

Review Vibration Condition Monitoring Program across Iluka Western Region

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Abstract

The aim of the project is to optimise the application of Condition Monitoring across the Iluka Western Region in the field of Vibration Analysis. The project is to ensure that Vibration Condition Monitoring (VCM) adds value as a viable and cost-effective maintenance strategy, and that the program represents an optimum return on investment of resources. Evidence of current procedures, systems and standards as applied to condition monitoring of rotating equipment was formally collected. These were reviewed across the organisation but also against practices elsewhere in industry and those outlined in both ISO and Australian standards. This project is heavily focused on cultural factors and implications for cultural change, and is still ongoing. Project steps included:

- *Internal policies and principles which should form the basis for the Iluka Vibration Condition Monitoring program were identified and collated.*
- *Industry practices and recommended ISO and Australian standards applicable to the project were compared to the standards and practices applied within Iluka.*
- *New and revised VCM procedures will be recommended based on equipment risk, criticality and cost.*
- *In accordance with existing culture, systematic modifications (both technical and administrative) required for ensuring recommended practices can be implemented and sustained across the Iluka Western Region will be examined.*

In finalising, the project recommendations will be made to contribute to the Iluka Reliability Program by optimising and where applicable, standardising Vibration Condition Monitoring practices for rotating equipment on site in the areas of policies, procedures, systems and standards.

Should Iluka implement the recommendations made, the expected outcomes of the project will be a reduction in failures on critical equipment leading to improved plant reliability and availability with less cost of consequential damage. This will improve equipment productivity and overall profits for the organisation.

1.0 Introduction

There has been recognition within Iluka of an opportunity to improve condition monitoring procedures and technology across the Iluka Western sites. This has led to support by management for use of an external organisation to work with site personnel to research current VCM processes and to recommend practices to optimise the use of VCM resources on site. Iluka employs a dedicated team of Reliability Engineers specific to individual areas which have proven a strong knowledge pool to support the project.

Iluka has recognised a present lack of optimisation and standardisation across the Western Region sites of VCM and general Condition Monitoring procedures. This situation of differing practices at sites makes for difficulty in managing predictive and preventive maintenance cost-effectively. An in depth study of current practices and aligning these with practices followed by industry and recommended by ISO and Australian standards will assist in managing the risk of

maintenance downtime and improving reliability as measured by extending mean time between failures of targeted equipment. The result will be savings in overall maintenance costs of relevant rotating equipment on site.

To accommodate the cultural aspects of the project, numerous site visits were conducted to ensure sufficient interaction and feedback from key stakeholders.

1.1 Present Situation

1.1.1 Generic

Iluka employs dedicated Reliability Engineers at all sites, with the potential to back a strong Condition Monitoring program. These Reliability Engineers operate with central support through Principal Engineers. However, the interpretation of the Reliability Engineering role appears to differ across the various sites, and often the work focus of the Reliability Engineers changes depending on personal background and training. This has in part contributed to a lack of formal VCM procedures and policies in some areas of the company, with no generic VCM standard.

1.1.2 Comparison between Sites

The Iluka VCM situation can be represented separately across Mid West and South West sites:

In the South West sites a number of 'champions' within Reliability Engineering have promoted the value of effective condition monitoring, including VCM. There has been a trend towards increased internal vibration monitoring and analysis, with purchasing of internal software and hardware. Key members in the condition monitoring program have taken Vibration Analysis courses in line with ISO recommendations. Much VCM work is still contracted out, however, and resources are stretched to cope with the amount of internal vibration data being produced. Until recently, external VCM work was contracted to two separate companies with differing report formats; this situation changed when one company purchased the competitor.

In the Mid West sites there appears to be recognition for the benefits of a well established condition monitoring program, however the profile is diminished with faith primarily placed in external contractors. At present, Vibration Condition Monitoring work is conducted entirely on a contract basis, although very basic handheld RMS carpet value accelerometers are currently being trialled. In general, little or no internal Vibration Analysis training has been undertaken.

1.0 Methods and Procedures

The project was undertaken following a number of predefined stages, which overlapped in some areas. Consideration was to be given to the differing requirements for alternate sites due to equipment age, type, and organisational culture. Project stages included, but were not limited to:

- Researching and documenting the **internal policies and guidelines** which should form the basis for the Iluka VCM program.
- Consult Iluka field reliability engineers and **acknowledge their input on the outcome of the project.**
- Document what **VCM technology** is available to industry and operated by Iluka specifically, and to what extent this technology is applied to condition monitoring of rotating equipment in Iluka.
- Research the industry practices and recommended **ISO and Australian standards** applicable to the project, and compare these to how well the standards are applied within Iluka, including warning and alarm limits.
- Recommend new VCM practices & procedures based on equipment risk, criticality, and cost.

- Recommend revised documentation and reporting systems which support communication and subsequent response to VCM results and recommendations.
- Examine and propose system modifications (both technical and administrative) required to ensure the new recommended practices can be achieved and implemented across the Iluka Western Region.

