SMMT
QUALITY MANAGEMENT
DIVISION

Industry Forum

Equipment Criticality for TPM Programmes and Reliability

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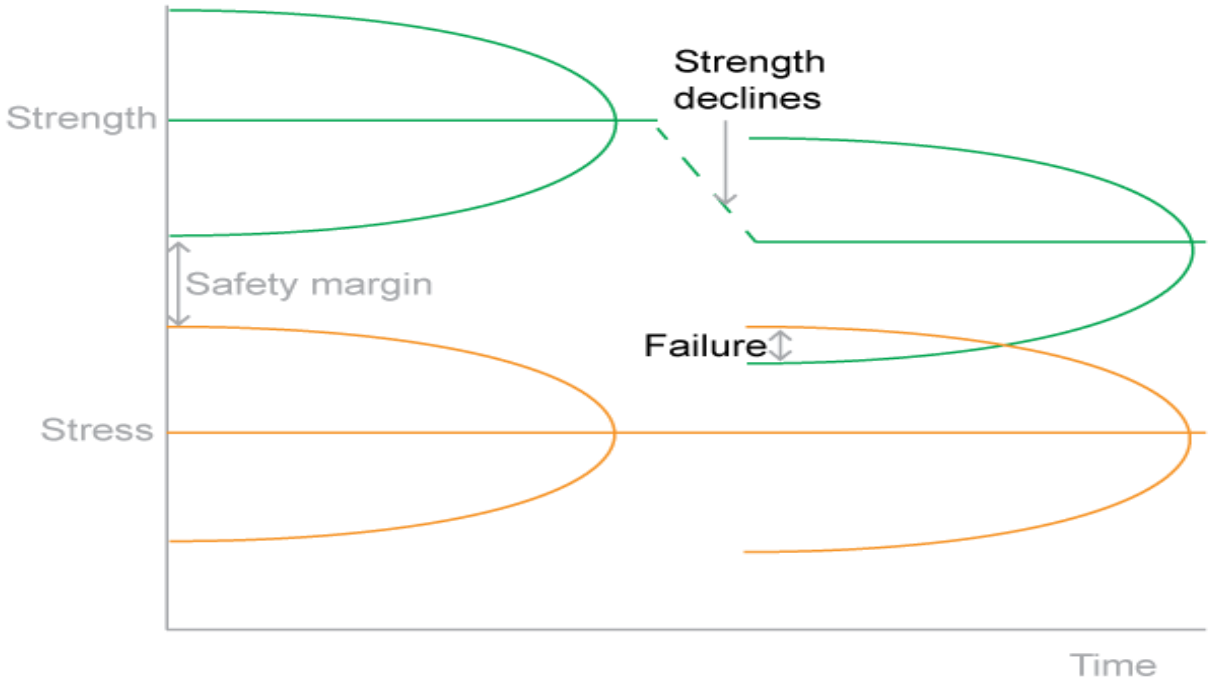
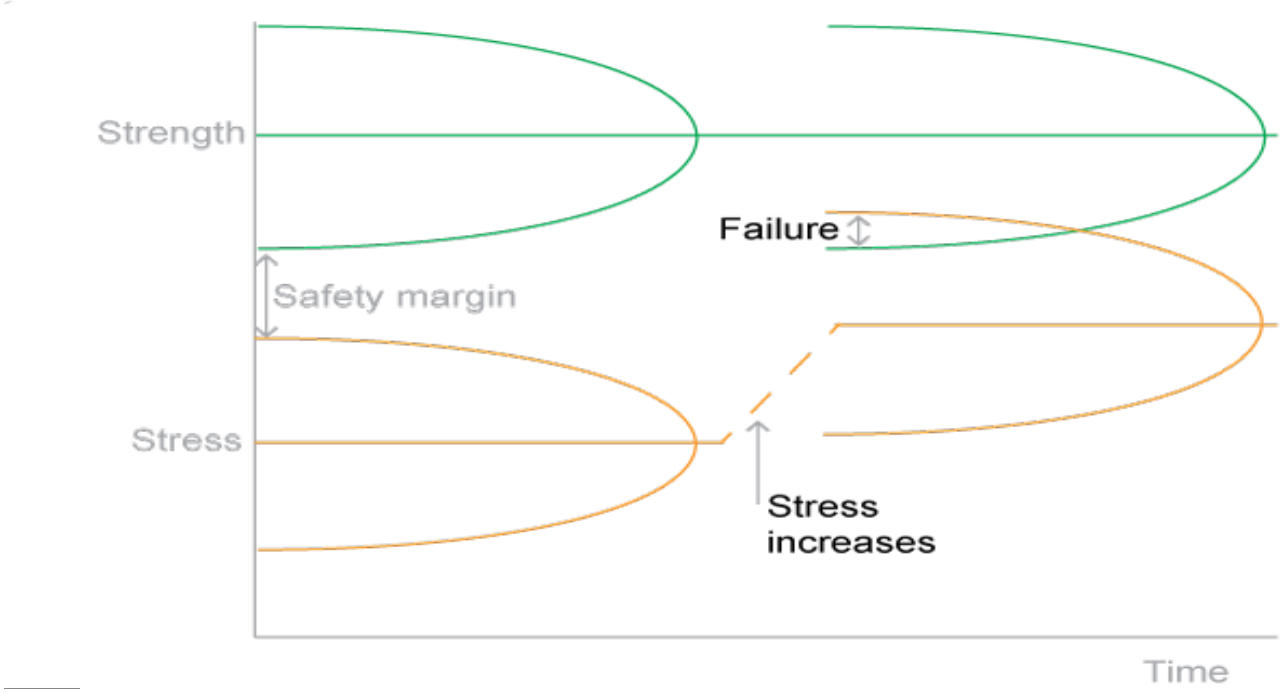
Why does equipment fail?

