SAFETY SCIENCE Monitor

ISSUE 1 2002

Article 3
ISSN 1443-8844

VOL 6

SHIPBOARD MAINTENANCE: POSSIBLE FUTURE TRENDS'

A. J. MOKASHI[1], H. DASTUR[1], *J. WANG*[2], A.K. VERMA[3]

[1]Indian Maritime Training Centre, Mumbai - 76, India, [2]School of Eng., Liverpool John Moores University, L3 3AF, UK [3]Indian Institute of Technology, Mumbai - 76, India. *J. Wang* is corresponding author

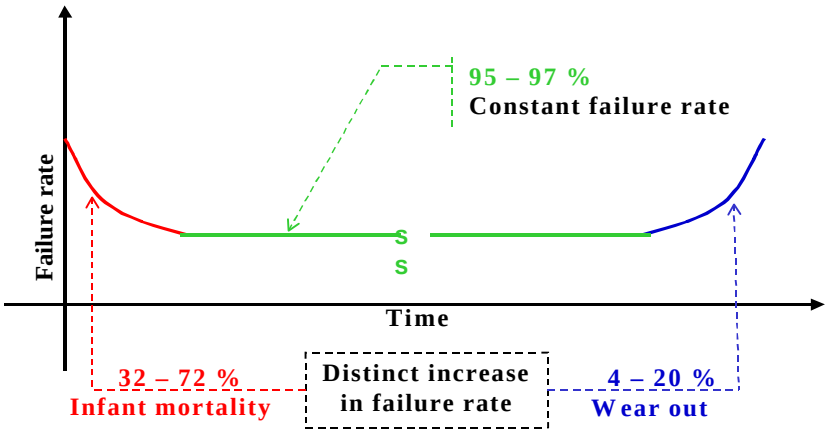
Abstract - This paper identifies the problems with the current maintenance practices as revealed by modern research. The limits of preventive maintenance especially with the paradigm of all components having a predictable useful life are discussed, against a backdrop of research from other industries.

The authors have suggested creation of awareness in the seafarers of the modern maintenance concepts of RCM and TPM to improve both reliability as well as cost effectiveness.

INTRODUCTION

Traditionally the maintenance onboard is carried out as per a schedule (preventive) that could be either calendar time or running time based. This is based on the assumption that every piece of machinery has a predictable useful life. However modern research investigating the way components fail has questioned this paradigm. Three such analyses have been carried out by United Airlines in 1968, Bromberg in 1973 & the US Navy in 1982 (NASA, 2000). While there is admittedly considerable variation in the results, the inferences drawn remain indisputable. We could divide the life cycle of a component into three stages.

- The 1st stage could be when the component is newly installed. The often-noticed high failure rate of components when new is called infant mortality.
- The 3rd stage could be the final stage when the failure rate drastically increases. This is termed as the wear-out.
- The 2nd stage or middle region accounts for the majority of the life of a component where the failure rate is constant.



Failure rate / Time relation

The figure above states the extremes in the values uncovered in these analyses. The points to note are:

1. Relatively very few components follow the age-old paradigm of a clearly identifiable wear out region.

2. Considerably more percentage of components have a high failure rate to begin with (infant mortality).

3. Almost all the components have a major percentage of their life where the failure rate remains constant (useful life?).

It has been noted that as systems get more sophisticated, they have more components that show infant mortality and less of wear out related failures.

1. This itself is a reason to question the logic of scheduled maintenance as a guiding philosophy. As pointed out only 4 – 20% of components are likely to gain from this. And even in their case, there are failures that take place before they reach the wear out stage.

2. However another point to note is that there actually more components which have a high failure rate when new. These would actually lose in terms of reliability if changed prematurely.

3. For the major part of the life of most components the failure rate remains constant hence there is really nothing gained by changing a component during this period. The important thing to note is that we cannot always predict the length or duration of this useful life.

"Reliability is the probability that a **system** will **successfully** perform its **intended functions** under **stated conditions** for a **specified period of time**." Mean Time Between Failure is thus the function of the variables highlighted (Blackwell et al., n. d.). So, to be able to use failure data the variables would either have to be kept constant or the variations would have to be accounted for. This is very difficult in the maritime environment and so the failure data cannot be considered portable i.e. originated in one ship and used in another. In any case there is no composite database of failure data from ships that is easily accessible, commercial sensitivity is often cited as the cause.