The project was conducted with an “action research” type approach, where strong input from all relevant personnel in the maintenance and reliability sector of the company is obtained. All individuals consulted will be made aware that all input will be given serious consideration, so as not to offend or distance any member involved in the project. This would also aid in developing a higher quality outcome through capturing of their knowledge and experience. The goal in this aspect was to ensure all key stakeholders (any member who may be affected by the outcome) were made aware of their ownership of the project. Input was obtained by the way of direct interviews, e-mail and telephone correspondence, and surveys. Principles of Change Management were to be applied throughout.

1.0 Results

3.1 VCM Survey

One primary source of stakeholder input into the project was through a survey. This was applied in order to gain insight into Key Stakeholder subjective opinions of current Iluka Vibration Condition Monitoring practices at specific sites. The survey sample consisted of relevant employees as selected with aid of the Principal Reliability Engineer. More specifically the survey sample included Site Reliability Engineers, Planning Coordinators, Maintenance Planners, and other Key Stakeholders in both Mid West (MW) and South West (SW) sites.

The survey was designed to be a researcher administered, semi-structured, individual target type. The survey was administered in person where possible, but in some cases had to be administered over the telephone. A draft version of the initial survey was piloted to Key Stakeholders at the Gingin site on June 8th. The survey questions were refined significantly and administered further based on findings from this pilot survey.

3.1.1 Survey Structure

The survey consisted of three sections: a predefined answer section, a series of open questions, and an open discussion. This was decided on based on the varying nature of the target individuals, their working environment, and the survey objective.

3.1.2 Survey (Section 1) Interpretation

The questions in section 1 were set out to require answers which could be scaled from one to five. The aim of this section was to generate a series of answers which can be diagrammatically represented and therefore visually compared to those obtained in other surveys. It would be short and concise, but provide a basic overview. The survey answers were structured as follows

1:	Strongly Disagree
2:	Disagree
3:	Neither Agree nor Disagree
4:	Agree
5:	Strongly Agree

The “target” value in all areas can be thought to be at least 4 – or “Agree”.

3.1.2 Survey (Section 1) Layout

The questions within this section were grouped into selected key areas. These areas were defined by a combination of suggestions from literature, stakeholder input, and the client mentor. The five key areas selected were defined as follows:

- Structure – VCM responsibilities and balance of responsibilities
- Process – Manner in which VCM is conducted in practice
- Culture – Role models, values, cultural infrastructure, and interpersonal communication
- Skills – Skills of internal employees involved with VCM
- Systems – Equipment (hardware and software) being used in the VCM program

3.1.4 Survey (Section 1) Graphical Results

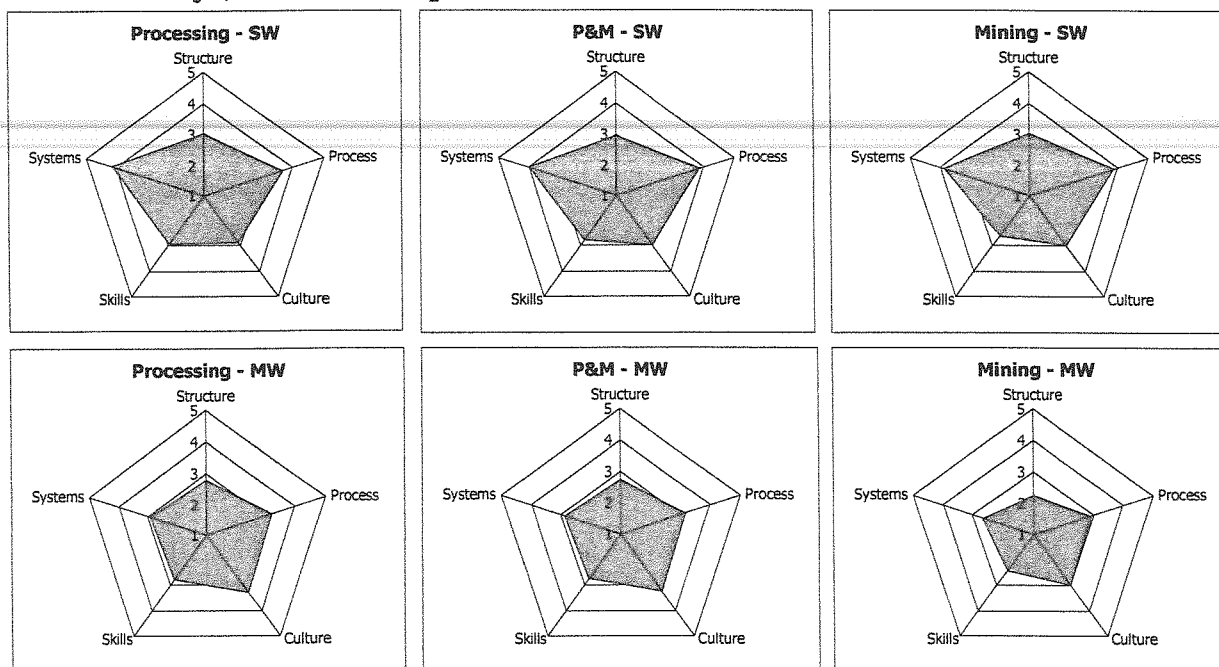


Figure 1 – Survey Section 1 Graphical Results

1.0 Discussion

4.1 Survey Results Discussion

From the graphical results it can be seen that there are trends of opinion among the Key Stakeholders surveyed in specific areas. It is interesting to note the differences between MW and SW sites, specifically with regards to perceptions of systems and processes. Considering the target value of “4” or “agree” in all areas, it can be said that there is significant room for potential improvement.

