Planning and Scheduling Best Practices

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Agenda

- Introduction
- Planning and Scheduling Defined
- Planning and Scheduling Detailed view
- Fundamentals of Planning and Scheduling
- Planning and Scheduling KPIs
- Benefits of Planning and Scheduling
- Questions

Who is Solufy

- Founded in 2003
- 100% dedicated to achieving excellence in Maximo planning and scheduling
- Staff comprised of current and former Maximo users, consultants, implementers, planners and schedulers
- Creators of the AKWIRE Visual Suite for Maximo

Who is Solufy

We help companies who are trying to implement and streamline maintenance planning and scheduling processes by providing best of bread planning and scheduling software, the AKWIRE Visual Suite for Maximo.

With AKWIRE, Organizations:

- Gain immediate insight into resource availability and utilization
- Maximize “wrench time” of work crews
- Achieve increased efficiency of planners and schedulers, and supervisors

All of Which:

- Increase productivity
- Improve employee satisfaction
- Increase profitability

We do this by providing the foundation for sustainable change relating to your planning and scheduling processes.

Introductions

Attendees

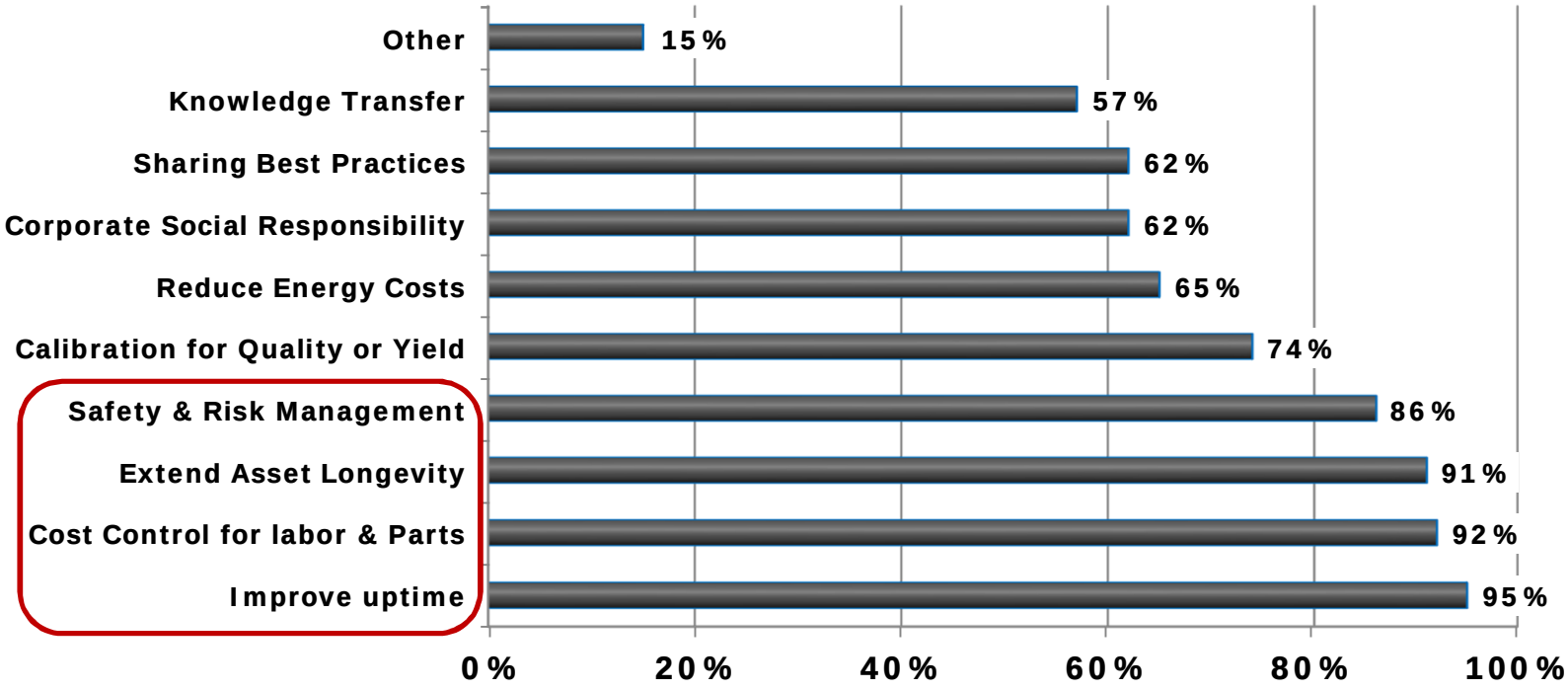
To What Level are you Planning and Scheduling?

