



RELIABILITY MANAGEMENT GROUP
MAINTENANCE PROCESS FUNDAMENTALS WHEEL©



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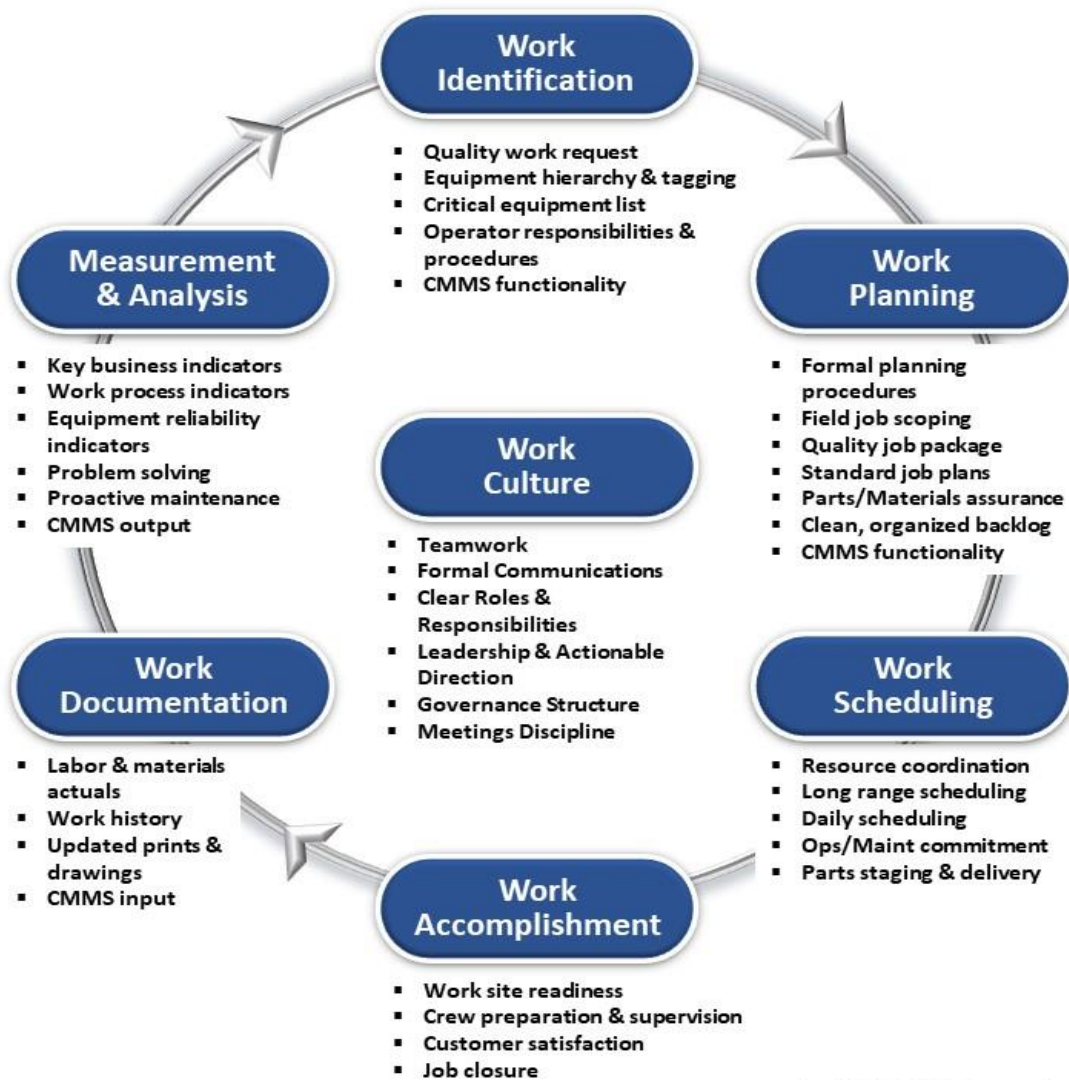
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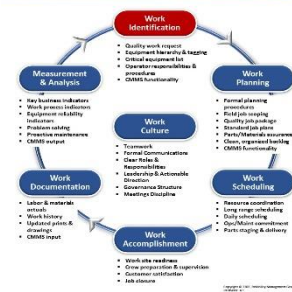
This document provides the seven steps of RMG’s Maintenance Process Fundamentals Wheel©. We provide insights and standard requirements that are necessary to ensure a successful Maintenance Process. The Maintenance Process Fundamentals Wheel© was modeled on the Plan-Do-Check-Action concept pioneered by W. Edwards Deming. RMG has taken this concept and customized and expanded it to specifically apply to work processes like maintenance, operations, materials, outages/turnarounds, safety/compliance, capital projects and others.



