



EFNMS Maintenance Benchmarking Committee

Conditioned Based Maintenance

Introduction:

First a great thanks to all the experts from CEN, SMRP and EFNMS contributing to the discussion. I think this is an example where a network of experts is valuable, and will support a common agreement and understanding of differences.

This is also an opportunity for us to impact the standardisation activities as expressed by Antoine Despujols.

The Story

I have discussed the situation with my two colleagues Mr. Lou Bricate and Mr. Stan Dard-Vader. They deeply apologize for confusing you. Therefore a short comment to the story. The oil sample had a high content of wear metals indicating a degradation process under development in the gear box.

A plan for dismantling of the gear was made – There was a planning window! – and the gearbox was taken out of service two weeks later without any impact on the production. – No downtime on the production process!

Most of you have captured the situation as above.

Conclusion on Question 1:

Question 1: Are human senses are included in CBM.....

	Yes, Human senses are included in CBM	No, Human senses are <u>not</u> included in CBM
Reinhard Kolb	X	
Dick Olver	X	
Juraj Grecik	X	
Antoine Despujols	X	
Kari Komonen	X	
Herman Baets	X	
Christer Olsson	X	
Tom Svantesson	X	

There is no doubt that the experts is in favour of including the five human senses in CBM, so I suggest that the Europeans accept the proposal from Antoine Despujols on putting a note in the Terminology standard revision, that human senses are included.

Such a decision will also support a harmonised definition between EN and the SMRP Glossary.

Please let me know if I have misinterpreted your comments for Question 1.

This was the easy one!!! Question two was more challenging



EFNMS Maintenance Benchmarking Committee

Conclusion on Question 2:

Do we include the subsequent activities from a CBM in CBM?

	Yes! we include the <u>subsequent activities</u> from a CBM in CBM?	No! The activities are deferred corrective	Comments
Reinhard Kolb	X		
Dick Olver		(X)	5.4.12 PM & PdM Yield. To be discussed during harmonisation
Juraj Grecik	X		
Antoine Despujols	X		Comment 1
Kari Komonen	X		
Herman Baets	X		We identifies the activities from CBM as: "Activities as a result of CBM"
Christer Olsson	X		
Tom Svantesson	X		

There is no doubt that the European experts are in favour of including the subsequent actions in CBM, although the picture is more diversified.

There is also a need for tracking the Yield from PM and PdM as expressed by SMRP and BASF.

I suggest including this broader discussion as a face to face meeting and/or a discussion in the harmonisation process and/or the TC319 WG 4. Especially the comments from Mr. Kari Komonen need to be discussed.

Comments from Mr. Reinhard Korb:

Dear Tom,

That's an interesting discussion !

Sorry, for answering your question so late. I had no access to my mails during the week. This is my answer: Although the EN 13306 does not explicitly include "human sensors" it makes a lot of sense to do so.

(question 1: YES)

If condition monitoring leads to planned repair actions (providing sufficient planning leadtime - depends on the necessary planning activities), the condition monitoring program is effective. Thus all measures resulting from the inspection and analysis results have to be counted as condition monitoring activities (as Dick argued very clearly). Thus I agree with Stan Dard-Vader, if the gear box was still in use until the begin of dismantling.

I like the statement of Juraj regarding partial failures!

My answer to Juraj's question: If the partial failure does not impact the main function of the asset until correction (after planning and preparing!) it should be preventive.



EFNMS Maintenance Benchmarking Committee

We could think of the following example: A water pump is leaking a little bit. However, there is not impact on flow an pressure up to now. As it is water (not safety issue) and the main function is not affected - preventive maintenance!

Comments from Mr. Dick Olver

Tom

Since I was copied I will enter into the discussion.

Question 1. As we have include human senses in the SMRP definition the answer is Yes

Question 2.

In the SMRP devolvement we thought it was important to understand how much work is being identified by your preventative and predictive maintenance program and developed the measure 5.4.12_PM-PdM Yield.