- Work Orders
- Labor & Materials

What Methods do you use?

- Stones and Chisels
- Paper/White boards
- Spreadsheets
- Custom or homegrown applications
- EAM/CMMS
- Planning & Scheduling applications

EAM Drivers

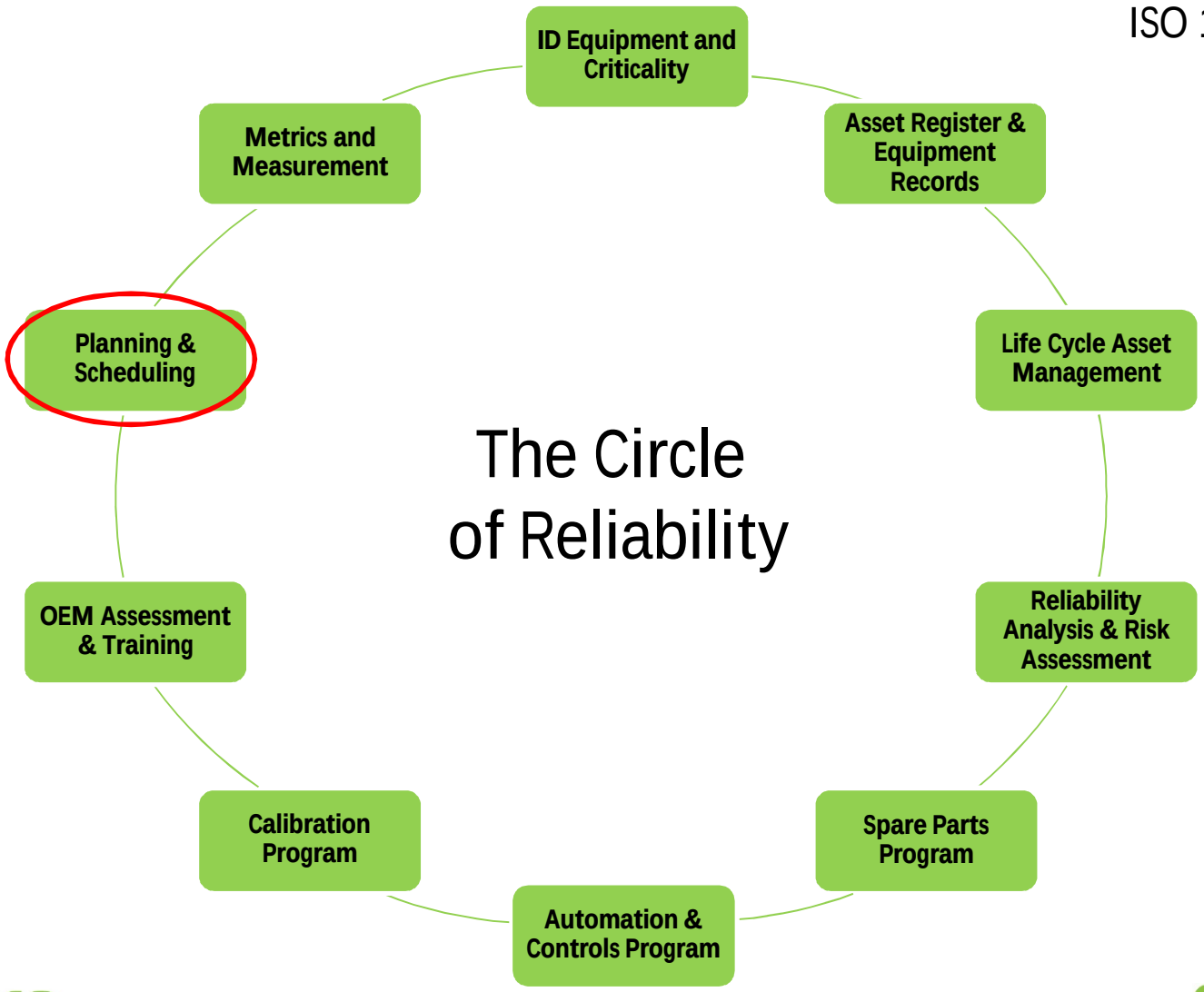


65 Participants / 1,300 (+) Plants / 463,000 (+) Employees

**ARC Advisory Group 2010 EAM and Field Service Management*

Reliability Strategy

ISO 14224



What is Reliability

Capable of being relied on; dependable

- American Heritage Dictionary

"… the ability of a person or system to perform **and** maintain its functions in routine circumstances, as well as hostile or unexpected circumstances."

