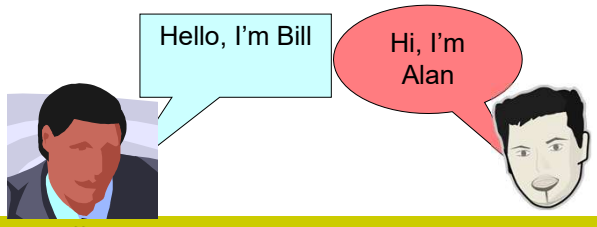
Goals of the Course

(What we are here to achieve)

1. Learn to stop Rotating Equipment problems
2. Learn to prevent Rotating Equipment problems
3. Maximise Rotating Equipment MTBF
4. Maximise Rotating Equipment Uptime and Availability

through …

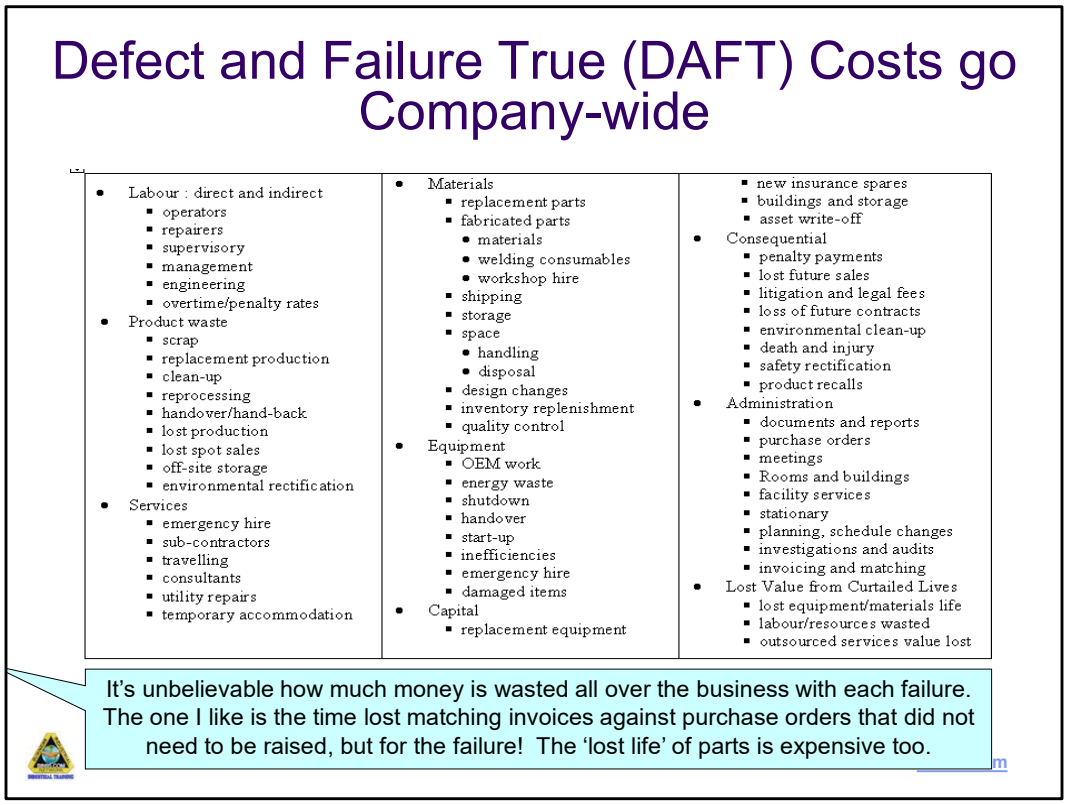
Maintenance and Reliability Excellence that delivers Rotating Machinery Health and Wellness



Follow Bill and Alan's efforts to improve their company's rotating equipment's health and reliability, and lower its maintenance costs while lifting its uptime.