Maintenance Process Fundamentals Wheel©



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Work Identification:

When identifying work, the first thing that comes to mind for the initiator is “When will the work get done?” The work priority assigned to a job becomes one of the primary drivers for planning & scheduling work. Two other critical factors impacting Work Identification are correctly identifying the equipment and outlining a complete and concise description of the work to be completed.

Work Priority

Correctly proving a work priority to a job involves some important factors. There are normally four levels of work priority.

- Emergency** This is a job that must be accomplished as quickly as possible and may break the daily schedule. Emergency priorities normally include issues with safety, regulatory/environment concerns, or immediate and critical loss of production.
- Urgent** This is a job that does not require an emergency job order, but nonetheless remains an important repair. Urgent work is most often planned and scheduled in the next 48 hours.
- Routine** These are jobs that may be slotted into the daily and weekly schedule as resources permit. Preventive and predictive maintenance work orders are in this category.
- Outage** Outage, overhaul or turnaround work are those jobs that are best accomplished when the equipment may be taken out of service. This is frequently also a Work Type in a CMMS.

Equipment Identification

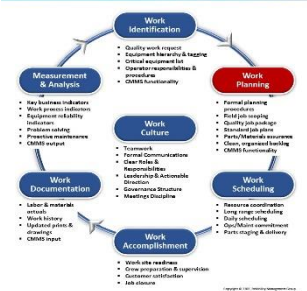
It is important that the piece of equipment that needs to be worked on is accurately identified and tagged. The correct identification of the equipment facilitates a number of decisions Can the equipment be isolated and taken out of service without affecting production? Will the planner be able to quickly find the equipment and scope out the problem and the work to be done? What HSE requirements are associated with that piece of equipment? The correct identification of the equipment also enables the work that is completed to be entered into the organization’s CMMS so that work order and equipment history may be captured and analyzed.

Problem Description

An accurate and complete description of the equipment problem is another essential component to Work Identification. An accurate description allows operations and maintenance people to gauge the importance of the repair, understand how it may impact production, assign the correct priority and provide the planners with an early indication of what the repair may need to be.

Summary

With the proper use of Work Priority, Equipment Identification and Problem Description work may be properly categorized and provide guidance for the next steps in the process, Work Planning & Work Scheduling.



Work Planning:

Work Planning requires an understanding of equipment, materials/parts, safety, regulatory compliance, crafts and standard job plans and procedures. These planning requirements which may be built into a CMMS, ensures a high level of standardization and consistency.

Scheduling Planning

At first this may sound odd to the ear “scheduling planning”. However, planning work is not simply a first in first out process (FIFO). Planners must carefully select which jobs they plan first, based on the priority of the work, production needs, as well as what work is scheduled according to the scheduling horizon.

Quality Job Package & Standard Job Plans

To enable the crafts to complete work effectively and efficiently, the elements of a Quality Job Package must be present. All jobs should have a quality job package, except for emergency work. Emergency work by its nature is unplanned, however a planning library may still be consulted for past job packages even on emergency work. At a minimum, a Quality Job Package and Standard Job Plans must have parts/materials, specialty tools, LOTO requirements, craft requirements, work procedures and safety requirements. Standard job plans may be developed over time and entered the planning library of the CMMS. Recurring work like preventive and predictive maintenance may be planned in detail once and then modified as needed. Even corrective work may be developed and entered into the CMMS with all the elements of a Quality Job Package or Standard Job Plans. The planner can readily reference these and modify them according to the specific job requirement rather than starting from scratch each time. This also provides the organization with a much greater level of consistency, efficiency, and quality.

