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ARE-524

UPTIME

Strategies for Excellence in Maintenance Management

By: John Dixon Campbell

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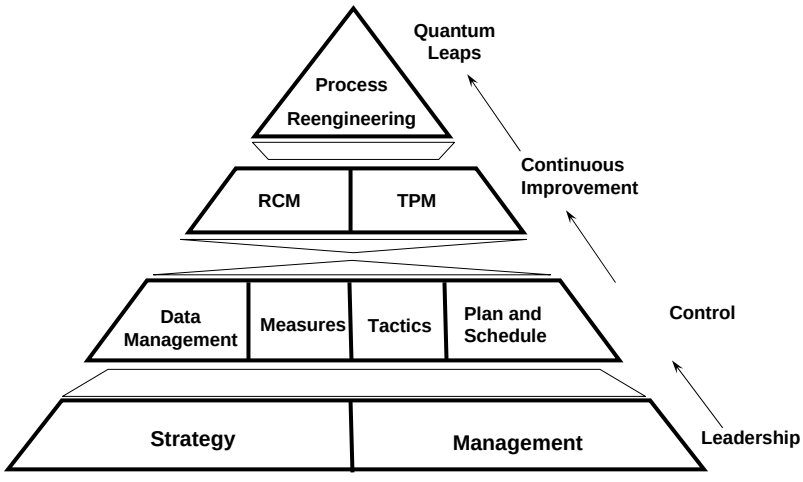

World Class Maintenance

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Section 3

Planning and Scheduling Resources

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"The surest way to be late is to have plenty of time"

Leo Kennedy

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CONTENTS

- **Introduction**
- **The Six Key Steps**
- **Planning Horizons**
- **Planning and Scheduling Tools**
- **Planning Standards**
- **Managing Materials**

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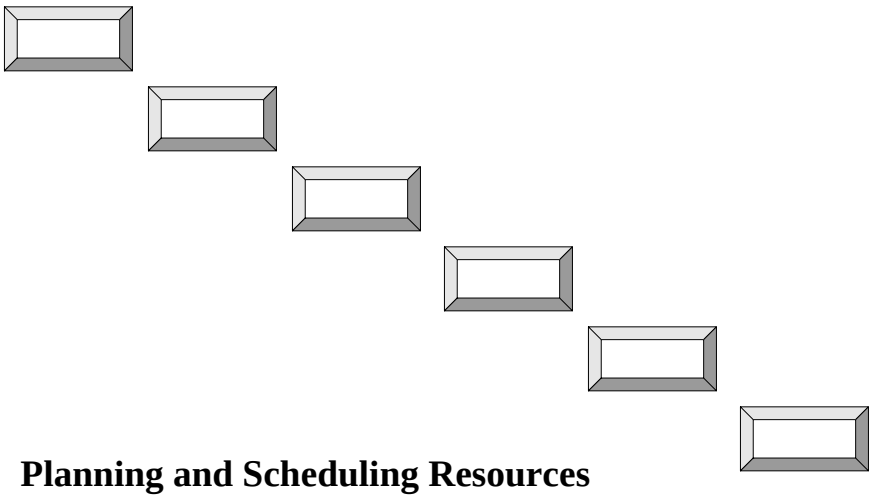

Planning and Scheduling Resources

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INTRODUCTION 1/2

- **Breakdowns, emergency repairs, unplanned and unscheduled downtime, overtime, spare parts availability- all rob the business capacity and profits.**
- **What is needed?**
- **A maintenance program that is effectively planned and scheduled to reduce labor and downtime when something goes amiss.**
- **Ensure that the correct parts and materials are used and repair will be of higher quality than an unplanned one.**

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INTRODUCTION 2/2

- **Here is what it takes:**
  - **Sequenced documented plan is made with description and drawings of what has to be done. Take time to review the repair manuals.**
  - **Use the most highly skilled people**
  - **Job not to start until all right parts are on-site**
  - **It is scheduled for the best production window with least disruption to customers.**
- **Studies have shown a clear link between planned maintenance and reduced cost.**

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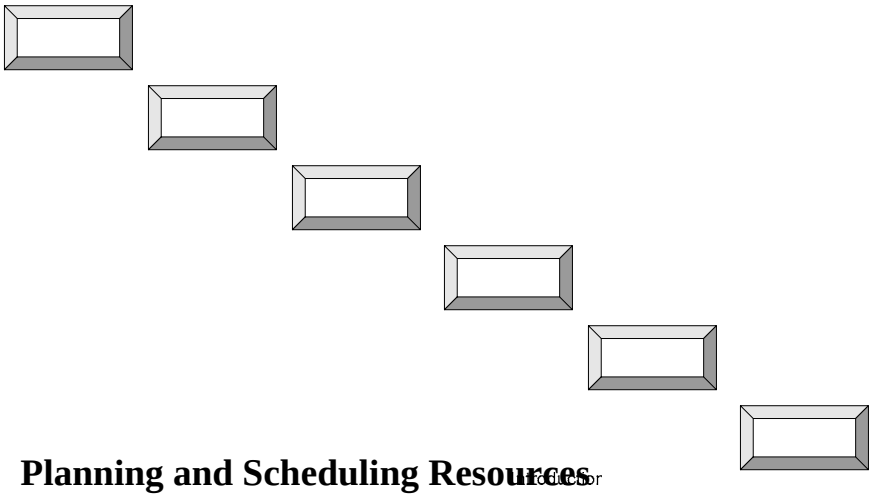

