MAXIMUM UPTIME:

USING THE 9 STEP RELIABILITY PROCESS

ARMS RELIABILITY

INTRODUCTION

Every business wants to secure a profitable future, right? While some things – such as broader market and economic conditions – are beyond your control, you **can** take control of the performance of the assets and equipment in your plant.

To do so, you need to work towards a proven reliability centred maintenance (RCM) model. RCM has been used for decades as a way to:

- **Reduce costs**
- **Divert staff time from emergency fixes to proactive maintenance**
- **Minimize unscheduled downtime**
- **Increase output and quality**
- **Boost the bottom line**

But RCM doesn't happen overnight. It takes careful planning and commitment to get to the point where your plant runs smoothly – so that unplanned failures disappear, equipment is maintained in like-new condition, and operating costs are kept to a minimum.

This ebook sheds light on the **9 Step Reliability Process** – a comprehensive, step-by-step process that can be used throughout the plant to achieve the goal of setting up an ongoing RCM model. By following the steps in this ebook, your plant will be on its way to achieving the many benefits outlined above.

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THE 9 STEP RELIABILITY PROCESS

The 9 Step Reliability Process is a flexible and responsive strategy for organisations seeking a more fail-safe approach to asset management.

The steps in the process are outlined below:

STEP 1: Create a cross-functional team to drive the process

STEP 2: Establish measurement systems

STEP 3: Ensure basic preventative maintenance strategies are in place

STEP 4: Perform root cause analysis on key equipment

STEP 5: Set up a computerised maintenance management system

STEP 6: Initiate a predictive maintenance program

STEP 7: Appoint equipment conscious operators

STEP 8: Ingrain root cause analysis as a way of thinking in the facility

STEP 9: Ongoing reliability centred maintenance

As a guide for the time required to complete the 9 Step Reliability Process, empirical experience suggests that, when performed on a small section of a plant or facility, the process could take nine months if it was worked on by one person (who had the task as a primary focus, but not their only job).

This process is not set in stone, and should be modified to suit the needs, tools and existing systems or policies within your organisation.

Some points to keep in mind:

- Training should occur at every step of the process
- Failure Mode and Effects Analysis (FMEA) can be performed at any time to solve problems and/or improve particular equipment that may be giving a plant specific problems
- Some steps can be performed in parallel or in reversed order

1

CREATE A CROSS-FUNCTIONAL TEAM TO DRIVE THE PROCESS

Groups always perform better than individuals. Hence, it's crucial that you form a cross-functional team to drive the entire reliability process. Your team should be available to manage the process from start to finish.

Where does the team come from?

Bring in personnel from various departments – including Maintenance, Reliability, Production, Process, and Engineering. Each person will bring unique insights and understanding, which will be critical at different steps in the process.

As well as steering the 9 Step Reliability Process, the group is responsible for troubleshooting and eliminating barriers.

Key tasks will involve:

- Developing common goals
- Making all disciplines more accountable
- Sharing and gaining "buy-in" for new ideas
- Providing input on job priorities
- Developing and working with problem solving groups to resolve production problems/restrictions

It is possible that operations or production may not buy into providing personnel for a team, often with good reason. If they say they are “too busy”, it’s a good idea for the rest of the team to get input from production about their biggest problem (not problems, but single problem), then resolve this problem. Once this has been done a couple of times, they will see the value and “find” the time to appoint someone to join the team.

2

ESTABLISH MEASUREMENT SYSTEMS

How do you measure the success of the 9 Step Reliability Process if you don't have any yardsticks? Set some benchmarks early on so that you can continually monitor progress.

