Rotating Machinery Health and Reliability Excellence

This is a sample of slides and notes from day 1 of this course. For more samples and info please see …

http://www.feedforward.com.au/Powerpoints/Reliability/machinery_reliability_Excellence.htm

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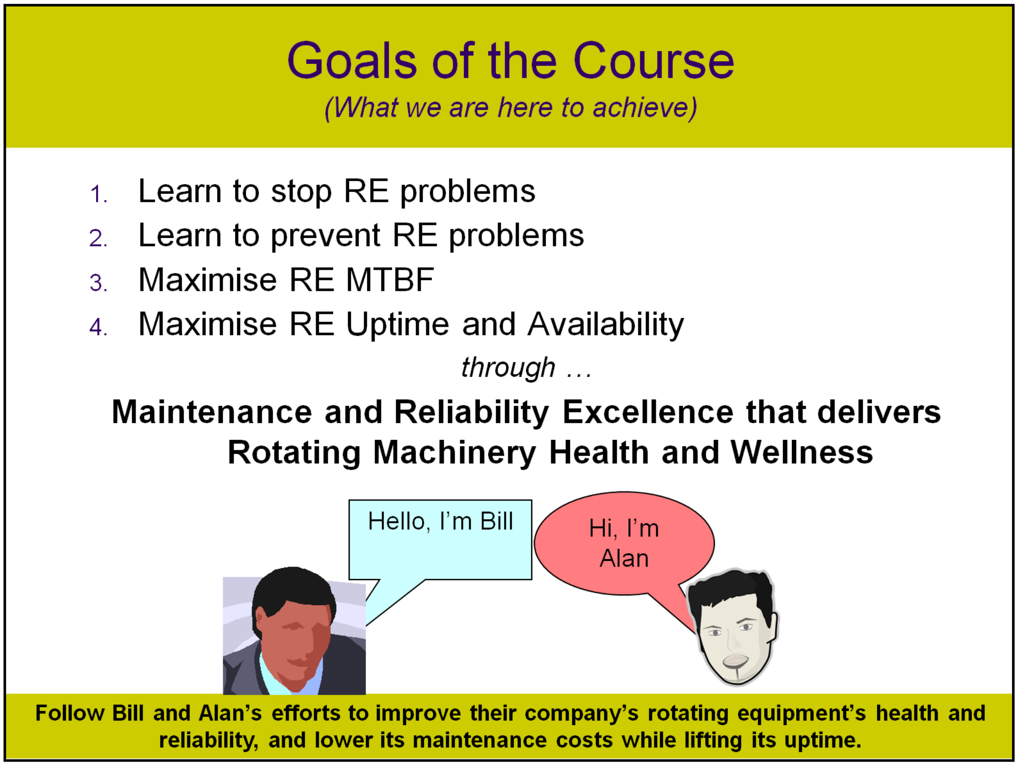
Welcome to this course on setting-up rotating machines and equipment for a long, trouble-free operating life. The course is divided into an introduction stage and an advanced stage. During the course you will cover, and come to better appreciate, the important issues for achieving Rotating Equipment (RE) reliability. Much of our industrial machinery rotates, it uses bearings and lubrication, and is mounted onto a supporting structure. What you learn in the course to improve rotating equipment performance can be transferred and applied to all of them.