From informal discussion with target survey individuals, it became clear that there is a general agreement in both MW and SW that a lack of resources exists in the Condition Monitoring maintenance program. In addition the survey highlights the need for improvement in most areas, although SW key stakeholders are satisfied with processes and systems (equipment) being used.

Although final recommendations will be diverse in nature, the survey results may aid in prioritising the implementation of recommendations in certain areas. Specifically, a focus on improving areas of Culture and Skills may filter down into all other areas as key employees gain confidence in their ability to run an effective Condition Monitoring program.

4.2 SWOT Analysis

In addition to the VCM survey a SWOT analysis was carried out on the current practices across the Iluka Western Region. The result was a single page comprehensive analysis of Strengths, Weaknesses, Opportunities, and Threats affecting the Iluka Vibration Condition Monitoring program, which was able to tie in directly with some of the preliminary recommendations proposed. The SWOT analysis deviated slightly from traditional applications of the analysis method, and was split into both geographic regions and topic areas corresponding to the survey areas of *structure, process, culture, skills, and systems*. This provided critical alignment with the survey framework, and aided in objectively identifying key considerations for future recommendations.

4.3 Flow Diagrams

Comprehensive flow diagrams were produced with the intent of representing the current understanding of “best practice” as would be appropriate within the Iluka VCM program. One flowchart was designed as a representation of the selection process for Vibration Monitored equipment, and a second flowchart to represent the idealised VCM process. These flow diagrams were designed based on ISO recommendations, industry standards, and key stakeholder input. They may be used as an aid to optimising the current VCM program.

2.0 Preliminary Opportunities Identified

A number of preliminary recommendations have begun to emerge. Recommendations may still change or be updated as the project is finalised. A few of the core recommendations found have been listed below, grouped into their relevant areas as defined in the applied VCM survey.

Structure

- *Introduce a dedicated Condition Monitoring Technician for SW and MW sites*
- *Assessment of VCM chain from data collection to maintenance completion*
- *Review and define roles of Reliability Engineers on site*

Process

- *Implement formal system for defining VCM requirements on equipment*
- *Encourage Root Cause Analysis for unexpected critical equipment failures*
- *Adjust internal VCM being conducted to capability and availability of internal resources*
- *Introduce VCM Standard catered to MW sites*

Culture

- *Re-introduce a regular Condition Monitoring meeting*
- *Introduce formal system to recognise and reward benefits of pro-active behaviour*

Skills

- *Increase responsibilities and technical knowledge of the internal Data Collector*
- *Undertake a Training Needs Analysis (TNA) of Stakeholders to identify areas of weakness*
- *Increase access to basic VCM training for all members involved with the program*

Systems

- *Improve equipment identification on walk routes through physical tagging on the equipment*
- *Improve identification and surface contacts for standard measurement locations on measured equipment*
- *Increase level of internal VCM hardware and software available to MW sites*

3.0 Conclusion

An effective Condition Monitoring program within mining and processing requires a significant amount of resources. Although currently there are 'champions' within the organisation with a passion, drive and support to implement an effective condition monitoring program, these persons are not able to effect change organisation-wide due to more pressing responsibilities within their interpretation of their defined roles. Despite the best efforts of these 'champions', current internal social structure still benefits the inherent wins associated with reactive behaviour. A cultural shift would have to take place to focus attention on the potential gains to be made through pro-active behaviour. Such a cultural shift will not occur without a management organised drive over time to reward "wins" related to Condition Monitoring, with less emphasis on rewarding repairs of equipment already failed. In order to facilitate this, predictive maintenance "wins" should be advertised more prominently company wide, with recognition for those responsible entities. This publicity will only occur through management supporting a drive towards recognition of Condition Monitoring gains. To add structure to such a drive, procedures should be implemented along the lines of recommendations made to maintain and encourage pro-active values within the Iluka Reliability sector.

At present, the Iluka Vibration Condition Monitoring program can be structurally divided into the South West region, and the Mid West region. There are some cultural and knowledge differences between these regions which must be addressed in order to optimise the VCM program being undertaken. An increase in VCM systems (both hardware and software) available to MW sites would benefit the Condition Monitoring program there, providing increased availability of analysis when required. In addition, a focus on improvements in training and cultural aspects of the Condition Monitoring program across all sites may in time benefit other areas in need of attention by creating a sense of ownership over the reliability program with those Stakeholders involved. To emphasize this point; one experience from a Key Stakeholder in setting up a VCM program in another company indicates that such an approach is conducive to creating an almost positive "competitive" atmosphere, with technicians attempting to outperform each other in their data analysis and equipment failure trend prediction.

4.0 References

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