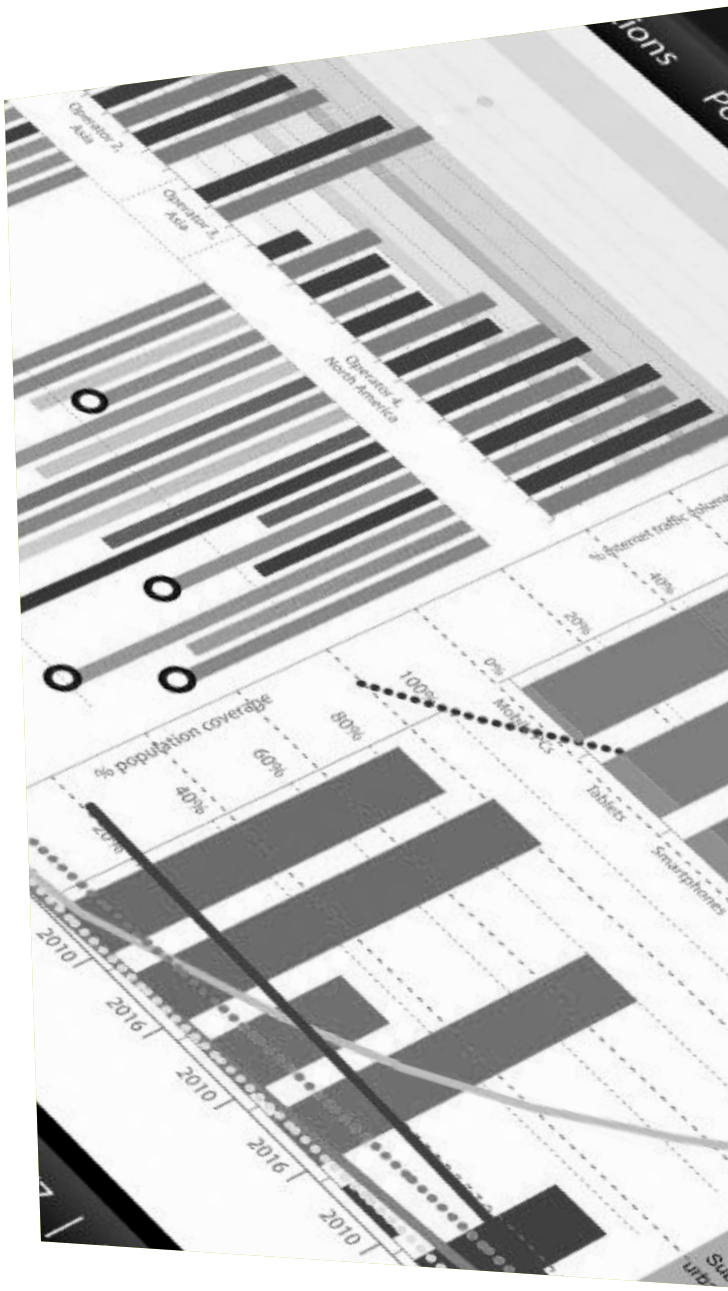
The metrics that you use will depend on what stage you are at and what you are trying to drive.

If you are in a totally reactive environment and wish to move toward a planned environment, then emergency work orders (or tickets) may be a good starting point. This way, you will soon see if you're accomplishing your goal of fixing problems that are plaguing operations. Driving this down from an initial large number is usually easy to do – and is very recognisable by all involved, which lends credibility to the group and process.

Then, the likely next major item to drive is ensuring that preventative maintenance (PM) is performed. Use a PM compliance metric to ensure that they are not "optional" (see the next section).

Next, you may move into scheduling, in which a schedule compliance number will be necessary.

As you can see, metrics are used to drive behaviour changes and improvements – but they will change as you implement each phase. They will also change as you move into a sustainability mode after working through all the steps in the 9 Step Reliability Process.



For further guidance on establishing metrics, you may want to refer to:

- *Developing Performance Indicators for Managing Maintenance*, by Terry Wireman
- Society for Maintenance and Reliability Professionals (SMRP) Benchmarking Committee: www.smrp.org

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ENSURE BASIC PREVENTATIVE MAINTENANCE STRATEGIES ARE IN PLACE

PM lies at the heart of the reliability process. If you want to achieve a successful RCM model, then PM is not an optional extra. It's mandatory.

With PM in place, the production team will never have to write a fix-it work ticket. How? Maintenance performs quality preventive inspections where impending problems are discovered and fixed before they become emergency work. The goal is to minimise production downtime.

PM has the following characteristics:

IT IS NOT OPTIONAL.

When a PM ticket is generated by the CMMS it **will** be completed. If, for any reason, a PM is canceled, it must automatically be reported and reviewed by the cross-functional team, who address and alleviate the problem by, for example, deleting or modifying the PM, adding more resources, improving management, and so on.

IT PROVIDES CONTINUITY.

Every workforce is dynamic. It is important to provide a stable, continuous system that is present through all personnel changes. PM provides ongoing requests to perform work, through all changes in personnel. While the documentation behind PM may seem detailed, these instructions are not for the regular mechanic, but for their permanent or temporary replacement – so that the PM is done correctly each time.