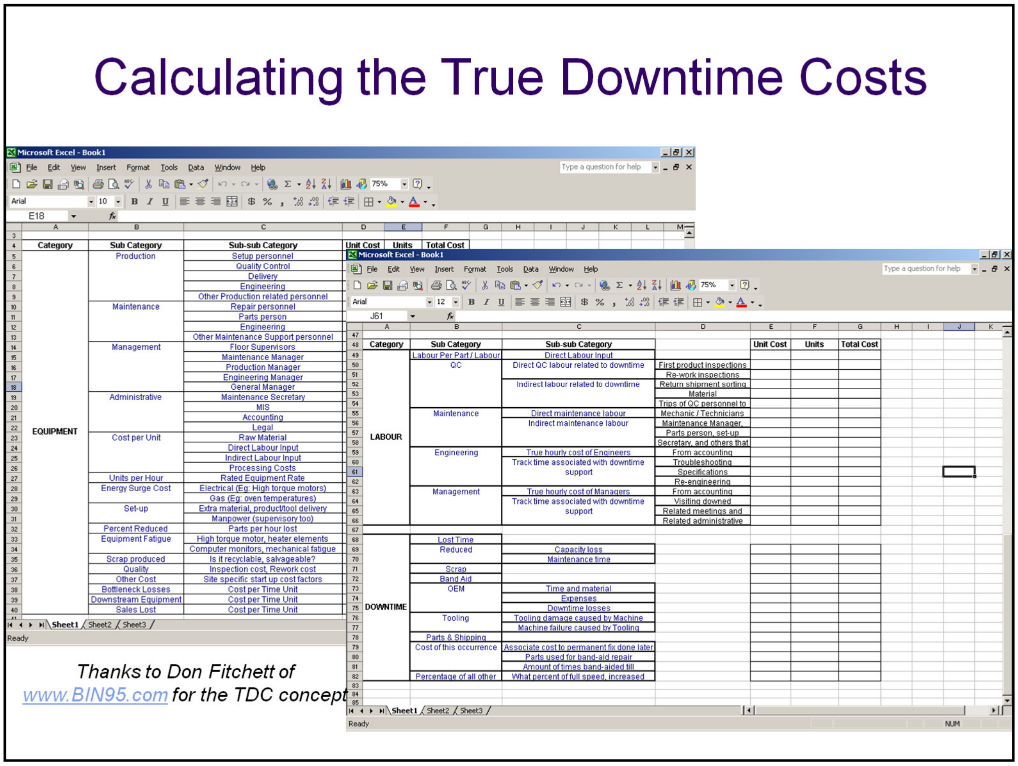
The course is brought to you by Mike Sondalini of Lifetime Reliability Solutions. Mike is an Australian equipment maintenance and reliability growth specialist who works around the world to help people and companies get outstanding reliability from their plant and equipment. His philosophy is to impart the knowledge and understanding needed to so look after all rotating equipment. Instead of focusing on specific equipment problems he provides an explanation and education that is the foundation for all rotating equipment health. To download complete 4 day course powerpoints, please see ...

http://www.feedforward.com.au/Powerpoints/Reliability/machinery_reliability_Excellence.htm



The aim of this presentation is to help you to overcome Rotating Equipment problems and get guaranteed long, problem-free operation of your RE. 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 RE problems in the operation.



The total impact of equipment failure is hidden amongst the many cost centres used in a business. For a failure incident to be fully and truly costed it is necessary to collect the numerous costs that surge throughout the operation into a single cost centre. It is not until all the costs, wastes and losses of failure are traced in detail throughout the business that the complete and true cost is known. This is done by following a failure throughout the business using the list of DAFT Costs in a spreadsheet similar to those shown in the slide.

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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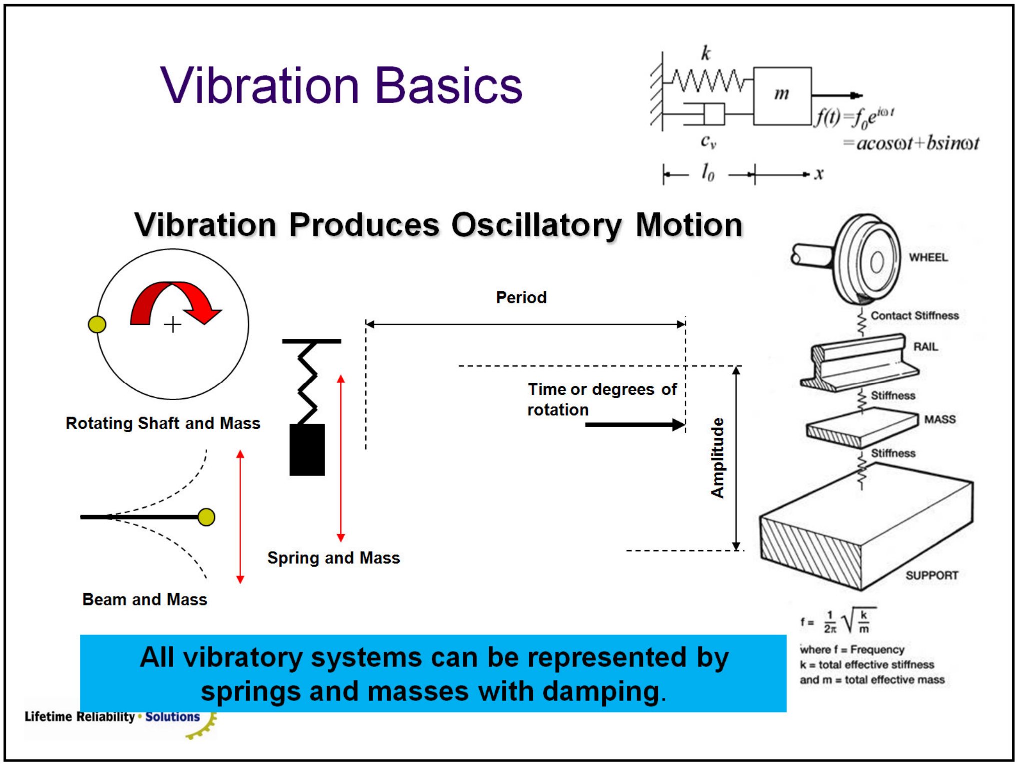
We need to be aware of all the ways that rotating equipment can fail. The failure mechanisms listed in the slide, corrosion, erosion and wear, can take a long time to cause problems. Though length of time is a relative term. It may be years, or many kilometres travelled, for a part in well controlled 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 p[illegible]s 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 prtevented.