- Wikipedia

The probability that a component part, equipment, or system will satisfactorily perform its intended **function** under given circumstances, such as environmental conditions, limitations as to operating time, and frequency and thoroughness of maintenance for a specified **period of time**.

- Answer.com

Reliability Centered Maintenance

A Reliability Centered Maintenance Process answers the following seven questions:

1. What are the **functions** and associated desired standards of performance of the asset in its present operating context (**functions**)?
2. In what ways can it **fail** to fulfill its functions (**functional failures**)?
3. What **causes** each functional failure (**failure modes**)?
4. What happens when each failure occurs (**failure effects**)?
5. In what way does each failure matter (**failure consequences**)?
6. What should be done to **predict or prevent** each failure (**proactive tasks** and task intervals)?
7. What should be done if a suitable proactive task cannot be found (**default actions**)?

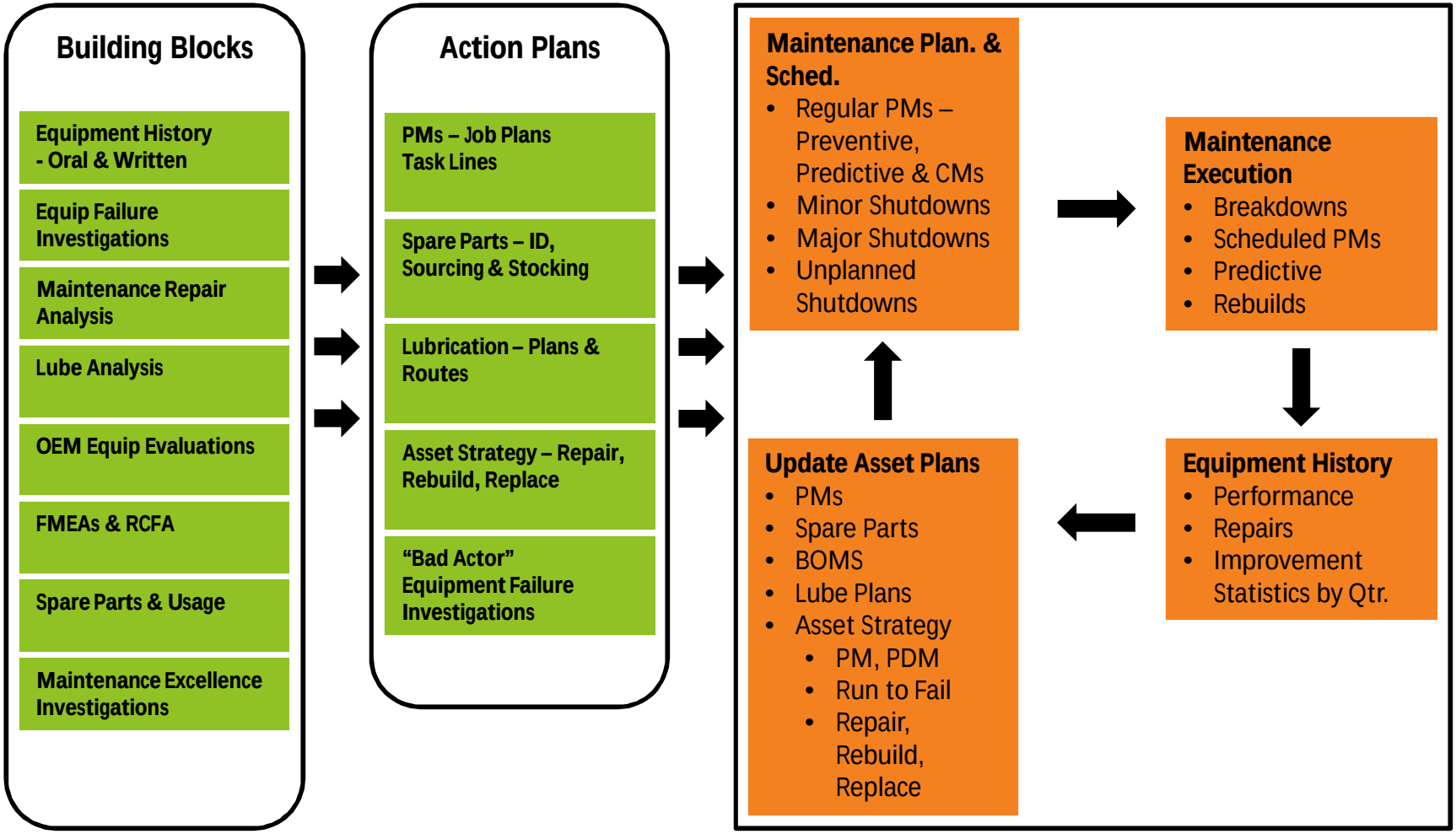
Source: SAE JA1011 standard

Reliability Centered Maintenance

Components of Reliability Centered Maintenance Program:

1. Complete Master Equipment/Asset List (Functions)
2. Asset Criticality Ranking (Effects, Consequences)
3. **Complete List of Job Plans and Tasks; including labor, material, tools (Default Actions)**
4. PM Optimization (Proactive Tasks and Task Intervals)
   - Calendar Based PMs
   - Condition Based PMs
   - Event Based PMs
   - Predictive PM
   - Inspection PM
5. Complete list of Inventory Items, Bill of Materials for Assets
6. **Planning and Scheduling Processes**
7. **Standardized Maintenance processes**
8. Communities of Practice

Asset Management Overview



Planning and Scheduling Defined

Work Planning:

The process in which maintenance work is ***documented***, resources are assigned, work procedures are identified, safety procedures are identified, labor & materials are identified, and interfaced with the scheduling element.

Work Scheduling:

The process in which all resources required for work are scheduled for execution within a specified time frame. Requires an understanding of the equipment/asset ***availability*** as well as technician, material, and tool ***availability***.

Coordination:

Logistical efforts of assembling necessary resources so the job is ready to be scheduled. Requires coordination of both Scheduling and Planning activities

Maintenance Excellence:

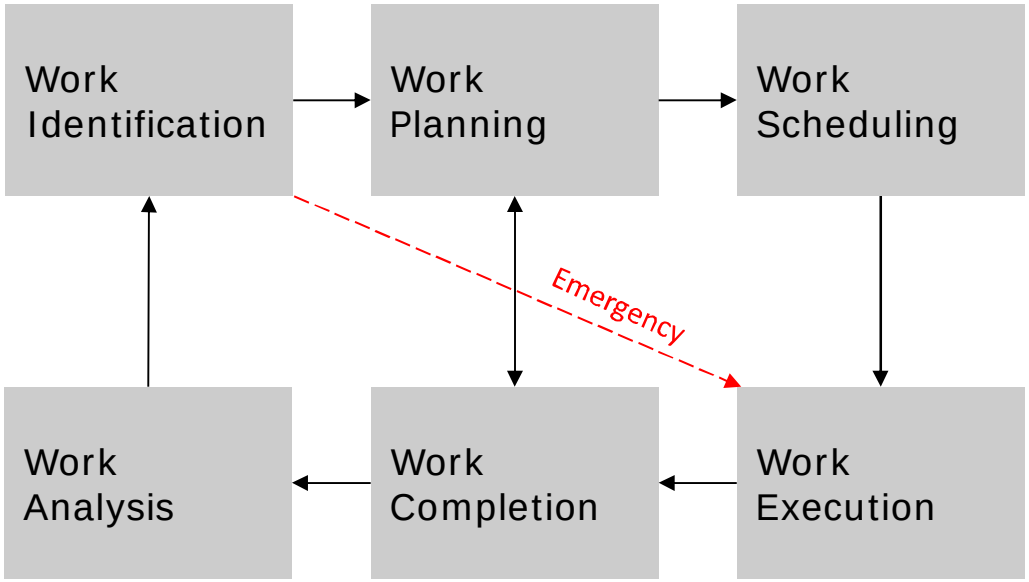
Having an effective maintenance strategy that **eliminates** non value added activities, **maximizes** condition based maintenance and **focuses resources** on the most critical assets

Doing the Right Jobs, with the right parts, at the right time…… the First Time

Processes Defined

- Work Identification
- Work Planning
- Work Scheduling
- Work Execution
- Work Completion
- Work Analysis

- KPIs??



Maintenance Planning Principles

1 – Separate Department for Planners

2 – Focus on Future Work

3 – Maintain Component Level Files

4 – Estimates Based on Planners Expertise & Historical Data

5 – Recognize the Skill of the Crafts

6 – Measure Performance with Work Samplings

Source:

Maintenance Planning & Scheduling Handbook

by: Doc Palmer

1 Separate Department

- Planners are organized into a separate department from the craft maintenance crews to facilitate specialization in planning and scheduling techniques as well as focusing on future work.
- Planners are not members of the craft crew for which they plan
- Planners report to a different Supervisor than the craft crews – a key best practices indicator. This avoids reassigning a planner to a toolbox. Separation reduces temptation.
- Planners plan work and the crews execute the planned work
- *Key Metric: % Labor hours spent on unplanned work*