As a part of this continuity, PM provides consistency as well. Ensure that PM tickets are written carefully so that two different personnel who tackle the same PM would get the same results. For example, how could two different people interpret the word "inspect"? To one person, this may mean checking to make sure something is there.

To another, it might mean disassembling, measuring wear and comparing against an engineering requirement. It may be obvious to the person writing the PM – but it is important to specify exactly what the expected outcome of the instruction is.

IT IS A CHECKLIST.

By taking the form of a checklist, a PM ticket is not seen to be "telling the mechanic what to do." Think of it like a pilot's pre-flight checklist – they check off against all the important items to ensure the airplane can fly. If necessary, you can provide further detail at the end of the work order for those who may be unfamiliar with the job.

IT IS AN INSPECTION AND MINOR REPAIR.

To properly allocate resources and minimise downtime, PMs must be routine and the timing must be constant. The production department needs to rely on a specified outage so that it can plan accordingly.

To achieve this, routine PM-type inspections should involve looking for impending problems during an allocated timeframe. If an issue is found that cannot last until the next scheduled maintenance, or if it's a quick fix, then it should be fixed on the spot. Otherwise, a PM-generated or follow-up work task should be raised to fix the problem at a later date, when the job can be planned and scheduled.

Every time PM is performed, the employee should review it to ensure that it still covers all the possible failure modes of the equipment. If the equipment changes or failures occur, a review of the PM should be instigated.

IT HAS A MEAN TIME TO REPAIR.

PMs, by their very nature, are repetitive inspections. Given this, it is easy to create a set of standards for their execution. These standards enable you to schedule the equipment downtime and tell the production team when you will have it up and running again. This is your Mean Time To Repair (MTTR). MTTR is continually adjusted to account for improvements in maintenance prevention, or other changes in tools and techniques.

IT HAS VALUE.

If there is no PM program, then one must be developed. Or, if one does exist, then now is a good time to review it. The intent of this review is to assess each PM and verify:

- The equipment it is scheduled against exists. "PM creep" is ever-present and a high-level review will make sure that things don't slip through the cracks.
- The correct people are scheduled for it. Over the years changes get made and never quite seem to get adjusted.
- The time allotted and frequency are about right, or match to what is being done. Again things change and somehow those changes are never reflected in the instructions.

At first this may seem like a daunting task. It isn't. A review is a quick, high-level task to eliminate or adjust the PMs to get rid of deadwood. An entire department's tasks for a large facility should take no longer than a day, with each PM taking under a minute to briefly review.

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PERFORM ROOT CAUSE ANALYSIS ON KEY EQUIPMENT OR KEY PROBLEMS

When it comes to asset management, the 80-20 rule applies: 80% of your maintenance is caused by 20% of your problems. Work on that 20% first and foremost, to free up your staff's time to work on the more valuable, ongoing maintenance work.

This can be done in several ways. If you're not in a reactive mode then you may wish to do a criticality analysis of your equipment, and then work on the top 20% by your defined criticality. If you are in a reactive mode then it should be pretty obvious which equipment is always failing and shutting production down.

At the outset, it may not be equipment but specific problems contained in your 80-20 rule. For example, if a particular problem is shutting down a major piece of production equipment frequently, then this problem is part of the 20% that needs to be fixed. One approach would be to use root cause analysis (RCA) to fix the problem so it never occurs again; and then if necessary use FMEAs or other tools to analyse the equipment and improve its availability even more. However, if you have limited resources, it would make more sense to tackle the next biggest problem that is causing downtime (which may or may not be on the same equipment). Focus on the problems that affect downtime the most to get the biggest bang for your buck at this stage.

Remember, the 80-20 rule will always be in existence – no matter how many problems you solve or how hard you work. What will change is that 20% of your problems may equate to 100 hours of downtime when you start. After fixing several problems, that 20% may only equate to 20 hours of downtime – a significant improvement.

In many facilities, a reliability engineer is assigned to solve these nuisance repetitive problems. However, it is important to realise that problem solving is not reserved for engineers or office workers. In fact, getting people in the area to lead or participate in the problem resolution will improve the results. After all, these people have the most to gain from any improvements in performance, and should take accountability for fixing it.

Whoever is assigned to the task should apply the principles of RCA in getting this job done. In RCA, you strive to get to the real cause of a failure. Without it, problems reoccur – as do the maintenance tasks. It is important to remember that RCA is very good at fixing what happened, but not so good at fixing what might happen in the future – so it pays to be careful about using RCA when perhaps FMEAs or Fault Trees would be more appropriate.

