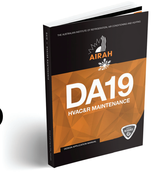
SPECIFYING A MAINTENANCE PACKAGE WITH DA19



The DA19 user guide is designed to assist building owners and managers in better understanding the steps they need to take to use DA19 to specify their maintenance needs. Steps 1 to 6 outline how to use DA19 to develop a scheduled maintenance specification for your heating, ventilation, air conditioning and refrigeration (HVAC&R) assets, aligning with your maintenance duties and objectives and enabling you to define a building- or facility-specific HVAC&R maintenance package for competitive tendering. Step 7 highlights information on the further journey towards applying performance- or outcomes-based maintenance to your HVAC&R assets.

STEP 1

MAINTENANCE OBJECTIVES

Define your overall **maintenance objectives.**

- Compliance requirements and WHS duties
- Short-term and long-term financial or organisational objectives
- Budget allocation to reflect objectives.

SEE MORE

STEP 2

IDENTIFY AND UNDERSTAND

Identify and understand your HVAC&R assets.

- What and where are your HVAC&R assets – heating, cooling, refrigeration, fire safety
- What assets have compliance, safety, energy or environmental impacts?

SEE MORE

STEP 3

ASSIGN A CRITICALITY

Assign a criticality to each asset.

- Can your business or building operate successfully without this asset?
- What happens when it breaks down?
- Does it consume a lot of energy or water?
- Are there WHS risks?

SEE MORE

STEP 4

SELECT A MAINTENANCE STRATEGY

Select a maintenance strategy for each asset (in light of steps 1 to 3).

- Assign a strategy for each asset
- Critical assets should be best practice
- Other assets will be good or best practice depending on objectives.

SEE MORE

STEP 5

TENDER PACKAGE

Put a **tender package** together.

- Document your maintenance requirement using DA19
- Identify each system, the objective, and the strategy.

SEE MORE

STEP 6

TENDER QUOTE

Seek a **tender quote.**

- Hand the tender package over to HVAC&R maintenance companies for a competitive tender quote.

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STEP 7

PERFORMANCE-BASED MAINTENANCE

Secure a **performance-based maintenance** arrangement.

- Now you know what you want from maintenance, you have the opportunity to enter into a performance-based maintenance arrangement with your maintenance provider.

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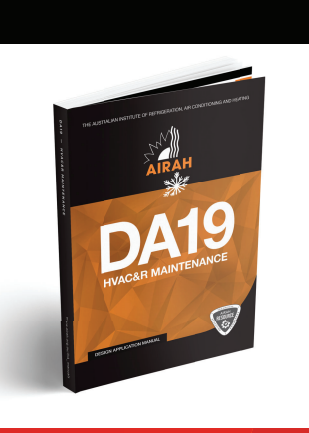
Facility managers – it is not sufficient for a facility manager to specify maintenance "in accordance with DA19". DA19 is not a maintenance specification and a range of decisions must be made to define the scope and extent of the maintenance program required. Maintenance investment must reflect the risk to the business and the performance level required of the asset. Assets with high performance expectations require performance oriented outcomes-based maintenance approaches.

SPECIFYING A MAINTENANCE PACKAGE WITH DA19



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STEP 1 MAINTENANCE OBJECTIVES

Define your overall **maintenance objectives.**

- Compliance requirements and WHS duties
- Short-term and long-term financial or organisational objectives
- Budget allocation to reflect objectives.

SEE LESS

MAINTENANCE OBJECTIVES

What do you want from maintenance?
Do you have compliance requirements, WHS duties, short- or long-term financial and organisational objectives? Maintenance should be planned, procured and delivered to achieve the owner's stated objectives.

These can include:
- Return on maintenance investment/asset protection and enhancement
- Legal compliance/health and safety
- Risk management/cost limitations
- Building sustainability/indoor environment quality
- Marketing/corporate image.

The budget allocated to funding maintenance should reflect the stated maintenance objectives.

ENVIRONMENTAL
Refrigerants, noise, energy

PERFORMANCE
Risk, cost, ROI, sustainability, (NABERS, Green Star, WELL)

COMPLIANCE/HEALTH AND SAFETY
Fire/smoke control, microbial control, ventilation, refrigerants

MAINTENANCE OBJECTIVES
For clients, maintenance managers and maintenance providers.

