

MAINTENANCE PROCESS

PULLOUT

Failure to maintain HVAC&R systems reduces their useful life, increases their operating costs and introduces unreliability, dissatisfaction and risk to a business's operation. Maintenance, on the other hand, improves safety, increases efficiency, improves reliability and increases satisfaction. Maintenance is about energy and water, noise and vibration, efficiency and control.

THE MAINTENANCE PROCESS

The link between maintenance practices and a building's performance in use is direct and undeniable. HVAC&R building systems impact on a building's performance in a number of areas. Maintenance procedures impact on a system's operating performance and efficiency. Operating equipment more efficiently lengthens the lifespan of equipment. Well-maintained equipment is less likely to break down and results in a safer and more comfortable environment. Maintenance is required to maintain or improve system operational efficiency, energy use, water use and a systems' sustainability over its "whole of life".

The maintenance process, illustrated in Figure 1, is a generic process that assists owners, managers, and maintenance providers in establishing a framework for the maintenance management of HVAC&R services.

The process begins with maintenance policy development and maintenance planning, and moves on to maintenance implementation and reporting, as well as maintenance performance review.

MAINTENANCE OBJECTIVES

The first step in the maintenance process is the definition of maintenance objectives. Maintenance should be planned and delivered to achieve the overall objectives of the owner.

The owners' objectives for maintenance policy can include:

- Return on investment
- Asset protection and enhancement
- Legal compliance
- Health and safety
- Building sustainability
- Indoor environment quality
- Risk management
- Cost limitations
- Marketing
- Corporate image.

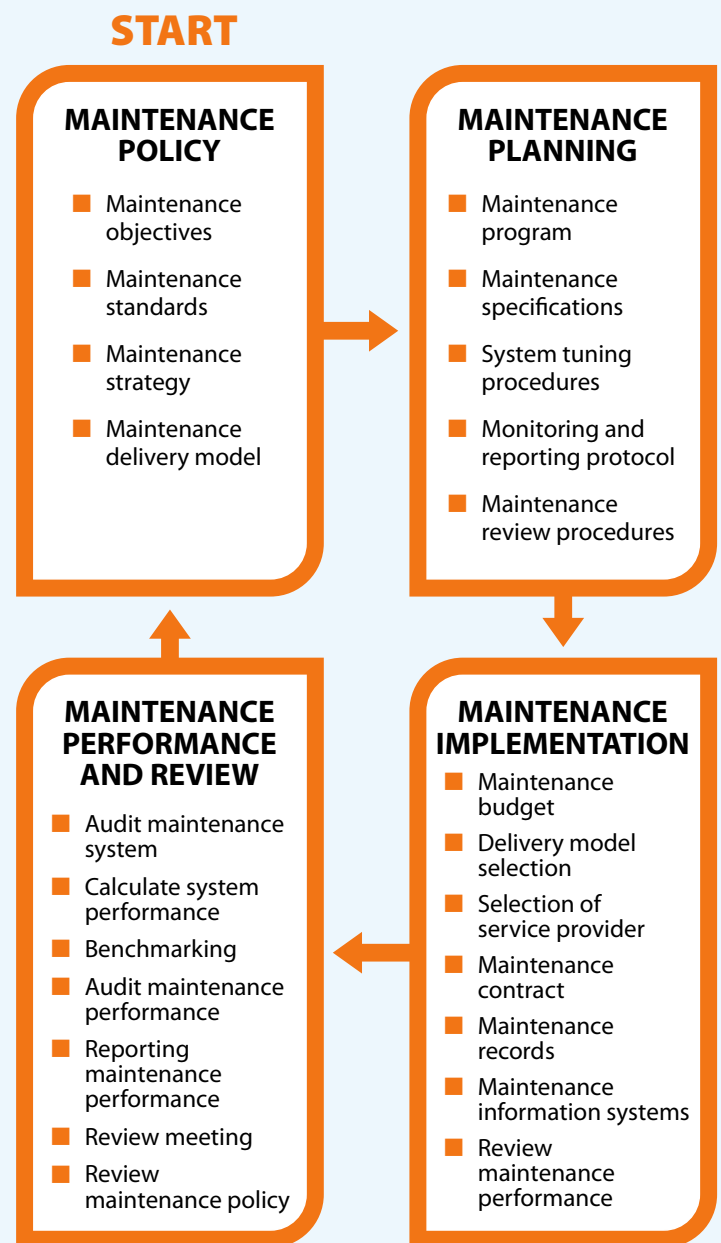


Figure 1: Maintenance management process.

Maintenance objectives serve as a guide to clients, maintenance managers, maintenance contractors and maintenance providers. Ideally, maintenance objectives are developed into the system design brief so that they are designed and built into the HVAC&R services, and the building owner can implement them through the maintenance policy.

MAINTENANCE POLICY

The maintenance policy is a formal document that outlines the policy for the operation and maintenance of a system or building. Maintenance policy should be based on the maintenance objectives and should include details of the maintenance strategy, the maintenance delivery model, and maintenance performance standards. Maintenance policy should take full account of the probability and implications of systems failure.