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SET UP A COMPUTERISED MAINTENANCE MANAGEMENT SYSTEM

Once you have fixed the repetitive problems using RCA, you're ready to plan and schedule ongoing maintenance. While it can be done manually, this is not recommended. Use a computerised maintenance management system (CMMS) to eliminate faults and achieve maximum results.

A CMMS provides a structured method for identifying problems ahead of time (through PM work orders), ensuring they get fixed (through planning) and allocating the proper resources (through scheduling). Items are not forgotten, people are held more accountable for tasks, and work gets done on time.

In short, a CMMS is the glue holding work orders, planning and scheduling together.

It enables:

- Prioritisation of requested work orders
- Collection of failure data and equipment history
- Automated generation of PMs
- More efficient planning and scheduling
- Generation of data to make accurate and timely decisions about crewing, costs, reliability, maintenance and so on

Let's look at the four elements of a CMMS in more detail.

WORK TICKETS

The work ticket is the fundamental building block of a CMMS, with things like accountability, equipment history, parts, planning, scheduling and failure data all stemming from it. Information on how long a job takes, and who does the work, can also be linked back to the work ticket – giving you valuable feedback for future work.

The implementation of a full work ticket system should be the first step in setting up your CMMS.

DATA

Data-driven decisions remove the emotional issues that cloud good judgment. A CMMS gives you the data to make proper, rational choices and decisions – and back them up. You might use some or all of the data below, which is all available in the CMMS, in making maintenance decisions:

- Labour records (how much time was spent on individual PMs)
- Performance reports for planners and supervisors
- Percentage of scheduled work
- Equipment history
- Parts information
- Job planning (tools, parts, instructions, manpower requirements)
- Equipment specifications
- Cost information at the equipment level
- Failure information

PLANNING

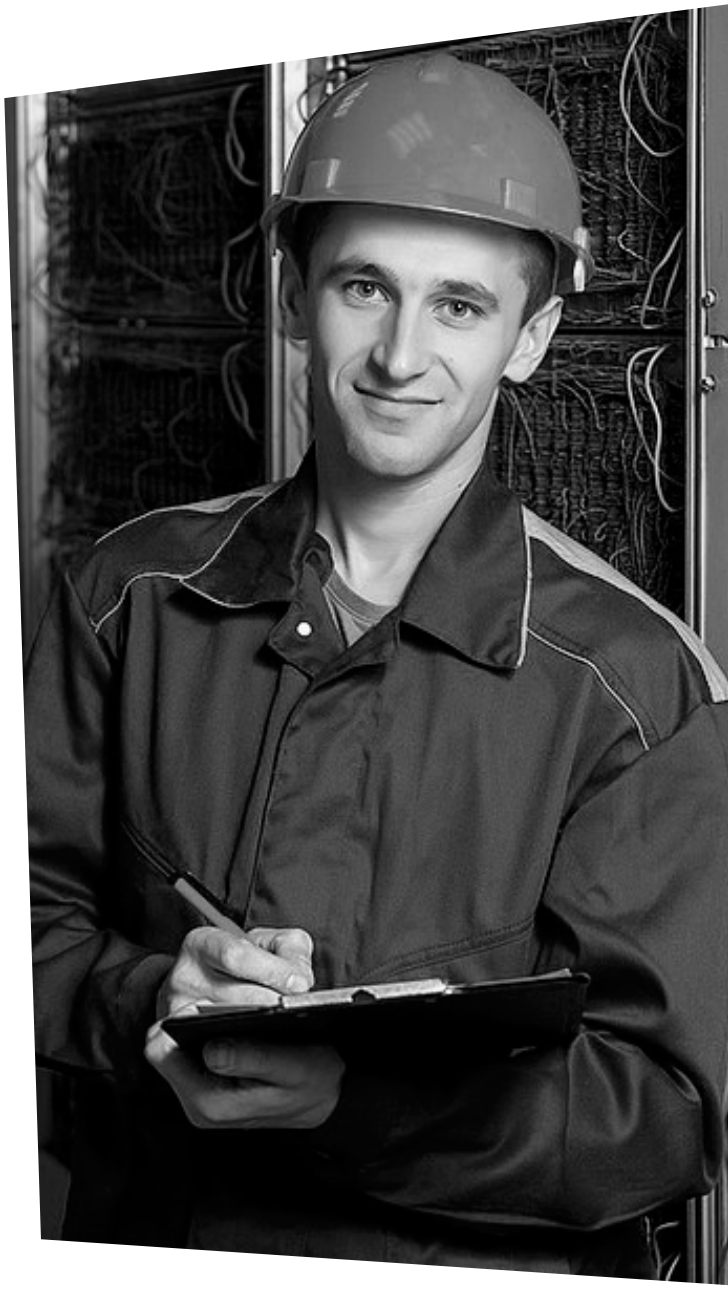
Planning is critical in the reliability process, and will help you get closer to the goal of zero hours of unscheduled downtime. It enables you to:

- Schedule the work identified in PM inspections
- Generate MTTR figures
- Handling all items in PM in a timely manner

The CMMS facilitates proper planning by generating work tickets and sending them to the planner, who is responsible for planning all the maintenance jobs submitted by "customers" in areas like operations, engineering, maintenance and reliability.

In planning, your task is to identify all the parts, tools, drawings, instructions, and other information necessary to get the maintenance job done. You also deliver the parts to the staging site in the area where the work is to be completed – including the purchase of outside or non-stock items.

SCHEDULING



In scheduling, the goal is to take all of the planned jobs that are ready to go and place them in a schedule at least four days in advance. It's typically completed in a weekly planning session with input from operations and maintenance, with all teams playing a role in ensuring that the schedule goes to plan.

Firstly, the planner should suggest a "best fit" schedule to minimise interruptions to the production schedule while meeting maintenance manpower requirements.

Then, the production team should prepare their operations to allow for the maintenance work to be completed. This may include filling tanks, generating extra inventory, running ahead or rescheduling.

The maintenance supervisor is responsible for meeting the schedule – and providing any feedback as to why the schedule is or is not working.

A word of caution: don't try to do scheduling too soon in the process. You'll only frustrate people. Any work to minimise the amount of emergency work must be completed first. You may choose to dedicate specific people to planned work, and start planning their work so that it is not interrupted for any reason. Over time, if done properly, you'll increase the number of problems fixed and reduce the number of emergencies – thereby freeing up more time to do planned work.

6

INITIATE A PREDICTIVE MAINTENANCE PROGRAM

Once you have your CMMS humming away in the background, with PM running smoothly, you're ready to initiate a predictive maintenance program – which will help you identify failures earlier in the process and potentially save hundreds of thousands of dollars.

Remember, you shouldn't aim to perform predictive maintenance on everything.

That simply wouldn't be viable.

Rather, work out which assets require predictive maintenance by performing reliability centred maintenance (RCM) or PM – depending on what is most established in your organisation. Use either approach to allow for conditioned based monitoring so that you perform maintenance when it is necessary, rather than based on a calendar time frame.

Predictive maintenance has the following characteristics:

It is only done if a benefit can be identified.

It is possible to do predictive maintenance that returns no benefit. For example, you could perform an oil analysis on a one-gallon gearbox at $25 a sample; or you could change the gearbox annually for the same cost. In this case, the consequence of failure is insignificant.

However, if the cost of unscheduled failure on that gearbox was $50,000, then it would make sense to perform a $25 analysis. Looking deeper, if you change oil frequently to avoid the failure, then you lose important information stored in the oil that the analysis would reveal. Yet if you change the oil yearly and sample it monthly you may see a trend that would alert you to an impending failure mode. This would allow you to plan corrective action at a cost of several hundred dollars – before a failure costing $50,000 occurs.

