XXVI International Conference – Forest Biobased Materials - TECNICELPA 2023
11, 12, 13 October 2023 – COIMBRA, Portugal

RELIABILITY AND ASSET MANAGEMENT BRIDGING TECHNICAL AND BUSINESS FIELDS - THEAPM JOURNEY

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SUMMARY

The industrial physical asset management is strongly related with the achievement of a conscious balance between risk, cost, and performance. By having the best of these three main actors we will be ensuring high levels of efficiency, in generating value from the assets.

To meet the business drivers, the digitalization plays, here, a key role by delivering reliable and data driven decisions. Digital enablers such as mobile tools, industrial internet, or predictive analytics are some of the technologies that can pulled up.

The aim of this paper is to share the challenges and innovations in the pulp and paper industry to maximize reliability, through Asset Performance Management (APM).

A case study will be used to illustrate an experience in this APM journey and how the principles associated to the implementation of practical technology achieved positive return on investment.

Keywords: asset, failure, maintenance, performance reliability

1. INTRODUCTION

Many industrial players |including General Electric Digital (GED)| has invested ambitiously in digital technologies.

An Asset Performance Management (APM) solution allows customers to optimize availability, reliability, risk and costs through optimized asset strategies leveraging a single, unified view of overall asset health, status, performance and maintenance information.

A key part of this objective is the optimization of maintenance and asset replacement decisions, supported via the following processes:

- Collect asset data through sensors, data collection tools or from external databases;
- Apply data through predictive models;
- Apply a methodology for decision making covering both engineering and financial aspects;
- Make decisions that most benefit the entire organization.

This paper intends to explore the classical reliability processes parametrized with the APM which enable the support decision process.

2. INDUSTRIAL ASSET PERFORMANCE MANAGEMENT (APM)

According to ISO 55000 clause 3.3.1, asset management is a co-ordinated activity of an organization to realize value from the assets. In other words, given a business or organizational objective, asset management is the set of activities associated with: [1, 2]

- identifying what assets are needed;

- identifying funding requirements;
- acquiring assets;
- providing logistic and maintenance support for assets;
- disposing and renewing assets

APM systems aim to provide tools to improve equipment availability and reliability while reducing risk and cost. Managing asset performance is a high value task that will be possible by enabling all activities drawn below in Figure 1.

Figure 1. Integrated approach utilizing data consolidation and analytics to optimize risk, cost, and performance of assets

These systems typically capture data related to asset condition which includes work order history, delay and loss accounting, online condition data via plant historians, and batch condition data such as oil analysis results and inspection results to provide a holistic view of the asset performance.

This data is then able to be used for reliability analytics and asset health visualization, to support development and fine tuning of various asset models including lifecycle costing and reliability modelling. The basics to support the different APM capabilities is shown in Figure 1, with a form of continuous improvement cycle.

2.1 Data Base Integration

An APM solution is implemented according to an agreed Functional Specification which should provide a solution in an integrated company environment, and mapped with user personnel, functional requirements and processes.

IT integration with company existing plant systems, such as ERP (Enterprise Resource Planning), control systems historian, condition monitoring systems and MES (Manufacturing Enterprise Systems), to provide technical proof on the integration capabilities. This overall integration scheme is summarized below in Figure 2.

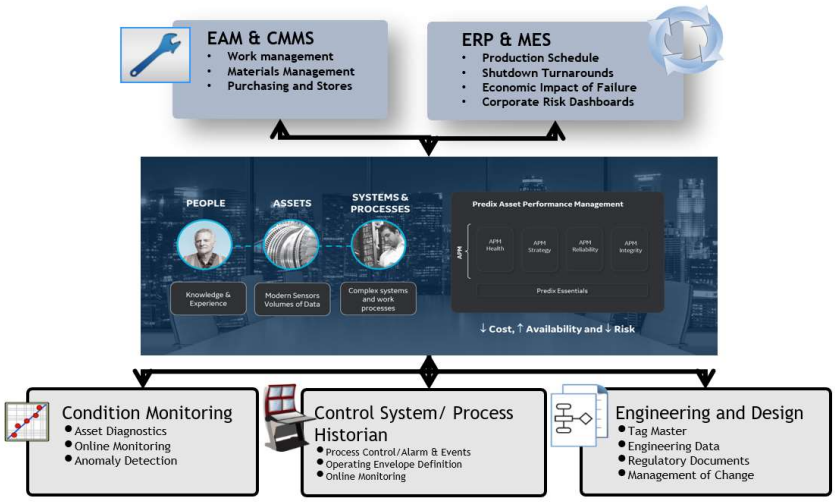

Figure 2. Integrated company data sources

The APM system consists in a group of three major streams, each stream is aligned to the APM solutions, identifying either technical or organization change requirements. Figure 3. Illustrate the main reliability processes pertaining to each stream.

