TMASYSTEMS

STUDY OF OPERATIONAL MAINTENANCE TECHNIQUES

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Why operational maintenance?

Effective operational maintenance is undeniably one of most obvious and cost-effective methods to ensure reliability, safety, and efficiency in enterprise operations. As organizations so often learn, inadequate maintenance of equipment can lead to wasteful and inefficient operations. On the other hand, good maintenance practices can generate substantial savings. And in the past decade, widespread technological democratization has empowered enterprises to readily implement and reap the benefits of facility maintenance programs at relatively low costs.

The overarching term "operational maintenance" refers to a set of routine, preventive, predictive, scheduled, and unscheduled activities aimed at improving asset performance and preventing equipment downtime. The goal: increasing efficiency, reliability, and safety of equipment usage. By promoting operational efficiency through maintenance practices, organizations can decrease the lifecycle cost of their equipment. But to do that, enterprises must understand and implement an effective mix of preventive, predictive, and reliability-centered maintenance technologies. When coupled with proper equipment calibration, tracking, and a computerized maintenance management system, such a maintenance can give rise to a truly reliable, safe system that is built around operational efficiency.

A New Perspective on Asset Lifecycle Management

Supply chain disruptions amidst the COVID-19 pandemic forced organizations to reconsider their legacy maintenance practices. With supply for parts and personnel dwindling, organizations had to outgrow archaic asset lifecycle management technologies and practices to navigate large-scale disruption. The pandemic tested an organization's ability to adapt and keep things running amidst severe uncertainty. This is where maintenance emerged as a key determining factor.

Operational maintenance doesn't just involve repairing assets but also prolonging the effective lifetime of them. Organizations often face the brunt of inadequate maintenance practices, leading to frequent planned and unplanned downtime. According to a report by Ponemon Institute, the average cost of downtime (planned and unplanned) stands at $9,000 per minute.[1] For smaller enterprises that number drops to $427 per minute – still a considerable amount of loss.[2]

For highly regulated and consumer-facing sectors, the financial costs are just one aspect of the impact of downtime. In the healthcare sector, studies suggest that healthcare organizations stand to lose up to $7,900 for every minute of downtime, besides substantial HIPAA noncompliance fines and reputational damage.[3]

References

1 Calculating the cost of downtime: https://www.atlassian.com/incident-management/kpis/cost-of-downtime

2 Downtime costs small businesses up to $427 per minute: https://www.carbonite.com/blog/article/2015/10/downtime-costs-small-businesses-up-to-$427-per-minute/

3 The Cost of an EHR Downtime: https://www.summit-healthcare.com/the-cost-of-an-ehr-downtime/

Understanding an Operational Maintenance Approach

In the post-pandemic era, organizations have realized the importance of rapid transformation in the face of disruption. For operational maintenance, this means ensuring faster, more reliable outcomes powered by the right mix of technology, best practices, and people.

Reactive Maintenance

Reactive maintenance is the "run it till it breaks" maintenance approach. No actions or efforts are taken to maintain the equipment either to prevent failure or to ensure that the designed life of the equipment is reached. Reactive maintenance (either corrective or breakdown maintenance) is the most basic form of asset management. Requiring little to no planning, this approach was the predominant component of maintenance strategies till as late as the last decade. And while the advent of the internet of things (IoT), edge computing, and AI have promoted the widespread use of more modern maintenance practices, reactive maintenance remains an integral part of the operational maintenance mix.

51%

of organizations still leverage reactive maintenance, at least to some extent [4]