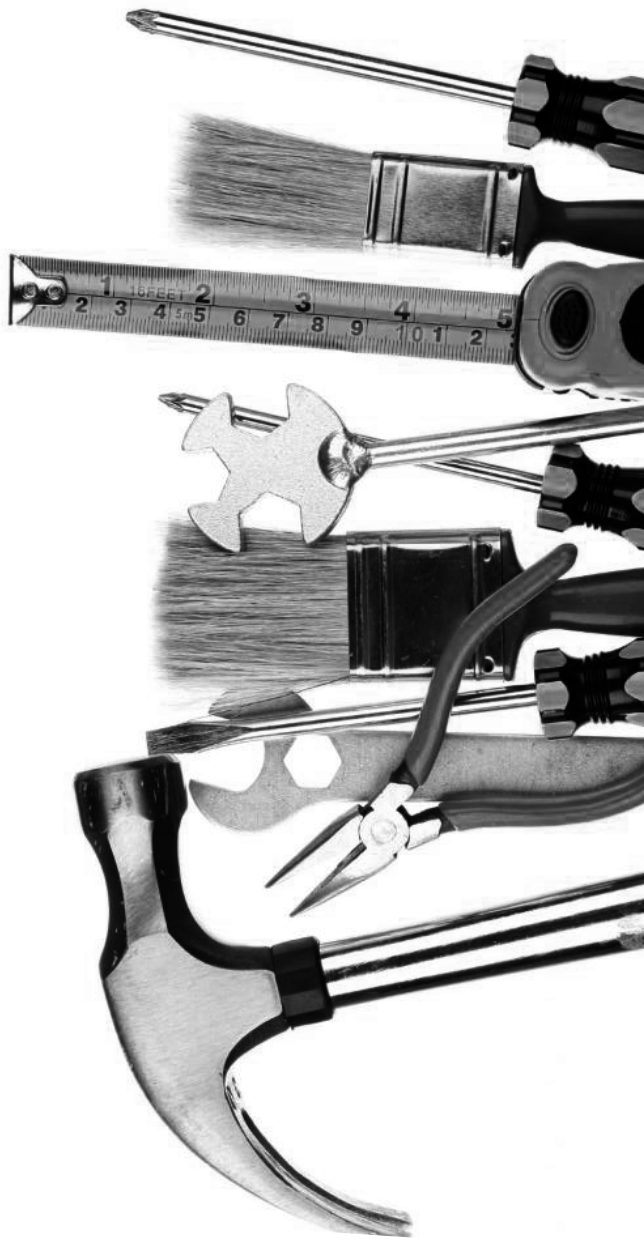
RCM can be used to identify the benefits and consequences of performing – or not performing – predictive maintenance.

It is used to predict one of the possible failure modes as identified by the RCM.

Predictive tools should be used to identify failure modes of equipment. There are many ways that failure modes can be identified, although we recommend the highly methodical and proven RCM approach.

It is used to adjust PM frequency and move towards condition based monitoring.

With PM in place and emergency work virtually eliminated, predictive tools can be used to ensure that PMs are being performed at