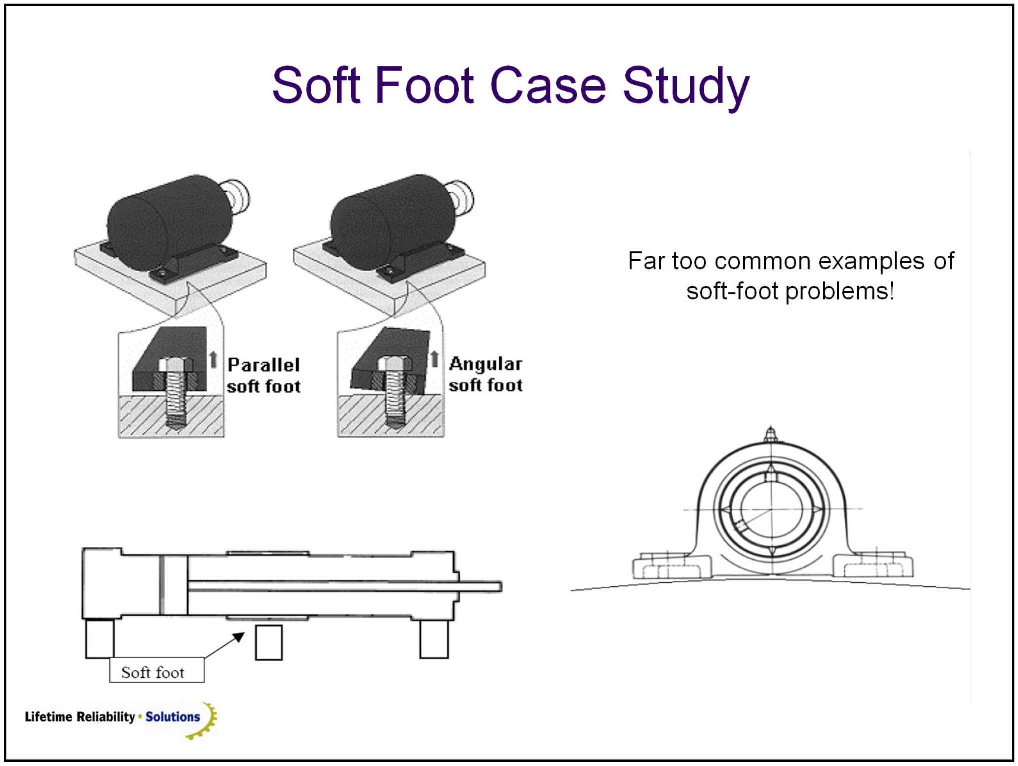


With rotating equipment it is important to have a good appreciation of the causes of vibration.