- Uncorrected Deterioration
- Increased Stress
- Insufficient Strength

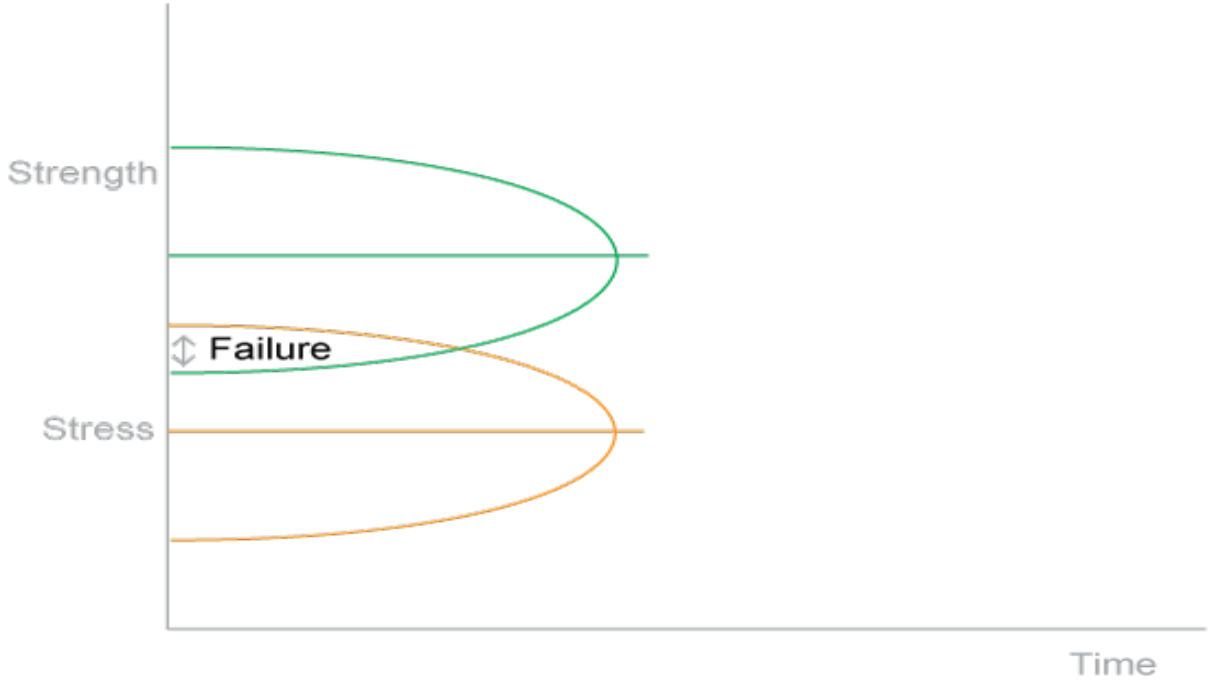
Equipment fails due to uncorrected deterioration



