Maintenance Planning
Principles

Increase Your Workforce without Hiring

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Richard Palmer & Associates
McGraw-Hill’s Maintenance Planning and Scheduling Handbook
Case Study: Work Order Planning Principles

- Business Case
- Planning
- Scheduling
- Reactive Work
Context: Good plants resist change, but terrible plants do allow change when trying to improve
Context: Improvement program started

Maintenance Management Improvement Program

- Communication
- Teamwork
- Storeroom
- Rotating Spares
- PM
- PdM
- Project Work
- Tools & Tool Room
- Shop Improvements

- Apprenticeship Program
- Technician Training
- Certification Program
- Supervisor Training
- Scheduling
- Planning
- Spare Parts Lists
- Equipment Database
- Improved Work Processes
Company vision should be how to PREVENT breakdowns, NOT how to recover efficiently.

Gifford Brown, Manager, Cleveland Engine Plants, Ford Motor Company
We originally thought Planning was mostly about trying to get *Parts and Tools* ready.
Parts

- Identify on Plans
- Reserve
- Order Non-Stock
- Some Staged
- Illustrated Parts Breakdowns and Lists
- Vendors Lists
- QA/QC
Tools/Vehicles

- Identify on Plans
- Reserve / Schedule
- Some Staged
But 

*Parts and Tools* were not the answer. Attention to *Coordination* was needed to achieve the results following:
PLANNING
Mechanical Maintenance Department

30 Mechanics Yielding the Effect of 47 Mechanics

17 Extra Mechanics
STOP! Be careful pushing for productivity. There must be a quality focus in workforce.
Vision of planning: Increase Productivity and Quality

Not simply: Provide Job Plans
Have the Right Jobs Ready to Go!

- Scope or purpose of job
- Safety
- Anticipated delays
  - Parts and Tools
  - Instructions
  - Clearances
  - Other Arrangements
Opportunity
"Our wrench time is above 80%"

Variations
"But we're always busy working"
"We're working as well as we can"

Productive Work
Unavoidable Delays
Reality:
Industry average for wrench time
25 - 35%
What the Reduction of Delays Does:

% Time without Delays

35 → 45 → 50 → 55

Doc Palmer
The Leverage of Planning

- Three Mechanics without “Planning”
  - $3 \times 35\% = 105\%$
- One Planner, Two Mechanics
  - $1 \times 0\% + 2 \times 55\% = 110\%$
- Ratio Planner to Mechanics 1 : 20 - 30
- $55\% / 35\% = 1.57$ (57% Improvement)
- $30 \text{ Mechanics} \times 1.57 = 47 \text{ Mechanics}$
The Leverage of Planning

- Value in salaries of 17 persons
- Presume $25/hr incldg benefits (in 1993)
- 17 persons X $25/hr X 2080 hr/yr
  = $884,000 per year
The Leverage of Planning

- $884,000 per year
- Is it only the value of current delays?
- No! Because it does not include cost of lost plant availability that could be improved
- Obviously can afford one planner
1. The planners are organized into a separate group from the craft maintenance crews to facilitate specializing in planning techniques as well as focusing on future work.

2. The planning group concentrates on future work—work that has not been started—in order to provide the Maintenance Department with at least one week of work backlog that is planned and ready to execute. This backlog allows creation of the weekly schedule. The craft technicians or supervisors themselves resolve any problems that arise after commencement of any job (except emergencies). After every job completion, the lead technician or supervisor gives feedback to the planning group. The feedback consists of any problems, plan changes, or other helpful information so that future work plans and schedules might be improved. The planners update existing job plans or otherwise file feedback information to aid future work.

3. The planning group maintains a simple, secure file system based on equipment tag numbers. The file system enables planners to utilize equipment data and information learned on previous work to prepare and improve work plans, especially on repetitive maintenance tasks. The majority of maintenance tasks are repetitive over a sufficient period of time. File cost information assists making repair or replace decisions. Supervisors, technicians, and plant engineers are trained to access these files to gather information they need with minimal planner assistance.

