Failure Modes and Effects Analysis (FMEA) and Reliability Centred Maintenance (RCM)

Session 3
Desired outcomes of FMEA-RCM
Desired Outcomes

So far we have looked at failure and what it means within the operations context.

Remember: “Operations” context

We agreed that failure in the operations context must be viewed through the eyes of the operator. Reliability being a measure of the machine’s performance from the operating context reflects this.

*Our desired outcome is increased reliability*
Desired Outcomes

We have also looked at the tools and techniques we can utilise in the application of FMEA including...
Root Cause Analysis
Why analysis
Brainstorming
Cause and Effect diagrams

**RCM**
The over-riding philosophy behind RCM is the utilisation of all the ‘best practice’ maintenance management tools available; sensible and economic targeting and then the maximum return on the time and resource we devote to the RCM exercise.
Desired outcomes of FMEA-RCM

Targeting RCM

We have examined ...

- How items fail
- Why items fail

And simplified each to 4 possible outcomes

We have seen how machines often fulfil multiple functions and that it is the failure of these functions that ultimately measures reliability.

But if a machine fulfils a number of functions, will the failure of one of those functions affect operations the same as another?
Desired outcomes of FMEA-RCM

Targeting RCM

Example:
A seawater pump on an offshore oil rig has two primary functions...

- Wash downs
- Fire fighting

If the pump had failed which functional loss would pose the most risk to operations?

**Risk** is the key.

Q? If there were two separate pumps – one for each function would the operational risk remain the same for both?

Would this affect how you approached their maintenance?
Overall Maintenance Strategy

This is the choice we make on our strategic approach to managing the resources and assets under our care.

A - Maintain all assets to the Original Equipment Manufacturers recommendations regardless of cost/usage.

B - Carry out extensive study into what could go wrong on all the equipment, fit hard wired monitoring equipment to determine the onset of failure and maintain sufficient spares to meet every eventuality

C - Contract all maintenance out

D - Do maintenance only when equipment breaks down.

E - Understand the equipment in the way we operate it (functional approach); the consequences of it breaking down and the likelihood of it breaking down – develop an overall strategy based on this risk
Setup/Running Cost v Risk - Trade off of different approaches

Low Risk
High Cost

Cost

Risk

Low Cost
High Risk

A
B
C
D
E
Overall Maintenance Strategy

Risk based Management
Risks: Criticality Analysis

This focuses Asset Care attention on those functions whose failure will have a significant effect on safety, the environment or production.

It is a qualitative scoring scheme taking into account:

- Likelihood of failure
- Consequences of failure

An auditable approach with production and maintenance inputs.
Risks: Criticality Analysis

Risk management is the process of…

- Understanding
- Quantifying
- Prioritising
- Reviewing and constantly improving

The mitigation of risk to business operations.
Risks: Criticality Analysis

The universally accepted equation for Risk is…

$$\text{RISK} = \text{Consequences} \times \text{Probability}$$

(of failure) \hspace{1cm} (of failure)
Risks: Criticality Analysis
Using the assessment grid score the following

For an North Sea oil and gas production platform...

Assess the risk of...

- Flood
- Fire
- Power cut
- Earthquake
- Contracting economy
- Expanding economy
- Inflation
- Deflation

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
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<tr>
<td>3</td>
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<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Likelihood
5 = unavoidable
1 = never in living memory

Consequences
A = Catastrophic
E = None
Risks: Criticality Analysis
Grading the results
To better understand and readily appreciate the picture we can define and categorise the outcomes

<table>
<thead>
<tr>
<th>LIKELIHOOD</th>
<th>CONSEQUENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Grading the results:
- **HIGH** (5) represents the highest risk.
- **MEDIUM** (3-4) represents moderate risk.
- **LOW** (1-2) represents the lowest risk.

Overall Maintenance Strategy
Risks: Criticality Analysis
Risks: Criticality Analysis

Risk Management to Criticality Analysis

CRITICALITY :-
Expands the **Consequences** side of the risk equation and allows us to introduce areas specific to our own operating context.
CRITICALITY - consequences

Evaluation of overall failure consequences entails the assessment of the impact of failure in areas that typically include…

- Safety (the implication on plant operation safety)
- Environmental (the implications to rectify and clean up)
- Production (the effects on plant throughput/performance)
- Downtime (how long effects on production must be tolerated)
- Corrective Maintenance Costs (the resultant costs to repair the system)
Dependant upon the organisation and its operational environment consequences that might also be considered include…

- Compliance (legislative, quality, industry standards)
- Knock on effect (% loss or time to recover loss)
- Value of lost product (typically in industries where staged multiple outputs are produced [Oil and gas, distilling, dairies, etc]).
Risks: Criticality Analysis