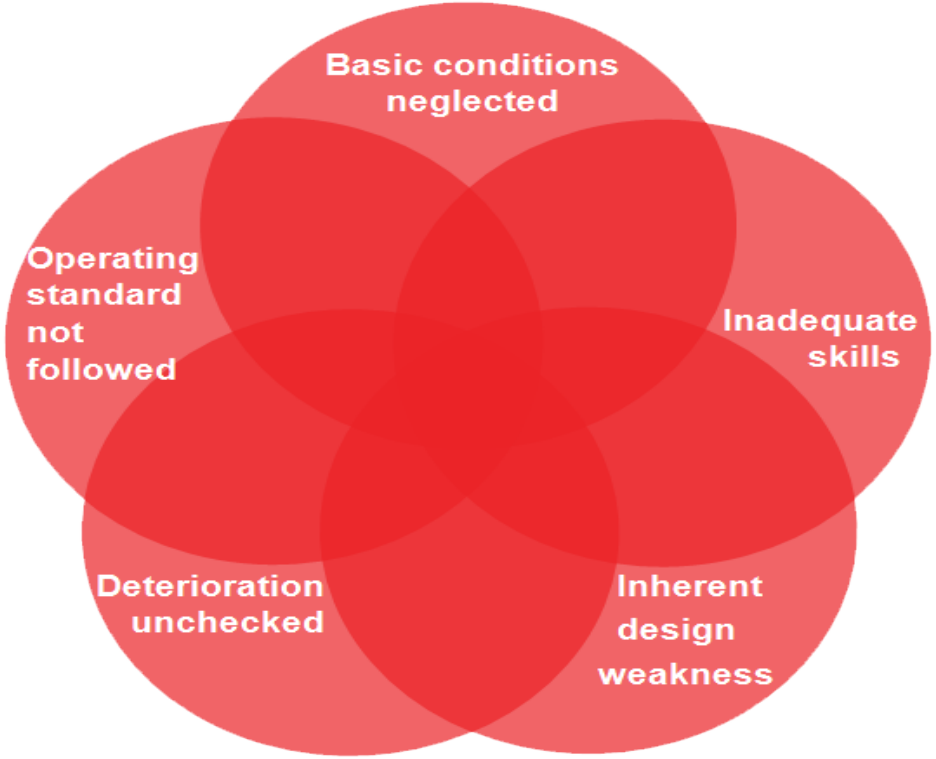
Equipment fails when the stresses are increased



