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RELIABILITY

A Holistic Effort

by Alan Luedeking

The foundation of any great reliability effort is the reliability culture within the organization that sustains it. Everybody within the organization must be aligned with its ultimate goals and mission for the reliability effort to succeed. Therefore, the mission and values must be clearly communicated, with reasonable expectations for compliance.

A holistic approach to reliability-centered maintenance (Rcm) relies on good asset condition management (ACM). This, in turn, relies on accurate condition-based maintenance (CBM), which can only happen with good data. Planning and scheduling (Ps) personnel cannot do their job properly if the maintenance technicians do not feed good data into the system in a timely manner. So, one of the first steps must be to invest in a good enterprise asset management system (EAM) or computerized maintenance management system (CMMS), train all plant personnel in how to use it effectively and impress upon them how they as individuals are important to the overall reliability effort. Remember, the reliability effort relies as much on good data as the culture of cooperation that stands behind it and supports it. Everybody in the organization must understand the importance of their individual role in the wider mission of the organization and, in particular, their interaction with this data system.

Plant management must understand and respect the fact that the boots on the ground (i.e., their technicians and operators) are their best source of information. They are the ones that wrestle with the day-to-day problems and fix them. They know how the machines should sound, smell and feel. Respect their expertise and their opinions. Train your technicians. Invest in quality competency-based learning (Cbl). The knowledge and experience gained will pay off multifold in advancing the entire reliability effort. Give them the tools to do their job right. This means buying a good laser shaft alignment system, vibration analysis tools, and ultrasound leak and corona detection systems. This CBM approach will allow your organization to optimize the preventive maintenance effort (Uptime Element Pmo) required to deal with the problem.