Objective

Equipment reliability is the ultimate measure of a PM/PdM program. This metric helps to understand how effective the PM/PdM program is at identifying potential failures.

Definition

PM & PdM Yield is a measure of corrective work that results directly from Preventive Maintenance (PM) and Predictive Maintenance (PdM) tasks in place. The measure is the amount of repair and replacement work that is identified when performing PM or PdM work compared to the amount of PM or PdM work being done.

My thoughts

I want to understand how much I am spending on CBM and if the cost of major repairs are included it will distort that number. I am also very interested in how effect the CBM program is and that effectiveness has two aspects,

- 1) are you having failure and
- 2) is the program identifying impending failures Three Scenarios If you are having failures and the CBM program is not detecting impending failures I have a serious problem with my CBM program

If you are not having many failures and the CBM program is regularly identifying impending failures need to continue If you are not having many failures and the CBM program is not detecting impending failures you need to review your program your program may be too extensive

Has been a good discussion, thank you for the opportunity to participate, dick

Comments from Mr. Juraj Grecnik:

Dear experts,

Very nice discussion.

1. I support the idea that CBM can include also human sensing, although not explicitly written in 13306.
2. In these cases we should consider the „partial fault“ (§ 6.4 in 13306) or „latent fault“ (6.3), though partial fault is better for this case, I think. This means a machine is working though not in 100% condition. However, the (partial) fault was detected during CBM and was subsequently corrected in a planned time. I think that partial fault is very common. Lot of maintenance is being deferred for long time as the machine or facility can still be used though not in full function. CBM has lot to do with the partial faults, do you agree? So I am in favour of condition based maintenance for all the human sensing as well as for laboratory analysis and consequent repair.



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So for me there is also a question where the partial fault maintenance (repair) belongs to – corrective or preventive?

Thank you for your opinions,

Comments from Mr. Antoine Despujols

Dear Tom,

Thank you for this interesting case which open the discussion about an important term of our standard.

In the revision a new proposal for the definition is the following :

7.4 Condition based maintenance

Preventive maintenance which include a combination of condition monitoring and/or inspection and/or testing, analysis and the following maintenance actions.

NOTE : The condition monitoring and/or inspection and/or testing may be scheduled, on request or continuous.

Which is not very different than the old one (“Preventive Maintenance based on performance and/or parameter monitoring and the subsequent activities”). Only a bit more precise.

About your questions :

Question 1

Nothing in this definition is said about the sensors used to perform inspection or to monitor parameters and the five human senses are a way to inspect items. So the answers is “Yes, Human senses are included in CBM”.

