Application of RCM to Construct a Maintenance Program for a Maritime Vessel

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Introduction

Outlining a vessel maintenance strategy that preserves reliable and safe operation is of great interest to both third party companies, ship owners and the society. Traditional maintenance procedures for a vessel's systems are commonly a result of recommendations from manufacturers, legislation and classification societies. The recommended practice is often a combination of preventive and corrective means. Utilizing a more analytical approach could potentially reduce unnecessary maintenance work and better tailor the maintenance plan to its context.

A maintenance method that has obtained successful results within several land-based industries is reliability centred maintenance (RCM). By combining operational and technical data with information based on employees' experience, the practice leads to a maintenance plan that promotes system reliability. Consequently, it is an adequate approach to use as alternative to the traditional maritime maintenance mind-set.

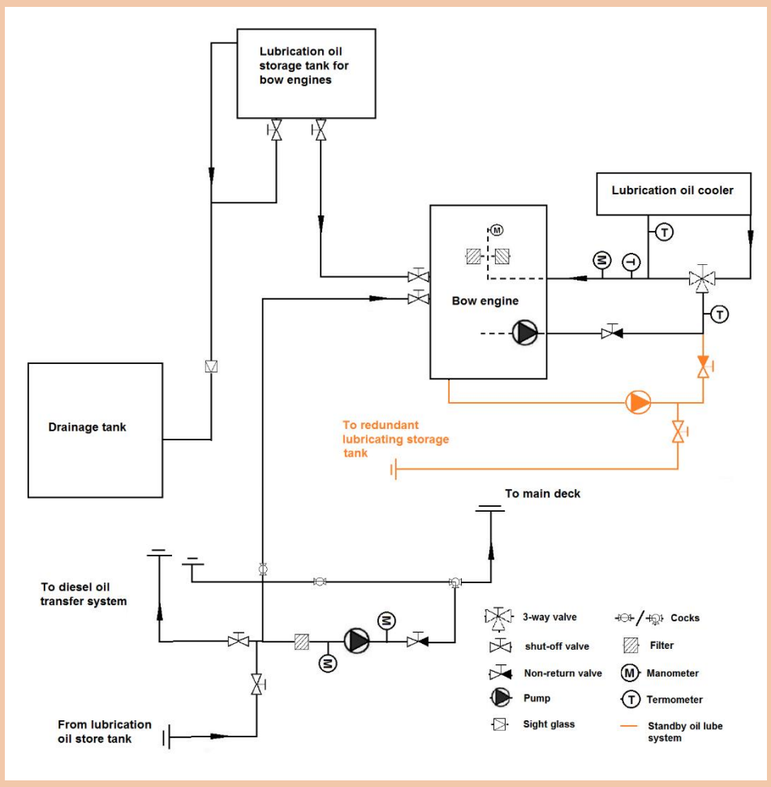

Figure 1. System illustration of lubrication oil system.

Objective

The main objectives of this thesis are:

1. Shortly present the traditional maintenance practice common in the shipping industry
2. Describe the RCM method, what the process includes, pros and cons
3. Perform an analysis on a technical system in maritime context, by the use of RCM
4. Based on results from the RCM procedure, establish a maintenance strategy that suits the system under consideration and ideally improves the current practice
5. Discuss whether the analysis results shows that the RCM procedure suits a maritime context

The scope of thesis is to exemplify the practice of RCM by analysing an engine's auxiliary systems on a vessel operated by Wilhelmsen Ship Management (WSM). Proper descriptions, such as the system illustration above, are given for each auxiliary system. In accordance with the RCM process, functional statements, identification of functional failures, FMECA worksheets and a final maintenance strategy for each auxiliary system are created. The results from the analysis is used as input to create a maintenance strategy that is applicable for WSM, using corrective and preventive means.

Method

There exists a variety of theories concerning which stages the RCM process should include. The approach utilized in the thesis is outlined by Moubray (1997). From this perspective, when a system is analysed by the RCM procedure seven questions should consistently answered:

1. What are the functions and associated performance standards of the equipment in its present operating context (functions)?
2. In what ways can it fail to fulfil its functions (functional failures)?
3. What is the cause of each functional failure (failure mode)?
4. What happens when each failure occurs (failure effects)?
5. In what way does each failure matter (consequences)?
6. What can be done to prevent each failure (proactive tasks and tasks interval)
7. What should be done if a suitable preventive task cannot be found (default actions)?