Categorising - consequences

<table>
<thead>
<tr>
<th>Effect of Failure Upon Safety</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal perceived hazard to personnel / full integrity of safety systems</td>
<td>0</td>
</tr>
<tr>
<td>Potential hazard to personnel / safety systems integrity impaired</td>
<td>10</td>
</tr>
<tr>
<td>Significant risk to personnel / safety systems integrity severely impaired</td>
<td>25</td>
</tr>
<tr>
<td>Life threatening risk to personnel</td>
<td>50</td>
</tr>
</tbody>
</table>

In this example Safety consequences are categorised. This is most easily approached by defining the two extremes and then two intermediary categories.

Ensure that the phrases used are common within the organisation and that where specialist internal knowledge is available (in this case HSE Manager) use it to ensure the integrity of the statements used.
The same principles apply for each category breakdown.

Consulting with the ‘client/specialist’ knowledge in each area ensures buy in from those departments and the overall acceptance of the analytical model and the integrity of items assessed against it.
Risks: Criticality Analysis

Categorising - consequences

<table>
<thead>
<tr>
<th>Effect of Failure Upon Production</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>No effect (by-pass/standby/spare capacity available)</td>
<td>0</td>
</tr>
<tr>
<td>Process availability compromised</td>
<td>2</td>
</tr>
<tr>
<td>Reduced process throughput/performance</td>
<td>5</td>
</tr>
<tr>
<td>Severe/total loss of production</td>
<td>10</td>
</tr>
</tbody>
</table>
Risks: Criticality Analysis

Categorising - consequences

<table>
<thead>
<tr>
<th>Estimated Production Downtime Due to failure</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (&lt; 12 hrs)</td>
<td>1</td>
</tr>
<tr>
<td>Medium (12 - 48 hrs)</td>
<td>2</td>
</tr>
<tr>
<td>High (&gt; 48 hrs)</td>
<td>4</td>
</tr>
</tbody>
</table>

Here 3 categories have been used; whilst acceptable during analysis, people will tend to opt for the middle ground and this can compromise differentiation. Try and use an even number of categories.
Risks: Criticality Analysis

Categorising - consequences

<table>
<thead>
<tr>
<th>Corrective Maintenance Costs (includes secondary damage, clean up and availability of resource)</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal (&lt; £1k)</td>
<td>1</td>
</tr>
<tr>
<td>Small (£1k - £10k)</td>
<td>2</td>
</tr>
<tr>
<td>Medium (£10k - £250k)</td>
<td>5</td>
</tr>
<tr>
<td>High (&gt; £250k)</td>
<td>10</td>
</tr>
</tbody>
</table>

The values should be adjusted to the organisation’s operating context.
Risks: Criticality Analysis

The ‘Probability’ side of the equation

<table>
<thead>
<tr>
<th>Hazard/Failure Probability</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improbable/Low (MTBF/useful life &gt; 10 years)</td>
<td>1</td>
</tr>
<tr>
<td>Occasional/Medium (MTBF/useful life 1 - 10 years)</td>
<td>2</td>
</tr>
<tr>
<td>Frequent/High (MTBF/useful life &lt; 1 year)</td>
<td>3</td>
</tr>
</tbody>
</table>

Again the definition of the failure probability should be adjusted to the organisation’s operating context. If the analytical model is to be used right across an organisation all operating environments within the organisation should be considered.

For example – distilling has slow processes which may take years yet the organisation may also encompass bottling lines where hourly failures may be the norm.
## Overall Maintenance Strategy