STRATEGY	HEALTH	RELIABILITY
• Asset Criticality Asset Strategy Management	• Asset Health Monitoring Content	• Spare Parts Analysis
• RCM, FMEA	• Maintenance & Lubrication Rounds	• Reliability Analytics tools
• Lifecycle Cost Analysis	• Visualization & Dashboards	• Root Cause Faiure Analysis
	• Data base integration	

Figure 3. Main working streams

2.2 Strategy Stream

APM Strategy stream provides the ability to effectively develop, implement, maintain, and optimize asset strategies over the asset lifecycle. These strategies are comprised of the individual and collective actions performed to maintain, operate, monitor and inspect assets at an optimal cost with maximum risk reduction. These strategies should be based on the output of rigorous engineering methodologies and analysis, manufacturer's recommendations, organizational best practices, and human experience depending on the type and risk profile of the asset.

Managing the assets effectively can provide tremendous value by enabling organizations to achieve the optimal balance of cost, risk, and performance.

The Strategy stream is also responsible for the definition of the assets which will need to have Health being monitored.

2.3 Health Stream

The Health Stream focus in data collection and aggregation to create Asset Health indicators that ultimately can become into useful recommendations. This statement summarizes the transformation from traditional preventive and condition based into predictive maintenance.

This stream provides data collection through rounds, aggregation and rules through policies and visualization through the Asset Health Manager but needs to be always built over comprehensive Asset Strategies. Where Failure modes happen, consequences and mitigation are understood by balancing monitoring actions risk and costs.

2.4 Reliability Stream

The Reliability Analytics module provides a collection of tools that apply reliability engineering principles to help you make tactical (short-term) and strategic (long-term) decisions for maintenance and operational equipment management activities.

Each tool provides a unique set of features that allow you to analyse data to develop strategies to improve reliability.

A classical process as the Root Cause Failure Analysis (RCFA) can be conducted by APM, allows you to analyse causes of failures. A root cause analysis also allows you to track the performance of the equipment by following recommendations implementation.

3. BUSINESS CASE

The business case was developed in pulp and paper manufacturing industry which is highly recognized for being asset intensive, with high capital costs and long investment cycles.

As industrial sites become more and more intelligent, the necessity to provide information about their condition and performance, is widely recognized. The need to gather into an interoperable system the assets condition as well as relevant process data which would provide the operational context, it would act as the basis for future integration of ML (Machine Learning) and AI (Artificial Intelligence) tools; to assist and make maintenance activities increasingly proactive.

3.1 Mobile rounds

Data collection is the first step of the APM process. By implementing mobile rounds for electrical, mechanical and operations activities, it is possible to start asset condition monitoring based on the information provided by the technicians using the current maintenance plans.

The use of the mobile rounds tool allowed to create a notification, associated to the correct asset, directly from the field.

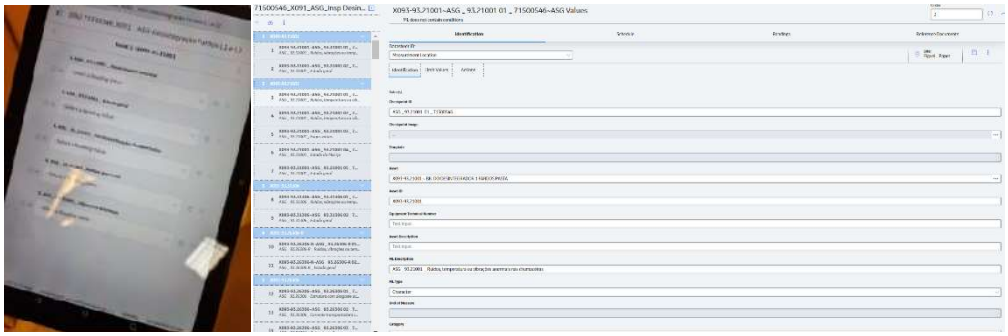

Figure 4. APM tablet application for capturing field data inspections

The final step of this use case was to aggregate the information coming from the field into a Health Indicator for inspections, and thus contributing for a DORI (Dynamic Operational Risk Index) indicator, aggregating all the main sources of assets information and define a general Health Index.