4. Planners use their experience and skills along with file information to determine time estimates for work orders. The time estimate should be a reasonable idea of what a capable technician might require to complete the proposed job without any unusual problems. Planners should possess excellent craft skills, organizational data skills, and communication people skills and be trained in planning techniques.

5. The planners recognize the skill of the crafts. In general, the planner’s responsibility is “what” before “how.” The planning group desires to develop detailed standard plans, but must also plan every job (except emergencies). Therefore, the planner puts as much detail as possible into every plan subject to the requirement to plan every job (to allow each plan to evolve over time). The planner determines the scope of the work request including clarification of the originator’s intent where necessary. The planner plans the general strategy of the work and includes a preliminary procedure if there is not one already in the file. The craft technicians use their expertise to complete the specified work. The planners and technicians work together over repeated jobs to develop better procedures and checklists.

6. Wrench time is the primary measure of workforce efficiency and of planning and scheduling effectiveness. Wrench time is the proportion of available-to-work time during which craft persons are not being kept from productively working on a job site by delays such as waiting for assignment, clearance, parts, tools, instructions, travel, coordination with other crafts, or equipment information. Work that is planned before assignment reduces unnecessary delays during jobs and work that is scheduled reduces delays between jobs.

McGraw-Hill’s Maintenance Planning and Scheduling Handbook
Principle 1

Protect Planners

- Planners not on craft crews
- Planners not pulling wrenches
Principle 2

Focus on Future Work

50%

80%

Plan

Do Job

Learn

Feedback
Effectiveness

Chasing Parts

Planning Future Work
Principle 3

Component Level Files

- Paper and Computer
- Work Order and Equipment Databases
THINGS TO REMEMBER
WHEN USING A COMPUTER

1. If you don’t know how you’d do the job without a computer, doing it with a computer won’t help one bit.

2. Doing something wrong is much faster with a computer.

3. Doing something right with a computer is only faster on the nth try.

Tom Stanton, Michigan Public Service Commission
Principle 4
Plans with Estimates Based on Planner Expertise

- Can Consult History and Other Craftspersons
  - Quickly Estimate Times for All the Jobs
- These Estimates Are Accurate Enough
  - To Generally Assign and Control Work
  - To Build Schedules
Principle 5

Plans Recognize the Skill of the Crafts

- What, Why - Before How
  - Not Perfect, but Ever-Improving Job Plans
  - Plan Nearly All the Jobs
- Do Not Be Distracted by Re-design
  - Need Coordination of Engineering
Result of being quicker & not perfect: More jobs planned.

% of non-admin hrs on planned or pm work orders

File: MMIAll\PlnCov1 & PlnCov2
Measuring wrenchtime is not required, but if measured:

**Principle 6**

Measure Planning Performance by Analysis of Delays with Work Sampling
Result of planning more work and having improved plans:
Planning by itself did not achieve results. That’s why scheduling is needed.
MAINTENANCE SCHEDULING PRINCIPLES


1. Job plans providing number of persons required, lowest required craft skill level, craft work hours per skill level, and job duration information are necessary for advance scheduling.

2. The weekly schedule drives productivity by goal setting. The weekly schedule frees the crew supervisor to focus on the current week without worrying about the overall backlog. The work order priority system must adequately define the relative urgency and importance of new work orders to determine if any should break into the current daily or weekly schedule and to guide the scheduling of the other work that can wait. Maintenance and Operations use the weekly schedule for advance overall coordination of their efforts.

3. A scheduler develops a one week schedule for each crew based on a craft hours available forecast that shows highest skill levels available, job priorities, and information from job plans. The schedule is more of a simple batch listing of work than a day-by-day, hour-by-hour schedule. The one week period is long enough to group together enough work to smooth out the lesser accuracy of individual job time estimates and allow grouping together of multiple jobs for the same equipment, system, or area. The one week period is short enough to provide a reasonable goal of work that can be protected against the majority of new maintenance work that should be able to wait a week and avoid interrupting the schedule.

4. The one week schedule assigns work for every available labor hour. Preference is given to scheduling higher priority work by under-utilizing available skill levels over scheduling lower priority work. Normally, the schedule inherently contains a sufficient amount of work hours on tasks that could be interrupted for new emergencies and high priority jobs that cannot wait until the next week.