Compliance with the law and associated statutory regulations applying to building or system maintenance is the minimum maintenance requirement that must be satisfied. Legal penalties apply for building owners and operators. Certification may be necessary to verify that maintenance obligations are being met. Specific legal requirements regarding the maintenance of HVAC&R systems can vary from state to state (and territory) in Australia.

STEP 2 IDENTIFY AND UNDERSTAND

Identify and understand your HVAC&R assets.

- What and where are your HVAC&R assets – heating, cooling, refrigeration, fire safety
- What assets have compliance, safety, energy or environmental impacts?

SEE LESS

IDENTIFY YOUR HVAC&R ASSETS

What, how many, and where are your HVAC&R assets?
Create an asset register for your systems (heating, ventilation, air conditioning, refrigeration, smoke control) and major components (fans, pumps, boilers, chillers, filters, cooling towers, package air conditioners.)

Identify every piece of HVAC&R plant and equipment on an asset register. Tag plant electronically to keep information up-to-date using bar codes, smart tags or scan codes.

Don't forget the controls; maintenance of sensors, actuators, and DDC or BMCS controllers is essential.

TYPICAL HVAC&R ASSETS

- **Heating** – Reverse-cycle air conditioning, heating hot water, ducted heating
- **Ventilation** – Supply, exhaust (bathrooms, kitchens, carparks, garbage)
- **Air conditioning** – Central, distributed, rooftop, split systems, chilled beams
- **Refrigeration** – Cool rooms, cold rooms, refrigerators, freezers, plant rooms
- **Fire safety** – Fire dampers, smoke control systems, fire mode controls
- **Major components** – Chillers, boilers, cooling towers, fans, pumps, control systems

STEP 3 ASSIGN A CRITICALITY

Assign a criticality to each asset.

- Can your business or building operate successfully without this asset?
- What happens when it breaks down?
- Does it consume a lot of energy or water?
- Are there WHS risks?

SEE MORE

ASSIGN A CRITICALITY

Assign a Criticality Risk Rating to each HVAC&R asset.
Can your business or building live without this asset? What happens when it breaks down? Does it consume a lot of energy or water? Does it pose a potential safety risk? Does it affect your business?

This assessment is mostly about organisational and personal risks: financial income risks, WHS risks and public health risks.

Criticality risk rating = criticality/risk of HVAC&R services to the core business of the organisation.

Examples of enterprise critical HVAC&R services include:
- Cooling and air conditioning systems serving critical data centre and ICT processing functions
- Mechanical and HVAC plant and systems serving critical or acute care areas in hospitals
- Cooling systems in commercial building lift motor rooms or PABX/communications rooms.

Ventilation and air conditioning systems may also be designated as critical to continued building operations (ventilation or indoor air temperature), although longer downtimes can often be tolerated.

Refrigeration systems may be designated as critical, based on the nature or value of the service.

STEP 4 SELECT A MAINTENANCE STRATEGY

Select a maintenance strategy for each asset (in light of steps 1 to 3).

- Assign a strategy for each asset
- Critical assets should be best practice
- Other assets will be good or best practice depending on objectives.

SEE MORE

SELECT A MAINTENANCE STRATEGY

Select a maintenance strategy for each HVAC&R asset, in light of the decisions you have made in steps 1 to 3. Because of differing risk and criticality assessments, it is unlikely that a single maintenance strategy will be applicable to all of the HVAC&R assets within your building. DA19 allows for three levels of scheduled maintenance: best practice Level A, good practice Level B or compliance Level C maintenance. All assets should receive a minimum of compliance Level C maintenance. Critical assets should receive a best practice Level A. Other assets should receive good practice Level B or best practice Level A, depending on the objectives.

MAINTENANCE MINDSETS
Proactive or Reactive?

Proactive maintenance – includes **preventative maintenance (PM)** techniques and **predictive maintenance (PdM)** techniques. A tailored contemporary maintenance program for a building or plant is typically a hybrid or proactive approach incorporating elements of scheduled maintenance, system monitoring and metering, plant conditioning monitoring, and predictive approaches such as data-driven analytics or fault detection and diagnosis.

Reactive maintenance (RM) is the principle of run-to-failure, then repair or replace individual components. Reactive maintenance is also called "operate to fail" or "breakdown maintenance" and is really the absence of an ongoing maintenance strategy.

MAINTENANCE MINDSETS
Preventative or Predictive?

