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Preventive Maintenance of Transport Vehicles is it improving production stability of a smelter?

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ABSTRACT

As a supplier Hencon started maintenance activities in the mid eighties in order to support customers in improving the maintenance on vehicles and getting the cost under control. After 10 years of experience with running state of the art maintenance practices in Russia, India and Mozambique, in this paper we will show what we have learned. Key Performance Indicators will be discussed. Based on that we will present the future of maintenance with the help of today's ICT.

Introduction

TPM or "Total Productive Maintenance" according to Wireman is "an equipment management program that involves all employees in the company in the maintenance and repair of the company assets, whether a facility or plant." (Wireman, 2004). Many Smelters are using this management system in order to determine the effectiviness of the equipment used and control their maintenance. This can be easily checked by typical words such as "OEE", "5S" and "SMEG" systems introduced on differtent levels inside an Aluminium production facility.

However looking at rolling equipment or " vehicles" it seems to be hard to reach for a cost effective safe transport system. Therefore in most smelters that we studied we discovered a less optimal fleet that is utilised at higher than normal cost. In general for a management that try to run a smelter as cost effective as possible, vehicles are the one area of management where TPM is difficult to implement, and therefore often neglected. It therefore is not unusual for a smelter director to complain that much to his surprise the transport system of an aluminium plant is one of the areas he cannot get (financial) control over.

It is this reason that in time decision makers believe and openly state to us that:

- It is better to not use vehicles because to much injuries happen with vehicles
- No matter what quality of vehicle you buy it will break and let you down in an uncontrolled manner
- A typical maintenance budget for vehicles is equal to the budget required to replace the fleet completly
- Vehicles are a liability risk, unpredictable and unsafe.

KPI's that influence the performance of maintenance on a fleet.

But why is it that vehicles do have such a bad reputation within our industry? While introducing new TPM maintenance system to smelters in different areas of the world, we discovered that in all cases the success, or lack of success, had to do with several key parameters that are not met.

1. End User involvement and Research

on the total investment of a smelter the capex required for a suitable fleet is relative low. However, the impact of this investment easily can stop the entire smelter, because metal will not be transported to the casthouse or anodes will not be distributed to the potline. Despite this impact on the total performance and efficiency of a smelter the choice of equipment and design of the logistic system and its safety impact, is not researched as thoroughly in the industry as for instance Anode backing or the Hall Heroult process.

2. Housekeeping

It still is common practice in most smelters. Only a view months after the introduction of new equipment this equipment looks warn and like it is used for 10 years instead of just a view months.

3. Knowledge

Customers all over the world lack knowledge at three levels. Level 1, during the definition phase most smelters lack engineering power. They therefore request an EPCM to select potential suppliers and vehicle concepts. However an EPCM is not used to produce or maintain equipment, therefore they lack knowledge to select the bid with the lowest operational cost. Level 2, most users do not understand the impacts of high magnetic fields in combination with abrasive dust on the equipment used. As a result operators make accidents and abrasive dust is penetrating vital components doing nothing else that forcing a maintenance crew to repair on a weekly or daily basis. The third level and therefore an ongoing reason for high cost, is the lack of knowhow and training of the people that maintain vehicles. Most vehicles are produced in Europe or Canada. However most of the maintenance crews are not trained or educated in this countries and therefore lack the knowledge and experience that is available in the design and production face of this valuable equipment.

4. Inventory control

As finance became a dominating factor in the technical decisions of a smelter, inventories are reduced and replacement parts needed to come more and more at a Just in Time delivery from the suppliers or OEM distribution channels. However, most vehicles are still fit to purpose for a specific smelter with components that the smelter insisted to use. The combination of technical customizing together with lack of budgets to allocate enough spare parts, results in a low availability of vehicles and multiple improvisations by the technicians that maintain the vehicles in order to fulfill the original purpose of such a fleet.

