Ensuring VCM Succeeds

Vibration Condition Monitoring
Practical Considerations that
Make or Break Your Program

A Global Leader
Shipboard Condition Monitoring,
Vibration Analysis &
Thermographic Imaging
Managerial Decisions

Vibration Reports are addressed to the Chief Engineer and copied to senior management of the vessel operator.

Chief Engineers receive recommendations:
- to postpone maintenance because the monitoring indicators are acceptable; or
- to increase maintenance because the machine is unhealthy.

VCM results are best used to fine-tune a fixed maintenance schedule.

Chief Engineers need the authority to deviate from a scheduled maintenance plan, when data supports the decision.

Scheduled maintenance is expensive. Using VCM as a complement to, not a replacement for, fixed maintenance allows you to defer planned maintenance with confidence, when data shows the machine is healthy. When results indicate a problem, you can take action before failure. Either way, you save money.

Managerial Decisions

How you go about VCM determines the benefits you realize.

- Managerial Decisions
- Personnel
- Technical Support
- Integration with Work Order Systems
- Class Society Involvement

Results of over 330,000 readings taken over 30 years, rated by CAC’s 3-scale measure of machine health and reliability:
- 2% unsatisfactory; 11% marginal; 87% satisfactory

Is it always necessary to carry out planned maintenance?

Is there an optimum data collection frequency or interval?

Planned maintenance can be safely deferred when recommended by analysts.

For most equipment, two times per year is the optimum collection frequency.

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There is an optimum data collection frequency. Below that threshold, reliability suffer. Beyond the threshold quality does not significantly increase, however costs continue to rise.

5 Areas of Practical Consideration

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Management needs a system that can show trends and summarize the data.

Too frequent reporting and/or too much detail is overwhelming to the person who has to read, understand, and respond to the report.

Too many recipients of copies, especially of non-essential information, clogs email systems.

Over-reporting clouds the really important information in a haze of information that is not as critical. We call this Data Smog.

Rather than enhancing the information a decision-maker can consider, a certain volume of information has the opposite effect – it distracts from it.

An effective and streamlined reporting protocol can avoid this common problem.

Personnel

Data must be collected by experienced and qualified personnel.

VCM depends on accurate data consistently collected thoroughly and accurately.

Proficiency requires extensive (and expensive) training.

Only those crewmembers who have received thorough training in vibration and data collection techniques should obtain vibration readings.

ISO qualification does not necessarily prepare a crew member to collect data effectively.

Certification courses provide theoretical instruction; they are not designed for the marine environment and provide little in the way of practical application.

An effective alternative is to develop, within your fleet, a team of data specialists who movie from ship to ship, collecting data.

This approach models the way in which outside specialists, like CAC, operate.
During an audit of a ship, it was found that the crew had been taking one reading at the top of this motor in the STBD direction. The $F_{\text{max}}$ was 45,000rpm and showed no problem. If a higher $F_{\text{max}}$ had been chosen, a new vibration frequency would have been found. In fact, if a reading had been taken in the RWF direction, a bigger problem would have been found - motor bar vibration at 44X-rotation rate. This shows how the way data is collected can affect results, and underscores the need for effective crew training.

Crew did not notice the pump speed increasing...

The speed of a Turbine-driven cargo ballast pump was increasing during the test. The data collector did not notice this fact while taking data. The Vibration Analyst recognized that vibration at the gear mesh frequency indicated a possible gear problem. However, the increasing speed meant that the load on the machine was abnormal. When the machine was retested at full speed, the vibration went away and was normal. This example illustrates the importance of recording conditions as well as readings, and underscores the need for direct contact between the person collecting the data and the analyst.

Readings taken in one direction only missed a critical vibration...

Effective crew training and commitment to continued learning are essential.

The technical support function consists of setting up the measurement points, choosing baseline parameters, reviewing data collection procedures, and providing feedback as to the results. The taking of data and evaluation of results cannot be trivialized.

Marine VCM has unique factors, such as hull vibration, ship operation restrictions, and class society review that can best be handled by specialists with experience in the marine environment.

The data collection specialist needs a support person or Senior Analyst.

A crewman or even a full-time data collection specialist cannot be expected to completely manage a VCM program. While computer assisted analysis is helpful, human analysis can more effectively detect trends and relate them to repair histories. The Senior Analyst can study fleet-wide trends, modify test parameters, and conduct testing with advanced methods such as modal testing.

Communication and collaboration between the Senior Analyst and the Data Collection Specialist are essential.

Data Specialist can describe the test conditions—for example, heavy seas, load conditions and other relevant observations.

The Analyst can call for more testing to be done to rule out hull vibration, faulty data, wrong machine, etc.

This collaboration qualifies and clarifies the readings, resulting in a more thorough analysis.
Integration with Work Order Systems

Technological innovations have recently made VCM more user-friendly.

Integrating data with existing work order systems and fleet management software – capacities we have at CAC – has complementary effects: it gives the analyst ready access to repair history, and it gives crew access to vibration data.

The vibration analyst needs to know the repair history.

The crew needs to have the vibration data integrated into the machinery history, and to know when to schedule data collection.

Chief Engineers, Marine Superintendents, Class Surveyors, and other decision-makers need a Summary Report that clearly shows what action needs to be taken, and the condition of machines from worst to best. Too often, the machine test results are not easily available to all the parties involved, or easily interpreted quickly.

Posting to a website is an excellent way to distribute the data. It is available to anyone with Internet access and a password. A full survey report can be distributed promptly. Items of greatest concern can be distributed immediately.

CAC Decision Point® is a secure website containing an interactive database of over 330,000 readings which can be accessed for analytical and comparative purposes.↓
Classification Society Involvement

Classification Societies are increasingly recognizing VCM. The growth potential of the approach is great.

CAC advocates that Classification Societies, through their membership in IACS, take four steps to support VCM.

Four things Class can do to help the industry reach the full potential of VCM:

- Establish clear rules;
- Train ship inspectors to read and understand monitoring reports, providing an important independent perspective;
- Develop a reward or incentive for ships to participate in condition monitoring programs; and
- Consider an approved review of a VCM program equivalent to a mandatory five-year opening.

A pair of Boiler Feed Water Pumps were opened in accordance with a Classification Society requirement. Both were rated as satisfactory in their performance at the time of the opening. One remained so afterwards, but the other actually became worse, indicating that the opening, itself, had an adverse effect on the machine. As both machines were satisfactory, they perhaps should not have been opened for inspection.

Another machine was satisfactory but had a leaking mechanical seal. Instead of just replacing the seal, they performed an overhaul. The unit remained in satisfactory condition. This is an example of where a focused maintenance procedure could have been performed at less cost than a complete overhaul.

The fourth machine was found to be marginal. It was overhauled but the machine did not improve.

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• 1969 CAC founded. Has served 600+ ships. 99% of clients are ship managers
• 1978 Contributed to ABS Condition Based Maintenance
• 1987 Contributed to “Guide for the Use of Vibration Monitoring for Preventative Maintenance” (SNAME T & R Bulletin 3-42)
• 1995 Implemented ABS Alternate Technique Program

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