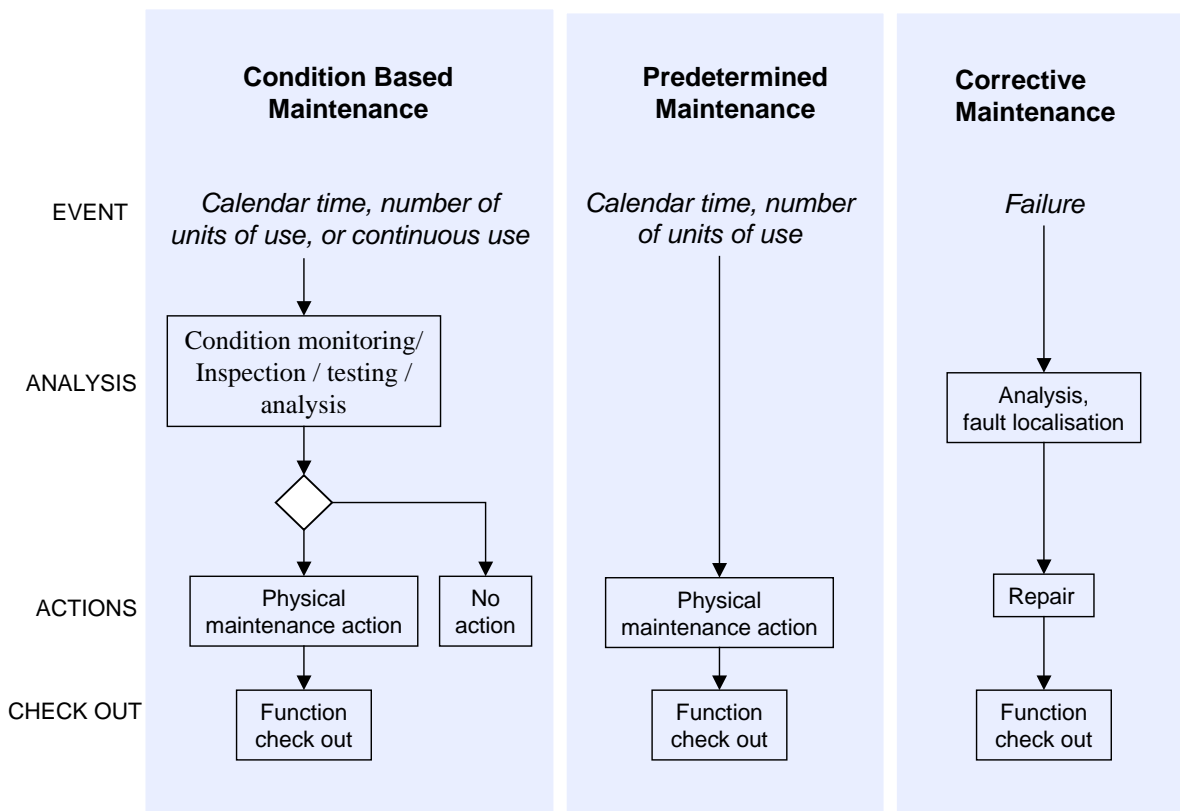
If you think that this point is not obvious we could possibly propose a note saying that human senses are included in CBM.

Question 2

The comparison between CBM, Predetermined Maintenance and Corrective Maintenance is represented below :



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Condition Based Maintenance includes the actions done to observe, measure and analyse the item and the following physical maintenance actions possibly done.

According to your case 2, the oil analysis “suggests a breakdown of the gearbox is eminent”. That means that the gearbox has not already failed. But when Lou Bricate dismantled it he find a failure ! Strange story ! Are you sure that Lou Bricate knows the definitions of failure and degradation ? Anyway we could imagine two scenarios :

- 1) The gearbox was degraded but not faulty and the history record is wrong : it was not a failure of the gearbox but a degradation and the physical action done to remove this degradation is a Condition Based Maintenance action.
- 2) The gearbox was faulty but in standby so this fault was not evident and only discovered thanks to an oil analysis and a dismantling (strange situation !). In that case the item has a fault and the repair is a Corrective Maintenance action.

So Stan Dard-Vader must understand what really happened before to answer the question of Lou Bricate.

Comments from Mr. Kari Komonen

Dear Experts



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Case 1: I understand that EN13306 does not limit the means of condition based maintenance. Therefore it may include human sensing.

Case 2: Let's take another example. By using predetermined maintenance programme Lou noticed that one bearing is failed. The same actions were taken in a workshop as in Tom's case. Where would you allocate those costs?

You did not tell about any production losses. Was the gearbox replaced and then repaired in a workshop (the failed one). In this case I would say that the condition monitoring activities and the replacement are condition based maintenance, whereas repair work in a workshop would be deferred corrective maintenance or refurbishment.

Another question is when we talk about condition based maintenance and when immediate corrective maintenance. I think that condition based maintenance is preventive, planned and scheduled maintenance. Did your case fulfil these conditions. If you notice today that you have to repair something during the same day (regardless the method used), I would include everything in immediate corrective maintenance, but if you plan and schedule in an optimal way a stoppage based on condition and then you repair the gear and put it back to operation, I would allocate all cost in to condition based maintenance.