5. Re-investment criteria

Most clients use the same criteria for an expansion that they use for a re investment of the fleet. Unfortunately replacing a car because it is worn out does not have an ROI. If this is recognized

to late as a result maintenance cost will rice out of control in order to keep the fleet in duty.

6. Empowerment:

Finally if all above is understood well it is too often that operations have the power to override any maintenance performance at all cost. This power can easily create a down curve in the availability of equipment and a cycle of repairs just long enough to survive the next shift.

It is these six criteria that often result in unpredictable performances of a fleet inside a smelter and as a result of this maintenance budgets that very often, much to the surprise of management, do show a negative impact on there overall perfomance since this this cost are variable indepent to the conversion cost of Aluminium.

Breaking the curve or the impact of Preventive Maintenance in our system.

It is nice to know the criteria, but what can we do about it?

On the research field there is little we can do on a practical level. However on a management level we can analyse trends what and invest part of our reveniews on research. This is what Hencon does with research on logistics and research on best maintenance practices with benchmarks between the different maintenance facilities we run.

This research results in a set of rules that we apply with every maintenance facility we start. The first and most important one is knowledge. Every maintenance facility of Hencon is run by a management that has the required knowledge and attitude. This knowledge is used to directly communicate with and assist the maintenance crew on its daily task. Where their individual knowledge is not enough they get direct support from the designers to allocate improvements and troubleshoot events that happen.

The second important factor we focus on is preventive maintenance and housekeeping. Washing and cleaning a vehicle before and after maintenance seems over the top. However it is this attitude that is the start of introducing a new attitude with regards to the use of vehicles within maintenance and operations. It is only on a clean vehicle that it is easier to recognise symptoms of failure and abuse that are reducing the lifetime and proper functioning of equipment rapidly.

The third factor is “the drumbeat of maintenance”. Doing a good PM job is focusing on the next interval of maintenance and assure yourself that the vehicle will perform during this next interval. It is anticipating on parts that will break because indicators show they are about to break, instead of replacing parts that are broken. This sounds controproductive and like wasting money. But, do remember the purpose of a fleet is to run, not to be repaired and therefore it is essential to train your maintenance crew to maintain and not to repair what is already broken. A typical example of this is that a well maintained and prepared engine will run between 10.000 and 14.000 hrs (on a machine with a utilisation of about 6000 hrs a year). Replacing this engine in time will safe down time and cost approximatly 40% less than waiting for that engine to fail.

Apart from training and knowledge this factor also requires that the maintenance crew becomes the coach and advisor of the users. Simple questions like did you notice anything strange and is there something I need to repair for you, do have a positive impact on cost and availibility of equipment.

The next step is empowerment that assures that the maintenance crew is able to perform its task efficient and up to the requirements. This sounds relative easy, but in many cases we notice that the time between requesting a part to be purchased and the actual delivery can take up 3 to 6 months untill final delivery. This is not an easy forecasting system to adapt to and therefore analyse the internal barriers that do cause delay and reduce any of them that you are not entirely sure of that it will safe you money. The right empowerment will give you the budget control you look for at much lower and predictable cost than a conventional system.

The fourth factor we apply is education and training. Having a good system is one, however if you do not train the crew it still will not bring you much. Most maintenance crews are underskilled when it comes to preventive maintenance. They simple do not know what to look for. They are able to repair what is broken, but they lack knowledge on recognising the symptoms that cause a part to fail. For instance replacing a seal on a hydraulic cylinder that leaks is a relative easy job. However, once that cylinder is leaking it is most likely that this replacement will become a regular job, because if the seal leaks most likely the shaft is damaged as well.

All of the above criteria we have been able to implement and influence succesfully in maintenance facilities in Russia, Mozambique and India. Despite the local differences all 3 facilities have in common that they reach an uptime or OEE of 95%. However in all 3 cases the critical succes also have been linked up with a typical attitude we only found with Hencon maintenance managers.

Worldwide maintenance support.