2 Focus on Future Work

- Planner focuses on future work and provides maintenance at least one week of backlog that is planned, approved, and ready to execute

- One Week backlog allows crews to work primarily on planned work

- Supervisors handle the current day's work/problems. Any issues that arise after any job begins are resolved by the techs or supervisors

- Two "Rules of Repetitive maintenance"
  - The 50% Rule – if a piece of equipment needs work, there is a 50% chance it will need the similar, if not the same, work within 1 year
  - The 80% rule – there is an 80% chance the equipment will be worked on again within a 5-year period

- Conclusion: feedback on jobs completed is path to increased productivity
  - After the completion of every job, feedback is given to the planner
  - Planners use the feedback to improve future work
  - Benchmark: 6 months of feedback make job estimates and costs more accurate

How many of you analyze job plan performance?

3 Component Level Files

- Planners maintain a simple, secure file system based on equipment/asset numbers – Best practice: individual component level – not by manufacturer or vendor.
- Information allows the planners to utilize equipment data and information learned on previous work to prepare and improve work plans – especially on repetitive tasks
- Historical information consists of both work order history and equipment databases
- Cost history assists in making repair or replace decisions
- Supervisors and engineers are trained to use these files to gather information they require with minimal planner assistance

4 Estimate Job Based on Planner Expertise

- Planners use personal experience and file information to develop work plans that will avoid anticipated work delays, quality or safety problems

- Planners are typically experienced senior level technicians, who are trained in the appropriate planning disciplines and techniques

- Planner training – specialized techniques including Industrial Engineering, Statistical analysis, etc. – on-the-job training and feedback is most effective

- Best Practices:
  - Choose from the best crafts persons to be planners
  - Expect to see a department productivity loss for a few months when an experienced person transitions to planner

- Payoffs - Good execution on an excellent scope job or excellent execution of a poorly scoped job

5 Recognize the Skills of the Craft

- Best Practice: all work is planned with a minimal level of detail in the job plans – use some standard plans
  - Choice: highly detailed job plans for minimally skilled crafts or less detailed job plans for highly trained crafts
  - Control the workforce or empower skilled, knowledgeable people?

- The planner determines the scope of the work request
  - This includes clarification of the originator's intent where necessary
  - Engineering requirements are gathered before planning

- The planner determines the strategy of the work (repair or replace)
  - Planners attached helpful procedures from their experience, files or reference documents for the technicians reference
  - Craft technicians use expertise to determine how to make a specific repair or replacement

- *Key Metric: Actual versus Planned Hours*

6 Measure Performance with Work Sampling

- Measure how much time technicians actually spend on the job versus other activities such as obtaining parts, waiting for instructions, etc.
- Wrench time = the proportion of hands-on time a technician spends working per hour – Best Practice: 60%
- Gives everyone a measure of how much Planning helps "put everyone on their tools in front of a job" instead of doing something else.
- Work that is planned before assignment reduces unnecessary delays during jobs and work that is scheduled reduces delays between jobs
- Management question: Is time spend obtaining parts or tools part of the job or is it a delay to be avoided?
- *Key Metric: % Wrench Time*
- *Key Metric: % Wasted Time = 1/Wrench Time*

Maintenance Scheduling Principles

1 – Plan for the Lowest Required Skill Level

2 – Schedules and Job Priorities are Important

3 – Schedule from Forecast of Highest Skills Available

4 – Schedule for Every Work Hour Available

5 – Crew Leader Handles Current Day's Work

6 – Measure Performance with Schedule Compliance

Source:

Maintenance Planning & Scheduling Handbook

by: Doc Palmer

1 Plan for the Lowest Required Skill Level

- Job plans need to identify the skills required to perform the work.
  - Are there special crafts that are required that will need to be informed of the work
  - Are there special tools needed

- Includes number of technicians, work hours per skill level and total duration for the job.

- Why do we call for the lowest skill level?
  - If we list two mechanics, one being a helper, we don't want to send our two best mechanics when it is not necessary
  - Impacts our ability to get other jobs accomplished
  - Limits the impact on wrench time

- Avoid two common traps
  - Always assigning two workers
  - Estimates should not be based on half or whole increments of a shift

2 Schedules and Job Priorities are Important

- Weekly and daily schedules need to be followed

- Priorities should be used appropriately for new work
  - Consider how to handle break in or emergency work
  - Do you have a process defined? Asset Criticality?