Field Job Scoping

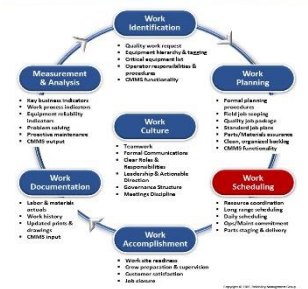
A defined level of Field Job Scoping needs to be established to ensure:

1. In the field, eyes on analysis of equipment problem confirming operations diagnosis
2. Clear understanding of clearance & safety issues
3. Understanding of the physical environment to ensure the proper job site is properly prepared
4. A clear understanding of tools, crafts & parts/materials required
5. An overlooked element of Field Job Scoping is the interaction it promotes between the planner and operations, crafts, and supervision.

Field Job Scoping is an essential component of the planning function.

Summary

The planning department is responsible for establishing the definition and discipline around planning for all the work to be performed. Scheduling Planning, Quality Job Packages and Field Job Scoping are the foundation of an effective planning process. The scheduling of jobs to be planned is the responsibility of “all departments” to ensure the jobs that best supports production, safety and regulatory goals are prepared and ready for the next step, Work Scheduling.



Work Scheduling

Work Scheduling requires the most coordination within and between departments of any of the work process steps. Discipline in the scheduling process is essential. Equipment, crafts, materials, tools, and safety requirements all need to come together to perform a job effectively and safely. Work Scheduling matches craft resources with production and equipment needs to make sure the right work is completed at the right time. The process outlined below provides a guideline for a typical efficient scheduling process. The process may vary based on the needs of the

organization.

Long Range Scheduling

Long range scheduling is work that may be added to a schedule from one to six months in the future. Work that falls into this grouping includes outage or turnaround work that may only be completed when the equipment is down. Preventive maintenance and predictive maintenance work may also be slotted into a long-range schedule. Seasonal work like insulation and painting can be added to a long-range schedule.

Three Week Scheduling

Multi-week scheduling is an essential element to a productive scheduling process. RMG frequently guides customers with a three week look ahead. The Three-Week Scheduling process is conducted weekly. Work that is scheduled in the Three-Week Scheduling meeting must be planned to assign specific resources to the job. In Three Week, Scheduling, the 3rd week out is populated with work from the Long-Range Schedule and with any Preventive or Predictive Work for that week. In the 2nd week out, work from the corrective backlog is added to the schedule to fill the schedule to 60% of craft capacity for the week.

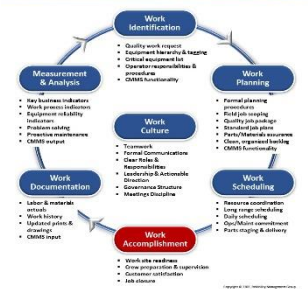
The schedule one week out is populated to a level of 80% of craft capacity. Approximately 20% of craft capacity is left free for potential break-in work that might arise. Arrangements for specialty equipment such as cranes, welding or lifts are finalized. Material requirements are confirmed, and staging is established.

Daily Scheduling

Daily Scheduling uses the Three-Week Schedule as a guide for work to be scheduled the next day. Formal daily scheduling meetings are held to confirm all resources that are required to staff the work one day prior to Work Accomplishment. Operations and HSE personnel attend these meetings to help set priorities and begin site preparation. The daily schedule is distributed to the Operations and HSE departments to ensure that job requirements like LOTO, equipment shutdown, burn & confined space permitting, and other items are coordinated. Carryover work from the previous day may be added to the schedule based on craft availability.

Summary

Work Scheduling contains the elements of timing, duration, and craft requirements. Job site preparation requirements are discussed and arranged. Coordination with Operations and commitment to maintaining schedule integrity are essential. As the scheduled work gets closer to Work Accomplishment, the details around timing duration and resources must be confirmed.



Work Accomplishment:

When Work Planning & Work Scheduling are successful, completing the work in the field should be a well-orchestrated routine. However, unexpected and unforeseen issues often occur and a 100% compliance rate to the schedule is not always possible. Tracking schedule compliance is important and identifying the reasons work is taken off the schedule is the single most telling metric to identify and remove barriers to an effective work schedule.