Best regards

Kari
A maintenance philosopher

Comments from Mr. Herman Baets:

Yes, Human senses are included in CBM.....

~~No, Human senses are not included in CBM.....~~

In the later case how do we then log the human sense activities?

Question 2:

At our site, we follow the standard 13306 and declare the complete action as CBM, because there was no failure, which induced an unplanned production loss.

Nevertheless, to create more transparency, we will create an additional maintenance type: “activities as a result of CBM” to keep these costs visible. We don't name it deferred maintenance.

Deferred maintenance could also be a leaking pump (no production loss or failing), that can withstand till the next shutdown. This example is what we call deferred maintenance.



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Comments from Mr Christer Olsson:

On the human side yes, I consider this included in PM - for example inspections using only human senses - CBM.

For the gearbox - I am sorry to see that this time the dark side seems to be right. Detection and action before failure is condition based.

Original story

Questions to EN 15341 indicator E17, O19 and the definition on Conditioned Based Maintenance

Background:

The question on the interpretation of the indicators E17 and O19 came on the table during the workshop in Denmark October 8th 2008, and as a consequence of the harmonisation effort with the SMRP metrics.

Objective:

The objective for bringing this issue to the table is to reach a common agreement for the facilitators at the benchmarking workshops and to explain the differences for the harmonisation with the SMRP metrics.

Question

The question is related to the definition to Condition Based Maintenance - CBM

Definition on Conditioned based maintenance from EN 13306:

“Preventive Maintenance based on performance and/or parameter monitoring and the subsequent activities”

Definition on Conditioned Based Maintenance from the SMRP Metrics Glossary:

Predictive Maintenance (PdM)	PdM is an equipment maintenance strategy based on measuring the condition of equipment in order to assess whether it will fail during some future period, and then taking appropriate action to avoid the consequences of that failure. The condition of equipment could be measured using condition monitoring, statistical process control, equipment performance, or through the use of the human senses. The terms Condition Based Maintenance, On-Condition Maintenance and Predictive Maintenance can be used interchangeably.
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Question 1:

SMRP metrics Glossary includes the human senses in CBM. EN 13306 don't address the issue of human senses, but I have seen human senses included in CBM in various literature, so will the European experts include or exclude human senses in CBM.

Yes, Human senses are included in CBM.....



EFNMS Maintenance Benchmarking Committee

No, Human senses are not included in CBM.....

In the later case how do we then log the human sense activities?

Question 2:

EN 13306 includes the subsequent activities from a CBM in CBM. I have illustrated the question in the case below.

Case 2:

Mechanics Lou Bricate has taken an oil sample from the lube oil system to a large gearbox (3 MW) and shipped the oil sample to the oil company for analysis.

The cost for the oil sample is ½ man hour at 25 Euro and 100 Euro for the oil sample.

One week later arrives the result of the oil sample, and the analysis from the oil company suggests a breakdown of the gearbox is eminent.

The gearbox is inspected and dismantled for overhaul. The oil company was right, one bearing had failed.

The gearbox was repaired and put in service.

The cost of the gearbox repair was 100 man hours at 50 Euro/h and spares and services for 15000 Euro.

Mechanics Lou Bricate and the indicator expert Stan Dard-Vader have discussed how to record the hours and costs to produce indicator E17 and O19.

Lou Bricate will count the 25 Euro + 50 Euro as CBM Costs and count the overhaul of the gearbox as Deferred Maintenance.

No! Says Stan Dard-Vader. According to the definition from EN 13306 we must count all the cost and hours from CBM and the subsequent activities as CBM. This means. 25 Euro + 50 Euro + 5000 Euro + 15000 Euro

I have discussed the question with several maintenance managers. All replies was that the procedures and work flow was in support of the arguments from Lou Bricate.

Who is right Lou Bricate or Stan Dard-Vader???