- Any disruptions to the schedule impacts the overall process
  - We are setting goals for maximum utilizations of available craft hours
  - When a schedule is interrupted, consider postponing a job not started rather than interrupting a job in progress – the job site needs to be secure before moving to the emergency repair.
  - Restarting the interrupted job may require additional review
  - Document how you will handle in-progress, urgent and non-urgent work

3 Schedule from Forecast of Highest Skills Available

- Develop a one week schedule for each crew based on forecasted hours available for the highest skill level

- Consider the following for the schedule
  - Job priority and job plan information
  - Multiple jobs on the same piece of equipment or system
  - Proactive work

- Supervisor for crew provides forecasted hours available

- Schedule should be based on how much work the crew can finish

- The goal of scheduling is to accomplish more work by reducing delays

4 Schedule for Every Work Hour Available

- Assign work for every available hour
- Include easily interruptible jobs for emergencies and high priority reactive jobs
- Complete higher priority work by under utilizing available skills
- Consider the following
  - 100% - all available hours are scheduled which improves accuracy of reporting (KPIs) on work accomplished vs scheduled based on total available hours
  - 80% - building inefficiency into the schedule by leaving a 20% buffer. If we hit the 80%, we need an additional 20%
  - 120% - Having additional work in the schedule ensures poor performance on schedule compliance.
- What defines emergency work? Consider a week without an emergency.

5 Supervisor Handles Current Day's Work

- Supervisor develops the daily schedule one day in advance based on
  - current job progress
  - The one week schedule
  - New high priority, reactive work

- The supervisor matches the personnel skills and the tasks

- Supervisor handles current day's work and addresses emergency work

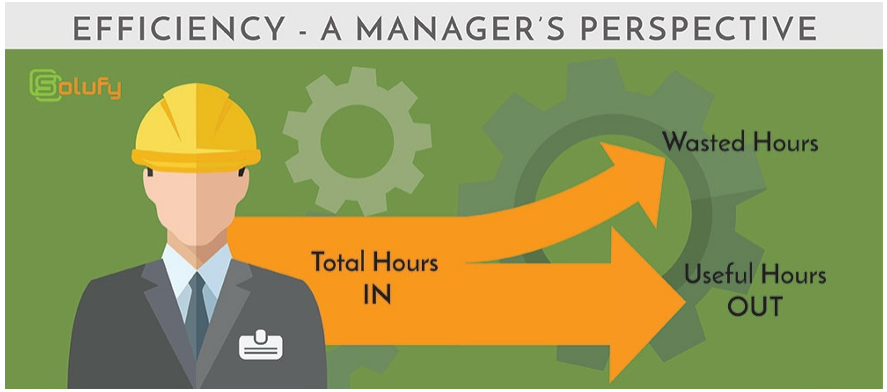
6 Measure Performance with Schedule Compliance

- Wrench time is the primary measure of work force efficiency and of planning and scheduling effectiveness
  - Best measure of scheduling performance
  - Schedule Compliance – jobs scheduled vs jobs started
- Work that is planned prior to assignment reduces unnecessary delays during job by eliminating non value added time
- Work that is scheduled reduces delays between jobs
- Schedule compliance is the measure of following the 1 week schedule and its effectiveness

Waste in Maintenance

Labor Productivity

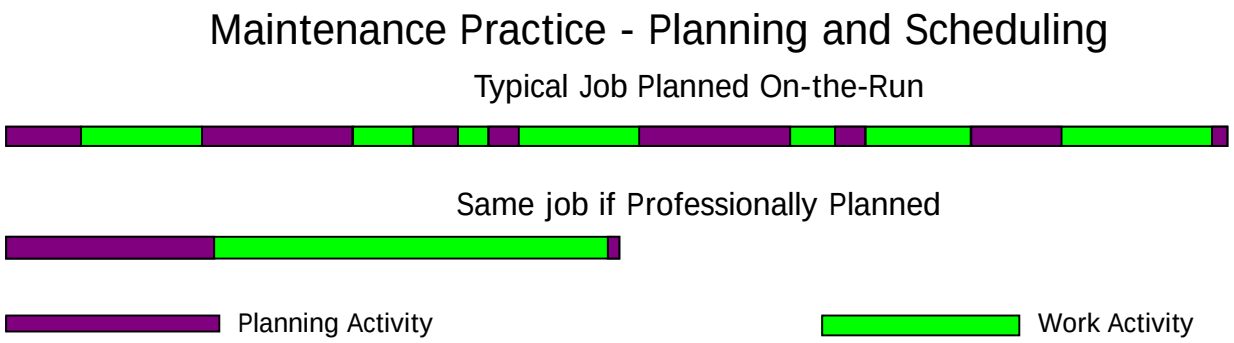
- Waiting for instructions
- Looking for supervisors
- Checking out the job
- Multiple trips to stores
- Idle at Job Site
- Special tools
- Waiting for approval
- Excess technicians per job