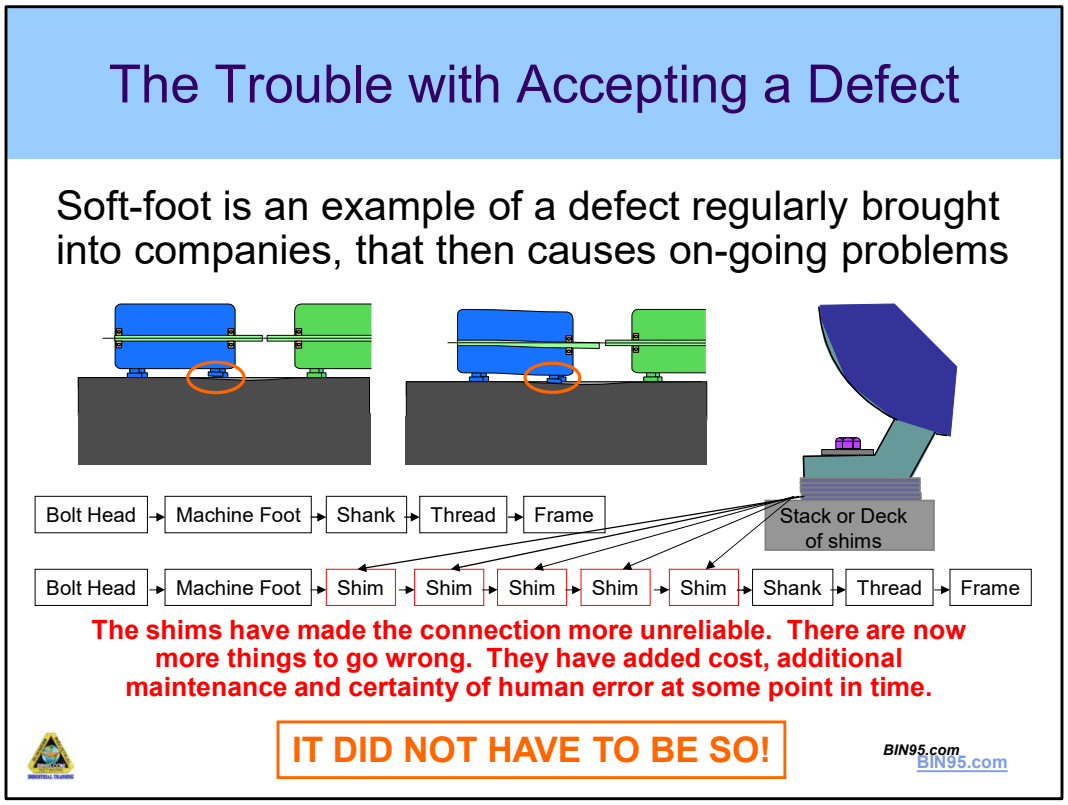
The aim of this presentation is to help you to overcome Rotating Equipment problems and get guaranteed long, problem-free operation of your Rotating Equipment. The course aims to deliver the four outcomes listed in the slide. It presents the information and the methods to do that.

To make the course interesting for you, and fun for me to develop, we will follow Alan (one of the company's maintenance supervisors) as he confronts the RE reliability problems in his operation. To help solve the downtime caused by the failure of equipment he gets help from his new maintenance manager, Bill. Bill becomes Alan's resource and coach as he addresses the Rotating Equipment problems in the operation.



What is not well understood, are the massive surge of costs and accumulation of losses that occur throughout a business when plant and equipment fail. The table lists more than 60 business-wide defect and failure costs that can arise from a forced stoppage. Most of these costs are hidden from view by the cost accounting practices in use today. Normal financial accounting practices do not recognised these costs for what they are; unnecessary waste and loss. Because many of the costs of failure are unseen, little is done to stop them, yet they continually rob commerce and industry of vast profits.

An astounding realisation is that repetitive failures which happen early after the last repair lose all the value remaining in the prior repairs. Look at it this way, the money spent on previous repairs were meant to keep the equipment going for a reasonable time. But when it failed early the money spent on the last repair never earns its worth back for the business. So the business loses money in making the new repair now needed, and it loses value from the money that was spent in the prior repairs. You get a double whammy slugged against the business – an investment loss and an operational loss!



Defects enter into organisations by the thousands a year, unless the organisation has put up defences. Once the problem is in your operation, you have to deal with it. In the slide, a soft-foot defect has been accepted into the plant. To correct it now requires the use of shims to fill the gap. Though this solves the problem, the shims have caused additional work. They also represent additional risk to the equipment. If they are lost it is highly likely the foot will be bolted down into the base frame without them, producing in a distorted and deformed machine. The parts in the machine will become deformed, be highly stressed, and fail faster.

By adding shims we may have stopped the deformation, but we have also reduced the reliability of the connection. From what should have been a bolted connection series configuration of five or six steps, the addition of the shims has turned it into a series process of 10 or 11 components.

The best answer to the risk of defects entering your business, is to ensure they are stopped before they cross your border. Put into place the necessary methods and precautions that ensure only high quality, high accuracy work is in your machinery from the outset. For the machine make sure the base is flat to within 0.025mm (0.001") across the feet and you will not need shims.

