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# Utilizing IIoT to Increase the Success of Reliability Centered Maintenance

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When it comes to selecting the appropriate maintenance strategies for a physical asset, many organizations have a very limited basis for their analysis and selection beyond the OEM manual, which often results in inefficient practices such as doing too much time-based preventive maintenance in an attempt to try and improve reliability.[1] Throughout the industry it has been seen that less than 20% of failures satisfy age-related characteristics and more than 80% of failures are in fact event-based or statistically random. Time based maintenance programs then have very little effect on overall reliability and for some failures, no effective form of scheduled maintenance exists.[2] Therefore, to be effective, there must be a basis that couples proven methods along with equipment experience to define a maintenance strategy.[3]

The maintenance leadership at Potash Corporation of Saskatchewan (PotashCorp) recognizes and understand this and have begun the process of instilling the concept of reliability centered maintenance (RCM) across the organization, and specifically at the Allan Division potash mine. This commitment to rigorous and detailed analysis, and the investment in the knowledge, time, and tools needed, have helped PotashCorp determine and ensure the most appropriate maintenance methodology is applied to the compaction circuits at Allan Division. Through RCM analysis, a resulting work plan for each compaction circuit and its failure modes has been identified and documented. This however is an intensive and thorough analysis, and as such, PotashCorp applied to the compaction circuit and other physical assets as they were deemed critical for operations. The reliability approach employed by PotashCorp overall allows a more appropriate (and less rigorous) methodology to be applied to other assets that are deemed low criticality to overall effective production and operations. Furthermore, a proper and effective RCM program requires effective communication and the need to connect work plans and actions to documented processes, which is a challenge for most organizations. Such documentation and communication enables further analysis towards the improvement of maintenance strategy selection and execution.

This paper will examine how the utilization of the Industrial Internet of Things (IIOT) is changing the options available when deploying RCM results and how the associated tactics are evolving at PotashCorp for critical assets in its operations, such as the compactor, and how this is further enabling the success and effectiveness of its RCM program, the reliability of its assets, and the overall successful operation from the mill.

## Background

Potash Corporation of Saskatchewan is the world's largest fertilizer company by capacity, producing the three primary crop nutrients – potash, phosphate, and nitrogen. Among the different sites and operations of the company and as part of the production process is the mill. There are several critical assets in the mill but among them, and the focus of

[1] Jeff Shiver, "8 Steps to Improve Asset Reliability", Reliable Plant 2017 Conference
[2] John Moubray, "Reliability-Centered Maintenance", 1997
[3] Jeff Shiver, "8 Steps to Improve Asset Reliability", Reliable Plant 2017 Conference

this paper, is the compactor, and specifically the compaction roller assembly bearings of this asset. The determination of the criticality of the assets was part of the foundation of the reliability centered maintenance approach adopted by PotashCorp. Ensuring the compactor is running at an optimal level and with the highest degree of reliability is paramount to ensuring production targets and achieving operational targets. RCM analysis completed on the compactor roll bearings determined that the temperature trending of the bearing was critical to preventing unscheduled shutdowns cause by bearing overheating. The company has instrumentation on the bearings to monitor the bearing temperature and utilizes OSIsoft PI to collect, monitor, and analyze this data. However, the control system does not act until the bearing temperature reaches 55 degrees Celsius as the compaction rollers are automatically shut down after 6 continuous hours of continuous operation at that temperature. Also at 55 degrees Celsius a notification is created on the alarm page and populates on a banner of the top 10 alarms on the bottom of the alarm page. At 60 degrees Celsius the control system automatically shuts down the compactor. Creating an alarm at temperature lower that 55 degrees Celsius would create alarms to operators that may or may not require maintenance, and would require the operator to assess the alarm and determine whether a maintenance work request should be created. Analysis has shown that it is the temperature trend of a bearing, relative to the temperature trend of the after of the other 3 bearings in the compaction roller assembly, that is key to assessing the condition of an individual compactor roller bearing. As such, it is critical to catch any trending temperatures outside of the operating norm and begin to determine what corrective action can be taken and when. The Mean-Time-To-Repair (MTTR) to replace the compactor roller assembly is 3 days, resulting in significant lost production time as well as the cost of repair, and so avoidance of such a situation is of great importance to the successful operation of the mill. The earlier the bearing failure is identified, the better maintenance and operations are able to schedule the compactor roller replacement without impacting operations.