Rounds can be more effective when they are done by mill operators in a shift based inspections. The system allows to generate notifications through the rounds process when there's a non-compliant or required parameter.

3.2 Policy Development

To enable holistic decisions to be made, condition and other data need to be interpreted using meaningful models.

It was developed a policy capable to retrieve information from Company ERP, MES, control system, rounds and in the future from IIoT. This Policy is able to use the current maintenance strategies, which the policy development considered the company base content across all the assets that have rounds associated with them. This content was created using manufacturer recommendations, RCM (Reliability Centred Maintenance), FMEA (Failure Mode Effect Analysis) or other processes.

With the full implementation of the Condition Base Maintenance process, this policy will fully comply with the ISO 17359 ("Condition monitoring and diagnostics of machines — General guidelines").

The current implementation not only considering the information provided by vibration system and rounds, but also thermography and oil analysis.

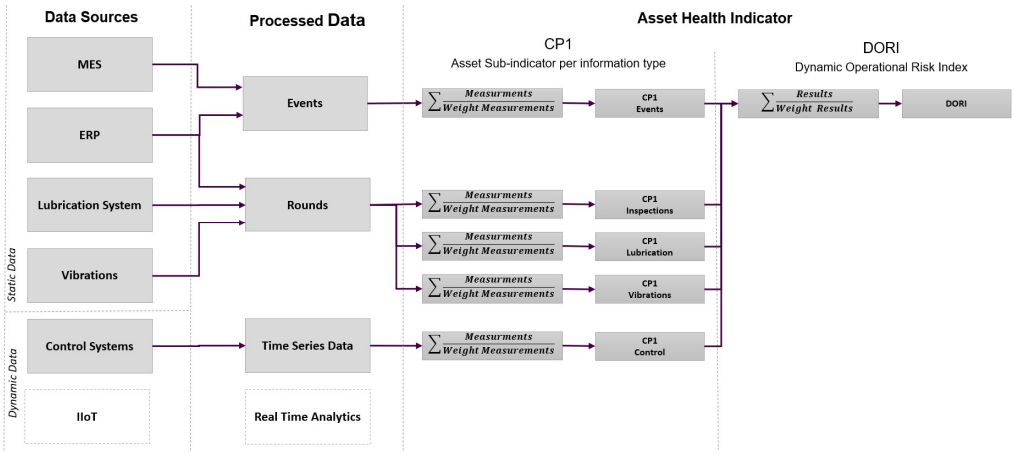

Figure 5. Aasset policy for acquiring asset health indicators

The policy is defined by asset criticality, the site subject matter experts, by identifying less good patterns of AHI, start a continuous improvement cycle by adjusting strategy to identified behaviour patterns.

3.3 Early Failure Detection and Value Capture

In a paper manufacturing system, working 24x7, it can be substantially significant to detect machine failure before it occurs and take necessary maintenance actions to prevent a detrimental breakdown of the system.

Established Health monitoring policies for critical assets, by aggregating information from multiple systems provides useful information on the system's health condition. The key benefit is the prioritization of work, to detect and prevent potential issues proactively.

Reduce unplanned downtimes and cost avoidance by planning task in advance is the first step for advanced analytics.

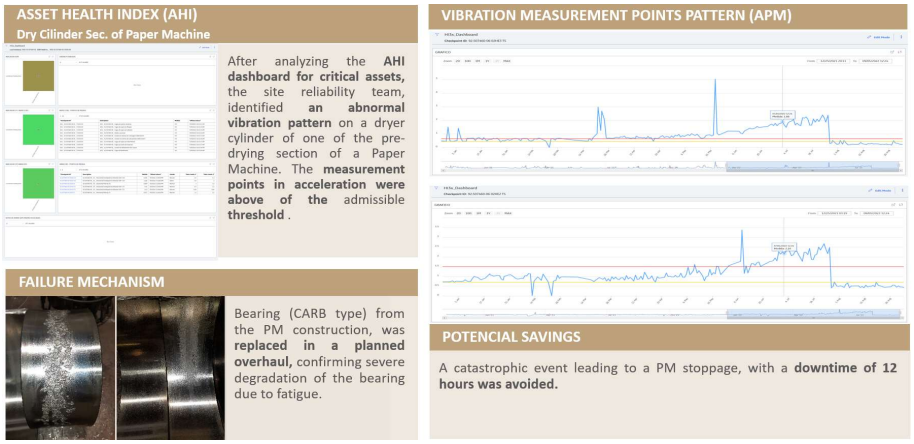

Figure 6. Early failure detection using Asset Health Indicators Analytics

As an example, the aggregated information, allowed, in a year, to prevent several potential failures in rolling bearings and gear boxes of a paper machine, reducing the failure downtime from 10 to 1 on this asset type events. Figure 6. illustrate one of the events early detected that was possible to plan the intervention and avoid a catastrophic stoppage of the paper machine resulting in a substantial financial saving.