optimum frequency. RCM can be used to implement predictive tasks that identify failure modes and, if necessary, plan and schedule fixes.



7

APPOINT EQUIPMENT CONSCIOUS OPERATORS

An Equipment Conscious Operator (ECO) is a person responsible for caring for the equipment they use. This person uses all of their available senses to identify problems with their machine; and to prevent deterioration by lubricating joints, making minor adjustments, tightening nuts and bolts, and so on.

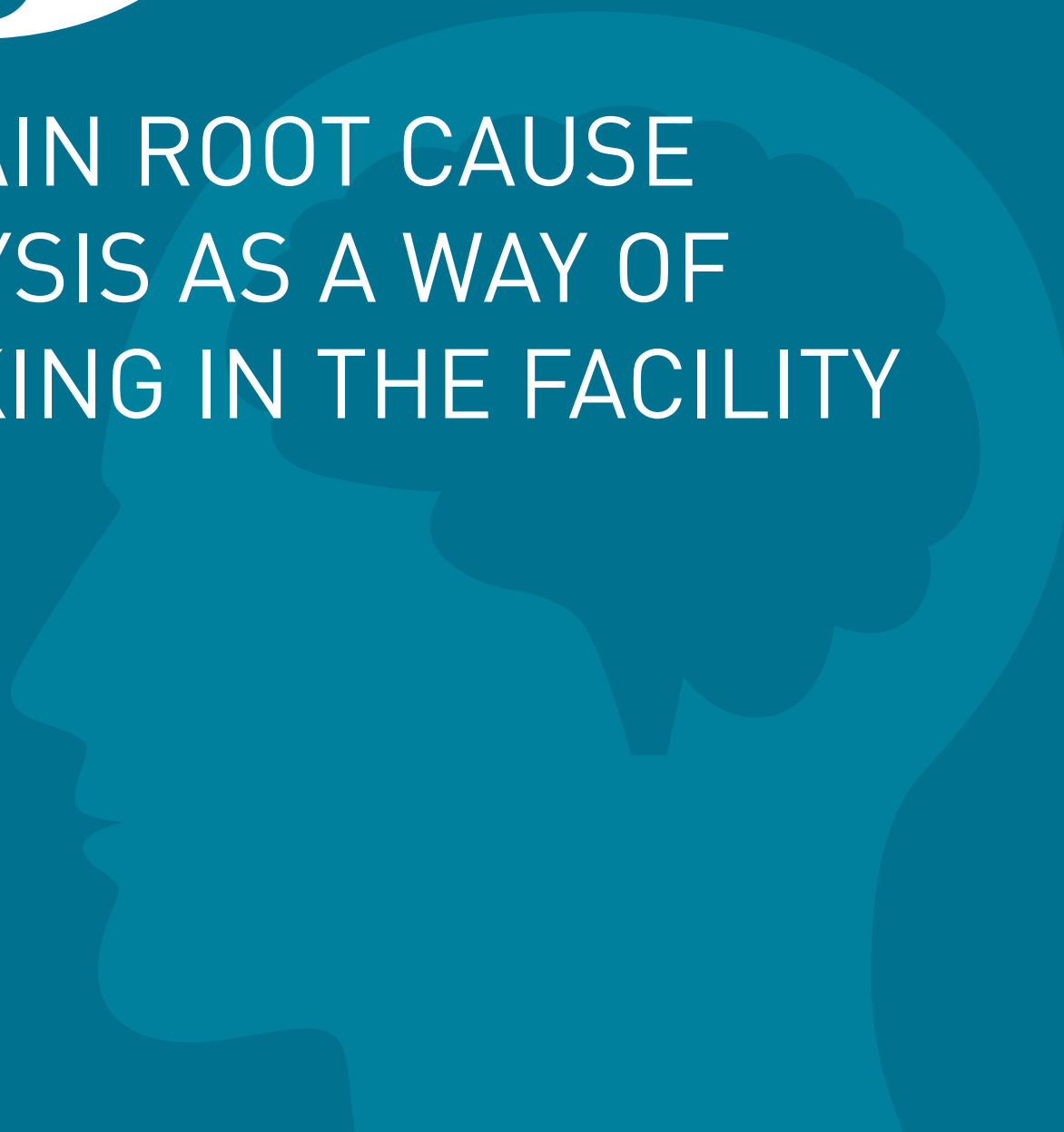
By appointing ECOs, you are empowering employees to take care of their own equipment and keep it in like-new condition.