Stores - Materials

- Waiting for Materials
- Travel time to obtain materials
- Time to move materials to job site
- Time to identify untagged materials
- Time to find substitute materials
- Time to find parts in remote/alternative locations
- Requisition/Purchase Order
- Time lost due to:
  - Other crafts having material problems
  - Wrong materials planned, ordered, or delivered
  - Materials out of stock

Planned Maintenance



Typical Maintenance Worker's Day - *Reactive vs. Proactive*

	Reactive without planning & scheduling	Proactive with Planning & Scheduling
Receiving instructions	5%	3%
Obtaining Tools and materials	12%	5%
Travel to and from job (both with and w/o tools and materials)	15%	10%
Coordination Delays	8%	3%
Idle at job site	5%	2%
Late starts and early quits	5%	1%
Authorized breaks and relief	10%	10%
Excess personal time (extra breaks, phone calls, smoke breaks, slow return from lunch and breaks, etc.)	5%	1%
Sub-Total	65%	35%
Direct actual work accomplished (as a % if whole day)	35%	65%

What do you need to Plan & Schedule

First things first - Do you have a documented definition of a planned job?

- What is the criteria for ending work to a planner?
- Does the person planning the job verify the job scope?
- Craft, Materials (including spare parts kits- kitting), Tools?
- Are special resources needed and identified?
- Are required skills identified?
- Is there a documented description of job steps (job plan)?
- Are there any Lock-out, tag-out or other safety issues identified?
- Necessary technical documentation is available?
- Are crafts people involved in the planning process?
- Are labor hours by skill identified?
- Any permits required, are they available?
- Any physical and environmental constraints.
- Approvals????
- Operations/customer impact??

Do you have a formal documented Checklist?

Planning & Scheduling Data Elements

- What do we need to support planning and scheduling
  - Labor – Need to know who is available for work
  - Plans – Specifying resource requirements on a work order or task level allow users to properly resource level during the planning process
    - Craft Labor Hours
    - Materials
    - Tools

Resource Information

- Shifts and Calendars – are essential for determining labor availability when scheduling
- Person Availability – Used to specify non-working time. Provides accurate labor availability while planning and scheduling work

Key Ingredients for Effective Planning

- Up to date Asset Records; P&ID's, Criticality
- O&M manuals, Equipment History files
- Experienced Planners
- Spare Parts & Materials - Kitting
- Robust Work Order management system
- Skilled Technicians & Operators
- Maintenance Shops & Satellite Stores
- Specialty Tools & Equipment
- KPI's (MTBF, MTTR, etc)
- Reliability Centered Maintenance strategy

As part of the Planning and Scheduling process, information should be collected that can be used for performance analysis..... if you don't measure it, how can you improve it?

Key Ingredients for Effective Scheduling

- Work Priority System
- Early work identification
- Adequate planned work order backlog
- Resource (labor) availability list
- Process to manage break-in work (i.e. emergencies)
- Operations schedule of equipment/asset availability
- Engineering / projects requirements for maintenance involvement
- Efficient coordination between multiple inputs

KPI's for Planning & Scheduling

Planning & Scheduling Metrics

- Schedule Compliance
  - Work order completion (timing)
  - Jobs completed vs. jobs scheduled
  - hours completed vs. hours scheduled
- Percent Planned Work
  - work orders processed thru planning over total work
  - Planned work vs. Unplanned corrective work
  - By work type
- Percent Scheduled Work
  - Work order labor hours scheduled vs. total labor hours available
- Backlog
  - Work Orders with Hours
  - Number of Work Orders
- Planning Efficiency (Estimation Accuracy) based on activity
  - Labor Hours - Est. vs. Actual
  - Downtime
  - MTBF, MTTR
  - Parts & Materials
- Maintenance Productivity
  - Wrench Time
  - Labor Utilization

Metrics and Analysis

$$\frac{\text{Work Order Hours}}{\text{Total Hours Worked}}$$ = % of hours captured on Work Orders

$$\frac{\text{Planned Work Order Hours}}{\text{Total Work Order Hours}}$$ = % of Planned vs unplanned hours

$$\frac{\text{Work Order Hours by Work Type}}{\text{Total Hours Worked}}$$ = % of Work Order Hours by Work Type

$$\frac{\text{Work Order Hours by Asset Class}}{\text{Total Hours Worked}}$$ = % of Work Order Hours by Asset class

$$\frac{\text{PMs Completed}}{\text{PMs Scheduled}}$$ = PM Compliance

$$\frac{\text{Desired Asset Uptime} - \text{Downtime}}{\text{Desired Asset Uptime}}$$ = % of Asset Availability

