A Convincing Cost-Benefit Case for Condition Monitoring

Tips to gain enduring management support, whether you own the assets or service others'.

Scott Yenchik, Reliability Director, CB&I Plant Services
Forrest Pardue, President, 24/7 Systems

What is the best way to justify a condition monitoring investment? This is a common question when gaining or maintaining management support for any equipment reliability program. Maintenance and reliability professionals are quick to recognize the value of equipment condition monitoring and predictive maintenance (PdM), but often have difficulty translating that value into terms the executives will appreciate.

In early 2014, the question was top of mind of CB&I, a large engineering, procurement and construction (EPC) service company, which needed a way to assure a petrochemical client's management team that its condition monitoring services were delivering hard value.

Since 2013, motors repair cost has decreased annually.

CB&I had been performing vibration analysis, oil analysis, ultrasound, motor management, infrared thermography, and visual inspections at the client's plant beginning in June 2013. The benefits were clear to the plant's Operations and Maintenance (O&M) personnel, who wanted to expand the program, but their management team remained unaware of the bottom line benefits. Without strong executive support, the expansion would never happen. Even worse, a decrease or elimination in funding would return the plant to reactive mode.

Thankfully, the answer was found in existing tools and a simple methodology. CB&I used this approach and together with the plant's O&M personnel, created a review team that initiated a cost-benefit analysis program in April 2014 with the following end goals in mind:

- To quantify the program's results in a language understood by the C-suite
- To validate the value and necessity of the existing condition monitoring investment
- To justify increasing the PdM program's scope
- To ensure that the figures were credible and convincing

Not only did the petrochemical managers accept the cost justification numbers and attribute the value to the reliability team's efforts, but they also decided to become more financially invested in equipment reliability. The program has since grown in scope and impact.

The review team built their successful cost-benefit case for condition monitoring using three easy steps, which anyone who owns or services critical assets can follow.

1. Start small and leverage available tools

A handful of lucrative "saves" is usually all it takes to convince management of how valuable a condition monitoring program can be. For critical equipment in particular, the financial benefits of failure cost avoidance are substantial enough to return a rapid return on investment.

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Cost benefits are based on the difference between what could have occurred upon failure vs. what action was actually taken as a result of monitoring. For this cost comparison, CB&I set a goal to assess just 5-10 condition cases per week, which is not very intrusive. Only fully closed cases would be included.

CB&I worked independently to develop the cost-benefit analysis process, and then involved the plant's reliability engineer, CMMS coordinator, and operations representative in the assessments. The cross-functional reliability review team asked questions about each selected condition scenario and negotiated their probability and likely costs of failure. In addition, they calculated the actual costs of recommended PdM actions. Costs such as parts, labor, transportation, and production impact were included.

Since these figures were not available from the client's CMMS, CB&I retrieved them from their Tango reliability information management system from 24/7 Systems, which integrates all CB&I condition monitoring activity. The software captures data on both actual and projected costs, providing the basis for measuring avoided costs.

The cost-benefit details were then exported to Excel for customized presentation to the plant's executive team, highlighting findings such as actual vs. projected costs, which equipment types had the highest total cost avoidance, and which "bad actor" assets represented the highest costs.

Condition Entry Case Cost Editor

Location: Cooling Tower » 91-UP-403-B Cooling Tower Pump » Motor

Actual Cost Line Items

Cost Item Type	Cost	Labor (in Hours)	Comment / Justification	Date
Labor	$7,500.00		Total cost of motor repair from Rotor Stick Armature	Jan 07, 2016
Transportation	$4,327.00		Equipment rental to remove motor and transport to and from RStick Armature	Jan 07, 2016
Labor	$2,247.00	59 hrs	Cost of labor in SAP	Jan 07, 2016
Parts	$800.00		Cost of supplies, non stores items in	Jan 07, 2016

Projected Cost Line Items

Cost Item Type	Cost	Probability Of Occurrence	Comment / Justification	Date
Labor	$4,000.00	100%	Approximate cost of labor, if motor ran to failure and damage associated equipment	Jan 07, 2016
Parts	$250.00	100%	Approximate cost of new coupling if motor ran to failure and damaged coupling	Jan 07, 2016
Parts	$48,000.00	100%	Approximate cost of new motor, estimate from Hoton Armature	Jan 27, 2016

The cost benefit for each condition case is captured in the reliability software.

2. Ensure trust with credible cost-benefit analysis results

Making the data visible is only half the battle. Any business case must be credible with numbers perceived as "real" in order for management to really pay attention. Though individual numbers may be debatable, having sufficient analysis cleanly presented in charts by asset type and by technology makes the savings tangible and actionable.

Building trust began with the plant's reliability review team members. CB&I faced resistance early on, but gradually the participants recognized the value of their efforts and the reviews were no longer considered a nuisance.

Within the first few months, 15-20 cases were assessed and documented, including an impressive $100,000 potential cost avoidance from a visual inspection on a critical asset. That was the moment of management buy-in at the first management review meeting. In these quarterly meetings, PdM cost-benefits are presented to the plant manager as a consensus opinion of the review team. The rapport with management soon became so positive that the plant manager began to contact the condition-based inspection technicians directly with equipment condition questions. The review team has also been invited to share its findings with other sites.

Confidence was also gained from Operations. Over time, consultation with the operations representative by the review team was reduced to seeking a final agreement. After 18 months, the team no longer had to involve Operations in each case.