The maintenance policy should be expressed in terms of asset management and life-cycle costs, and should state where and to what extent maintenance is required.

The maintenance policy should be coordinated with any building energy management plan, water conservation plan or any building/business sustainability plan.

Maintenance policy can be developed prior to system construction so that the design can take full account of the policy. Providing a clear and appropriate maintenance policy delivers increased sustainable performance.

The process of preparing the maintenance policy can educate management, and help secure resources for and commitment to ongoing maintenance.

MAINTENANCE PERFORMANCE STANDARDS

An essential task in maintenance management is to establish a baseline of system information and performance, including system performance standards. System performance standards or system operation standards help to define the appropriate level of maintenance, and can be used in the monitoring and review of maintenance delivery and maintenance strategies. System performance standards can be used as maintenance performance standards, and the data used to assess the effectiveness of the adopted maintenance regime.

System performance standards could comprise both technical and financial indicators for the building or system, such as:

- Energy use and costs (kWh or \$/m²)
- System performance data (temperatures, flow rates)
- Water use and costs (kL or \$/m²)
- Maintenance costs (\$/m²)
- System down times (hours/annum)
- Breakdown frequencies (number/annum)
- Breakdown response time (minutes/event)
- Complaints received (number/annum)
- Environmental indicators (CO₂ equiv/m² per annum)
- Illness or accident frequencies (number/annum).

Baseline system performance standards provide a reference against which to measure the effectiveness of maintenance implementation. Where system performance standards are adopted as maintenance performance standards, they should be clearly outlined in the maintenance management plan.

Maintenance performance standards can be monitored to ensure that maintenance is effective. Maintenance performance standards for a particular building or system can be assessed against industry standards or benchmarks.

Financial indicators can also be expressed relative to business turnover.

Maintenance performance standards can be stated as targets or goals in performance-based plans and strategies.

System performance data can also indicate system compliance or a regulatory breach.

BENCHMARKING

The purpose of benchmarking system data is to compare the operation or performance of a system with other systems in a peer group. The objective of the comparison is to establish whether the system performance achieved is above or below selected datum performance levels.

Benchmarking datum can be based on the minimum acceptable performance, an average performance, or the industry best practice. Benchmarking can be carried out either internally, within a large organisation, externally within an industry sector, or globally.

One of the major difficulties when attempting to benchmark system data is ensuring that the comparisons being drawn between systems or buildings are fair and equitable. Even in similar buildings (construction and services) organisational, cultural and operational differences can have a significant effect on system performance data.

MAINTENANCE PLANNING

Once the maintenance objectives, policy and performance standards have been defined and the maintenance strategy and delivery model selected, it is possible to develop a maintenance management plan. The maintenance management plan is essential to achieving effective and optimal outcomes.

The maintenance plan should define a structured approach to maintenance. It should include the maintenance program, incorporating maintenance specifications for all systems, maintenance monitoring, reporting and review procedures, system tuning procedures and performance standards.

The maintenance plan needs to be based on the following:

- Operating and maintenance manual
- Commissioning data
- Asset register
- Maintenance strategy
- Maintenance delivery model
- Maintenance schedules
- System-specific tuning procedures
- System-specific maintenance program
- System-specific performance standards.

MAINTENANCE IMPLEMENTATION

Maintenance implementation means the implementation of the maintenance management plan. Implementation can cover everything from selection of a maintenance strategy and the development of a maintenance program, to the selection of a delivery model and a service provider, contractual arrangements and other maintenance management issues. These aspects of implementation are all discussed in detail in AIRAH's *DA19 HVAC&R Maintenance* manual, along with audits and surveys, system tuning procedures and maintenance for sustainability.

MAINTENANCE REPORTING

Maintenance reporting can be required for the following purposes:

Verification for local accountability

Maintenance managers need to know what maintenance is being carried out and when.

Verification for statutory obligations

It is essential that plant is maintained in a safe operating condition and to ensure that it complies with the necessary statutory requirements. In the event of an accident, or similar occurrence, the owner may be required, by law, to demonstrate that maintenance, to an acceptable standard, has been carried out.

Records are also required to verify maintenance provision against statutory maintenance requirements where these are in place. Complete and accurate records are required to enable annual certification and sign-off against requirements.

Monitoring the maintenance policy and its effectiveness

Maintenance management entails achieving safe and reliable operation at the lowest life-cycle cost consistent with the requirements and objectives of the owner.

Maintenance records provide the historical information required to enable the maintenance managers to make necessary changes to policy and practice during the life of the plant.

Observing performance trends

Monitoring system performance helps in fault diagnosis and to initiate corrective action when necessary.

Performance trends usually provide the first signs of developing trouble in the plant. Careful monitoring of these trends may indicate early warning of possible breakdown or the requirement for plant replacement.

With this warning, the maintenance manager can take the necessary action for planned service.

Tracking performance trends against maintenance activities is also an essential aspect of tuning the building systems. Tuning is an iterative process and relies on accurate and complete records for optimum outcomes.

Financial planning

The statistical information gathered on past maintenance can assist in the forecast of future maintenance and life-cycle costs.