Results

The below extract of the results for the lubrication oil system is also representative for the remaining auxiliary systems.

Failure mode, level 1: Lubricating oil system failure

						Consequences						
Failure mode Level 2	**Failure mode Level 3**	**Effect**	**FP**	**MTBF**	**Hidden/Evident**	**H**	**E**	**OH**	**P**	**R**	**RI**	**Maintenance task**
a. Attached pump failure	1. Leakage on pump seal	Leakage of lube oil, dirt on pump seal, reduced pressure of circulating lubricating oil, wear on engine parts	B	5 years	Evident	2	2	2	2	2	2	Run to failure
	2. Contaminated oil	Increased wear on rotating parts, foreign particles reduce the lubricating effect, increased friction loads	B	6 months	Hidden	4	4	4	6	4	6	Condition monitoring
	3. Wear/fatigue/tear	Lube oil not circulating at correct pressure, more wear on rotating engine parts, component failure	C	5-7 years	Evident	2	2	2	2	2	2	Periodic restauration
	4. Filter failure	Increased wear on rotating parts, foreign particles reduce the lubricating	B	6 months	Hidden	4	4	4	6	4	6	Condition monitoring

Figure 2. Extract of FMECA worksheet for the lubrication oil system.

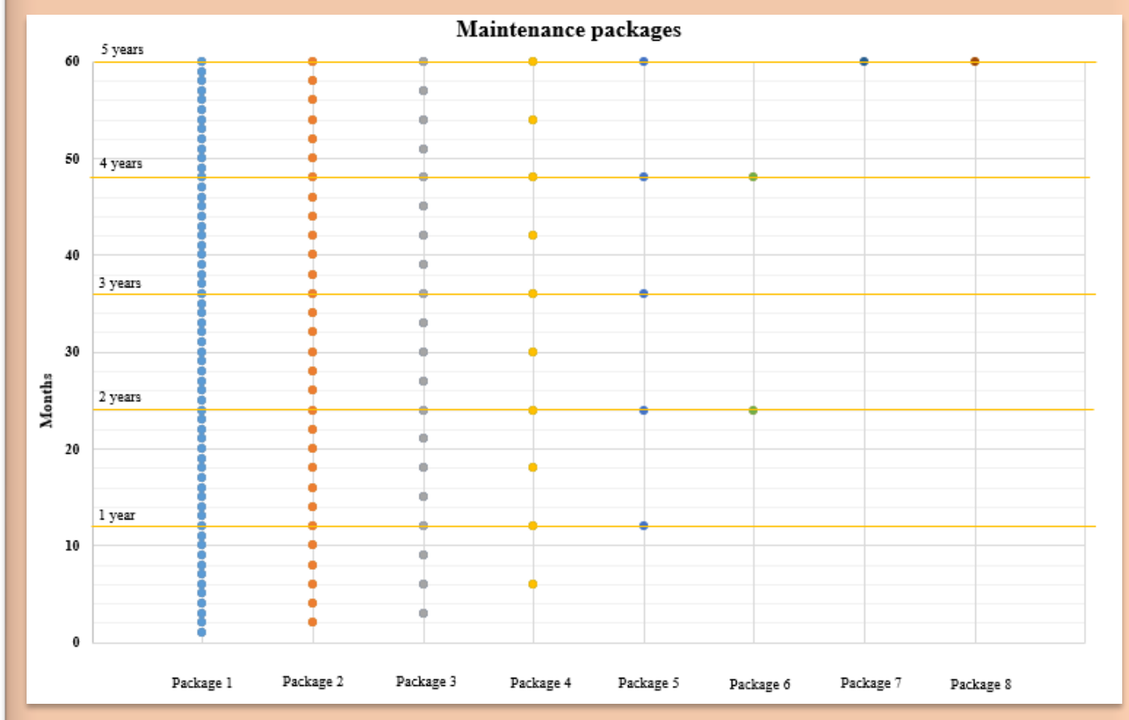

Figure 3. Part of the maintenance package plan for the auxiliary systems.

Conclusion

The RCM practice is an approach that may successfully outline a maintenance strategy for a maritime technical system. However, the detail level must be considered to its operational context as the method may be perceived as time-consuming and very comprehensive.

References: MOUBRAY, J. 1997. Reliability-centered maintenance, New York, Industrial Press.