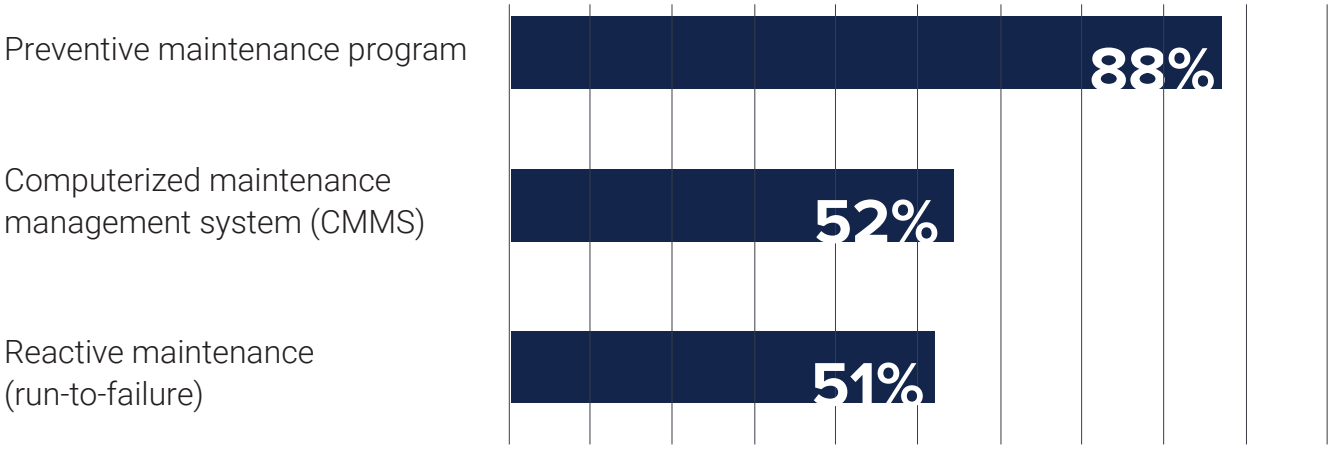

Fig. 1: Maintenance strategy components by preference [5]

[4] 2021 PE Maintenance Report: https://cfebucket2.s3.amazonaws.com/CFET-2021/Services/PE+Maintenance+Report/Assets/PLE2103_RES_Maintenance_Report_ATS.pdf

[5] ibid, 3

There are several reasons that reactive maintenance continues to find itself in the operational maintenance mix. It has minimal implementation cost, there is no need to stop operations for periodic inspections, and it requires a small team of permanent staff. The advantages of using a reactive maintenance approach, however, can be a double-edged sword.

When dealing with new equipment, minimal incidents of failure would be expected. As a result, manpower or capital costs would not be expended until the equipment breaks or fails. Since there is no associated maintenance costs during this period, it might actually be seen as budget savings.

Eventually, however, more money is spent than if a proactive maintenance strategy had been initially instituted. In fact, reactive maintenance raises future capital expenditures. Studies show that a reactive maintenance strategy can cost up to 8 times more than a proactive maintenance strategy in the long run. Overall costs rise because waiting to maintain the equipment until it breaks leads to more rapid deteriorations that shorten the life expectancy of the asset. This results in more frequent equipment replacement and, therefore, higher capital expenditure. Additionally, primary equipment failure causes subsequent problems or failures in associated secondary devices, leading to further overhead costs. Since the equipment is operated until it fails, a larger inventory of repair parts may need to be stocked.

Extensive unplanned repairs can also lead to higher labor costs than if the equipment had not been operated until failure. If the equipment fails during operations, a variety of costs are associated with operational shutdowns, or if the failure occurs during off hours or near the end of work hours, additional maintenance overtime costs may be incurred. All of these costs that could be minimized by taking a different maintenance strategy.

Advantages and Disadvantages of Reactive Maintenance

Advantages

- Has lower initial costs
- Requires fewer staff

Disadvantages

- Increases costs due to unplanned downtime of equipment
- Increases labor costs, especially if overtime is needed for untimely repairs or replacement
- Increases costs associated with repair or replacement of equipment
- Results in possible secondary equipment or process damage from equipment failures
- Does not promote efficient use of staff and resources

Preventive Maintenance

Preventive maintenance refers to a series of procedures that are performed on either a time-based schedule or a schedule based on machine run time. These procedures are designed to detect, preclude, or mitigate degradation of a system (or its components). The goal of a preventive maintenance approach is to minimize system and component degradation and thus sustain or extend the useful life of the equipment.

Preventive maintenance was pioneered to increase the reliability of vessels for the U.S. Navy. By expending the necessary resources for maintenance activities that meet the equipment designer's requirements, equipment life is extended, and its reliability is increased. Due to increased reliability and maintenance, more money is saved than when using a program of reactive maintenance. According to 68% of respondents in a survey by Plant Engineering, preventive maintenance was cost effective, while only 22% felt the same about reactive maintenance. For another 70% of respondents, preventive maintenance practices are more effective in reducing probability of failure than any other maintenance program.[6]

Given current maintenance practices, equipment reliability, and the impact of equipment downtime, there is little doubt that organizations relying purely on reactive maintenance could significantly cut back on costs and damage to business by instituting a suitable preventive maintenance program.

While preventive maintenance does not provide enough reliability to be sole component of a robust maintenance strategy, it does have several advantages over that of a purely reactive program.

6 ibid, 3

By performing preventive maintenance on equipment as the equipment designer envisioned, the life of the equipment can be extended. This translates into dollar savings. Preventive maintenance, like lubrication and filter changes, will generally allow the equipment to run more efficiently and result in dollar savings. While it will not prevent catastrophic equipment failures, it will decrease the number of failures and significant equipment downtime. Minimizing these failures translates into savings in both maintenance and capital equipment costs.