Think of an ECO like the owner of a car. Any car owner is responsible for checking the tires, changing the oil, listening out for strange sounds or watching for signs that the car isn't running smoothly. If they hear or see a problem, they take it to the mechanic to fix.

In other words, ECOs should look after their equipment, but not be expected to make significant repairs. Be aware that a significant amount of training is required to get your ECOs to the point where they can care for, clean and inspect their equipment diligently. But this training certainly pays off – as it will both help to maintain the equipment and provide early alerts if things are going wrong.

8

INGRAIN ROOT CAUSE ANALYSIS AS A WAY OF THINKING IN THE FACILITY

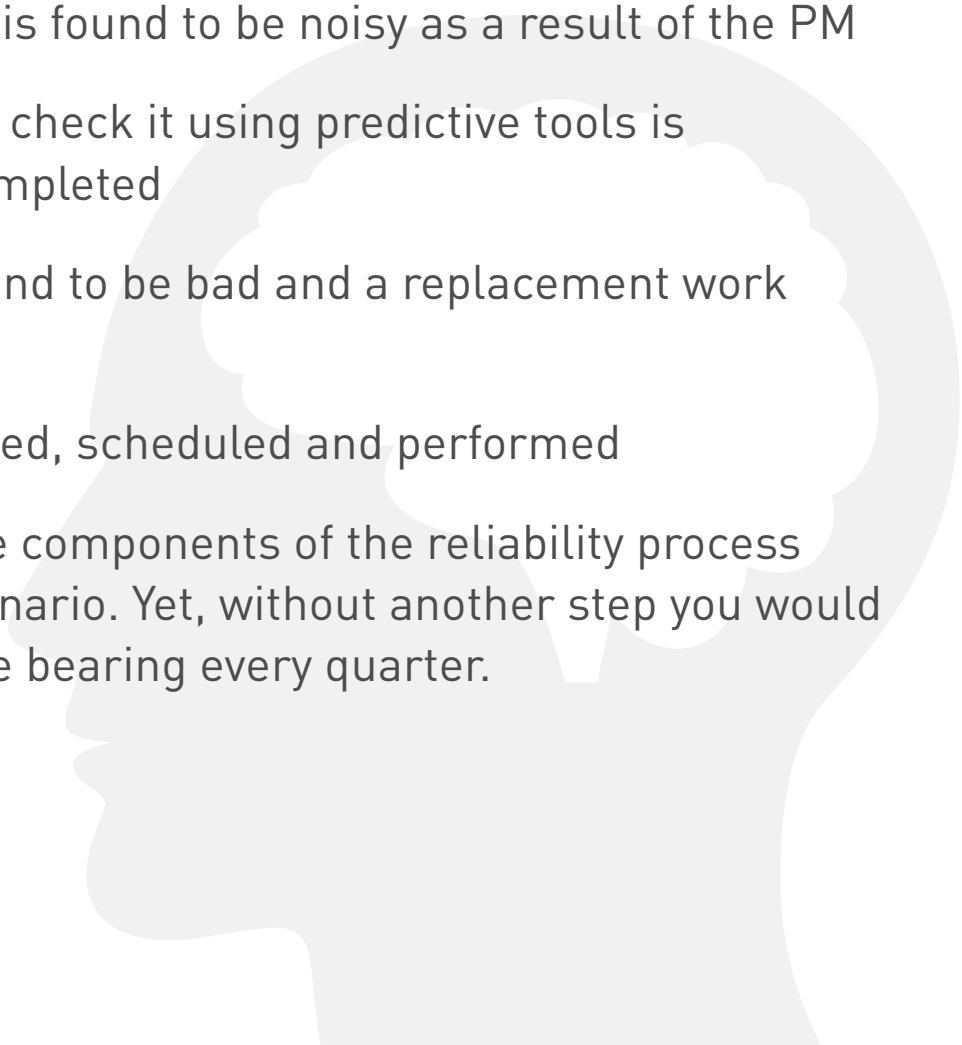


Steps 1 to 7, outlined previously, are an excellent start in working towards zero downtime. Yet you need to take it two steps further to really ensure the best performance of the assets and equipment in your plant. The first step is to make RCA an ongoing, ingrained way of thinking.

Consider this scenario:

1. PM is performed quarterly
2. A hanger bearing is found to be noisy as a result of the PM
3. A work request to check it using predictive tools is submitted and completed
4. The bearing is found to be bad and a replacement work request is issued
5. The work is planned, scheduled and performed

At face value, all of the components of the reliability process are present in this scenario. Yet, without another step you would continue to replace the bearing every quarter.



You need to start asking deeper questions about “what caused the bearing to fail” – particularly if that bearing has a typical life of eight years – if you want to solve long-term causes of downtime. In this scenario, you need to perform RCA.

An RCA may reveal misalignment, improper assembly, no lubrication, improper selection for the operating parameters, or another specific cause. Root cause allows the real problem to be found and remedied – so you get maximum return on the repair investment.

9

ONGOING RELIABILITY CENTRED MAINTENANCE

Theoretically, RCM forms an integral part of every step outlined above. After all, RCM is all about driving continuous improvements to minimise the consequences of failure.

However, many organisations aren't ready for RCM until they have gone through the process of appointing a cross-functional team and ECOs, implementing PMs, getting their CMMS up and running, and so on.

Teams, systems and organisational cultures simply aren't ready for RCM until the above changes have been made and appropriate processes have been put in place.

Once your organisation is "ready" for RCM, you will reap enormous benefits from it. RCM is a methodology where a preventive program is designed for the life of the equipment by defining the failure modes, identifying the consequences of failures, and then – if they are deemed to be of significant consequence – using preventive and predictive tools to prevent these failures from occurring.

SUMMARY

With the 9 Step Reliability Process in place, you can strive towards a goal of achieving a maximum Overall Equipment Effectiveness (OEE).

OEE tracks the performance of individual pieces of equipment by measuring its availability, performance and quality – when the thing works well, it rates highly.

Remember, the real value in OEE is not in the actual number itself – since it is not an absolute measure – but in trending. Your goal is to continually improve your operation, which the trending OEE will demonstrate.

Implementing the 9 Step Reliability Process takes time. Yet persistence pays off as you start to eliminate unplanned downtime and experience the state in which your plant is up and running at maximum capacity.

About ARMS Reliability

Since 1995, ARMS Reliability has been at the forefront of proactive asset management strategies for a range of blue chip companies throughout the world. These companies have entrusted us with delivering business goals through effective asset management and improvements in operational productivity.

ARMS Reliability is a service, software, and training organisation providing a "one stop shop" for Reliability Engineering, RAMS, and Maintenance Optimisation for both new and existing projects.

If you would like to discuss your situation and what the essential elements are to achieving best practice Asset Management in your organisation, then give ARMS Reliability a call or

ENQUIRE NOW

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