Both predictive and preventative maintenance strategies are intent on extending the life of equipment and preventing unexpected breakdowns, but they have a very different approach.

Preventative maintenance (PM), is carried out using specific tasks (such as those covered by the schedules in DA19), on a calendar date or time/usage basis, to reduce plant lifecycle costs and improve efficiency.

Predictive maintenance (PdM) leverages technology to directly, and continuously, monitor performance against a set of baseline data. It attempts to predict when key maintenance or repair activities need to take place. Some form of digital condition monitoring system or data analytics system must be in place to provide this data.

EXAMPLE – ASSIGNING MAINTENANCE STRATEGY TO HVAC&R SYSTEMS

HVAC&R asset	Criticality	Reason	Maintenance strategy
Refrigerant chiller	Critical	Serves critical process Contains > practical limit flammable refrigerant Energy use > X kJ	PdM
Kitchen exhaust	High risk	Potential fire risk Potential odour complaints	PM – Level A
Air conditioning system	Critical	Outdoor air ventilation (for occupation) Energy use > Y kJ	PM – Level A PdM
Toilet exhaust	Standard	Non-critical, natural alternative	PM – Level B
Split air conditioner	Standard	Non-critical, natural alternative	PM – Level B

LAYOUT OF A TYPICAL DA19 MAINTENANCE SCHEDULE

Action	Frequency (m) Maintenance level A	B	C	Explanation

DA19 scheduled maintenance tender documentation needs to define the maintenance level to be applied to each system or item of plant – **best practice Level A, good practice Level B, or minimum compliance practice Level C.** From this, DA19 provides detailed maintenance schedules with instructions and specified maintenance task frequencies.

GOOD PRACTICE VERSUS BEST PRACTICE MAINTENANCE

COMPLIANCE LEVEL MAINTENANCE
- Scheduled compliance maintenance
- Breakdown maintenance

- Systems are maintained to protect health and safety of the community
- Health and safety risks are controlled
- Owner's liabilities are managed
- High probability of insurance conditions being met
- Poor NABERS Energy rating
- Frequent breakdowns, occupants significantly disrupted
- Accelerated deterioration of equipment leads to high CapEx
- Maintenance costs are elevated without up-to-date system documentation and knowledge bank
- Asset condition in accelerated decline
- Asset value in decline, high lifecycle cost

GOOD PRACTICE MAINTENANCE
- Scheduled compliance maintenance
- Scheduled preventative maintenance
- Limited condition-based maintenance
- Infrequent diagnostic review
- Breakdown maintenance

- Health and safety risks controlled, owner's liabilities are managed, high probability of insurance conditions being met
- NABERS rating competitive, but declines as equipment ages
- Infrequent breakdowns, occupants generally satisfied
- CapEx managed via lifecycle audits
- Drawings and equipment records are kept up-to-date, in owner's control, costly recurrent audits required to identify system condition and status
- Asset condition commensurate with system age
- Asset value decline in line with age of equipment, moderate lifecycle cost

BEST PRACTICE MAINTENANCE
- Team-based maintenance
- Scheduled compliance maintenance
- Risk-based scheduled preventative maintenance
- Scheduled performance maintenance, system recommissioning
- Condition-based maintenance
- High-frequency diagnostics
- Team-based continuous improvement
- Breakdown maintenance (low risk only)

- Health and safety risks controlled, owner's liabilities are managed, high probability of insurance conditions being met
- NABERS rating maintained or improved
- Breakdowns are rare, occupants informed and forgiving
- CapEx optimised on extended equipment life
- Drawings and equipment records are kept up-to-date, in owner's control
- Audits unnecessary
- Asset condition improves through the duration of the maintenance agreement
- Asset value maintained/enhanced, lowest total lifecycle cost

STEP 5 TENDER PACKAGE

Put a **tender package** together.

- Document your maintenance requirement using DA19
- Identify each system, the objective, and the strategy.

SEE MORE

TENDER PACKAGE

Document your maintenance requirement using DA19.
- Put a tender package together, listing the system or HVAC&R asset, with the objective and the selected scheduled maintenance level
- Talk to service providers in terms of systems; they will break scheduled maintenance tasking down into component level in accordance with DA19 procedures.

