prepare them for later transmission;
- Transmit and Receive: to use the best available and most cost effective technology to transmit the data to a central location, either on demand or at preset intervals;
- Process and Archive: to collect the received sensor data, process them, produce the necessary reports, and manage the vast flow of data; and
- Disseminate and Use: to disseminate the reports, graphs, and graphics, and provide end users with information tailored to their needs.

Much has changed and manufacturers, software developers, and suppliers working in the area have achieved much. Spectacular progress in telematics has been achieved, and most of the questions relating to the first three components have been solved. Today, equipment can be instrumented, data collected, processed, transmitted, and archived. However the question remains, Can all this information be efficiently disseminated and a business case built on the basis of improved day-to-day fleet management?

As with most things, the answer is "yes and no." Craig Vorster, Equipment Manager for Hubbard Construction put this challenge into context when he said, "The manufacturers and their engineers try to know everything about one machine. That would be nice, but I am a fleet manager with several hundred machines of different makes and models in my fleet. I need to know one or two things about every machine, not everything about one machine."

That, briefly, is the challenge now being addressed by the Association of Equipment Maintenance Professionals (AEMP) and the like-minded, farsighted, collaborative group it has assembled.

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Note. This manuscript was submitted on July 15, 2010; approved on August 26, 2010; published online on August 1, 2010. Discussion period open until March 1, 2012; separate discussions must be submitted for individual papers. This paper is part of the ***Journal of Construction Engineering and Management***, Vol. 137, No. 10, October 1, 2011. ©ASCE, ISSN 0733-9364/2011/10-793–796/$25.00.

How Do Telematics Work?

The current state of play for telematics in construction is depicted in Fig. 1. Every company owns a mixed fleet, and every machine can be fitted with telematic instrumentation. Sensors, antennae, and other hardware installed by the original equipment manufacturer (OEM) or by third parties can collect data and measure a wide variety of parameters. It is possible to collect, buffer, transmit and receive data on position, temperature, pressure, fuel consumption, speed, movement, and almost anything else imaginable. That part of the system is in place and working. Price points are coming down. Reliability is going up. In exchange for this, fleet managers must accept that every OEM and every third-party supplier will develop, implement, and market their own technology. It is simply neither possible nor cost effective to standardize the first two components of the system.

The same can be said for the process and archive component. Every OEM and every third-party supplier will develop and market their own unique way, use the data to improve their products, and see it as a brand-specific competitive advantage. The end-user benefits from the improvements, creativity, and competition this generates but must again accept that standardization across a mixed fleet of makes, models, and sizes is neither possible nor, in most cases, desirable.

Standardization becomes a very real issue when considering dissemination and use of the information, and this is where a balance must be struck between knowing everything about one machine and knowing something about all machines. Once again, consider the three "disseminate and use" components defined in the diagram.

Specific Health Reports

The OEM and machine-specific machine health and performance reports are now available from most systems. These reports tell the fleet manager everything about one machine and make high-bandwidth use of all the archived data. They are valuable for specific forensic studies of machine health, performance, utilization, and production but are a source of massive information overload when it comes to managing a large mixed fleet. The volume of information is overwhelming, the format of the information is different for each hardware supplier, and accessing the information requires switching from website to website. These reports are solely for individuals who monitor machine health. It will and should continue to be developed by OEMs and third-party suppliers as part of their competitive product development process. It will continue to

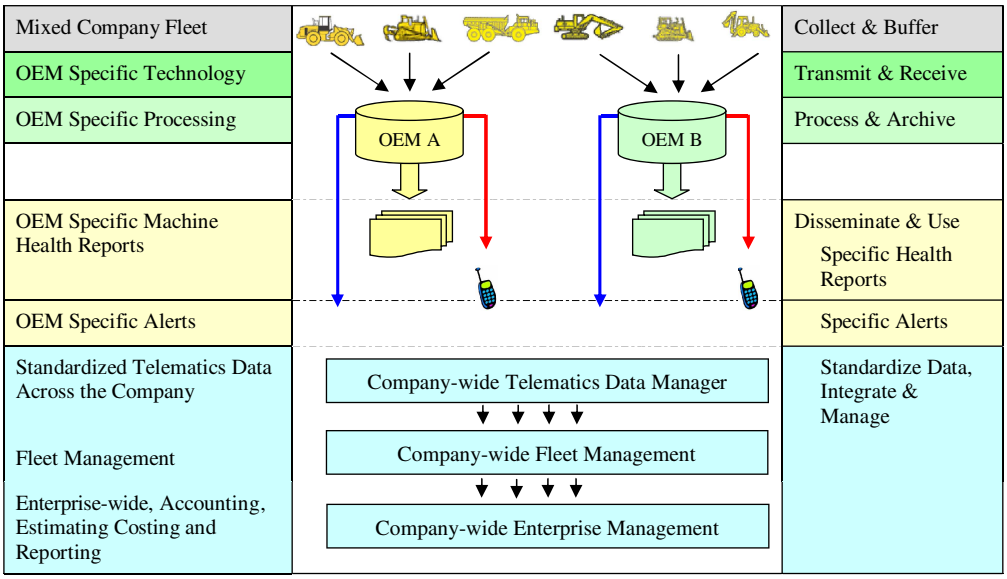

Fig. 1. How telematics work (from Vorster 2009, with permission)