Planning and Scheduling Resources

Introduction

The Six Key Steps

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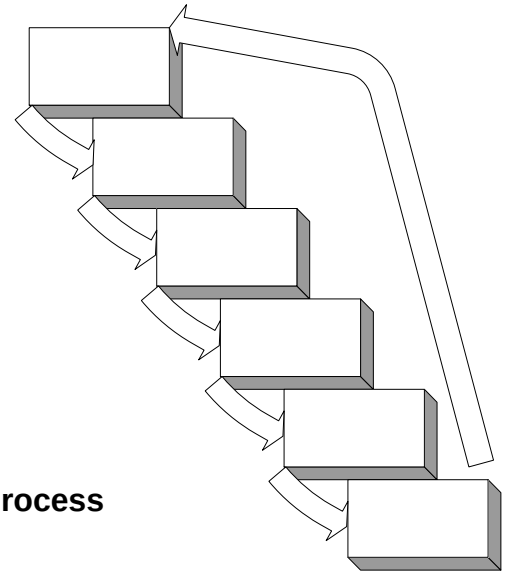
THE SIX KEYS STEPS 1/9



The Maintenance Process

Planning Horizons

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THE SIX KEYS STEPS 2/9

1 - IDENTIFY 1/1

- **Random observations have low probability of catching a problem before it becomes expensive.**
- **It is much better to program inspections by opertaors who are equipment sensetive.**

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THE SIX KEYS STEPS 3/9

2 - PLAN 1/1

- **Planning is ensuring that all resources necessary to do the job are accounted for.**
- **Most obvious planning tasks are to determine:**
  - **What has to be done**
  - **In what sequence**
  - **With what skills**
- **The planner must be someone who has the technical skills and plant-specific experience to be credible to those executing the pan.**
- **He shall estimates the overall cost, allowing cash flow projections and repair-or-replace decisions.**

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THE SIX KEYS STEPS 4/9

3 - SCHEDULE 1/2

- **Scheduling is a matter of availability**
- **When can you coordinate with the people who have the needed skills?**
  - **Who is at work?**
  - **Who is sick, on vacation or on training course?**
  - **There are mandatory jobs that should have priority such as preventive maintenance, normal load of emergency breakdown work and other planned work already started.**
- **Do you have the parts?**
- **Do you have the agreement of the production department to release the equipment?**

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THE SIX KEYS STEPS 5/9

3 - SCHEDULE 2/2

- **Do you have the parts?**
  - **Checking the on-hand status of the maintenance store.**
  - **Checking the lead time for directly ordered items**
  - **There is credibility gap between stock records and what is actually there**
- **Do you have the agreement of the production department to release the equipment?**
  - **Need close working relationship with both the production planner and the shop-floor leader.**

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THE SIX KEYS STEPS 6/9

4 - ASSIGN 1/1

- **Autonomous, self-directed work teams do all but the most specialized maintenance diagnostics and repair work themselves**
- **Traditional organizations usually delegate the day-to-day work assignment to the area or craft foreperson**
- **In either case, it is usually helpful if the team or foreperson has few days of planned work in advance**
- **This allow flexibility, as emergencies, unplanned work, or crew changes fluctuate**

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THE SIX KEYS STEPS 7/9

5 - EXECUTE 1/1

- **Well-trained, motivated team players keep maintenance process revolving**
- **They add the real value: quality, cost, time and service**
- **If the maintenance team is supported by effective systems, treated fairly and allowed to proceed with the work, you will be rewarded with cost-effective maintenance management**

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THE SIX KEYS STEPS 8/9

6 - ANALYZE 1/1

- **The job isn't finished until the paper work is done**
- **Thoughtful analysis of the failure and your response to it, will lessen the chance of repeating the same mistake**
- **Maintenance work should be incorporated into the equipment history**
- **Especially if the work was significant, you should redesign the preventive maintenance and operating procedures so the failure does not recur**

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THE SIX KEYS STEPS 9/9

- **This is the core of maintenance management process**
- **Some enterprises seams to be programmed to hit only the *Execute* button**
- **Firefighting method leaves less and less time for sober thought and careful planning**
- **Praise should be given to Fire Preventers and counseling to those addicted to crises**