EXAMPLE
Documenting DA19 scheduled maintenance requirements for HVAC&R systems

HVAC&R asset	Objective	Criticality rating	DA19 maintenance level
Air cooled chiller	Asset protection, risk and compliance, energy and NABERS	Reliability – serves critical process Health and safety – refrigerant compliance Efficiency – high energy use > X kJ	Level A and C
Kitchen exhaust	Risk and compliance	Health and safety – potential fire risk Health and safety – potential odour complaints	Level A and C
Air conditioning system	Asset protection and compliance	Reliability – serves operational staff area Health – outdoor air ventilation Safety – fire dampers and smoke controls Efficiency – medium energy use > Y kJ	Level B and C
Toilet exhaust	Standard	Non-critical, natural alternative, no compliance	Level B
Split-system air conditioner	Standard	Non-critical, natural alternative, no compliance	Level B

STEP 6 TENDER QUOTE

Seek a **tender quote.**

- Hand the tender package over to HVAC&R maintenance companies for a competitive tender quote.

SEE MORE

TENDER QUOTE

Issue maintenance tender package for a competitive tender – you now have enough information to hand over to a HVAC&R maintenance company for a competitive tender or quote on your specific maintenance specification.

In any maintenance program, detailed maintenance instructions for all HVAC&R assets need to be compiled. DA19 provides detailed maintenance schedules with instructions and specified maintenance frequencies (Level A, B or C). The scheduled maintenance program for HVAC&R assets is developed from an amalgamation of all the individual DA19 maintenance schedules and task instructions to create a facility-wide systems approach to maintenance delivery.

MAINTENANCE BUDGET
Lowest price is not the best criteria on which to assess competitive maintenance tenders.

The best way for owners and managers to optimise maintenance outcomes and expenditure is to enter into a long-term partnership with a maintenance service company and agree on a best-practice approach to maintenance – including agreed maintenance performance standards.

THE MAINTENANCE PARTNERSHIP

Role of FM in maintenance
The facility manager acts on behalf of the owner or demand organisation to ensure that the building and its systems are functioning optimally.

Managers need to respond to complaints quickly and efficiently and drive the maintenance process. They may also:
- Provide the link between system maintainers and building tenants and occupants
- Often act in a supervisory role for maintenance staff and contractors
- Maintain documentation such as the asset register and operating and maintenance manuals
- Monitor, meter, record and report system performance, ensuring that performance data is available to relevant maintenance team participants
- Communicate maintenance issues and resolve access issues
- Report on the maintenance effectiveness and arrange for the periodic review of the performance maintenance plans and procedures.

Successful maintenance management relies on the ongoing commitment of managers to maintenance planning, maintenance funding and user education.

Selecting a maintenance provider
The selection of the maintenance service provider is the key to satisfactory maintenance, which will result in reliable plant performance, good plant life and reasonable expenditure.

Lowest tender price is the least appropriate way to select a service provider. Value for money should be the determining factor.

The ideal situation is where the demand organisation (client) and maintenance service provider establish a partnering relationship, recognising that the service provider needs to make a profit and the client needs to contain the costs.

A potential service provider should have the following attributes:
- Competent, committed and well-trained technicians
- Appropriate licences, insurances and accreditation
- Appropriate level of resources.
- Efficient and accurate maintenance management system
- Informative reporting system
- Accurate and timely invoicing
- Economical and reliable after-hours service
- Quality, environmental and safety management systems.

STEP 7 PERFORMANCE-BASED MAINTENANCE

Secure a **performance-based maintenance** arrangement.

- Now you know what you want from maintenance, you have the opportunity to enter into a performance-based maintenance arrangement with your maintenance provider.

SEE MORE

PERFORMANCE-BASED MAINTENANCE

Moving to performance-based maintenance
A performance-based maintenance regime applies an optimum mix of different maintenance approaches (preventative and predictive), based on risk, costs and consequences. Establishing the appropriate mix and focusing on continuous improvement are equally important in a performance-based maintenance strategy.

A performance-based maintenance delivery model requires a longer-term commitment from both parties as significant effort is required to get the processes matched to the outcomes.

Prescriptive or performance maintenance mindset – task versus outcome focus

It is best practice for owners to recognise the partnership and teamwork that must exist with HVAC&R maintainers (and possibly other specialist trades such as BMCS specialists) in order for the objectives of the maintenance program to be met. This requires clear communication of the objectives, how they will be measured and the frequency of measurement. Ideally, a series of lead and lag indicators will be used to guide the performance of maintenance, so that there is a high probability of the objectives being achieved.

