The future of Marine Engine Remote Monitoring in Marine Applications

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Global mariners are familiar with new industry trends. They've seen many new technologies come and go over the past centuries. The age of sail eventually grew into the age of steam powered paddle-wheelers with sails. These hybrid vessels quickly removed the sails and trusted in the paddles and boilers for propulsion. Shortly thereafter, propeller technology took over, providing safety from the dangers of the exposed side paddles. As seamen increasingly began to value safety at sea, improvements in control room technology became the standard. Eventually technology allowed unmanned engine rooms with a high degree of operational data logging. The next obvious step was to attempt to monitor the engine data from shore, thus the beginning of the remote monitoring industry trend we are seeing today. And why not? Isn't remote monitoring already a standard in land based power and even the offshore wind industry today? Unfortunately, the marine industry isn't so simple.

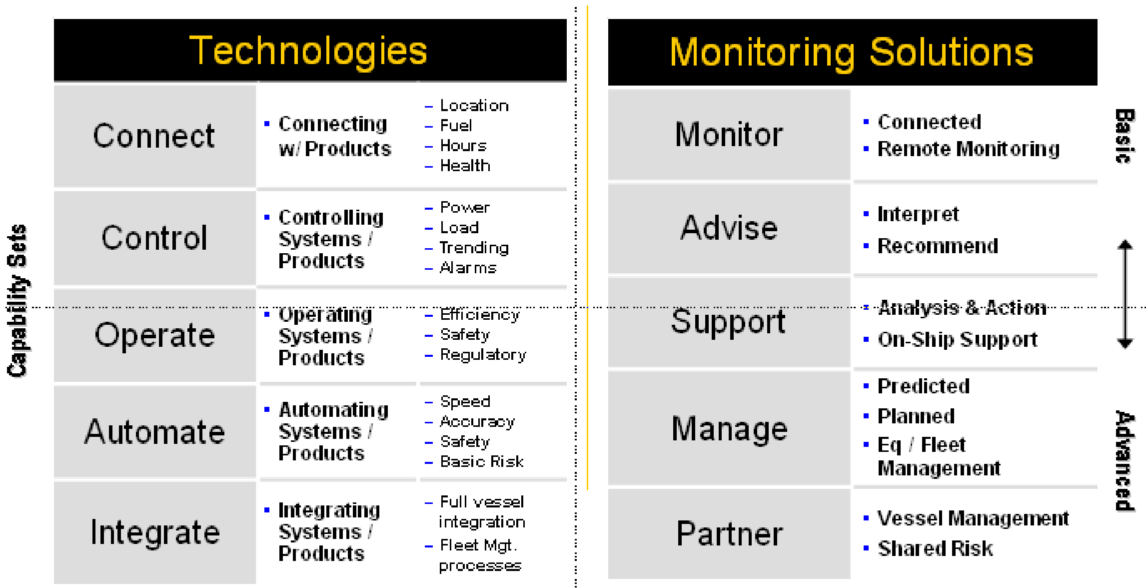
In the modern marine operating environment today, shipping companies still maintain traditional engine room theories on how to manage installed assets. Skilled on-board engineers who monitor vessel operating conditions from an engine control room or from the bridge are still the norm. However, remote monitoring technology is advancing at such a pace that asset suppliers have capabilities to advise the engine room staff on the condition, deterioration, and eventual failure of most types of equipment. Naval Architects will shortly need to understand how to design and install this technology during the new-build period to optimize the benefits to the owners. Owners need to begin to understand this new technology in order to build the advantages into their operating procedures and financial models. This paper explains the evolution of remote monitoring technology, some design requirements, and the advantages to the owners and shipping companies.

There are limitations in the amount of data that a human can process in a single second. For example, a human eye has the capability to process one frame per millisecond. While this enables us to understand vessel operational data live, when we combine multiple datasets, this limitation is significant. Have you noticed how it is near impossible to catch a fly? The primary reason is that a fly can process 20 frames per millisecond and our world appears to move in slow motion to a fly as compared to how we see it. Imagine if we could process 20 times the data from an operating vessel at a time. How would we use this data and what would we do with the information the data delivers?

Data is only one element of remote monitoring. Advancing the technology to the next paradigm requires the ability to convert the data into information, the information into recommendations, and the recommendations into action. This requires a subset of definitions that are critical to understanding the evolution of remote monitoring. We consider remote monitoring as the ability to monitor and read operational parameters from a remote location. Condition-based monitoring builds on remote monitoring by utilizing the operational parameters to define running conditions. A vast step forward is the ability to convert this conditional data being fed into a centralized location into useful advanced warnings, extended maintenance recommendations, and, ultimately, a lowered cost of operation.

