

Will increasing the frequency of overhauls or component replacements increase reliability?

Introduction

If the myth “Increasing the frequency of overhauls or component replacements will increase reliability” were true, then:

- *Organisations would achieve better efficiency and effectiveness by scheduling more frequent overhauls and replacements.*

Is this true?

Discussion

All assets have the potential to fail. The core of reliability engineering is about ensuring that the asset, or its constituent components, will perform in a satisfactory manner for a given period of time when used under specified operating conditions, i.e. minimising the potential for an actual failure to occur. It can therefore be considered an essential activity within an asset management system in order to ensure that assets can generate value through meeting organisational objectives and stakeholder needs.

Conceptually increasing the frequency of overhauls or component replacements can deliver a better outcome. However, achieving an outcome that is both efficient and effective requires:

- the failure being attributable to age or usage related failure modes
- accurate timing
- avoiding the introduction of other factors or failure modes that may also lead to functional failure.

To test the myth we need to look at each of these points:

The failure being attributable to age or usage related failure modes

Functional failure means the asset, or one of its components, fails to deliver the required outputs. What are your most likely failure modes that lead to this functional failure? Are they random, essentially unpredictable, events, or is there some way of predicting their occurrence? Does the probability or likelihood of the failure mode change over time, age or usage? Does its probability or likelihood of occurrence relative to other potential failure modes change?

Self-evidently, replacing a component that fails due to a randomly occurring failure mode with another, equally randomly failing component, doesn't actually achieve anything, no matter how often you do it. You are, in fact, just increasing the downtime of the asset in order to conduct the maintenance, failing to increase the available operating time and hence generating value, and costing more.

On the other hand, if there is a time, usage or age driven failure mode, then the issue becomes: Can I predict the failure timing?

Accurate timing

So, you want to manage the potential for an asset to fail by timely overhauls or component replacements? Optimally, we want to overhaul or replace the component using a just-in-time philosophy. Overhaul or replace it too early and we waste the remaining or residual life of the asset. Too late, and the risk cost of failure becomes unacceptable.

Reliability is driven by the concept of Mean Time Between Failure (or MTBF). While a useful concept, on its own it is somewhat useless for setting individual overhaul or replacement frequencies. This is because, being the mean time, 50% of assets are replaced too late, and 50% too early.

So if you are going to use the MTBF as the starting point for determining overhaul or replacement time, intuitively you will want to move backwards in time (i.e. more frequently), but to when? Maybe 10% too late and 90% too early? Or 5% too late and 95% too early? What is needed is a clear understanding of any particular asset or component condition, the corresponding likelihood or probability of failure and the timing of overhaul or replacement that aligns with what you consider to be the maximum acceptable risk of failure and the cost-benefit of doing so.

Avoiding the introduction of other factors or failure modes that may also lead to functional failure.

Some assets have a higher rate of early life failures than once they have been operating for a while (sometimes known as burn-in or start-up failures). This is the first part of what is known as the bathtub curve. Clearly, replacing assets or components that have higher early life failure rates means that you are going to have more failures than if you replaced them less frequently.

Another issue that needs to be taken in to account is wear and tear caused by repeatedly dismantling equipment. Repeated dismantling also creates more potential for internal contamination, or for faulty workmanship to occur.

Conclusion

Is the statement "Increasing the frequency of overhauls or component replacements will increase reliability" a myth?

Yes it is!



ASSET MANAGEMENT COUNCIL

Acknowledgment and thanks to AMCouncil AMBoK Team in writing of this article and giving permission for the Asset Management Council to publish.