3. Quantify the PdM program successes and act on conclusions

For CB&I, nearly $2 million in cost avoidance savings over the first-year analysis period were revealed. The reliability team provided this benefit to the plant by:

- Using enough technology to thoroughly complete the job
- Increasing the value of the technology they had already acquired
- Honoring a commitment to provide enough processes and resources to deliver the full benefit of the technology

Nearly $2 million in cost avoidance savings over the first-year analysis period were revealed

Cost-benefit analysis results allow the petrochemical plant to visualize hard dollar savings, validate the condition monitoring program, and justify PdM expansion costs. It also reveals trends in equipment and asset types. For example, plant personnel had been unaware that their motors had the highest rate of faults and how expensive those failures really were. Easily fixable problems such as loose components, balance issues, and bearing degradation were among most prominent issues. In fact, the plant had spent $430,000 on motor repair issues in a recent quarter.

To reverse this trend, the equipment type and fault count data was used to guide the plant's motor management strategy, and someone was hired to work full time on motor management.

- Motor procedures were created for shaft rotation, motor repair and replacement, and motor handling for on-site and off-site requirements.
- Stored motor offline meg ohm readings and resistance-to-ground readings were tested to identify motors with low RTG readings.
- Climate control storage improvements were made and a station was set up to apply/energize the motor heaters of larger motors.

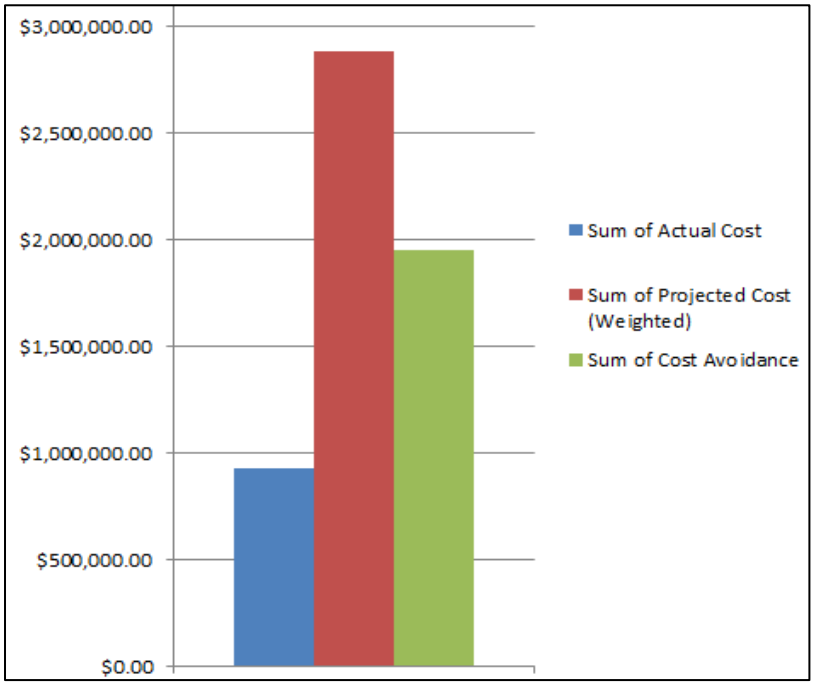
- An opportunity was identified to focus on better alignment practices including laser alignment.
- Vendor surveillance was instituted to track motors going to shops, check the work quality, and hold people accountable.

Similarly, the data in Tango showed that gearboxes alone represented $661,000 in costs, and almost a million dollars in savings was possible with condition monitoring. As a result, gearboxes became a focus of the lubrication analysis program and spurred investment in more oilers, better cleanliness, and a filter cart.

Data from the system also shows where savings are lacking for a certain asset or site, allowing the team to evaluate whether they're not using the PdM technology correctly, whether it's not generating sufficient value, or if it works but there are insufficient processes or resources to support it properly to get the full benefit.

CB&I has plans to extrapolate the data further for continuous improvements. For example, the next step is to address the root causes of deteriorating conditions. They also intend to leverage the information across the plant and with other sites, e.g., if a $200,000 save is made for one motor, and the ~~plant~~ company owns three similar motors, do those also need the same PdM?

Any asset owner, operator, or service provider who builds a business case for condition monitoring following these three steps is sure to enjoy similar advantages and enduring executive support.



Total cost avoidance savings for closed condition entries was $1,952,792. Source: CB&I

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Author Bio

- Scott Yenchik is the Reliability Director at Chicago Bridge and Iron (CB&I). He is a certified maintenance and reliability professional (CMRP) who has worked in the field of maintenance, reliability, and electric motor repair for 20 years in different capacities. Scott has a BA degree and is certified in multiple PdM technologies, including Vibration Analysis Level III, IR Thermography Level II, and Airborne Ultrasonics Level I. He has previously worked for Shaw Group, Rockwell Automation, Nova Chemicals, Azima DLI, and Computational Systems, Inc.

- Forrest Pardue, President of 24/7 Systems, has worked in the field of vibration analysis and production maintenance for the last 25 years. In 1997, he co-founded 24/7 Systems, a company focused on the development of reliability information management software and services, to facilitate the measurement, management, and improvement of plant machinery reliability. Forrest earned a BSEE from North Carolina State and an MBA from Lynchburg College.