### Risks: Criticality Analysis

#### A Typical Criticality Scoring Template

<table>
<thead>
<tr>
<th>Functional Area</th>
<th>Function No.</th>
<th>Description</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Safety Implications of Loss of Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal perceived hazard to personnel/full integrity of safety systems maintained</td>
</tr>
<tr>
<td>Hazard to personnel in immediate area / safety systems integrity impaired</td>
</tr>
<tr>
<td>Hazard to personnel in multiple areas/plant-wide / safety system integrity severely impaired</td>
</tr>
<tr>
<td>Life threatening risk to personnel</td>
</tr>
<tr>
<td>Environmental Implications of Loss of Function (includes costs to rectify/cause up)</td>
</tr>
<tr>
<td>Minimal losses to plant / within Best Practice limits</td>
</tr>
<tr>
<td>Localised/controlled release (small spillage cleaned up) / no impact on operation/reportable</td>
</tr>
<tr>
<td>Spillage/emission uncontrolled within plant / impact on operation and local environment</td>
</tr>
<tr>
<td>Major spillage/emission, long term clean up, direct damage to plant and environment / requires assistance from local authorities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Production Capacity and Quality Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>No loss / 100% spare capacity / no quality implications</td>
</tr>
<tr>
<td>Up to 10% loss of production and or quality losses (units per shift)</td>
</tr>
<tr>
<td>10-40% loss of production and or quality losses (units per shift)</td>
</tr>
<tr>
<td>40-80% loss of production and or quality losses (units per shift)</td>
</tr>
<tr>
<td>Total loss of production capacity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value of Lost Product (default to highest value on multiple product capability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Down Stream production implications (Knock on effect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little or no effect spare capacity</td>
</tr>
<tr>
<td>5-50% loss of downstream production lost per shift</td>
</tr>
<tr>
<td>50-75% loss of downstream production lost per shift</td>
</tr>
<tr>
<td>Halts all downstream activity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Downtime to recover function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Corrective Maintenance Costs (labour and materials to repair/recover function)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Small</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hazard Failure Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improbable / low</td>
</tr>
<tr>
<td>Occasional / medium</td>
</tr>
<tr>
<td>Frequent / high</td>
</tr>
<tr>
<td>Safety Criticality</td>
</tr>
<tr>
<td>Environmental Criticality</td>
</tr>
<tr>
<td>Production criticality</td>
</tr>
</tbody>
</table>

| OVERALL CRITICALITY |
Scoring and weighting Criticality Analysis Models

The relative system criticality ratings are expressed in terms of Production, Safety, Environmental and Overall Criticality in the following manner.

- Safety Criticality \(= A \times F\)
- Environmental Criticality \(= B \times F\)
- Production Criticality \(= ((C \times D) + E) \times F\)
- Overall Criticality \(= (A + B + (C \times D) + E) \times F\)

Where,
- \(A\) = Safety consequence score
- \(B\) = Environmental consequence score
- \(C\) = Production consequence score
- \(D\) = Downtime due to failure score
- \(E\) = Corrective maintenance cost score
- \(F\) = Hazard / Failure probability score
Deciding at what level to apply the model

There are two levels at which criticality analysis is commonly applied.

- Functional
- Asset

Functional level application has distinct advantages (which we have already addressed) in that production can more readily relate to what a function is (and therefore the consequences of its loss) as opposed to at asset level which tends to be more engineering/maintenance orientated.

Production/operations might not know or care what asset ensures they have an air supply – they know and care if a they lose that air supply.
Overall Maintenance Strategy

Risks: Criticality Analysis

Deciding at what level to apply the model – Working with Functions

Reminder on identifying functions….

**Primary** – why the equipment was bought in the first place

**Secondary** – PIECES
- Protection
- Image / Appearance
- Environmental integrity
- Control / compliance / containment / comfort
- Economy / efficiency
- Safety / structural integrity
Overall Maintenance Strategy

Risks: Criticality Analysis
Identifying functional boundaries
Risks: Criticality Analysis

Deciding at what level to apply the model

**Asset level** application is a more engineering/maintenance orientated approach. It can be difficult to engage production/operations staff in the analysis if the asset is not solely responsible for providing a function.

We shall now look at typical criticality assessment outcomes carried out at the functional level.

*Whilst as maintenance people we are always tempted to undertake analysis at asset level, consider a first pass analysis at Functional level and then targeting higher criticality functions for asset level analysis as and when resources allow.*
Risks: Criticality Analysis

The Criticality Analysis Team

- Joint Production/Maintenance team works through a flowsheet or block diagram of the plant and assigns criticality ratings to equipment

- All assets reviewed including services and utilities

- Either paper-based or computer based scoring scheme can be used
Overall Maintenance Strategy

Risks: Criticality Analysis

Points to note and record for the process when carrying out analysis…

- Any precedents established
- Assumptions
- Justifications of allocated scoring where appropriate
Risks: Criticality Analysis

Overall Relative Criticality

Typical Outcomes

- High criticality functions
- High/Medium criticality functions
- Low/Medium criticality functions
- Low criticality functions
RCM, FMEA and CBM are expensive (either contracted direct cost or in time and resource internally)

How might you optimise this cost?
Risks: Criticality Analysis

Optimising cost

RCM and FMEA

- Carry out on higher criticality assets
- As each asset type is identified and analysed note the generic type (pump, motor, inverter, etc).

- Use initial analysis on that type as a model for a lower criticality asset of the same type.
- As the criticality decreases consider variables such as frequency of PM.