Equipment fails as it has insufficient strength

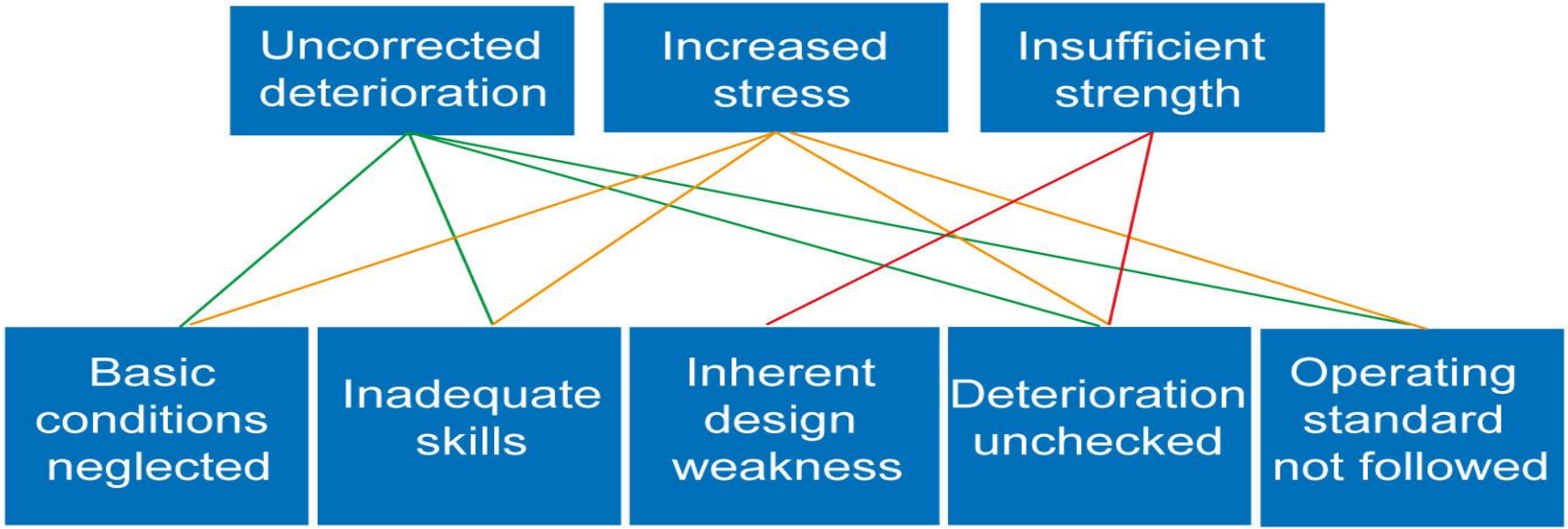


What are the causes of physical failure?



Cause and Effect

The relationship between the three failure types and the five causes



Traditional Maintenance Approaches

- Maintenance regimes are often time based rather than focussed on critical equipment.
- Although backups and contingency for when machines fail may be in place, many organisations operate this on an intuitive level. Can be costly ££££
- Mind Set “All equipment is critical”
- Lack of critical spares being held for critical machinery – not fully knowing what is needed, or what to hold and how much to hold.
- Operator Care is not always focussed on the critical elements of equipment, therefore relies on reactive maintenance.

IATF & TPM

Nonconformity Analysis – UK only All CBs
IATF 16949 Audits 2019 YTD – Major NC

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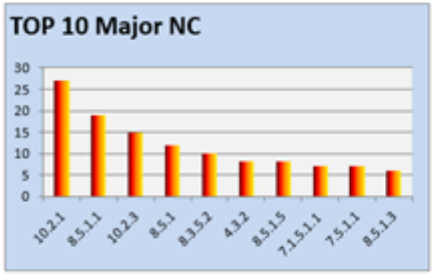
IATF Clause	Major NC
10.2.1	27
8.5.1.1	19
10.2.3	15
8.5.1	12
8.3.5.2	10
4.3.2	8
8.5.1.5	8
7.1.5.1.1	7
7.5.1.1	7
8.5.1.3	6



10.2.1 **ISO 9001** Nonconformity & corrective action
8.5.1.1 Control plan
10.2.3 Problem solving
8.5.1 **ISO 9001** Control of production and service provision
8.3.5.2 Manufacturing process design output
4.3.2 Customer specific requirements
8.5.1.5 Total productive maintenance (TPM)
7.1.5.1.1 Measurement systems analysis (MSA)
7.5.1.1 Quality management system documentation
8.5.1.3 Verification of job set ups

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Nonconformity Analysis – UK only All CBs
IATF 16949 Audits 2019 YTD – Minor NC

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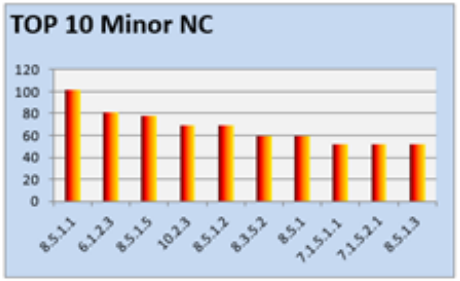
IATF Clause	Minor NC
8.5.1.1	101
6.1.2.3	81
8.5.1.5	78
10.2.3	69
8.5.1.2	69
8.3.5.2	59
8.5.1	59
7.1.5.1.1	52
7.1.5.2.1	52
8.5.1.3	52



8.5.1.1 Control plan
6.1.2.3 Contingency plans
8.5.1.5 Total productive maintenance (TPM)
10.2.3 Problem solving
8.5.1.2 Standardised work – operator instructions and visual standards
8.3.5.2 Manufacturing process design output
8.5.1 **ISO 9001** Control of production and service provision
7.1.5.1.1 Measurement systems analysis (MSA)
7.1.5.2.1 Calibration/verification records
8.5.1.3 Verification of job set ups

