Six Elements of a Successful Maintenance Management System

Part Two – Preventive Maintenance & Work Management Systems: The Base of Pillar

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Preventive maintenance (PM) and work management are the root elements of the successful maintenance management system. Reactive, unmanaged systems are destined to failure. As failures increase and become less manageable—as must happen in an unmanaged system—an organization is forced to become more reactive, feeding a reactive downward cycle. The other elements: Stock, Inventory & Procurement; Work Force Development; Statistical Analysis and Performance Indicators become irrelevant and impossible to put into practice.

PM is managed maintenance. It is the work done before an asset or equipment fails (to prevent that failure). That work can be anything from cleaning graffiti from the exterior to a wholesale replacement of a unit. The goal of PM is only partly preservation of the asset itself. The prime goal of PM must be to preserve the operation of the asset or component. The entire reason for the assets existence is to make possible some function or operation. While each asset has a built-in dollar value in of itself, the function is why it is there. The trick is to determine what and how much work is relevant to keep the asset or part of the asset functioning.

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A good maintenance management program makes preventative or scheduled maintenance the highest priority. If more than 20 percent of the workforce's time consists in responding to service calls, the maintenance is not being managed and a dangerous downward slide toward larger number of reactive calls and less managed maintenance is inevitable. That preventive maintenance programs pay for themselves is no longer in much doubt but must not be taken for granted. The cost of preventive maintenance in the amount of resources delegated for implementation must be weighed against reduced unscheduled response and repair. A maintenance organization should create a significant reduction in responsive calls after beginning a preventive maintenance program. There is a direct relationship between preventive maintenance and reactive maintenance. Directing resources toward PM reduces the resources required for reactive maintenance. PM programs exist in many different forms and combinations.

Preventive Maintenance Program Types

Tighten, Lubricate and Clean (TLC) Programs

Preventive Maintenance as defined in this article consists of several components or concepts. Tighten, Lubricate and Clean (TLC) is probably the most familiar definition of preventive maintenance to most in this industry. Many early studies seemed to indicate that PM (perhaps better defined as TLC PM in these studies) failed to show any effect on decreasing the downtimes of traffic signal equipment. These studies may have been used to demonstrate that PM is ineffective. They may in fact better illustrate that TLC is only a portion of a good PM program.

Replacement Programs

Replacement programs are a more proactive form of reactive maintenance, basically replacing an asset or part of an asset before it fails. This is one of the most popular maintenance methods (whether recognized or not) in the transportation world, probably because it occurs more or less naturally as part of a technology change or 'upgrade.' In many agencies the movement to replace incandescent lamps with LEDs has had the more or less unintended effect of also replacing signal heads and head mounting structures that badly needed replacement. Until the late 1990's this was the only preventive maintenance program for many DOTs.

Predictive Maintenance (PdM)

Predictive Maintenance is a maintenance activity that predicts and suggests actions to be taken to extend the life of the unit. A predictive maintenance check does not in of itself extend life. Predictive Maintenance (PdM) is a concept not often used in the traffic signal world but that should be familiar from daily life. Most people not only service their automobile regularly but also monitor their engine temperature and oil pressure as well. Predictive Maintenance programs can be as simple as that.

For a transportation agency, there are two forms of predictive maintenance. The first form of predictive maintenance is those checks or measurements that are taken as part of specific PM work. The checks made to the neutral terminations of traffic signal field indications for electrical "back feed" voltages are good examples of checks made to suggest actions to perform but that do not correct failures themselves. The second example can be defined as operational. Traffic Signal Systems enable technicians and/or Intelligent Transportation System (ITS) operators to monitor systems and system reports for predictive signs of decreasing level of service (LOS) and asset failures. Agency technicians analyze daily system error log reports for asset failure symptoms and patterns. Smart Traffic Center Operators stand watch over central display screens and are the first to view system alarms and detect decreases in LOS.

Conditioned Based Maintenance (CBM)

A close cousin of PdM is Condition-monitoring or conditioned based maintenance (CBM). PM checklists contain checks that require a technician to measure the physical condition of an asset or a specific aspect of an asset. Like PdM this check is not in of itself an improvement to the operation of the asset, but a substandard condition will suggest an action that may be taken to prevent a future failure. An entire PM program may be based on CBM such that asset or equipment

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condition is taken as the base for preventive maintenance. Many organizations are more likely to replace traffic signal heads by condition rather than life cycle. The lifespan of traffic signal heads near salt water are remarkably reduced when compared with those in farther locations.