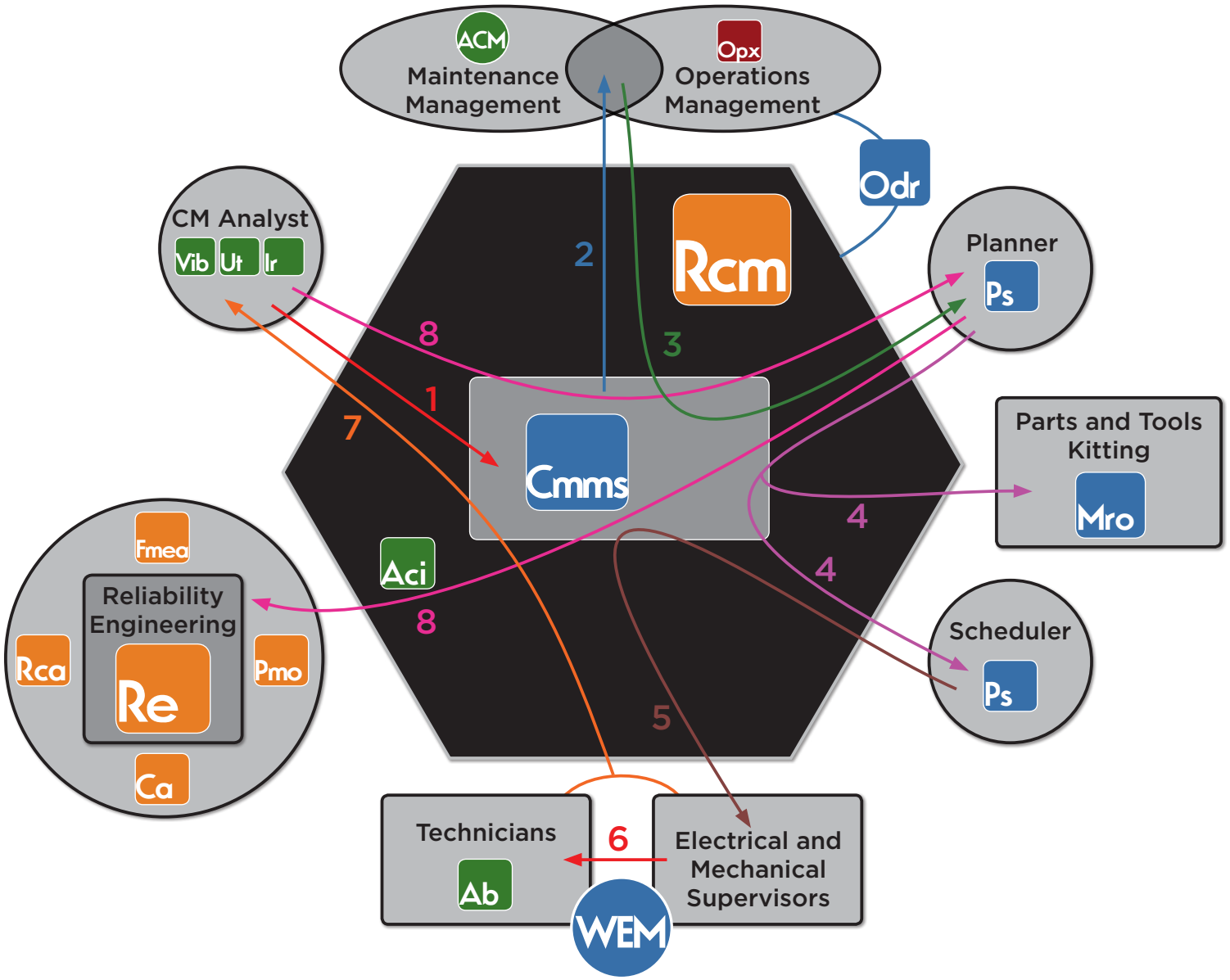


Figure 1: Maintenance reliability workflow

STAGE 1

Figure 1 takes a closer look at the holistic reliability approach in a world-class program. Suppose ultrasound testing (Ut) detects a bearing fault in a critical motor early in the P-F curve. The analyst enters this data in the EAM system or CMMS and trends it. The analyst decides to request a work order in the CMMS with recommendations. This is Stage 1 in the work order process. The request must clearly state what the asset is, where it is located and why the work is being requested.