*Example: a monthly PM becoming a 3 monthly PM on an asset of lower criticality (dependent upon certain factors)*
Risks: Criticality Analysis

Optimising cost CBM

Condition Monitoring (CM) is the tool of CBM. Techniques vary and should be appropriate to the criticality.

- Vibration analysis may be appropriate on higher criticality assets, on similar assets with a lower criticality the frequency or the technique may alter.
- What other consideration drives the decision?

**Question:** *a CM contractor recommends vibration analysis monthly on all motors over 20Kw – would you agree or disagree?*
Risks: Criticality Analysis

An example of varying techniques appropriate to criticality.
Risks: Criticality Analysis

Optimise the drafting of PM's

Same principle as applied to optimising RCM and FMEA (for which PM compilation or the information to allow compilation to be done is normally the outcome).

- Carry out on higher criticality assets
- As PM's are generated for each asset the generic type is identified (pump, motor, inverter, etc).
- Use initial PM on that type as a model for a lower criticality asset of the same type.
- As the criticality decreases consider variables such as frequency of PM.

EXAMPLE: a monthly PM becoming a 3 monthly PM on a lower criticality asset

NOTE: CM routines are considered as PMs
Risks: Criticality Analysis

Planned Maintenance Routines (PM’s)

PM’s drafted are asset specific

Specific PM’s converted for more generic use

Generic PM’s

Reduced frequency generic PM’s

Nil PM’s

An example of specific and generic applications
Overall Maintenance Strategy

Individual machine maintenance tactics

REACTIVE
Nil Maintenance or Run to failure

PROACTIVE
Scheduled Overhaul or replacement Test / inspection Condition monitoring Re-design

Risk Based (Functional Criticality)

Criticality rating and asset characteristic dependent

Determined through criticality/cost/practicality

Low Criticality or where failure mode has no deterioration characteristics
Maintenance tactics for individual machines
Having decided on an overall approach we can now look at the options we have regarding individual machines

- **Condition based or predictive maintenance** – let the equipment tell you when it needs maintenance (Including Front Line Operator Asset Care)

- **Planned maintenance** – often intrusive, including the replacement of components irrespective of condition

- **Functional testing** where failures remain hidden

- **Continuous Improvement** or ultimately design-out

- **Run to failure/Nil maintenance**

So what do we use?
Maintenance tactics for individual machines

All Maintenance tasks

Reactive Tasks
- Run to failure
- Nil Maintenance
- Breakdown only

Proactive Tasks
- Improvement Maintenance
  - Re-design
- Planned Maintenance
  - Scheduled overhaul
  - Scheduled discard/replacement
  - Scheduled Test/Inspection
  - Scheduled Condition Monitoring

Predictive
How a risk based overall strategy impacts at machine level

Our risk based approach (Criticality Analysis) addressed functions.

A function will have a number of assets under it (revisit the functional boundary exercise here if you need to).

Q? What criticality do the assets within a function have?

A All the assets within a function assume that function’s criticality
Overall Maintenance Strategy

Individual machine maintenance tactics

**REACTIVE**
- Nil Maintenance
- Run to failure

**PROACTIVE**
- Scheduled Overhaul or replacement
- Test / inspection
- Condition monitoring
- Re-design

Risk Based (Functional Criticality)
- Criticality rating and asset characteristic dependent
- Determined through criticality/cost/practicality
- Low Criticality or where failure mode has no deterioration characteristics
Reactive and Pro-active tasks

How a risk based overall strategy impacts on the type of tasks

As we saw in the session addressing failure, different components within a machine fail in different ways.

We also saw that our ability to identify the onset of failure to ultimate machine failure (P-F interval) determines the kind of task we can undertake in that machine’s maintenance.

At component level P-F interval, our ability to detect deterioration and our confidence in detecting that deterioration must drive the type of maintenance we can undertake on that component.
Proactive tasks

Where the P-F interval can be determined and we understand or have evidence of a components failure pattern we can carry out any one or a combination of the following tasks:

- Scheduled overhaul
- Scheduled replacement
- Scheduled Test / inspection
- Scheduled Condition monitoring
Reactive and Pro-active tasks

Proactive tasks

Scheduled overhaul

A task that regardless of the machine condition through periodic interventive maintenance returns the component/machine to its original condition and specification

Example:-

Stripping down a pump assembly every 2 years replacing all possible components
Proactive tasks

Scheduled replacement

A task that regardless of the machine condition through periodic interventive maintenance replaces a component.

Example:-

Replacing a drive belt every 6 months whether it shows signs of wear or not
Proactive tasks

Scheduled Test / inspection

A task that through interventive maintenance tests/inspects components and replaces them as required.