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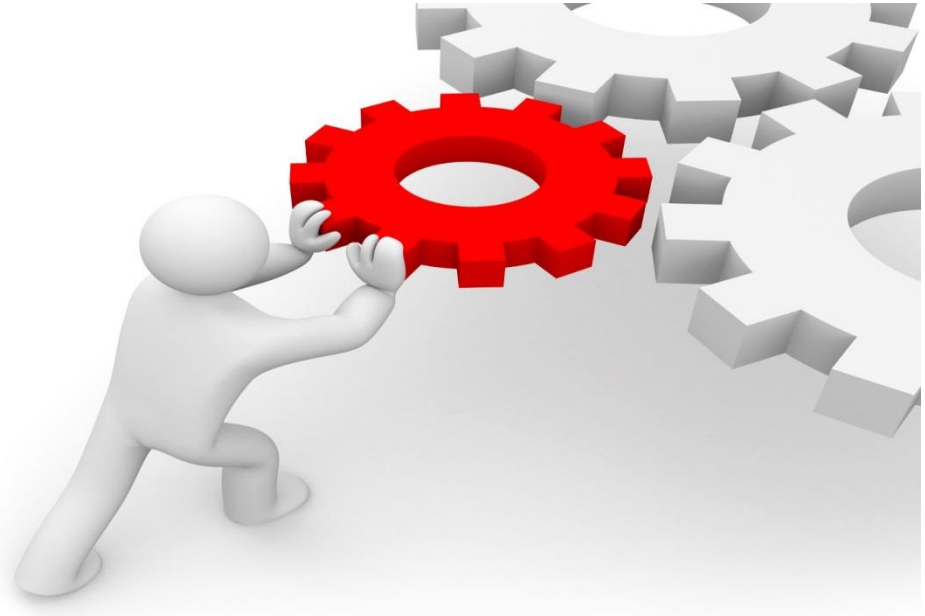
TPM is a common NC for many organisations in the UK

How do I consider the best Maintenance Strategy?

- How important or critical the equipment is to the running of the plant. What needs maintaining?
- The cause of the equipment's deterioration and failure.
- The rate and frequency of deterioration.
- The cost of maintenance

Which?

Who?



How?

What?

When?

Equipment Criticality

Equipment Criticality Ranking (ECR)

ECR is the foundational step :

What is it?

- Assessment of equipment failure and the consequences of failure.
- Focusses on various levels of equipment: Machine, Assembly, Sub Assemblies, component and sub-component levels
- Can be adapted for your plants priorities

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ABC Critical Equipment Ranking

In order for maintenance to be both **efficient and effective**, equipment must be prioritised through a ranking process:

A: Critical Equipment

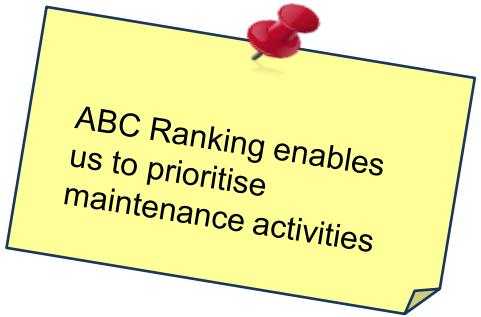
- Is essential to maintain against failure

B: Important Equipment

- Should maintain if cost of maintenance is less than cost of failure (lost production plus repair costs)

C: Ancillary Equipment

- Should maintain through first level maintenance where appropriate

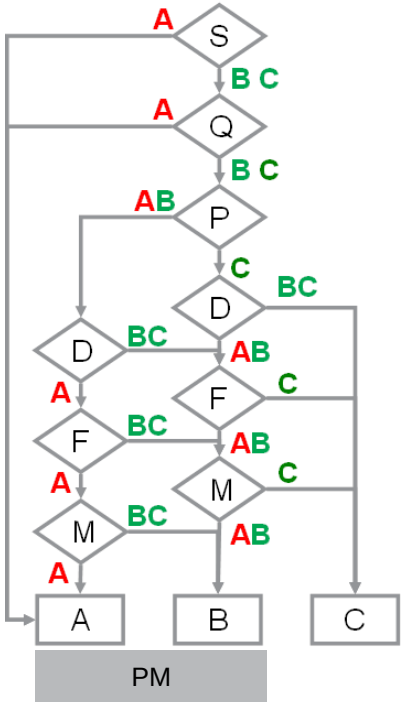


4 Steps for Equipment Criticality

1. Develop Equipment Hierarchy (Master Equipment List)
2. Select only one failure for the equipment (e.g.. Plausible & Maximum risk for breakdown)
3. Select dimensions for risk (Safety, Quality, Production, Delays, Maintainability)
4. Use the flowchart to determine A,B,C criticality - Start at the top of equipment hierarchy and work down the list (Assembly, Sub- Assemblies, Components)