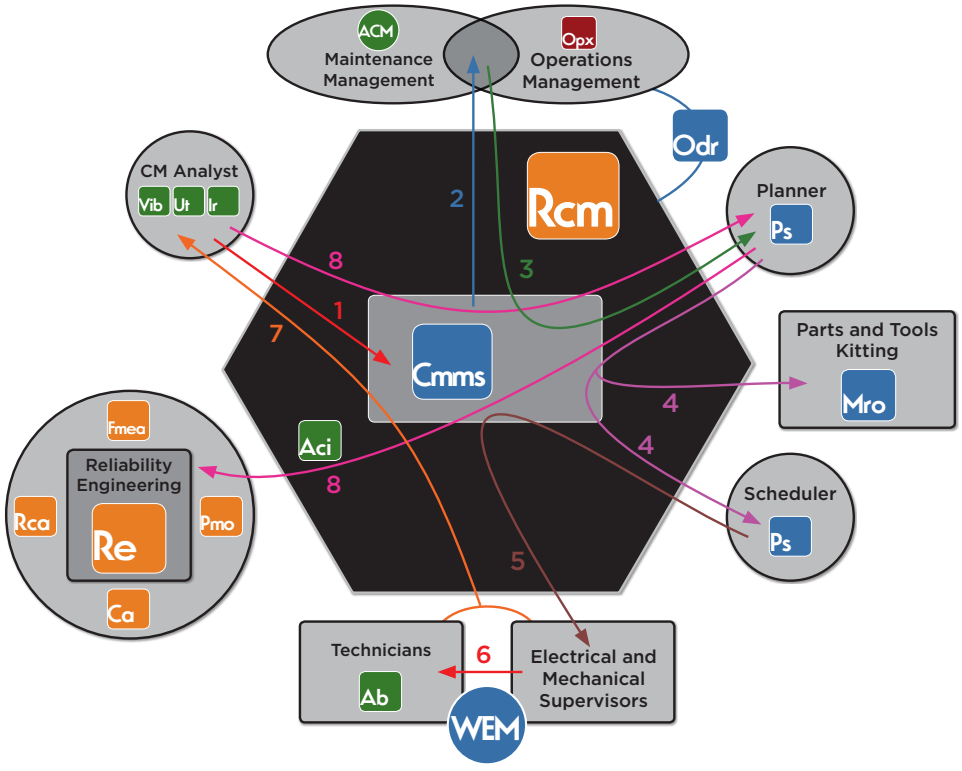
STAGE 2

The work order request now enters Stage 2, a review by management, both maintenance and operations. This double review is very important as it promotes buy-in from operations as well. The review process ensures that only truly needed or valuable work is approved. It also offers a chance for other open work orders for this asset to be combined with this one to streamline planned activity. For instance, perhaps the vibration analyst detected misalignment on this asset in the past and a work order was created to align the machine. However, the work was never carried out, resulting in the bearing damage the ultrasound analyst has now detected. The review process would catch the older open order and either cancel it or add it to the present order. This would prevent the millwright from going out to align the machine tomorrow only to have a repair technician go out the following week and remove and repair the motor, but do no alignment on it. The review process attempts to eliminate inefficiency, duplication and the occurrence of detrimental work sequences. It is also very important that this process includes a mechanism for generating feedback to the requester, particularly if the request is not approved.

STAGE 3

Once the work order is approved, it enters Stage 3, assignment to the maintenance planner for action. Only approved and truly necessary work enters the planner's backlog, as guaranteed by Stage 2. The planner's first job with the new work order is to ensure the work is properly prioritized. Two things are needed: the criticality ranking of the asset ascertained from the criticality analysis (Ca) process and its operational criticality. Both of these factors can be multiplied together to create a more accurate prioritization of the workflow. These two factors should exist for all equipment, since they are crucial

in the process of determining the priority of work. The planner reviews existing work plans (not work orders!) to see if one is already available and, if not, creates a new work plan as needed. At this stage, the planner should feel free to consult the maintenance supervisor and technicians since valuable insight may be gained for what parts, tools and equipment should be specified in the work plan. Once the work plan is complete, the planner orders the maintenance, repair and operations (MRO) spares required to complete the job. Thereafter, the planner should always verify that the parts are available and kitted (best practice). Upon kitting, the CMMS parts inventory control module will be automatically updated. The planner should not be concerned with scheduling, only with creating a good work plan and prioritizing the plans properly so they move through the system efficiently and in the right order.



STAGE 4

The work order then enters Stage 4, assignment to the scheduler, who allocates the human resources required and the necessary time to accomplish the task, with a cushion for unforeseen complications. The scheduler too should consult with the maintenance supervisors and technicians to get a better handle on time estimates to complete the job and when it might be most convenient to perform it. The scheduler must schedule the work within the failure forecast imposed by the requesting analyst and in accordance with the priorities established by the maintenance planner. This is a very challenging mission and at times can feel much like herding cats. However, a good work plan and understanding by the supervisors and technicians involved can do much to smoothen the scheduling process. Coordination with operations is crucial at this stage; operations "owns" the equipment and must sign off on the schedule to bring the asset down.

STAGE 5

Upon assignment to the appropriate maintenance and electrical supervisors, the work order now enters Stage 5. The supervisors, in turn, must assign the specific tasks in the work plan to their respective repair technicians, electricians and millwrights, and verify that MRO spares has delivered the necessary tools, parts and equipment kit to the proper location, or that a technician has been assigned to retrieve the assembled kit from the appropriate storeroom.