Advantages and Disadvantages of Preventive Maintenance

Advantages

- Cost effective in many capital-intensive processes and equipment
- Provides flexibility for the adjustment of maintenance periodicity
- Increases component life cycle
- 70% organizations consider preventive maintenance practices as most effective in reducing probability of failure
- Generates energy savings
- Reduces equipment and/or process failures
- Lowers costs significantly over reactive maintenance programs

Disadvantages

- Does not eliminate catastrophic failures
- More labor intensive
- Includes performing unneeded maintenance activities, which has the potential to result in incidental damage to components

Predictive Maintenance

A predictive maintenance approach strives to detect the onset of equipment degradation and to address the problems as soon as they are identified. This allows casual stress on equipment to be eliminated or controlled, prior to any significant deterioration in the physical state of the component or piece of equipment. This supports both current and future functionality of the asset.

Predictive maintenance bases maintenance needs on the actual condition of the equipment, rather than on a predetermined schedule. In contrast, preventative maintenance activities are based on time (calendar time or equipment run time). For example, most people change the oil in their vehicles every 3,000 to 5,000 miles traveled. This is effectively done based on oil change needs on equipment run time. No consideration is given to the actual condition and performance capability of the oil. It is changed because it is time.

Within the predictive methodology, the operator of the car might have the oil analyzed periodically to determine its actual condition and lubrication properties, they could find that they can extend the oil change until the vehicle had traveled 10,000 miles. This is the fundamental difference between predictive maintenance and preventive maintenance. Predictive maintenance is used to define needed maintenance tasks based on quantified material and equipment conditions.

On average, a predictive maintenance program could reduce machine downtime by as much as 50% compared to reactive maintenance practices.[7]

There are many advantages of using a predictive maintenance program:

1. Eliminate catastrophic equipment failures
2. Schedule maintenance activities to minimize or eliminate staff overtime costs
3. Minimize inventory, as parts or equipment will not need to be ordered ahead of time to support unanticipated maintenance needs
4. Equipment will operate at an optimal level, which will also save energy costs and increase plant reliability

Key metrics for predictive maintenance[8]

25% **Increases productivity**

70% **Reduces breakdowns**

25% **Lowers maintenance cost**

[7] Manufacturing: Analytics unleashes productivity and profitability: https://parsable.com/blog/quality/12-manufacturing-maintenance-statistics-to-consider-when-planning-for-2020/

[8] Predictive Maintenance: https://www2.deloitte.com/content/dam/Deloitte/de/Documents/deloitte-analytics/Deloitte_Predictive-Maintenance_PositionPaper.pdf

The significant downside to using a predictive maintenance approach is its initial implementation costs. The up-front costs of starting this type of program can be expensive. Much of the equipment requires expenditures in excess of $50,000. And training of in-plant personnel to utilize predictive maintenance technologies and practices effectively requires substantial additional funding. Beginning a predictive maintenance program requires an understanding of the facility's predictive maintenance needs and the right approaches. It is also essential to have a firm commitment from the organization including management and staff to make it work.

Advantages and Disadvantages of Predictive Maintenance

Advantages

- Provides increased component operational life and availability
- Allows for preemptive corrective actions
- Lowers equipment and/or process downtime
- Lowers overall costs for parts and labor
- Provides better product quality
- Improves worker and environmental safety
- Raises worker morale
- Increases energy savings

Disadvantages

- Increases investment in diagnostic equipment
- Increases investment in staff training
- Savings potential is not readily seen by management

A Balanced Approach: Reliability-centered Maintenance

Reliability-centered maintenance (RCM) is the maintenance approach that assesses equipment condition and determines the maintenance requirements of any physical asset in relation to its operating requirements.

The RCM methodology addresses key issues not dealt with by other maintenance programs. This approach recognizes that all equipment in a facility is not of equal importance – to the process or to facility needs and safety. This focus means recognizing that equipment design and operations differ and that each piece of equipment has a different probability of failure from degradation.

A reliability-focused approach means structuring a maintenance program based on understanding equipment needs and priorities as well as financial and personnel resource limitations. It is used to plan activities such that ***equipment maintenance is prioritized while operations are optimized.***

Simply put, RCM is a systematic approach to evaluating a facility's equipment and resources to meet maintenance requirements without the need for a lofty budget and large resource pool. This results in a high degree of equipment reliability and cost-effectiveness. RCM also recognizes that maintenance activities on equipment that is inexpensive and less important to the facility's overall reliability can be left to a reactive maintenance approach. This ensures that both labor and financial resources are allocated on priority for more critical and expensive equipment. Top-performing organizations have adopted the RCM approach, which utilizes all available maintenance tactics, most primarily a predictive strategy.