See the suggested examples of potential lead and lag indicator measures that owners could use to target the outcomes that meet their objectives for the maintenance performance standards of HVAC&R asset maintenance in a commercial building. Please note: measures and frequencies are suggestions only.

Another issue to consider is how digital information technology can be leveraged to generate improved maintenance outcomes in a performance-based approach. Applying digital solutions to maintenance planning, delivery and assessment is called **smart maintenance** in DA19.

Smart maintenance is a digital transformation strategy based on new technologies that capture data, automate tasks and free up human resources. Not all maintenance functions can be digitised, so smart maintenance uses digital intelligence to reduce the number of technician site visits while delivering superior service.

OUTCOME	COMPLIANCE	HEALTH AND SAFETY
LEAD INDICATOR MEASURE	Monthly – compliance tasks completed to schedule	Monthly – owners safety inductions up-to-date for all personnel. Safe work management plan up-to-date. Tool box talks held to schedule
LAG INDICATOR MEASURE	Annual – compliance statement	Monthly – lost time injury frequency and lost time register

COMFORT CONDITIONS	ENERGY PERFORMANCE	WATER PERFORMANCE
Daily – Zone DB temp within 21.5°C to 23.5°C during occupied hours	Daily – energy monitoring < benchmark Daily – energy optimisation routines enabled	Daily – water monitoring < benchmark
Monthly – customer complaint frequency	Monthly – base building rolling annual energy/m² < 375 MJ/m² Annual – base building NABERS energy rating > 4 stars	Monthly – base building rolling annual water/m² < 600 L/m² Annual – base building NABERS water rating > 3.5 stars

INDOOR ENVIRONMENT QUALITY	INDOOR ENVIRONMENT QUALITY	OUTDOOR ENVIRONMENT
Daily – CO_2 in the occupied space is: 100% < 1000ppm, 90% < 800ppm	Monthly – filters cleaned to schedule	Quarterly – plant noise measured
Quarterly – ventilation system settings checked to schedule	Quarterly – particulates in air monitoring PM_{10} < 25 μg/m³, $PM_{2.5}$ < 50 μg/m³	Annual – compliance with regulations

RELIABILITY	SYSTEM DOCUMENTATION	MAINTENANCE PERFORMANCE
Monthly – preventative maintenance tasks complete to schedule	Monthly – change register, records any changes to the physical system or operating parameters	Monthly – performance meetings are held with maintenance team; performance objectives achieved
Monthly – system reliability KPI, availability hours	Monthly – changes are reflected in asset register, system drawings, functional specifications, maintenance documents	Annual Review – with maintenance team; performance objectives reviewed

SMART MAINTENANCE – DIGITISATION OF MAINTENANCE

A lot of maintenance procedure is about information – generating data, comparing and analysing information, recording results. Managing information flows lends itself well to digitisation, and advances in digital technologies are providing new opportunities for more advanced maintenance services and solutions.

Time analytics pulled from big data, relayed by wireless sensor networks, analysed by cloud-based algorithms and visualised on mobile computing devices, are changing maintenance, disrupting traditional practices and creating new value opportunities.

INFORMATION TECHNOLOGY IN MAINTENANCE HELPS US TO:
- MAKE EFFICIENT USE OF SENSOR INFORMATION AND MONITORED DATA
- UNDERSTAND SYSTEM OPERATION, PERFORMANCE AND HISTORY
- IDENTIFY WHEN SYSTEMS ARE FAILING AND HOW TO REPAIR THEM

BY CAPTURING, ANALYSING AND REPORTING ON PLANT AND SYSTEM PERFORMANCE, SMART MAINTENANCE SYSTEMS CAN:
- MAXIMISE THE EFFICIENCY OF THE MAINTENANCE WORKFORCE
- MINIMISE THE PLANT AND SYSTEM FAILURE FREQUENCY
- OPTIMISE THE PLANT AND SYSTEM OPERATION

Smart maintenance can deliver customer value by providing a real-time view of their maintenance needs, so they can make informed decisions. Collected data is used effectively to improve plant and system efficiency and guarantee user satisfaction.

DIGITISATION IN MAINTENANCE

MAINTENANCE TASKS	Smart schedules, smart tags, digital tools Wireless sensors and data loggers Data from digital controllers
MAINTENANCE MANAGEMENT	CMMS – computerised maintenance delivery BIM – asset data, design, as-built, benchmark BMCS – building services data and controls EMS – building or precinct wide energy use
DIGITAL ANALYSIS	Condition monitoring Performance monitoring Data driven analytics Automated fault detection Automated fault diagnosis

For SMART maintenance, it is essential that every item of plant/equipment be identified on the asset register.