Work Site Readiness and Preparation

Operations and SHE play important roles in ensuring that the maintenance crafts can be as efficient as possible in performing their work. All safety, environment and regulatory requirements and permits must be in place for the crafts to safely execute the work plan. Operations must ensure that the equipment is prepared and ready for the crafts to start the job in accordance with the schedule. This includes making sure the work site is as clean as possible.

Crew Preparation and Supervision

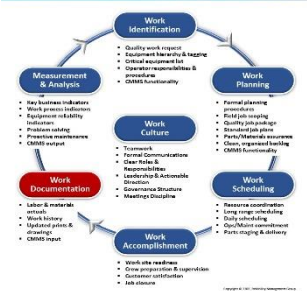
A morning tailboard meeting is the first task that must be performed at the start of the workday. The tailboard meeting communicates the schedule, job assignments, tool and materials needs, job packages, coordination needs with operations and between crafts and safety and regulatory requirements to the members of the crew. Even with well executed preparation unexpected circumstances often occur as the work is being performed. It is essential that supervision follow up as frequently as possible with the crafts and jobs to assist the crews in overcoming these unexpected obstacles. Supervision's role in Work Accomplishment includes problem solving, problem identification, problem mitigation and leadership.

Job Closure and Customer Satisfaction

Once the repair is completed by the crafts, several tasks remain to close out the work. The equipment needs to be tested and Operations must be consulted to ensure the repair has been completed to allow Operations to continue production. Permits must be reviewed and closed. The job site must be cleaned and returned to the condition it was in when the crafts started the work. Parts and materials that were not used must be returned to stores.

Summary

A well-developed plan and schedule will deliver the results that are desired if the work is correctly executed, and the organization is proactive in identifying and solving unexpected occurrences. Crew and job site preparation are two essential elements in ensuring this.



Work Documentation:

Work Documentation is an important element in the overall work process. The timely and accurate reporting of the work accomplished in the field feeds labor, materials, equipment, job order and costs records and history. The capturing of this data updates backlogs and forms the foundation that permits the organization to analyze and make improvements. The steps outlined this far on the Maintenance Fundamentals Wheel provide the organization with the tools to work off the backlog in the most efficient manner. The next steps in the Wheel provide the organization with the

information and data to effectively eliminate much work from entering the backlog at all.

Work and Equipment History

Collecting costs and activity on Work and Equipment History provides the basis for an organization to begin identifying where there is opportunity for improvement. The documentation of this history starts with entering the actual parts/materials used, craft hours expended, a description of the work that was performed, as well as other valuable information. Entering this data in detail will also provide the CMMS with the information to develop and recognize reliability trends.

CMMS Input

The timely entry of data in the CMMS helps the organization in many ways. The closure of work in the CMMS keeps the backlog clean and facilitates both the planning and scheduling processes. Documenting the actual parts, materials, labor, and work completed feeds both the job order and equipment histories. Additional valuable information that facilitates the next step in the process, Work Measurement and Analysis may also be captured. The entry of reason, cause and failure codes can provide the mechanism to help isolate the type of problems that the equipment may be having. A CMMS also provides the benefit of taking the collection of data from the work completed and easily rolling the data into a metrics package.

Updated Prints & Drawings

While completing the job and the job package, changes and modifications are frequently made to the equipment. These may be marked up and redlined when closing out the work. This information is invaluable for the next time work must be performed on the equipment. Updating the prints and drawings is frequently done outside the CMMS in a Document Management System. The updated prints and drawings need to feed back into the planning process so that the job packages that are created accurately reflect the equipment that is in the field.

Summary

Proper Work Documentation provides the organization with opportunities to improve reliability, better forecast equipment lifecycles, and positively impact equipment availability and up time.



Measurement & Analysis:

Collecting data in the Work Documentation step allows the organization to turn data into information that facilitates decision making. This is accomplished in the Work Measurement and Analysis step. Activities in this step include Problem Solving, Proactive Maintenance and Indicators.