Many agencies use a combination of these types for their preventive maintenance. The daily PM check of the signal system's error logs and operational reports by technicians is predictive maintenance. Technicians use the system like an automobile's dashboard of gauges to look for typical patterns and deviations from these expected patterns that may act as a 'predictor' of future failures. The semi-annual and annual PM checks at the intersection include TLC tasks along with CBM that may involve replacement of infrastructure components or equipment depending on the conditional assessment performed by the technician.

Reactive Maintenance

Reactive Maintenance is the opposite of preventive maintenance. Whatever the term; reactive maintenance, unscheduled maintenance, emergency repair, fire fighting; this is what is being avoided. Though, heroic and somewhat addictive to technicians, this is no way to run a maintenance shop or maintain an asset. It may make sense in some cases to wait for something to break before fixing it but in the instance of operating traffic signals, and for the purposes of this paper, it will be assumed that 'uptime' is the goal.

There is an external cost to reactive maintenance, not as easily quantified as other costs may be. Less measureable are losses in morale and work ethic. Never planning, always reacting, being continually in a position of catching up, is extremely stressful. There may be a feeling of euphoria in diving in and solving problems while traffic piles up in queue and the police stand in the street but the stress is undeniable and the let-down unavoidable. Reactive staffs have a wait-and-see attitude in general. They are busy waiting (unproductively) for the next disaster rather than analyzing the last failure or improving the system to avoid future examples of the last one. They are resting up for the next all-nighter.

PM Planning and Scheduling

PM is scheduled maintenance. Scheduling is more important for PM than any other type of maintenance. Checks must be performed when scheduled or the entire purpose of PM is defeated. Schedule drift is a common problem for PM planning. The PM planner schedules a check on a certain date. For some completely valid reason—usually reactive maintenance—a check must be deferred to the following week. Over a period of time it is possible to observe that this check and other related checks 'drift' a little farther from the original date each year. This drift can negatively affect the entire PM schedule.

Work Management System

Work Management is the process of recording, tracking and maintaining all maintenance activity data. The work management system is used to track the process from the original service request, to planning, scheduling and acquiring work performance figures. Failure and root cause data may be recorded and tracked as well. A Computerized Maintenance Management System (CMMS) is best implemented by the organization to simplify the discipline and routine collection of this data. Without this collection, analysis, and failure forecasting, much of the benefits of a proactive maintenance system will be impossible to acquire. Most of the data needed by the various maintenance processes is collected at this stage and the relationships between the processes cannot be established if they are not tabled in a closely controlled fashion.

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The relationship between asset and work management may be created within the CMMS as well. Service requests and work orders may be linked to the assets they were created for. In this way, records of parts usage, asset life cycle costs, and asset failure patterns are created and maintained.

Planning & Scheduling

Work management is truly defined by planning and scheduling. Planning and scheduling are the tools used to manipulate the work to make it manageable. It is not possible to reach the 80 percent scheduled maintenance goal without planning.

For a proactive agency, when work is requested by a customer, a project is authorized, or a PM checklist deficiency is discovered, a CMMS service request form is created to record all available information. The request is also assigned to a specific work planner-inspector. The planner is responsible for planning and scheduling the work to complete the request. The planner uses the CMMS to evaluate the availability of resources including technicians, vehicles and parts and with the information schedules and assigns these resources for the work. The planner is also responsible for follow-up. He or she must review their estimate of time, quantities and costs for accuracy and reschedule incomplete work. The planner is not restricted to in-house resources but may use contracted resources if available.

Contracting Maintenance

Many agencies have largely switched larger construction operations (like pole installation) to their contracted workforce. Large, predictable scheduled maintenance projects have also been provided to contractors. The transfer of inductive loop installation, LED-signal head replacement and the installation and repair of underground conduit has proven to be more cost effective when accomplished using an agency's Indefinite Quantities (IDQ) contractor—more information regarding the IDQ follows in the implementation article.

Next time: "An Army Travels on Its Stomach" or "Stock, Inventory and Procurement."

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