ASSET REGISTER TO RECORD PLANT DATA	An HVAC&R asset register is a record of all assets associated with the building or facility HVAC&R systems: components of a system are sub-assets. HVAC&R plant is a sub-asset of the whole building asset list. Each asset and sub-asset is given a unique identifier on the register which then provides a structure for recording and retrieving maintenance information. Each item listed should be included in the HVAC&R maintenance program.
DIGITISING ASSET INFORMATION	Asset lists should be provided in an electronic format to facilitate the construction of digital maintenance schedules and building logbooks, and to support the operation of maintenance management systems and field data capture and reporting devices. Plant can be electronically tagged with the asset register information and identified using bar codes, smart tags or similar. BIM data is leveraged into facilities management data.

Condition monitoring uses several advanced digital techniques to assess the condition and performance of components so that optimum equipment performance can be sustained.

When applying condition monitoring:
- Always obtain base readings early in the life of the equipment
- Undertake monitoring on a regular basis and plot trends
- Always attempt to get a high signal to noise ratio for the measured variable
- Always measure at fixed reference points
- Remove all other variables.

Once the results have been reviewed, maintenance actions are initiated by the trends highlighted.

In **data-driven** analytics, the physical condition, performance, or efficiency of a system is evaluated by monitoring selected digital input/output data and comparing the actual data received against a defined baseline. Any variance in the two datasets is used to identify the appropriate maintenance intervention. Using a combination of digital monitoring and analytical software algorithms, this process can be automated to a large extent, providing both continuous monitoring and alarm, as well as automated fault detection and diagnosis.

Data-driven analytics/Software as a Service (SaaS)

Data Integration | System Analytics | Cloud Services

Software as a Service (SaaS) is a software licencing model where the software platform is hosted in a remote centralised location (cloud servers). The SaaS model is becoming more prevalent in HVAC&R for energy management and fault detection and diagnostics.

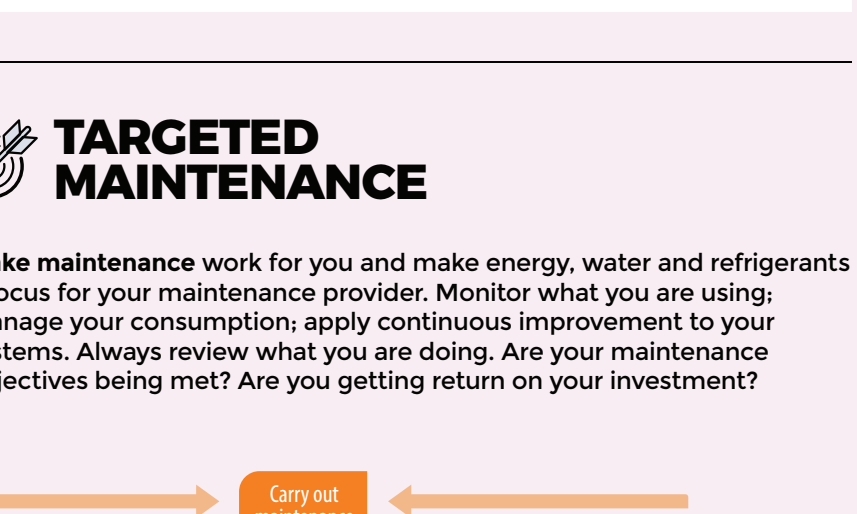
- Data redundancy is provided
- No server maintenance is required
- Updates are rolled out automatically
- Leverages offsite expertise and algorithms.

- Requires reliable access to the internet
- Licencing model typically requires a monthly/yearly fee
- Requires external access to the building.

Digitised asset registers and digital platforms (BIM, BMCS and CMMS) are going to play a huge part in the near future of data driven maintenance.