Problem Solving

The history collected in the Work Documentation step and entered a CMMS helps organizations identify where their Bad Actors are and stimulates the activity around making beneficial long-term decisions. These decisions may be around deciding what equipment, parts, procedures, and work plans can make the production process most reliable and profitable. Reliability techniques such as FMEA and RCFA may be employed by using the data to identify and eliminate defects. Decisions on life cycle costs may also readily be made by analyzing this information.

Proactive Maintenance

The data may also be used to target and update the current preventive and predictive maintenance programs. Keeping your preventive and predictive programs evergreen provides more benefit than simply following the programs by rote. No organization has all the labor resources to do all the preventive and predictive maintenance that they would like to do or is recommended by the manufacturer. Analyzing the data that is collected will assist and organization in identifying and prioritizing the activities that will provide the greatest benefit.

Indicators

The metrics package can provide useful information on not only the health of the work process, but also pinpoint opportunities with the equipment. With the proper discipline around documentation, the data in the CMMS can move an organization from a knowledge-based system to an information-based system. Indicators normally fall into three general categories. These are Work Process, Equipment Reliability and Business Indicators. The three indicators form what RMG calls a Chain of Success[®]. Effectively operating the work processes will feed this linked set of indicators. The Work Process Indicators measure the health of the work process. This includes such metrics as schedule compliance, PM compliance and backlog. The next set of indicators in this chain are those that highlight Equipment Reliability. These include indicators like MTBF/MTBR and availability. The final set of indicators focuses on Business Indicators. These most often translate to costs and throughput. When all these sets of indicators are operating properly a direct linkage should be recognizable. If there appears to be an issue with the linkages, then the reporting of these indicators needs to be examined.

Summary

The success of the Measurement and Analysis step of the Maintenance Fundamentals Wheel is what moves an organization from being an efficient provider of maintenance services to being an effective provider of maintenance services. The former allows an organization to efficiently accomplish a great deal of work and keep the backlog in check. The latter helps the organization to minimize the work that enters the backlog to begin with. The organization may then spend less time fighting fires and repairing and more time on preventive and predictive activities. This maximizes uptime. Uptime and low-cost availability are what an effective maintenance organization produces.



Work Culture

Many things can influence Work Culture. The work process described in this discussion of the Maintenance Fundamentals Wheel swims in the ocean of an organization’s Work Culture. The Work Culture of the organization may facilitate and enhance this swim or force employees to drown in the process. The elements of a well performing Work Culture that RMG looks for include those enhancers highlighted in this section. Volumes of information is available on each of these subjects, so these are discussed at a succinct level,

Teamwork

Effectively executing the maintenance process requires an immense amount of communication and coordination. This is true not only within the maintenance organization, but with all the organizations the maintenance department works with. Having a clear and common vision and set of goals around the maintenance effort helps facilitate this Teamwork.

Clear Roles and Responsibilities

People and organizations require a clear understanding of what is expected of them. Defining a clear set of roles and responsibilities and training people in these is an important factor in making accountability a positive influence in the organization as opposed to a negative one.

Leadership and Actionable Direction

An organization needs to clearly demonstrate that they have leaders who assist not only in identifying barriers and opportunities, but also providing direction that is actionable. This encompasses leaders in any position of an organization.

Management by Walking Around

This is a concept that has tremendous value. Nothing can replace going into the field and seeing first-hand how work is being performed. This demonstrates that leadership is interested in what is actually happening in the field, cares about their co-workers and provides the opportunity to improve the relationship between management and employees.

Formal Communications/Meetings

Meetings must have a formal, published agenda with clear objectives for the meeting. The agenda must be adhered to. Exceptions may be highlighted and recorded for future assignments and resolutions. The highlights and decisions of the meeting should be published and distributed to everyone to verify that all participants left the meeting with a common understanding. Unorganized meetings can be a huge morale killer and demotivator.

Listening and Constructive Feedback

It is important to a Work Culture that people see and experience that they are being listened to. People have varying viewpoints, experiences, opinions, and solutions. Listening does not necessarily mean agreement. Feedback needs to be constructive and on subject.

Summary

The Work Culture enhancers highlighted here all can have a very positive impact on how efficient and effective the maintenance work process can be. In addition, striving to accomplish these can just simply make your organization a better place to work.