4. RESULTS AND DISCUSSION

From the management of fixed assets point of view, these requirements imply the need for a continuous and dynamic lifecycle management, high levels of equipment efficiency, increased reliability and flexibility of the fixed assets and lower maintenance cost of production equipment.

An APM (Asset Performance Management) system quickly showed up to be the answer, the system that would allow us to manage the industrial physical assets according with our principles and culture of reliability and asset management, leveraged by the Digital transformation in Maintenance.

It was a long journey searching for the right tools and partners, seeing the solutions working live, in similar industries, was determinant for getting a decision.

The need to demonstrate value was always a must have within the overall process, a couple of value drivers were established to monitor the achievements and progress of the implementation, table 1. shows the most relevant to our business.

Table 1. Business value drivers

ROI[a]	Value Driver	Target	APM Enablers
OPEX Optimization	PM[b] cost reduction	▪ Maintenance strategies based on data, experience, and reliability analysis	Reliability Analysis Strategy Management
	Spares cost optimization	▪ Monitor roller health and need for maintenance, to optimize spare hold level	Health Manager Reliability Analytics
Productivity	Personnel Effectiveness	▪ Daily O&M dashboard ready in seconds ▪ Monthly report ready in a 1-2 days ▪ Digitize all operator Rounds, to automate data collection and analysis. ▪ Monitor and prioritize needs for data collection	Dashboards Rounds Systems Connectivity Health Manager
	Work Prioritization	▪ Full view of Asset Health combined with Criticality to prioritize work for assets that need it most	Health Manager Systems Connectivity Analytics (Policies)
	Uptime	▪ Single dashboard provides operations access to all critical systems for faster decision making and	Systems Connectivity RCA[c]

		troubleshooting ▪ Perform RCA(c) and equipment improvement based on measurable impacts on both maintenance and production costs.	
Visibility	Data Transparency	▪ Establish and follow data quality best practices, with the right information properly logged at the right level.	Dashboards
	Informed Decision Making	▪ Utilize data to identify bad actors in terms of maintenance cost impact, production impact, maintenance effectiveness, etc	Dashboards Systems Connectivity
	Access to information	▪ Every maintenance engineer, operator, etc, can access the right data at any time	Dashboards Health Manager

(a) Return of investment
(b) Preventive maintenance
(c) Root Cause Analysis

As the complexity and competitiveness is increasing in a global economy environment, Companies need to improve their performance, by increasing their ratios of ROI (Return on Investment), which will only be possible by improving their ROA (Return on Assets) indices. The success of the solution was found early in the journey, but consolidation was required before it settled and spread.

5. FINAL REMARKS

Performing Asset Management is more than installing a software package, it is implementing principles and methodologies that will generate quick and remarkable returns not only by defining proper maintenance strategies and priorities but also by taking decisions on asset rehabilitation and replacement.

This requires from organizations a digital transformation that will face new challenges such as:

- increasing awareness of new digital technologies available;
- increasing skills of the workforce through smart use of technology;
- revising work processes;
- redefine IT architectures.

The Organizational alignment in terms of business processes and technology is fundamental to ensure priorities and expectations for the organization while increasing the awareness to strengthen the confidence and engagement of all the stakeholders. To do a transformational effort like this some initial assumptions have to be taken into consideration:

- It is crucial to have support from senior leadership;
- Requires change management and culture shift;
- Requires dedicated resources in a multi-year effort;
- Do step by step by small incremental projects ;
- Remember that data integration takes time and can be challenging;
- Keep measuring the success and communicate frequently across the organization.

We need to realize that there is no ‘easy button’ for reliability excellence, although APM is a great step to support it. It is not the final destiny. If we do not put into operation the strategies identified as well as the process transformation, the uptime doesn’t appear by itself.

Acknowledgements

The authors would like to express their gratitude to top management for trusting in the project and

keeping the confidence on it even when a pandemic period was being settle, challenging all to work remotely.

Asset Management involves processes technology and people, and a special word goes to all APM team members and local maintenance teams because without them, this project would not be possible.

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