Simple structured system to rank the equipment

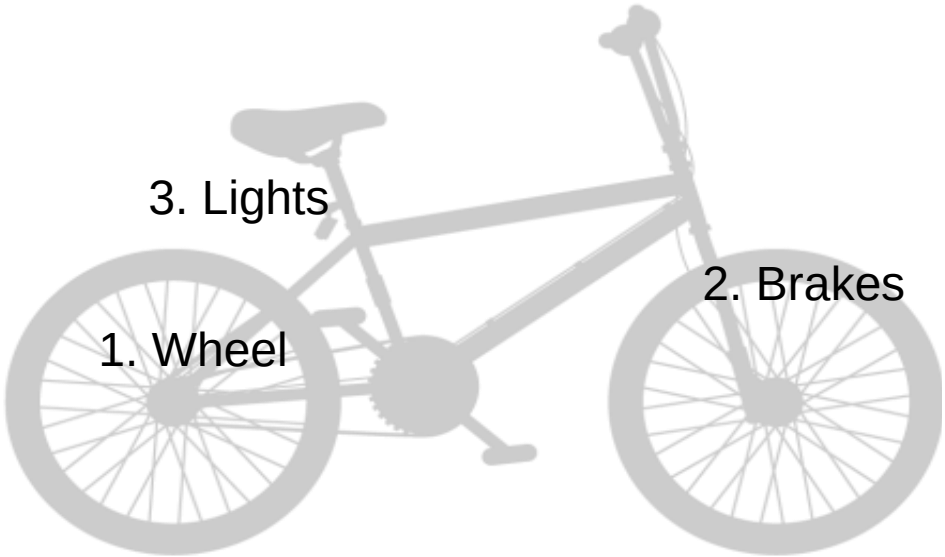
Evaluation Element	A Rank	B Rank	C Rank
Safety and Environment **(S)**	Serious problem	Minor issue	No safety or environmental implications
Quality and Yield **(Q)**	Product defect or substantially reduce yield	Quality variation or have some affect on yield	No affect on quality or yield
Operating Status **(P)**	24 hour operation	7 to 14 hour operation	Intermittent use only
Delay Factor **(D)**	Shutdown whole plant	Shutdown part of plant	Standby unit available
Failure Interval **(F)**	Frequent (every quarter)	Occasional (once per year)	Infrequent (less than annual)
Maintainability **(M)**	Repair time more than 4 hours	Repair time 1-4 hours	Repair time less than 1 hour



Mitigation Strategy

Equipment Criticality	Mitigation Strategy
A Critical (High)	Contingency Plans Hold Critical Spares Predictive Maintenance Preventative Maintenance
B Critical (Moderate)	Predictive Maintenance Preventative Maintenance
C Critical (Low)	First level preventative maintenance Run to Failure

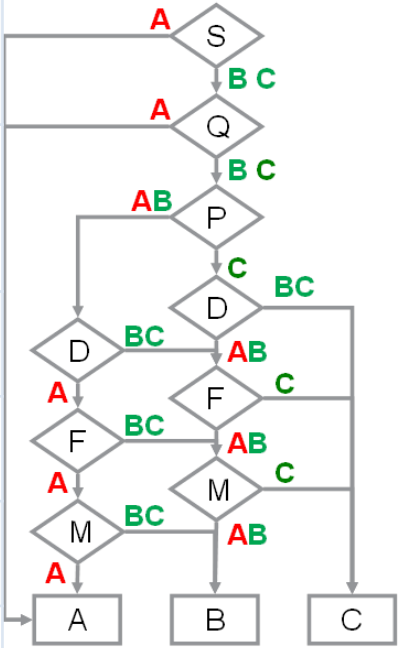
ABC Ranking Criticality Exercise



1. Determine criticality for the main systems of the bike using the evaluation criteria
2. Determine criticality for the sub-assemblies
3. Review the equipment criticality and determine the maintenance and spares strategy that you would adopt

Evaluation Criteria for Bicycle

Evaluation Element	A Rank	B Rank	C Rank
Safety and Environment **(S)**	Serious safety problem/ Injury	Minor issue/ minor safety risk	No safety or environmental implications
Quality **(Q)**	Will cause defect or substantially reduce performance	Quality performance variation	No affect on quality performance
Operating/ Usage Status**(P)**	Use everyday/constant	Use regularly	Intermittent use only or not used
Delay Factor **(D)**	Shutdown or Complete Stoppage	Slow operation	Standby available
Failure Interval **(F)**	Frequent (every week/month)	Occasional (once per quarter)	Infrequent (less than annual)
Maintainability **(M)**	Repair time more than 3 hour	Repair time 1 to 3 hours	Repair time less than 1 hour