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Presently, and with the available technology at the time of the RCM analysis, the decision was made to have operators complete a visual inspection twice per shift of the compactor roller assembly. Planners also check the bearing temperature trend on the compactors as part of a monthly preventive maintenance strategy. This manual check of bearing temperature trend utilizes bearing temperature data that is being collected automatically by the OSIsoft PI data historian. If a manual inspection or a trend analysis shows a failing state, a work request is created manually and the work management process begins. If the bearing temperature reaches 55 degrees Celsius for 6 hours, the compactor is automatically shut down and a manual work order is created for the emergency repair, although in some case the roller can be cooled so that operations may continue while the replacement compactor roller assembly is made ready and downtime is arranged with operations. Although the RCM analysis determined these

practices to be the best maintenance methods at the time, there exists a few challenges and shortcomings to the current approach:

1. Manual operator inspections are required

Although there exists a high degree of procedure adoption and acceptance at the mill and by the operator, because these checks are manual they can be prone to error or lack of adoption by operators, resulting in missed inspections.

2. Operators are inundated with alarms

Operators are inundated with alarms from the Delta-V and OSIsoft PI systems, leaving them requiring discernment as well as increasing the likelihood that one or more of these alarms are missed or ignored.

3. OSIsoft PI and Oracle do not connect

The OSIsoft PI system which manages the sensor data does not connect with Oracle eAM, where work orders are generated and maintenance information is documented.

4. Historical analysis is completed too late

Historical analysis has shown that temperature trending provides an opportunity to trigger planned work that can be done on regular down days, and well in advance of the control system shut down. Unfortunately, this historical analysis is often completed after the bearing assembly has been replaced. Planners who repeatedly see no change in bearing temperature trend begin to feel that the trend analysis is not necessary, and of course the P-f interval remains the same, so Murphy's law says the month the planner does not review the temperature trend, will be the month there is a compactor roller bearing failure.

Implementing full maintenance plans based on RCM analysis may be difficult for several reasons, including getting people to upload the results along with required data of the RCM analysis into the ERP system, and then having maintenance and operations personnel follow the work process as outlined by the RCM analysis. When PotashCorp began the RCM analysis every effort taken so that the analysis would not end up as a 'nice report on the shelf'. The RCM methodology deployed included the steps required to operationalize the RCM analysis, including updating procedures, data loading, and training. At the end of the RCM analysis, PotashCorp recognized that there were limitations to current condition based maintenance options that impacted the results of the RCM analysis. IIoT was identified by PotashCorp as an opportunity to enhance their existing suite of condition based maintenance options. Specifically, IIOT presented an opportunity to leverage the data being collected in OSIsoft PI. For example, on August 15th, a compactor at the Allan Division was shut down after being at 55 degrees C for 6 hours, resulting in unscheduled downtime and lost production. If a work order had been created for maintenance to change the compaction roller bearing assembly when the bearing when the temperature exceeded

WorkAlign® IIoT presented an opportunity to leverage the data being collected in OSIsoft PI.

more than 1.3 times the average of the other 3 bearings on the compaction roller assembly, maintenance would have been notified on June 11th for the first time, providing ample time – 2 months - for work to be completed on a regularly scheduled down day. Automation of this analysis reduces effort required by the planner while increasing the reliability of the process. At the time the RCM analysis was conducted, there was no ability to automatically trigger work orders from PI data, but the development of the VIZIYA IIoT application appeared to be a viable option to solve this problem.

## IIoT Enabling a More Predictive Company

Most companies have heard about the transformational change that the Industrial Internet of Things (IIoT) promises, and most as well have likely begun to explore the different options and opportunities available to them. In a recent survey of manufacturing professionals, there exists many deterrents to implementing these solutions despite the optimism for the technology. The top two deterrents cited by respondents in this survey were the high cost of implementation (37%) and inadequate infrastructure (37%).[4] In the case of PotashCorp, these were key considerations in the selection of a IIoT solution and since PotashCorp already utilized the two primary requirements for implementing the WorkAlign® IIoT, namely that of already having OSIsoft PI as their data historian and a supported CMMS in Oracle eAM, it was a relatively easy step to adopt the VIZIYA IIoT application and the solution architecture.

PotashCorp has been a long-time customer and partner with VIZIYA Corp, being instrumental in the development of products based on specific company and industry needs that seamlessly bolt-on to their existing business infrastructure, Oracle E-business Suite including Oracle Enterprise Asset Management (eAM). VIZIYA's WorkAlign® IIoT product again meets this need for the company while also connecting another critical piece of operational software, OSIsoft PI. As official partners of both Oracle and OSIsoft, VIZIYA developed the WorkAlign® IIoT product as the most robust and reliable means of connecting these two disparate systems and creating a two-way data integration in which key reliability data could be documented and acted upon in the maintenance system and by the maintenance team.