The criteria discussed made us wonder if we would be able to facilitated the same attitude and performance without the requirement of taking over the management and starting up a mainteance facility. Since we do have the knowledge, we know the criteria and modern technology should be able to share this 2 items with our clients we started the development of new software in order to support our clients further.

The result of this attempt is shown in below figure.

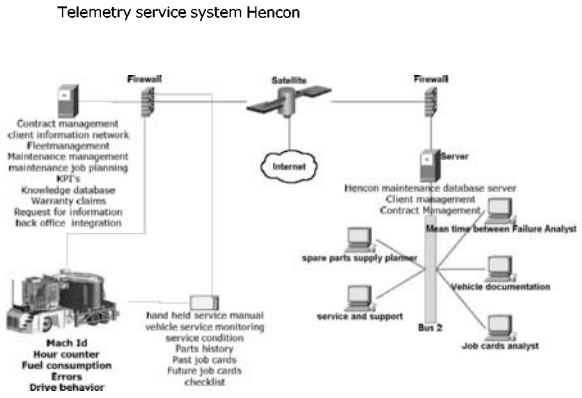

Figure 1: Hencon remote maintenance control system

With today's IT services it is possible to access any vehicle and collect on line data on its status that can help to inform a maintenance crew on the well being of the equipment. This was the primary reason for us to test a vehicle data system as described in figure 1 within our industry.

The next step we enable with this system has to do with accessing data that normally is collected and generated in a maintenance shop with regards to, preventive maintenance, troubleshooting and repair jobs executed. Accessing this data online in the same environment as the vehicle trace system, allow analyses on maintenance in comparison with the actual use of the vehicle. Doing this on line means that data that normally is only available with a time delay of a couple of weeks now comes available on the spot, the minute the service is completed. Sharing this data with designers, maintenance analyst and our most experienced maintenance managers, allow us to start allocating trends. As a result the knowledge available in the best maintenance managers can be shared instantly with maintenance personal all over the world.

Based on this trends monitored in the system it will be possible for less experience maintenance personal to learn from the experiences collected by the best in maintenance and share lessons learned on troubleshooting, root cause analyses and best practices.

Now what questions did we answer with the help of this system:

- Knowledge: the support model allows knowledge to be shared with all users at different levels of education and offers a 24/7 communication channel with the designers for troubleshooting and continuous improvement
- Management: its online content access the best practice experience collected in the last 10 years of doing maintenance. Apart from that the technology also allows to share this content in "real time" between users and managers. This means the minute the job is not executed correctly the manager already can know this, prior to releasing the vehicle to production again.
- Empowerment: the system offers a full online history but also powerful tools to set and plan future actions in detail and allocate the necessary tools and parts required to successfully execute such future jobs. Even years ahead from today.
- Housekeeping and inventory control: remain issues that need to be tackled by other means.

Although the system is tested at this moment and a commercial launch will be planned early 2013. The initial test already show that the system will be a support to our existing operations and do allow us to directly support customers all over the world with accurate data and direct maintenance support in line with the lessons that we learned in the past. As a bonus we have seen that the system also generate valuable operational data on, where vehicles are active and in what status they are.

Conclusion

With regards to all our experiences we do see that:

- A reliable service level and OEE of 95% is essential for a successful operation of a smelter with a compact fleet
- Knowledge and know how on practice and preventive maintenance systems is not well spread into industry. The theory is known but practical skills are harder to learn and maintain
- Within India, Russia, Europe and Mozambique we found consensus on best practices. Implementing this best practices results in lower cost and higher uptime. Although the level of integration requires a long term process with the end users and clients
- Today's information society allows any user in the world to reach this same level of advantages, as long as the relation between customer and designer is established at minimal cost to both parties

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[1] *Total Productive Maintenance, Terry Wireman Industrial Press Inc., 2004*

[2] *Vehicle Data Management, R. Roth Internal report Hencon (2011)*

[3] *Key Performance Indicators Hencon Services, M.G. Meijer Confidential customer information (1986-2011)*