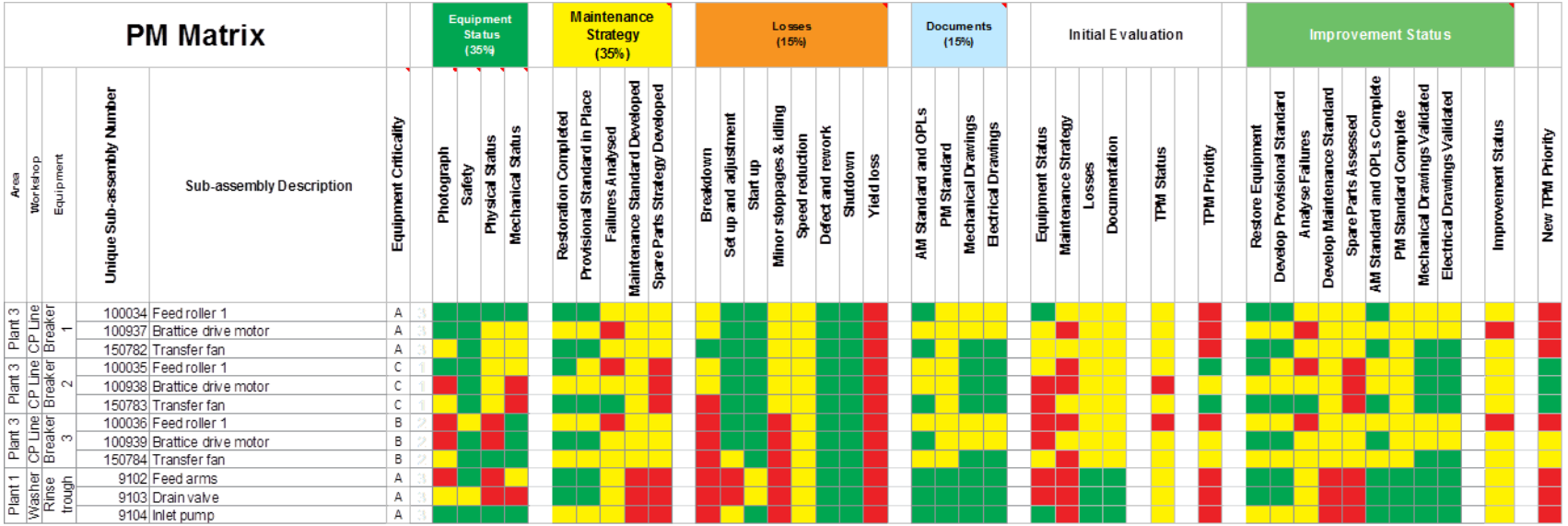


Equipment	ABC Critical?	Maintenance Strategy (CB, TB/PM, Run to Failures)	Hold Spares (Yes/No)
Wheel			
Tyre			
Spokes			
Axel			
Brakes			
Blocks/Pads			
Cable			
Lever			
Light			
Battery			
Bulb			
Light Fixings			

Equipment Criticality Ranking – the benefits

- Proactive Maintenance Strategy, will help to avoid downtime and unexpected Maintenance Costs
- Identify what to be considered for Preventative Maintenance
- Organise and hold the correct spares
- Prioritise the development of staff training/knowledge/expertise on the machines for fast repair recovery
- Gather relevant documentation and drawings up-to-date based on criticality
- Consider the best approaches to keep the plant running in the event of a breakdown
- Understand the business-wide consequences associated with equipment failure, providing you with ROI on prevention and reliability programs.
- You'll be better prepared for inevitable machine failure, get back up faster and prioritise prevention and response measures.

Understand and Evaluate the equipment



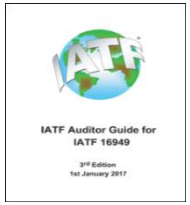
PM Matrix: Tool to help organise and prioritise all aspects of equipment maintenance management and activity

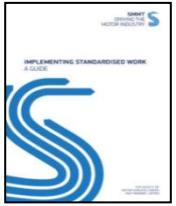
Questions?

Publications

To purchase publications, visit the SMMT QMD stand for an exclusive event offer.

IATF Publications





AIAG Publications

VDA Publications