The product allows the readings to be captured in the same way they are now but for Work Orders and Work Requests to be created automatically based on the operating context of the machine. In the compactor bearing assembly application, if the temperature rises beyond the set parameters, VIZIYA IIoT sends out email notifications immediately rather than waiting for inspections. The VIZIYA IIoT can create the correct maintenance object in the ERP system like a Work Request, Work Order, or Meter Reading, and keep everyone up to date along the way. At its core the WorkAlign® IIoT seeks to bridge the gap between operational data and maintenance work management. For PotashCorp, VIZIYA IIoT is viewed as a method to augment condition based

[4] IoT Institute Research April 2016 as reported in Industry Week May 6, 2016 by Karen Felder (reliabilityweb.com)

maintenance and to better implement maintenance strategies based on the RCM analysis, as a means of achieving greater reliability through a more exacting implementation of RCM.

Among the key features and benefits of WorkAlign® IIoT which PotashCorp is utilizing are:

1. The Ability to listen in real-time for events and alerts.

With built in capabilities to listen to OSIsoft PI and other incoming sources you can continually listen for events based on defined criteria and create actions to perform when they occur. This reduces labor intensive Inspection time while increasing awareness of machine conditions.

2. Create actions and workflows and attach them to events.

When an event is detected the VIZIYA IIoT can push notifications to VIZIYA Mobile users and alert VIZIYA Scheduler users that a new work order has impacted the schedule. It can also call any custom stored procedure or web service.

3. Complete the cycle between maintenance and reliability.

Built in capabilities to write data such as a work order number back into OSIsoft PI completes the communication channel between reliability and maintenance.

4. Reduce Unexpected Failures.

Listen for events from equipment sensors and initiate workflows in your CMMS such as creating work order, work requests, meter readings and more…

5. Complex Workflows

Allows for escalation of events as failures progress, making sure you never create a duplicate work order or object in your maintenance system. For example, assume a work order is generated when a temperature value hits 50 degrees. When the temperature hits 100 degrees, the system will update the existing work order to an emergency.

6. Integrated dashboards.

When Connect reliability and maintenance teams with valuable insight into the status of their assets.

7. Templated Actions.

Make it easy for a front-end user of SAP, Oracle, Maximo, etc. to manage your integration. It is designed to be created and maintained by front-end users, similar to configuring a PM Schedule, Work Order, or other routine objects in your maintenance system.

8. Meter Entry

Automated meter entry into SAP, Oracle, Maximo, etc. of meter readings tracked in OSIsoft PI.

Overall, the VZIYA WorkAlign® IIoT product allows Potash Corp to effectively and efficiently utilize its existing infrastructure and investment while also allowing it to

improve its RCM program and actions without unnecessary new infrastructure or the delayed realization of a positive ROI.

## PotashCorp – Set Up For Success

The ability to easily and effectively utilize the VIZIYA IIoT was made possible by the discipline and effort that PotashCorp – Allan Division has put in place through their commitment to reliability centered maintenance concepts. In addition to their Oracle eAM and OSIsoft PI systems, PotashCorp also already utilizes the VIZIYA WorkAlign® Scheduler and Mobile products, which are used to effectively schedule maintenance activities. Maintenance and operations personnel are enabled with WorkAlign® Mobile so they can receive notifications in the field and identify break-in work and act accordingly, saving valuable time and effort while helping to further prevent or limit costly repairs.

PotashCorp – Allan Division is an excellent example of how with the right initial discipline and approach to maintenance, and with investments in core technology to enable the maintenance and reliability teams like Oracle eAM and OSIsoft PI, an organization can begin to take advantage of the promise and potential of the industrial internet of things in small but tangible ways, seeing benefit immediately and without an outsized effort

## About VIZIYA

Headquartered in Hamilton, ON, with offices in Barcelona, Perth, Atlanta and Dubai, VIZIYA is the industry leader providing bolt-on software products to enhance ERP- based asset maintenance systems. VIZIYA's proprietary WorkAlign® Product Suite delivers seamless integration into existing ERP systems. With over 55,000 users at 850 sites across 6 continents, the world's best companies use VIZIYA products to help them better maintain their assets. Visit viziya.com for more information.