be of value to fleet managers on an as-needed basis, but these reports, and this part of the "disseminate and use" process, will never find use on a day-to-day basis across the breadth of a large mixed fleet.

Specific Alerts

OEM and machine-specific alerts are currently in place. They are initiated at each OEM or third-party hardware supplier's site and follow the "red route" to an individual manager's phone or e-mail messaging systems. They provide minimum urgent information of value but have the potential to become overwhelming if not well managed. They are, in many instances, part of day-to-day fleet management but no comprehensive telematics system can build a solid business case based on this as the only company-wide information produced.

Standardize Data, Integrate, and Manage

This is the step that the AEMP initiative seeks to achieve. It requires the development of protocols in which a limited number of standardized and well-defined data fields are exported on a regular basis along the "blue route" from the OEM specific processing site to a company-wide telematics data manager, who receives and integrates it into the enterprise management systems. The challenge is not trivial, but it is doable. Three steps must be achieved.

First, the end-users must define the essential telematics data, and it must be available in a well-understood, standardized format. The one or two things necessary to know every day about every machine must be defined.

Second, OEMs and third-party suppliers must develop the routines needed to push the defined and standardized data to each of their customers at agreed intervals. The technology is not new. Millions of people download podcasts from news and entertainment sites every day. It should be possible to "podcast" essential equipment management data from OEM A to Company B every day.

Third, innovative and creative software developers need to develop telematics data managers that call for the defined, well-understood, and standardized data available at each OEM specific processing site; combine it into a single company database; and provide it to the enterprise accounting, estimating cost, and reporting systems.

This component of the system integrates telematics into the day-to-day corporate management system. Without it, the most promising fleet management technology of recent years has no real business case and is destined to remain out in the cold. The AEMP initiative must succeed—too much is at stake and too much money can be made.

What Data Should Be Captured and What Are the Benefits?

Ultimately, every end-user must decide on which data best enhances their company operational needs. However, four key indicators have shown from experience to be critical to any telematics program. These indicators have improved not only fleet management but also equipment design and operations.

Actual Machine Hours

This information provides the end-user with actual hours daily; this affects machine service scheduling and utilization, which are critical to equipment cost recovery. Typically, companies that do not collect this data electronically have to rely on reported hours, which are generally 10–15% inaccurate. This either causes the equipment to be overmaintained or undermaintained. In either case, this costs additional funds or reduces the mechanical condition of the equipment. Utilization improvements of up to 40% are not uncommon once the projects realize that the home office has the ability to monitor machine time accurately. If internal rental rates are charged for equipment, the equipment improves revenue recovery and reduces maintenance costs. Internal rental rates can be more accurately developed because of better utilization and maintenance data. Operations can also benefit from this data and better manage the equipment on each project to reduce costs. Some machine hours are over reported and therefore, cost the project excessively. Estimators can obtain better historical data with which they can become more competitive on the next bid. Fuel conservation can also be achieved by knowing when the machine is actually working versus idling.

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Machine Location

This information, when captured electronically, allows for improved billings by accurately detailing the exact location of any machine at any given point in time. This data also allow the end-user to set electronic geofences and curfews to deter unauthorized use of the equipment and act as a theft recovery tool. This information can also be used to dispatch maintenance staffs more accurately, which serves as a time management tool.

Machine Health

Every conceivable machine health issue can be custom set for values with alerts sent to multiple people. This serves as both a training aide for the operator and a maintenance tool when diagnosing equipment issues and managing warranty claims. This time and date stamped history allows the identification of operator trends and chronological events that may precipitate a failure.

Real Time Fuel Consumption

This information is one of the most valuable to every contractor. Fuel consumption is a more accurate measurement of how hard a piece of equipment is working than the use of hours alone. Having the ability to see real fuel consumption allows the contractor to be proactive and determine if there is a mechanical issue with the unit, an application issue, or an operator issue. Once these data are readily available, they will be used by every contractor to schedule maintenance and component overhaul or replacement.

Hours, location, machine health, and fuel consumption are the most important pieces of information regarding equipment maintenance that an equipment maintenance manager should monitor routinely. However, the ability to retrieve the vast array of stored data when something happens is also extremely valuable.