Generally the manufacturer's recommendations form the basis of a time based maintenance policy, however it is prudent to remember the constraints a manufacturer or supplier works under. He has no idea of the status of the variables mentioned in the operating context of the user. For example, a pump manufacturer does not know the sort of conditions a particular operator might use the pump under. The variations could be in the fluid being pumped, the suction head available, the discharge pressure required, the level of NVH (Noise, Vibrations & Heat) emissions both exposed to & allowable and finally the effects and consequences of failure on the system. To avoid warranty claims, he has to sort of consider a "worst case scenario" and then recommend a maintenance plan based on it. Often this leads to over maintenance,

which has its own problems, namely secondary or maintenance caused maintenance. This is said to account for 20-30% of all the maintenance carried out (Jones, 1995).

Since we have rebuked scheduled maintenance as an ideal approach, the other alternative that comes to mind is Condition-based or Predictive Maintenance. However it cannot be indiscriminately used everywhere. Generally P-F interval is used as a criteria to decide whether Condition-based Maintenance can be used or not (Moubray, 1997). This is the delay time from the point where the deterioration of performance can be detected to the point when the component functionally fails. This has to be clear and consistent. At the same time the duration of this interval has to be long enough to be practical to monitor at intervals less than and if required carry out corrective action.

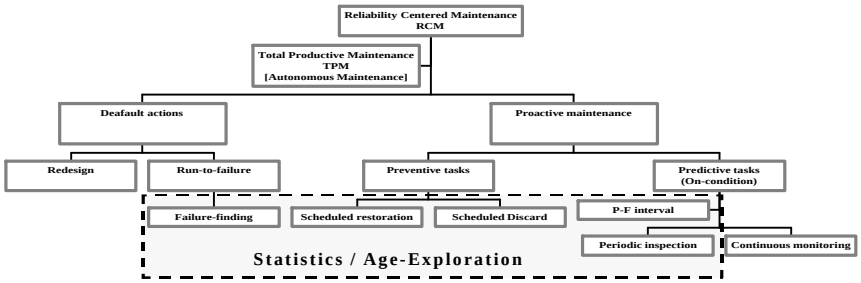
EMERGING MAINTENANCE APPROACHES

The aviation and automotive industries have done considerable work in maintenance management. The aviation industry has developed an approach based on the recommendations of Maintenance Steering Groups that were formed to advice on the appropriate maintenance approach for Boeing 747. This in turn has led to the development of what is known as Reliability Centred Maintenance (RCM). As the name suggests the idea behind his approach is to make the maintenance program Reliability "centric". While this may sound obvious, the innovation in this is that it makes the maintenance program focused on reliability of the **system function** as opposed to **component condition**. It thus gives us the option of ignoring failures that do not have any impact on system reliability. This is particularly valid in a system with adequate redundancies, where now one can consider not doing any proactive maintenance and there by exercise the option of "Run-to-Failure".

This approach recognises the importance of the operating context when deciding on the appropriate maintenance methodology. It is important to note that it does consider both forms of proactive maintenance i.e. preventive & predictive at the same time it even explores the possibility of not carrying out any maintenance.

The Japanese automotive industry has been practicing what is called the Total Productive Maintenance (TPM), which encourages the participation of the operator in maintenance (also referred to autonomous maintenance). TPM helps create the right environment for implementation of RCM, since the operator's participation is critical in keeping the maintenance program, operating context sensitive.

Relation between TPM, RCM & other maintenance approaches.



WAY AHEAD

Often insiders in the shipping industry perceive it as being different from shore industry, to the extent that the modern management concepts are not necessarily applicable to them. However it should be noted that RCM has already been used by DNV on some ships. While engine manufacturer Wärtsilä has started offering maintenance program based on RCM for their engines. In fact RCM was first used by the US Navy and currently the UK Navy also uses it. It has also been used ashore in industries like nuclear, chemical etc. With the ever present “commercial pressures” to reduce costs, the technical departments in the shipping industry, can look at RCM to get the biggest bang in reliability for the buck spent on maintenance. It is important to create awareness in the seafarers of the current approaches.

References

BLACKWELL, P., BAILY, R., HAUSNER, E. (n. d.) How Reliable Is Mean Time Between Failure (MTBF)?

JONES, R.B. (1995) Risk-Based Management: A Reliability-Centred Approach. Gulf Publishing Company.

MOBRAY, J. (1997) Reliability-centeredMaintenance.2nd ed. Industrial Press.

NASA (2000) Reliability Centered Maintenance guide for facilities and collateral equipment.