Today we struggle in this area for a variety of reasons, many of which include the limitations of a single source provider to have the capabilities of monitoring vast amounts of data and making any level of useful recommendation. For this reason, we define Advanced Condition Monitoring as the ability to integrate algorithmic capabilities into the data-stream to identify critical parameters with high velocity. Considering the number of monitored assets aboard a merchant vessel today, numerous advancements will need to be made for such a solution to be offered to the marine industry by a single supplier.

To begin to understand the complexities of Advanced Condition Monitoring ("ACM"), it is important to understand the technology value chain involved with each monitoring solution.



As suppliers evolve in the ability to provide open architecture for asset monitoring, an element of the future challenges becomes more transparent: How can a single supplier monitor all this data and provide value, integrate solutions into the vessel management system, and ultimately partner with the operator in sharing risk? This is the ultimate value-add offering in remote monitoring and the future for operators who desire to partner with solution providers with the intent to lower operating costs. Arguably, ACM is the solution to this challenge. The first providers to combine a technology derived from algorithmic processes with a commercially viable solution using remote capabilities with localized support will represent the future.

The future of remote monitoring is not limited to the monitoring element alone. The value chain of solutions will evolve for the "do it myself (DIM)" customer to an operating environment of "do it for me (DIFM)" ship owners. The methodology to achieve this milestone is a combination of technical, commercial and legal solutions. Selling solutions moves the suppliers into a proactive mode, partnering with the operators and predictably anticipating operational challenges and preventing them. It includes extending maintenance intervals, optimizing vessel performance and fuel consumption, reducing manpower requirements, and eventually and possibly even changing the owner environment into remote and non-remote engaged operators. Don't misinterpret this prediction; there will always be the need for a living operator on the bridge of the ship to anticipate risks and make corrections. However, in the future remote monitoring world, the remote operators will have the advantage of significantly reduced costs and thus can be much more competitive eventually capturing a leading market share.

If we examine the technologies in place today, it becomes clear that the ability to combine the operational assets onboard a ship into a single remote monitored data-stream, and make actionable decisions from the data is very limited. The leading marine remote monitoring solution providers today focus on four key areas:

- viewing
- reporting
- trending
- data-logging

If we examine some parallel industries (for example: mining), we begin to see the usage of this data for value messaging, supply chain management and fuel consumption optimization. This capability is creeping into the marine industry, albeit very slowly, as marine vessels are significantly more complex than a mining machine. In addition to the inherent complexity associated with marine vessels, asset suppliers in the marine industry are not wholly comfortable opening up their operational architecture to third party monitoring solutions. The risk of safety, warranty validity, and eventually proprietary knowledge unknowingly entering the open market is unacceptable and represents a significant obstacle that will need to be addressed prior to industry acceptance. Despite the common usage of J1938 / 39 communication architecture, we are far from connecting all assets to a single data bus on board a vessel. It is critical that the vessels being designed today anticipate this challenge and strive to bring all operating assets onto a common bus for eventual communication capability. So are we limited in reaching this ACM goal? How do we enable the next evolution in remote monitoring to take place? As with all future predictions, we need to examine the progress one step at a time.

Step 1: Predictive Component Maintenance

This sounds much more rudimentary than it actually is today. There are numerous conflicting elements of this step that prevent it from becoming normalized including:

- The lack of willingness by asset suppliers to share the early indicators for failure. Most suppliers in the industry provide and promote their own operating and maintenance schedules. Few define a pre-failure predictive protocol for operating machinery.

- Most suppliers profit on the parts business and in theory, while outside warranty, a failure of a component is profitable revenue. This challenge must be overcome, and we must challenge asset suppliers to become more willing to share this data and to integrate this data into a series of remote monitored asset solutions. Many operating assets are not installed with an electronic monitoring capability, preventing the ability to link to a common communication bus. Architects have the ability to incorporate this expectation today for most equipment, providing options to the owner to allow them the ability to prepare for a vessel retrofit once the technology advances.

Step 2: Commercialization of the predictive component maintenance solution.