Example:-

Stripping down a pump assembly every 2 years test/inspect all components replace anything outside tolerance
Proactive tasks

Condition Monitoring (CM)
Is the tool of Condition Based Maintenance (CBM) and is preferable because of the following failure pattern which we have seen before and can be induced by interventive tasks.
Proactive tasks

Scheduled Condition monitoring

A monitoring task that determines the condition of specific deterioration characteristics of a component/machine to determine whether an interventive task is required.

Example:-

Carrying out vibration analysis on the bearings within a pump assembly to identify the onset of deterioration

Note
Condition Monitoring tasks (CM) should be scheduled appropriately to the P-F interval and are satisfied (can be signed off) if the results are within the determined parameters.
Reactive and Pro-active tasks

Reactive tasks

Where P-F interval is negligible and we cannot determine a realistic failure pattern that would allow one of the following kind of tasks

- Scheduled overhaul
- Scheduled replacement
- Scheduled Test / inspection
- Scheduled Condition monitoring

We may have no other way but to accept that our only option with that component is ‘Run to Failure’.

If this is not an option and an unacceptable risk is identified, then **Redesign** of the component or process is essential.

The only other option possible (and then usually only as a stop gap) is a contingency plan in the event of such a failure (an acceptable contingency may be 100% spare capacity [e.g. An alternative machine exists that is able to take over the full capacity of the lost item]).
Reactive and Pro-active tasks

Optimum detection area for High to Medium criticality functions
There are a number of issues we have addressed that guide our decision as to what type of task should be done. These include…

- Criticality
- Type of asset
- Nature of deterioration/failure

The following slide can be used in conjunction with the outputs from a criticality analysis or on a stand alone basis. Either way it will help determine the kind of maintenance appropriate.

Used in conjunction with the previous optimum detection area guide (previous slide) it allows us to determine which stage of deterioration we wish to identify … and therefore focuses the tasks we decide upon.
Task Decision Tree

1. Will the loss of function caused by this failure mode on its own become evident to the operator under normal circumstances?
   - Yes
   - No

2. Is a task to detect whether the failure is occurring or about to occur technically feasible and worth doing?
   - Yes
   - No

3. Does the failure mode cause a loss of function or other damage which could hurt or kill someone?
   - Yes
   - No

4. Is a scheduled restoration task to reduce the failure rate technically feasible and worth doing?
   - Yes
   - No

5. Does the failure mode cause a loss of function or other damage which could breach any known environmental standard or other compliance regulation?
   - Yes
   - No

6. Does the failure mode have a direct adverse effect on operational capability (output, quality, service or operating cost)?
   - Yes
   - No

7. Is a task to detect whether the failure is occurring or about to occur technically feasible and worth doing?
   - Yes
   - No

8. Is a scheduled restoration task to reduce the failure rate technically feasible and worth doing?
   - Yes
   - No

9. Is a scheduled discard task to reduce the failure rate technically feasible and worth doing?
   - Yes
   - No

10. Could the multiple failure affect safety or the environment?
    - Yes
    - No

11. Is a combination of tasks to avoid failures technically feasible and worth doing?
    - Yes
    - No

12. Does the failure finding task to detect the failure technically feasible and worth doing?
    - Yes
    - No

13. Scheduled on-condition task
    - Yes
    - No

14. Scheduled restoration task
    - Yes
    - No

15. Scheduled discard task
    - Yes
    - No

16. Combination of tasks
    - Yes
    - No

17. Re design is compulsory
    - Yes
    - No

18. Re design is compulsory
    - Yes
    - No

19. Re design may be desirable
    - Yes
    - No

20. No scheduled maintenance
    - Yes
    - No

21. Re design may be desirable
    - Yes
    - No

RCM Decision Diagram © Aladon Ltd 1991
Overall Maintenance Strategy

Individual machine maintenance tactics

- **REACTIVE**
  - Nil Maintenance
  - Run to failure

- **PROACTIVE**
  - Scheduled Overhaul or replacement
  - Test / inspection
  - Condition monitoring
  - Re-design

**Risk Based (Functional Criticality)**

- Criticality rating and asset characteristic dependent

- Determined through criticality/cost/practicality

- Low Criticality or where failure mode has no deterioration characteristics
RCM promotes all aspects of ‘best practice’ in the pursuit of improved machine reliability. In the FMEA-RCM approach, which we will start to examine in the next session, we shall see how all the aspects we have addressed to date point us towards a stepped implementation.

In this session we have addressed...

- Desired outcomes in line with Risk Based management
- Reviewing the operation our maintenance supports from the operators (functional) aspect.
- Reviewing the maintenance tactics open to us
- Assuring our maintenance tactic outcomes