MAINTENANCE MONITORING AND REVIEW

General

The maintenance process does not finish once the maintenance contract is awarded, nor once maintenance service providers have been appointed. Monitoring of maintenance performance must then be initiated and the effectiveness of the maintenance policy periodically reviewed. This monitoring and review activity provides the opportunity for continuous improvement of the maintenance process.

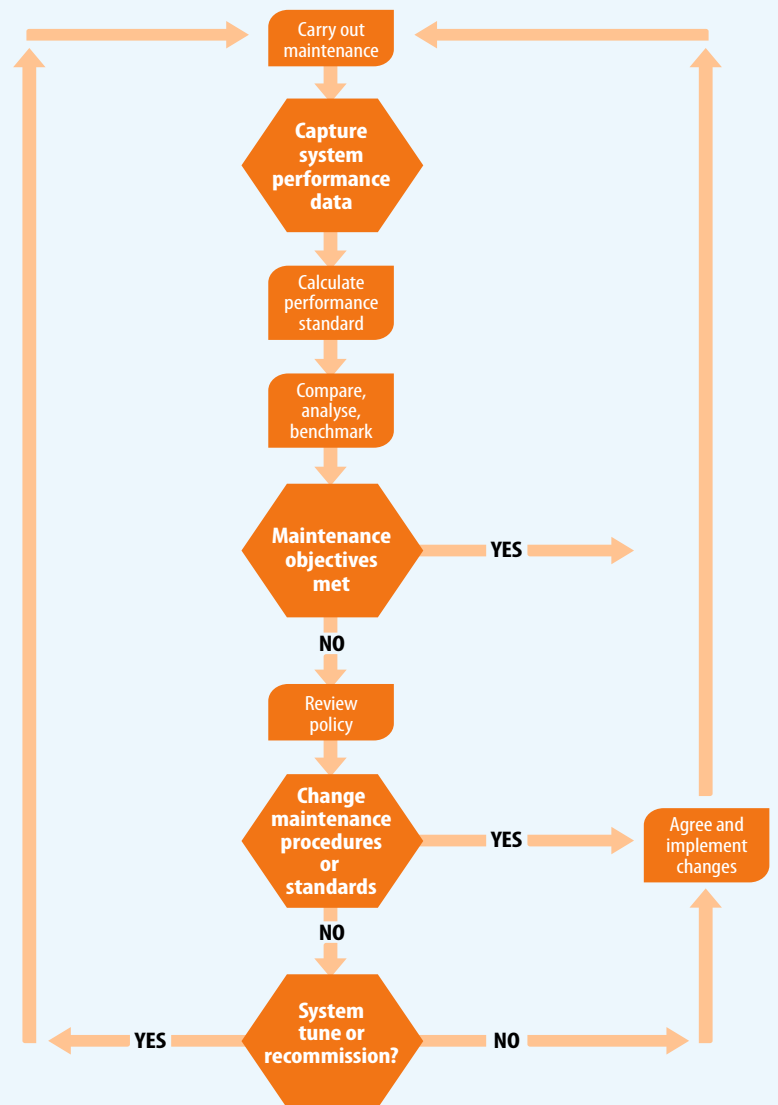
A performance review of maintenance implementation usually occurs on two levels: a review of the maintenance system, and a review of the maintenance performance. Any maintenance review should include a review meeting with the maintenance provider. During a review meeting it may be appropriate for the maintenance provider to report on energy and water use, and identify opportunities to improve system sustainability and operation.

Maintenance system review

In any review of the maintenance system the maintenance procedures, records and administration arrangements are audited to check that all legislated requirements are being complied with, and that the maintenance implementation complies with the owners' maintenance policy and objectives and the requirements of the maintenance contract.

Maintenance performance review

The basis of any monitoring and review system is the accurate collection of operational data (meter readings, temperature logs, energy use, etc) and the proper interpretation of the information collected. If data profiles are trending in the wrong direction, corrective actions can be adopted immediately. In particular, poorly performing HVAC&R systems may need to be tuned or recommissioned if data shows a lack of operational control or efficiency. Tracking performance trends against maintenance activities is an essential aspect of tuning the building systems. Tuning relies on accurate and complete maintenance records for optimum outcomes.



An early task in the maintenance management plan is to establish baseline or benchmark system information and data. This data should be adjusted as best as possible for known variations or abnormalities within a building (e.g. partial vacancies, refurbishments, etc) and adopted as maintenance performance standards.

The maintenance performance review should be based on these maintenance performance standards, as specified in the maintenance management plan. Comparison of the actual building performance data against the maintenance performance standards provides a tool with which to assess the effectiveness of the maintenance policy, management, strategy and delivery. Care should be taken not to create too large a database of performance information that may become unmanageable and inefficient. For larger systems, only the nominated system key performance indicators need to be analysed in this regard.

Performance review report

Once the maintenance system and performance has been assessed it should be reported and formally reviewed.

As with any review process, the opportunities for continuous improvement as a result of feedback from the review should be formalised. The purpose of the review report is to identify any failures in the system and any opportunities for future improvement. ▲

More information

This month's Skills Workshop was adapted from AIRAH's DA19 HVAC&R Maintenance technical manual, which is available in AIRAH's online store at www.airah.org.au

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