There must be a resounding business case for a single supplier to invest in the technology and knowledge from various suppliers to build a common remote monitoring platform that will meet all the needs of the vessel owner at an affordable price. Each operator balances on a fine line of risk and reward. No doubt, the reduction of a single off-charter day for a vessel generates significant savings, however, at what return on investment? Today we have solutions that are targeted to individual assets (example engines, load management systems, bridge equipment); however, no single supplier has effectively brought all these assets into a single data system. The naval architects today should anticipate the increasing need to build into the vessel design electronic solutions that will cost effectively allow third parties to access the data-bus and export data from multiple sources at rapid rates at near zero cost. No supplier will likely be able to afford to retrofit an entire vessel in the commercial proposal to a ship operator; therefore, the ships being designed today are an important link in enabling this technology solution for the future.

Step 3: The implementation of an Advanced Condition Monitoring technology

Advanced Condition Monitoring technology can interpret millions of data-points per second for all monitored assets, translate the data into useful information, and allow a limited number of Fleet Managers to immediately make a recommendation or take action. This milestone requires asset suppliers to be more open with their operating systems, and to allow third parties access to critical operational risk experience databases. This is likely only to be accomplished with pressure from the supplier of the leading cost assets on-board a vessel, either the power management supplier or the engine supplier. Architects need to partner with these suppliers to select sub-systems that only utilize electronic data communication solutions. The suppliers need to partner to provide the algorithmic solutions that will enable a rapid conversion of data into useful information for the Fleet Managers. This single issue is representative of a multi-faceted challenge that is yet to be overcome.

Step 4: The creation of a vessel health management system

This solution would combine the information output of the ACM system, with a series of remote personnel who can evaluate solutions both on and off site and make critical operational decisions. We can never fully remove the human value of diagnosing a product health situation. Additionally, we need to understand the operating profile of the vessel. For example, we should never be in a position to shut down a critical system to protect the asset at the risk of running aground or hitting a fixed bridge structure. A vessel health management system will likely be replicated from existing land-based solutions that are in place today, and is a realistic step once the ACM technology evolves.

Step 5: A continuous improvement process is needed to constantly evaluate lessons learned and remove risk from the client solution.

The marine industry will continue to evolve, as will the on-board technology. Each new technology presents new risks. Consider alone the challenges presented by IMO III, and the impacted emissions reduction equipment. How will a vessel health management system balance the need to move cargo with the environmental regulations and operational needs of the ship? Who is empowered to make those rules as related to remote monitoring and what is the impact of a wrong decision? We need a strong governing body to set limits on vessel health management and the tools utilized to provide value to the shipping company in the future.

The future of remote monitoring is full Vessel Health Management with Advanced Condition Monitoring. These potential solutions are constantly being challenged due to improved and evolving marine technology and operational regulations. We are only at the cusp of this journey in the technology evolution today, with various suppliers introducing new and improved solutions every year. Each has its own value, and each has its own limitations. When a single supplier is able to combine all managed assets into a single data-stream, evaluate the data from multiple vessels at once at very high speeds using ACM, combining a localized solution in a commercially viable vessel health management tool, we will have achieved the vision of this paper. That future of remote monitoring is not today, but it is realistically achievable by the year 2020.

About the Author:

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P. Jaime Tetrault has been with Caterpillar for 15 years holding various leadership positions. He is currently the Director for global after sales activities, including parts and service for Caterpillar Marine Power Systems, based in Hamburg, Germany. Jaime provides leadership to Caterpillar's main marine brands including MaK and the Caterpillar brand. He is responsible for developing the marine product support strategy for the corporation and deploying across the global regions thru the Caterpillar distribution network. His current focus is on improving the service capabilities of the distributors to globally consistent levels while exceeding customer expectations.

Jaime is a graduate of the United States Merchant Marine Academy in Marine Engineering, and holds a Master's Degree in Business from Indiana Wesleyan University. He is a USCG licensed engineer in Steam, Diesel and Turbines. He has worked for a competitive medium speed engine manufacturer in the field service department and has run marine service workshops in North America. Jaime joined Caterpillar in 1995 and has held previous positions with Caterpillar including Business Development Manager for Independent Power Projects (IPP's) with Caterpillar Power Ventures, Heavy Fuel Engineer for the 3600 platform, and Sales Manager for both the Americas and Europe, Africa and the Middle East (EAME). His prior position was the Regional Manager for the Americas for marine sales and product support. Jaime accepted his current position in April 2009 as the leader for the newly formed Marine Product Support division.