The Slow Destroyers

- Corrosion
- Erosion
- Wear

These methods of failure are known as failure mechanisms. They cause 'age-related' (i.e. based on the usage) failures in equipment parts undergoing their impact.

1) *How do you identify slow degradation (though 'slow' is a relative measure)?*
   - *On-condition and by process changes*

2) *When do you address it?*
   - *Once a selected parameter is breached*

Cavitation damage on the blades at the discharge from a Francis turbine

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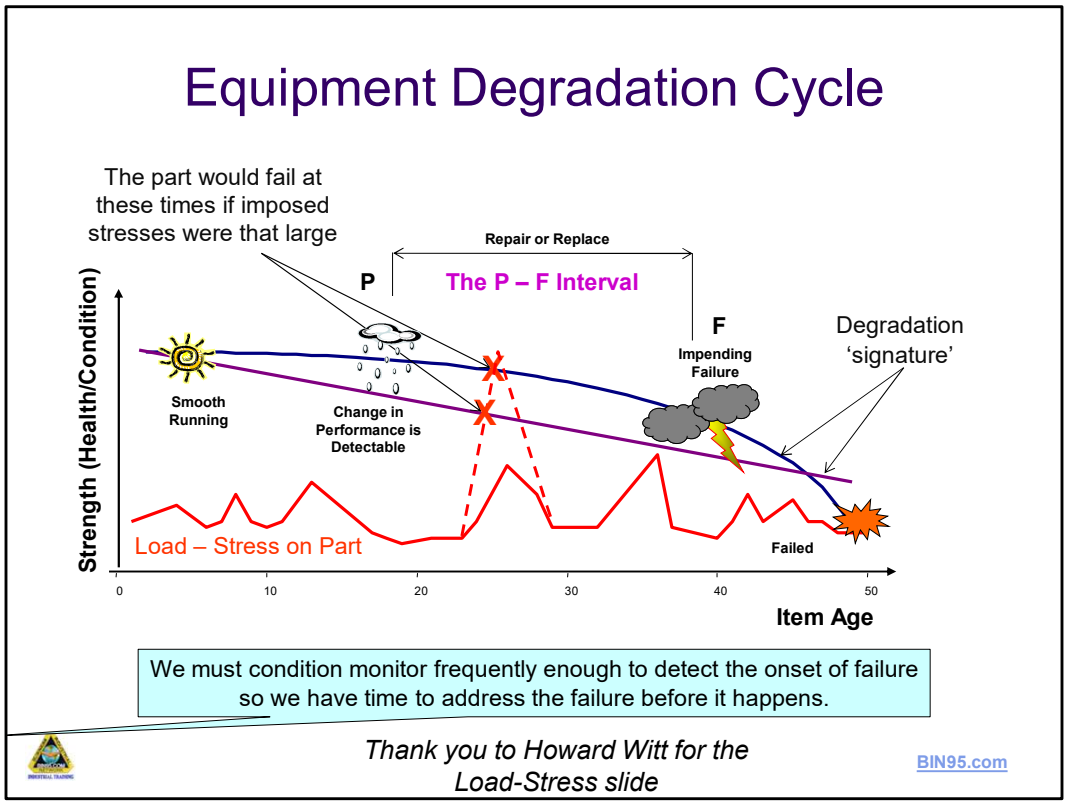
We need to be aware of all the ways that rotating equipment can fail. The failure mechanisms listed in the slide, corrosion, erosion and wear, can take a long time to cause problems. Though length of time is a relative term. It may be years, or many kilometres travelled, for a part in well controlled benign situations, or it can be several weeks for a different part in demanding situations. Age related failures require us to look for evidence of them as the equipment is used and monitor changes in selected parameters. These parameters include thickness, weight, length, depth, colour, odour, etc. They reflect the changes that occur as a part is used or 'ages'.

Slow degradation can take a long time to impact on equipment performance. To prevent the failures that result we typically use condition monitoring to trend the changes in selected parameters. We set acceptable limits and once breeched the parts are replaced. We need to match the frequency of observation to the expected rate of degradation so failures are prevented.



The degradation cycle shows the failure sequence for equipment parts. From normal operation they go through recognisable stages of degradation. This is the basis of condition monitoring, which is also known as Predictive Maintenance.

The degradation curve is useful in explaining when and why condition monitoring is used. Knowing that equipment parts show evidence of developing failure, it is possible to inspect at regular time intervals for signs of changes in behaviour. The point at which degradation is first possible to detect is known as the potential failure, 'P', point. The point at which failure has progressed beyond salvage is the failure 'F' point. We must condition monitor frequently enough to detect the onset of failure, so we have time to address the failure before it happens.