Additional Benefits

For the equipment owner/operator/maintenance manager, additional data captured and provided through telematics can be used to expedite machine diagnostics, manage warranties, and be used for predictive maintenance. The types of data that can be captured are limitless and can provide dramatic improvements in operating costs.

A perfect example is the use of chips in large mining truck tires, which can provide tire pressure and temperatures instantly. This technology alone can save natural resources, labor, and time while simultaneously increasing production—A real win-win for everyone. As part of the predictive maintenance process, most contractors take routine oil samples. Typically, 60% of all oil samples come back without issues, and this means that the contractor has spent time, money, and labor for naught although some trending data is gained. Today, OEMs are introducing sensors that can be placed in any oil compartment will send a signal to the equipment owner advising of either water or fuel contamination or a high particulate count, which then initiates taking an oil sample to identify the exact contaminates and the corrective action necessary. This again will reduce costs for the contractor making him more competitive.

Cranes

The use of telematics in cranes is an interesting issue and deserves individual attention. Although many of the same benefits can be realized with the use of telematics in cranes, the Specialized Carrier and Rigging Association (SC&RA) has shown reluctance to use telematics on cranes because of liability issues. Many construction industry associates oppose this and believe that cranes, more than every other type of construction, would benefit substantially from telematics use. Cranes are statistically the most dangerous type of equipment used in construction and having the ability to know how many times the crane had exceeded its capacity and proactively taking corrective actions could dramatically improve the safe operation of this equipment and reduce accidents. European crane manufacturers have used this technology for years, and it has proven to be effective. Unfortunately, the litigious construction climate in the United States has made crane manufacturers and users hesitant to embrace this technology.

Operations

Telematics data are useful to a number of industry players in addition to the fleet manager. Operations personnel now have the ability to increase machine performance, reduce costs, and instantly document data from the field. Technology, such as intelligent compaction, records the exact compaction achieved by the compactor without having to take compaction tests. These data can then be wirelessly transmitted directly to the client. Load out quantities for loaders and excavators can be instantly and accurately measured, recorded, and sent wirelessly. The efficiencies that can be gained from these technologies benefit the client, contractor, and ultimately, the OEM.

Dealerships

Dealerships now have the ability to be proactive. They can monitor equipment within their areas and advise equipment owners of pending equipment failures, thus reducing repair after failure costs. This also reduces maintenance costs because the diagnostic times are reduced, and often the required part is on hand when needed. When product improvements are issued from the OEM, the dealer can know instantly which machine within their area requires the improvements and can schedule these with the equipment owners. This type of proactive action provides benefit to the customer and enhances the customer/dealer relationship.

OEMs

OEMs can now monitor machine performance and health, can therefore immediately recognize areas where product improvements are required, and can make the essential changes rather than waiting for warranty claims to identify issues. The collection of this data allows the OEM to constantly improve product design, efficiency, productivity, and safety.

Future Benefits

As construction equipment migrates into an era of reduced emissions, it will become more dependant upon electronic controls to manage operational systems. Hybrid equipment will require substantially increased use of electronics, and telematics will play a significant role in the management of this equipment. Diesel engines will run at constant speeds driving electric generators, which in turn will power electric motors. All of these systems will rely on electronic management systems.

OEMs will design construction equipment with systems that provide alerts before system failures to minimize downtime and reduce costs. These systems will capture equipment health data and relay it to servers that will perform predictive calculations and then notify both owners and dealers.

Equipment productivity will be measured electronically and transmitted through telematics to owners, increasing accuracy in outside billings and measurement of fleet output. Equipment

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manufacturers currently are working on systems for trucks, loaders, and excavators, and tractors will follow thereafter.

Individual operator performance will be monitored, allowing equipment owners to identify performance trends and schedule the appropriate training for improvement.

Conclusion

Today, construction equipment is extremely advanced and equipped with technology to collect volumes of data regarding every aspect of the machine's operation. Many equipment fleet managers struggle with the available volume of data. However, focusing on the key indicators of machine hours, location, health, and fuel consumption would provide fleet manager most of the information necessary to monitor equipment use on a daily basis. Then, the additional information and reports generated by the OEM is a side benefit, available whenever required.

Going forward, this technology will undoubtedly continue to improve, become more reasonably priced, and provide more of the essential information necessary to make the contractor safer, more productive, and efficient. Until recently, the construction equipment manager had to use intellect, intuition, and experience to try to discern what was going on with the equipment for which the manager was responsible. This process can be compared with a veterinarian whose patient cannot communicate symptoms or past abuse. Despite this, a diagnosis had to be made and a treatment prescribed. Today, telematics provides equipment users, manufacturers, and maintenance staff with the information necessary to make educated decisions on the basis of actual real-time information. Because of this vast array of available data, the fleet manager has now become a valuable contributor to the company's profitability.

References

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