5. The crew supervisor develops a daily schedule one day in advance using current job progress, the one week schedule and new high priority jobs as a guide. The crew supervisor handles the current day's work and problems even to rescheduling the entire crew for emergencies. Maintenance and Operations use this schedule to coordinate their efforts on a daily basis.

6. Wrench time is the primary measure of workforce efficiency and of planning and scheduling effectiveness. Work that is planned before assignment reduces unnecessary delays during jobs and work that is scheduled reduces delays between jobs. Schedule Success is the measure of adherence to the one week schedule and its effectiveness.
Advance Schedule - Why?

- Sets Goals
- Insures a Sufficient Amount of Work
- Insures Sufficient Proactive Work
- Better Intercraft Coordination
- Improves Success of any Staging/Kitting
Scheduling Principle 1

Plans with Lowest Required Skill Level

- # Persons and Skills
- # Labor Hours and Duration
Scheduling Principle 2

Schedules Are Important

Job Priorities Are Important
Scheduling Principle 3

Schedule from Forecast of Highest Skills Available

- One Week
- Long Enough to Smooth Estimates, Consider Multiple Jobs on Same System, & Consider Proactive Work
- Short Enough for Achievable Goal, Protecting, & Following New Plant Priorities
Scheduling Principle 4

Schedule for Every Workhour Available

- 100%, not 120%, not 80%
- As a “batch” of work not specifying exact days unless necessary
- Acceptable to Supervisor
- Agreeable to Operations for sometime next week
Concept of “Working Persons Down” When Filling Schedule

1. Planned Backlog
   - 100 Workhours of High Priority Helper Work
   - 100 Workhours of Low Priority Skilled Machinist Work

2. Resource Forecast
   - 100 Hours of Skilled Machinists Available
Scheduling Principle 5

Crew Leader Handles Current Day’s Work

- Daily Schedule
- Matches Names to Tasks
- Daily Coordination of Resources, Clearances
- Emergencies
Schedule Principle 6
Encourage Performance by Analysis of Schedule “Success” (Compliance)

<table>
<thead>
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<th>Sch Jobs Finished</th>
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We were frustrated at first because crews did not want to wait on planners for “urgent” work.

John E. Day, Jr. P.E., Manager, Engineering & Maintenance, Alumax of South Carolina
We decided that because plans do not have to be “perfect,” we could quickly plan urgent work that was not an emergency. But we never tell supervisors to wait. We also learned to avoid “standing” work orders because they cannot be scheduled.

Classification of Work Orders to Determine Type of Planning Required

- **Reactive** versus **Proactive** Maintenance
- **Minimum** versus **Extensive** Maintenance
CLOSED WORK ORDERS PER MONTH

Mechanical Maintenance

- Started Weekly Scheduling
- Changed Planning Approach
- Ran Out of Backlog

Result: We emptied a 2-year old backlog in 6 weeks
Result: Reactive % lessened as we did more proactive work
Add Two More Plants
Add Electrical and Instrument Crafts

137 Craftspersons
Yielding the Effect of
215 Craftspersons

78 Extra Craftspersons
78 Extra Craftspersons to:

- Do Outage/Projects/Contractor Work
- Add New Fuel Capability to Existing Units
- Build & Maintain New Unit
- Insource
- Maintain New Cogeneration Facility
- Do Maintenance Services for Others
- Not Lay Off
  - High Morale - Deming #12 “Joy in Work”
Our objective

“SUCCESS”

Level of Effectiveness

- >95% Availability
- >50% Wrench Time
- >80% Planned Coverage
- >3 Week Backlog and Equip NOT Breaking (John Day)
  - Reactive Work < 20% and OT < 3%
- Contractor Work Only on Specialty Items
Conclusion:
Work Order Planning Principles involve:
- Ever-Improving Job Plans,
- Fully Loaded Schedules,
- Quickly Planning Reactive Work
Solufy AKWIRE Users Group 2016 San Antonio

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