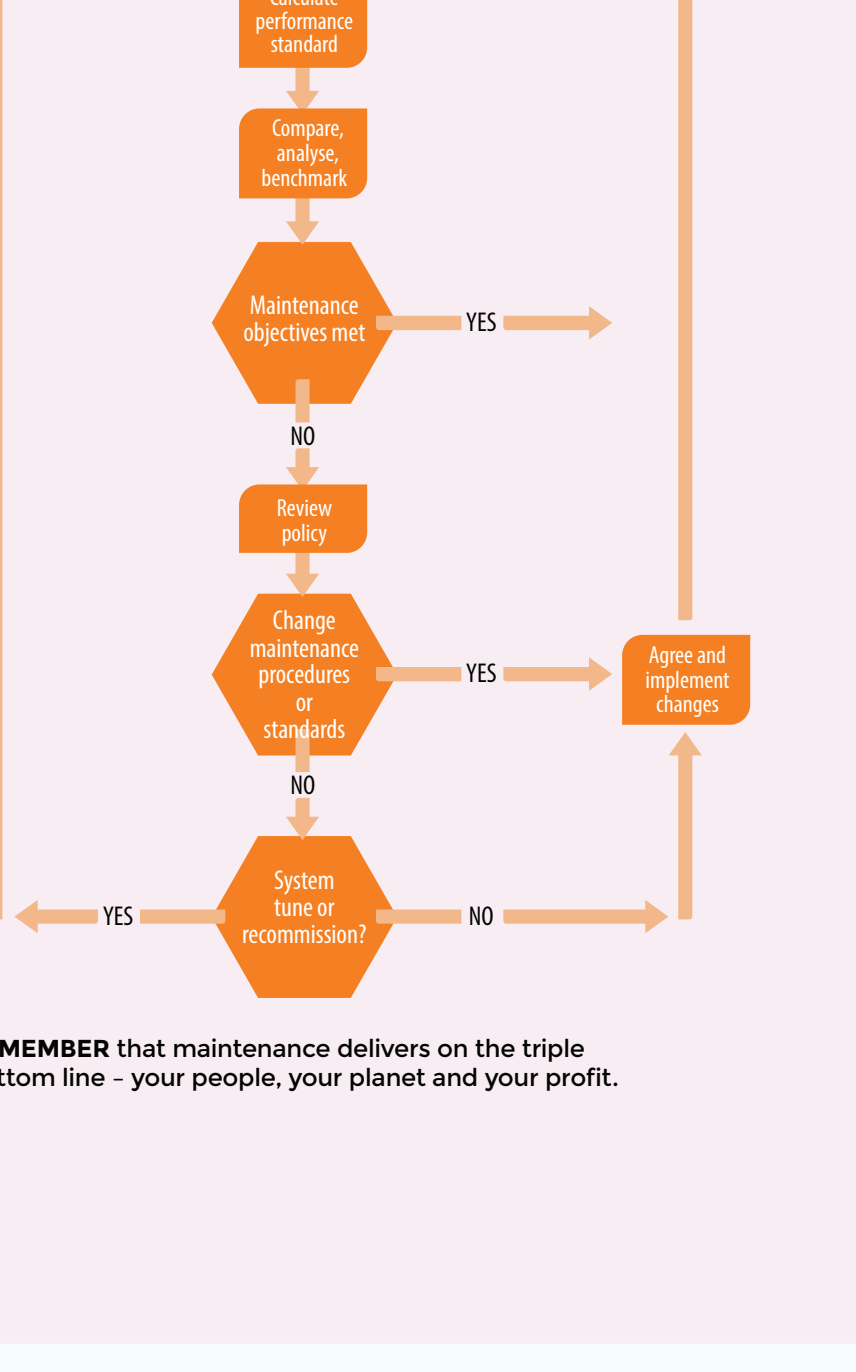
Protecting maintenance information and data

We all know about the threats of cybersecurity around data acquisition and storage. It is essential to have an Information Management Plan, with security management at its core. Security strategies should be part software or computational, and part user awareness with access control and threat protection.



TARGETED MAINTENANCE

Make maintenance work for you and make energy, water and refrigerants a focus for your maintenance provider. Monitor what you are using; manage your consumption; apply continuous improvement to your systems. Always review what you are doing. Are your maintenance objectives being met? Are you getting return on your investment?



REMEMBER that maintenance delivers on the triple bottom line – your people, your planet and your profit.

DA19 is used throughout the Australian property, facility management and HVAC&R maintenance industries as the authoritative guideline for HVAC&R maintenance. It is a document that can be used by an owner, operator or manager, as well as the service technician who does the technical work in the plant room. Further comprehensive information on all of these topics is provided in AIRAH's DA19 HVAC&R Maintenance.

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