STAGE 6

The work order now enters Stage 6, the carefully timed work execution phase. Following all properly documented safety procedures, the electrician disconnects the motor and the repair technician performs the bearing replacement job. Next, the millwright reinstalls the motor and rough aligns it. The electrician reconnects the cabling and the millwright, who also observed all safety procedures and ensured the asset was locked out and tagged out before commencing work), now proceeds to eliminate soft foot in the motor and does a final alignment to the proper targets and tolerances. A well-trained millwright working with a good laser alignment system can save the organization many thousands of dollars in the work execution phase by properly measuring, analyzing and correcting soft foot on the machine and aligning it accurately in a shorter amount of time, thereby ensuring it will not break down again sooner than anticipated (Uptime Element Ab). Good alignment results in reduced equipment downtime, reduced MRO spares expense, lower power consumption and greater production from accurate alignment, all quantifiable benefits that go directly to the bottom line and justify the capital expense of the laser alignment system.

Once the millwright and electrician have completed their work, they report back to their respective supervisors. Stage 6 is now complete.

STAGE 7

The work order next enters Stage 7 and many things happen at once. The supervisors return the asset to active duty status in the system. Operations is notified that the asset is ready for service again and MRO spares is notified of any unused parts and supplies that should be returned and reintegrated into the MRO spares inventory. Any special tooling and equipment are accounted for and returned to the tool room. The supervisor also budgets the time, perhaps in concert with the scheduler, for the technician(s) to enter their observations (e.g., as-found condition of the bearing from physical observation, repair actions taken, parts used and time elapsed) into the work order. This data is very useful to the planner and reliability engineer. The CMMS system notifies the vibration and ultrasound analysts, who should immediately schedule follow-up data collection on this motor to ensure all is well, unless it is already on a preinstalled ultrasound online vibration data collection system. The analysts enter their the findings into the CMMS system and the work order now enters Stage 8, the final stage.

STAGE 8

In Stage 8, the CMMS system sends the work order back to the planner to be formally closed. The planner ensures all important data has been entered and distributed within the system, particularly to the reliability engineering (Uptime Element Re) department, thereby enabling key performance indicators (KPIs) needed by management and reliability personnel to be updated.

As good data accumulates, reliability engineering will take advantage of it to improve the entire maintenance reliability process. The failed, or soon to have failed, bearing may be examined to assist with failure mode and effects analysis (Fmea), thereby further informing the root cause analysis (Rca) process. The reliability engineer should review data to discover frequent failure patterns. This will help to identify training needs, drive out defects, streamline production and help to improve the design process. As the plant becomes more efficient and more productive, greater resources can be allocated to defect elimination (De), further impelling the transition from a reactive to a

A Word to CEOs:

Reliability is a never-ending journey of continuous improvement. A world-class reliability program is not achieved overnight, yet you must start somewhere.

Hcm

Your first step on the road to victory is to vest your entire human capital (Hcm) in its success. True reliability excellence means that everybody in the organization feels ownership for the assets and their efforts are aligned to the mission, vision and values of your organization. Everybody matters and everybody counts, from the sweeper who makes sure the floor is safe to walk on to you in the C-suite.

Es
Int

Reliability is a culture, not just a goal, and it flows from the top-down. Therefore, executive sponsorship (Es) with integrity (Int) and enforcement are a must. Obtain buy-in to the culture of reliability from everybody or the effort is doomed to fail. If you start with this realization and build up the culture within your organization to sustain it, your reliability effort will ultimately succeed and you and your stakeholders will reap its rewards.

proactive and reliability-centered maintenance culture. As asset reliability improves, more time and training can be dedicated to further improving process and people flows (Uptime Element Hcm) and strengthening the important CBM programs, including vibration analysis (Vib), oil analysis (Oa) and ultrasound testing (Ut).

In a world-class reliability program, necessary work flows logically through the entire system, in a coordinated and prioritized manner, structured through a well programmed and managed CMMS or EAM system. All stakeholders in the organization work together in harmonious cooperation toward the same goal: the fulfillment of the organization's mission and vision.

Alan Luedeking, CMRP, CRL *is Executive Vice President of Ludeca, Inc. in Doral, FL. He has 30+ years experience in machinery shaft alignment and training and holds an ISO level I Vibration Analyst certificate as well as a Level I Ultrasound Inspection certificate. Besides his work, Alan enjoys spending time with his family and numismatics.*
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