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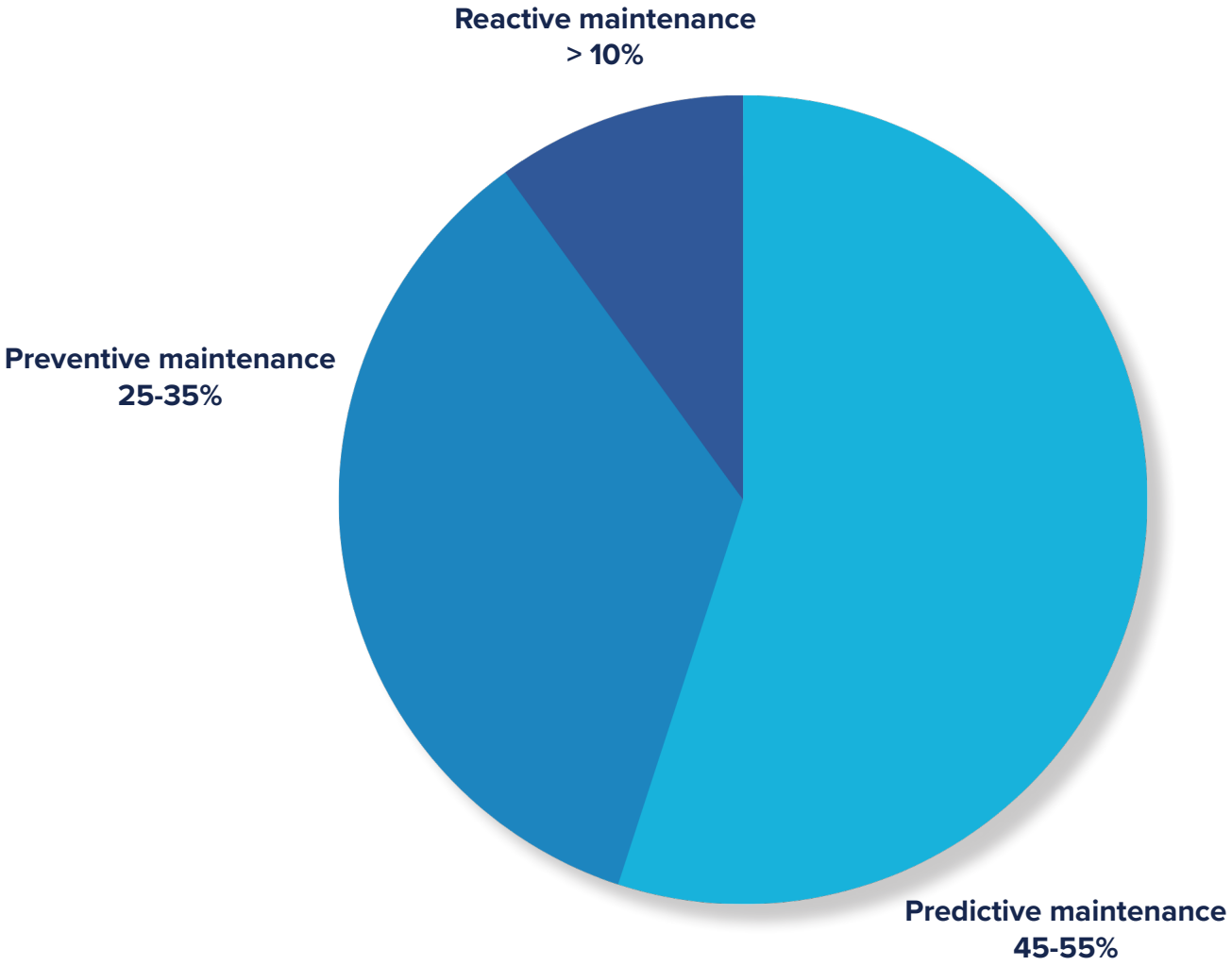
Because RCM is so heavily weighted on utilization of predictive maintenance strategies, its program advantages, and disadvantages mirror those of predictive maintenance. In addition to these advantages, RCM will allow an organization to match its resources more closely to operational needs and improve reliability while reducing associated maintenance costs.



The Technological Leap

The gap in capabilities of legacy operational maintenance practices and emerging technologies is substantial and growing.

The opportunities to improve and benefit from a modernized maintenance approach are abundant. This is where a technology partner, like TMA Systems, can prove to be a competitive edge.

34%

of organizations believe outdated technology is a key impediment to the improvement of the maintenance framework. [9]

For more than 30 years, TMA Systems has been providing state-of-the-art configurable technology to help organizations transform their maintenance process. Our reliable, innovative, and trusted software solutions are key enablers in reducing downtime, increasing maintenance productivity, improving equipment reliability, and cutting costs across sectors and organizations.

By leveraging a comprehensive set of integrated tools such as work orders, preventive maintenance scheduling, inventory control, project management, contract management, and advanced asset management, TMA Systems provides the enterprises with the mission-critical capabilities that have been tested on the field. Moreover, all these tools and the data gathered through them, feed into an executive dashboard, providing insights on real-time organizational performance. TMA Systems strives to empower facilities management teams with powerful asset maintenance and management solutions, so that businesses can do what they do best: *grow*.

6 ibid, 3

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