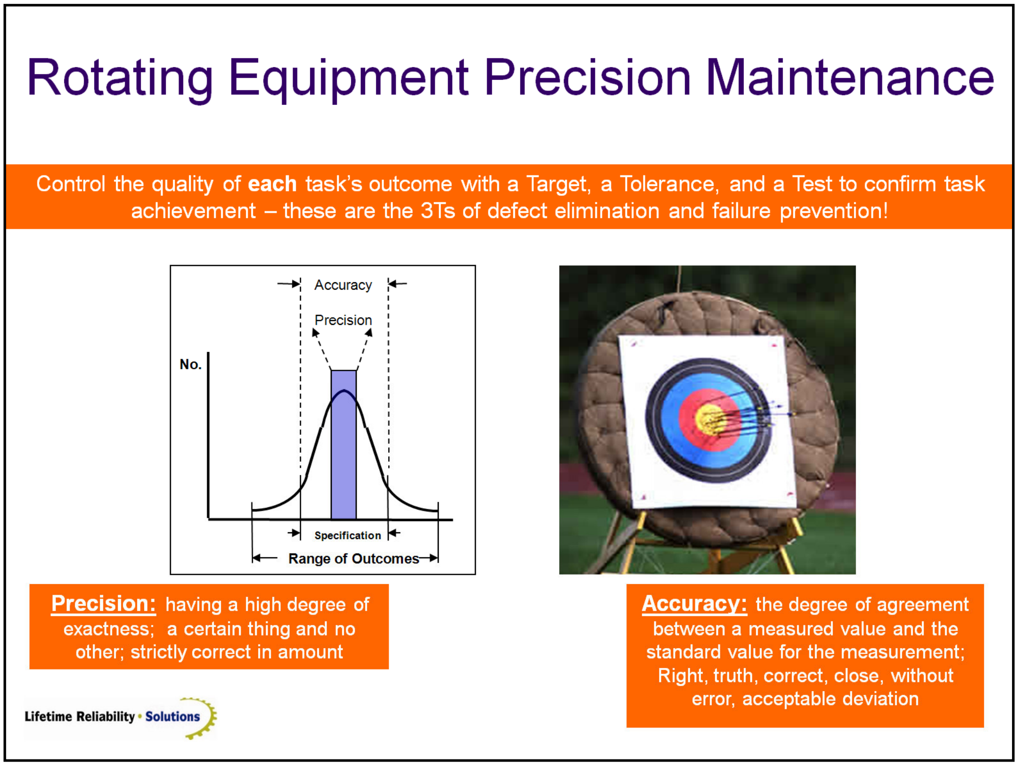
Vibrations result when matter is forced to move. Vibration is natural. Everything made of matter vibrates if excited to near its natural frequency. The matter behaves as a compressed spring loaded down with a weight. Our machines and their parts are made of matter. Your plant and equipment sits on floor and foundations, which sit on compacted earth. The floor, foundations and earth are made of matter and behave as springs.

In the rail assembly shown on the slide, each component has a natural frequency that excites it and makes it vibrate. The rotating shaft and mass spinning about a centre point shown on the slide produce a periodic vibration that coincides with the speed of its revolution, and an amplitude that reflects how far out-of-balance the mass is from the centre of rotation. This vibration is transferred throughout the machine and its foundations. In this case it is a forced vibration because the amplitude of the spinning shaft forces the attached parts to move in response to it.

There is some highly involved mathematics that can be used to model situations involving vibration. The mathematics represents matter as combinations of loaded springs and dampers. The stiffness of the springs reflect the effects of excitation and the dampers reflect the effects of the mass deadening the excitations.



These are common situations where soft-foot occurs. If the items are bolted down without fixing their soft-foot problem, the equipment is distorted out-of-shape, or the mounting feet do not fully contact the base and properly support the forces created when the equipment is used.



A technique for controlling the outcome of human controlled processes, is to build feedback loops into a process that provide information to continually correct our actions. These are known as the '3T's of failure prevention' – Target, Tolerance, Test.

The archery target bullseye has a tolerance. It is not a small dot, rather it is a disk of some 100mm diameter. Hence the target is dead-centre, but anywhere inside the bullseye is full marks. We know we are in the bullseye because we have an edge to measure from. So it is when the 3T's are used to control failure in a process – we set a target, give a tolerance that is acceptable and provide a means to measure if we within tolerance. Once we confirm we are inside the tolerance we know we are right and can move to the next task.