KPI's for Planning & Scheduling

- Other Related Metrics
- Percent Work in Progress/Scheduled (Status)
  - Past schedule date
  - # hours
  - # jobs
- Scheduling Efficiency
  - Schedule Compliance X % Scheduled Work

- Reports:
- Activities with Associated plans
- Weekly Labor Schedule
- Costing Report
- Work Order Aging Report
- Work orders not processed past the "Planned" status in days
- Activities not finished where actual hours are higher than estimated
- Compliance Report
- Break In/Break Out Work

Benefits of Planning and Scheduling

- Average "wrench time" (maintenance efficiency) is 25 - 35%. Leading practice is more than 60% - how to close the gap? Effective Planning & Scheduling

- Maintenance Overtime – average is the US: over 14% (Leading practice: below 4%), Cause: reactive maintenance. Result: higher cost. Solution: better planned and scheduled maintenance work

- Planned work versus unplanned work has a cost ratio of 1:5 – that is, planned work cost about 20% as much as unplanned work;
  - Why? All work has the potential for delays and will benefit from historical analysis and planning
  - Solution: Planning by experienced Crafts persons. Best Practice: > 80% of all maintenance work is planned

Benefits of Planning and Scheduling

- Extra Stores inventory – about 50% of the average maintenance budget is spent on spare parts. In reactive organizations up to 20% of spare parts is not needed.
  - Stocking too many spare parts -- “just in case”
  - Expediting spare parts delivery (unplanned usage)
  - Single item purchase orders
  - Spare parts that “vanish” (Sometimes called “shrinkage”)

- Wasted energy consumption: well maintained equipment requires 6 to 11% less energy to operate than poorly maintained equipment. Major Sources of wasted energy (below). Solution – planned maintenance
  - Air leaks
  - Steam leaks
  - HVAC cleaning
  - Coupling alignment
  - Coolers and heat exchangers

Planning and Scheduling
Wrench Time Improvement

Maintenance Practice - Planning and Scheduling

Without Planning and Scheduling		With Planning and Scheduling	
0	Planner / Scheduler	1	Planner / Scheduler
12	Total Craftspeople	11	Total Craftspeople
35%	Direct Work percentage	65%	Direct Work percentage
4.2	**Equivalent Full Time Workers**	**7.15**	**Equivalent Full Time Workers**

Represents an increase of 2.95 FTEs

Conclusion

- Where to start?
- Is it easy – No.
- Is it worth the effort – Absolutely!
- Improved metrics
- You can expect to see an increase in productivity
- Decrease backlog
- Increased employee satisfaction
- Improved safety
- Improved reliability
- Better data in the system
- Better understanding of asset performance
- Increased efficiency of technicians, planners, schedulers and supervisors.

Questions

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Why Planning and Scheduling?

Its all about the numbers
Lets use the following example

- 10 Maintenance technicians
- 35% wrench time
- 140 hours of wrench time per week

- At 50% wrench time
- 200 hours of wrench time per week

- That's a difference of 60 hours per week

- No changes to processes
- No changes to systems
- to add 60 hours of wrench time per week you need to add 4.3 technicians

- What is the cost of adding 4.3 Technicians

Why Planning and Scheduling?

Lets do the Math

- 10 Maintenance technicians at 35% wrench time
- 8 hrs/day/tech X .35 X 10 Techs = 28 hrs/day
- 8 hrs/day/tech X .35 X 10 Techs X 5 days = 140 hrs/week

- 10 Maintenance technicians at 50% wrench time
- 8 hrs/day/tech X .50 X 10 Techs = 40 hrs/day
- 8 hrs/day/tech X .50 X 10 Techs X 5 days = 200 hrs/week

- 200 – 140 = 60
- 2.8 hours per day per tech
- 14 hours per week per tech
- 4.3 techs at 14 hours per week (60/14 = 4.3)

Why Planning and Scheduling?

Lets do the Math

- What is the cost of adding 4.3 techs?
- You can't add 4.3 so you need to go with 4 or 5

5	Number of techs
$65.00	Burdened Rate
$45.00	Overtime Rate
2080	Standard Hours Per Year
5.6	Overtime Hours Per Week
280	Overtime Hours Per Year
$676,000.00	Cost of Standard Hours
$63,000.00	Cost of Overtime Hours
$739,000.00	Total Cost to add 4.3 (5) Technicians