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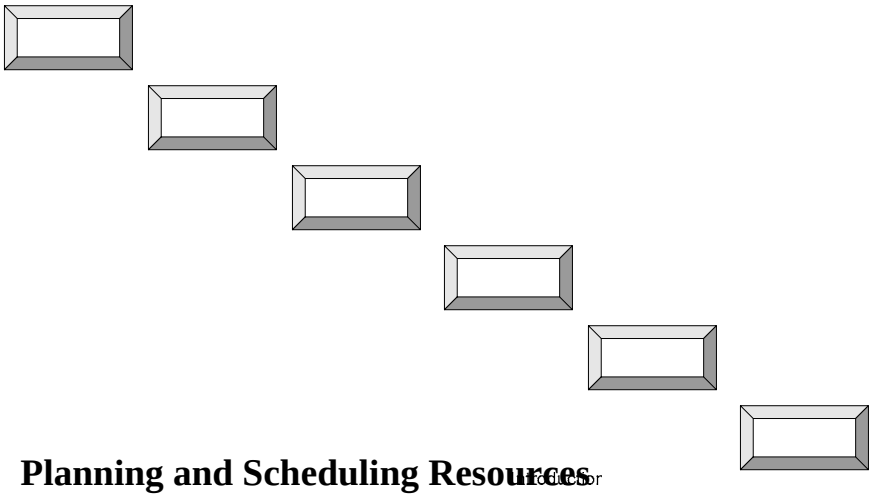

Planning and Scheduling Resources

Introduction

The Six Key Steps

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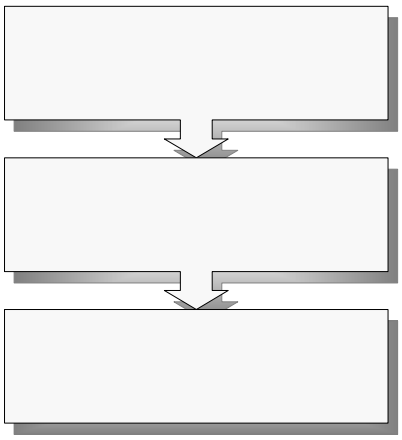
PLANNING HORIZONS 1/10

Planning Horizons



Planning Horizons

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PLANNING HORIZONS 2/10

1 – LIFE CYCLE AND LONG RANGE PLANS 1/3

- **This kind of planning is closely associated with strategic planning for maintenance**
- **The planning process involves creating a vision of future performance including human, financial and physical resources as well as action plan to achieve the vision**

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PLANNING HORIZONS 3/10

1 – LIFE CYCLE AND LONG RANGE PLANS 2/3

- **Life-cycle planning for physical plant, equipment and fleet means getting the most economically from maintenance and operating activities**
- **Age is not the best indicator of failure rate in most complex equipment systems**
- **It is usually helpful to develop a long-range forecast of major project and maintenance cost based on past experience**
- **Besides studying history, scheduled inspection for age-related maintenance – painting, corrosion work, roads and civil structures, roofing – can help the plan**

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PLANNING HORIZONS 4/10

1 – LIFE CYCLE AND LONG RANGE PLANS 3/3

- **These life-cycle plans are geared for major/significant work**
- **They should fit neatly into the operation's overall business strategy**
- **Make hefty expenditures only on assets that contribute long-term value**
- **Keep on mind that any new or replacement capital purchases will have a direct bottom-line impact on maintenance requirements of all kinds**

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PLANNING HORIZONS 5/10

2 – ANNUAL PLAN AND BUDGET 1/3

- **If you don't plan and budget properly, you are jeopardizing all of your efforts to improve maintenance quality**
- **Empowering workers and departments integration, won't really pay off if the equipment isn't adequately maintained and enhanced**

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PLANNING HORIZONS 6/10

2 – ANNUAL PLAN AND BUDGET 2/3

- **In the annual maintenance budget we need:**
  - **Accurate equipment histories**
  - **Periodic inspection**
  - **Condition-based monitoring**
  - **Emphasis on continuous improvement**
- **Plant shutdowns, equipment overhauls and major inspection should forecasted by month, priced and incorporated**
- **New technology, systems, procedures and organization changes that affect capability must be factored**

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PLANNING HORIZONS 7/10

2 – ANNUAL PLAN AND BUDGET 3/3

- **This type of zero-based budgeting and planning is more challenging than relying on last year's budget plus or minus five percent but it's far more useful for planning the staff, long lead-time parts and cash flow**
- **It commits everyone to the concept of planned maintenance throughout the year**

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PLANNING HORIZONS 8/10

3 – WORK ORDERS AND PROJECTS 1/3

- **In recent years, particularly with the advent of just-on-time manufacturing and the advancement of microcomputers and software, the maintenance work order has received much bad press.**
- **The typical paper-driven work order had anywhere from three to eight copies**
- **In some operations, a work order number is required for every job done by maintenance and for every item released from stores**

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PLANNING HORIZONS 9/10

3 – WORK ORDERS AND PROJECTS 2/3

- **The use of work order:**
  - **Planning and scheduling mechanism for complex jobs**
  - **Cost collection mechanism against a particular equipment or production cost center**
  - **Way to capture delays and measure productivity**
  - **Tool to determine and manage work backlogs**
  - **Means of saving equipment histories to analyze failure and effectiveness of your preventive maintenance efforts**

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PLANNING HORIZONS 10/10

3 – WORK ORDERS AND PROJECTS 3/3

- **The advantages are numerous**
- **Today, there are inexpensive and simple computerized maintenance management software packages available so that the benefits can be enjoyed with little paper**

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THANK YOU

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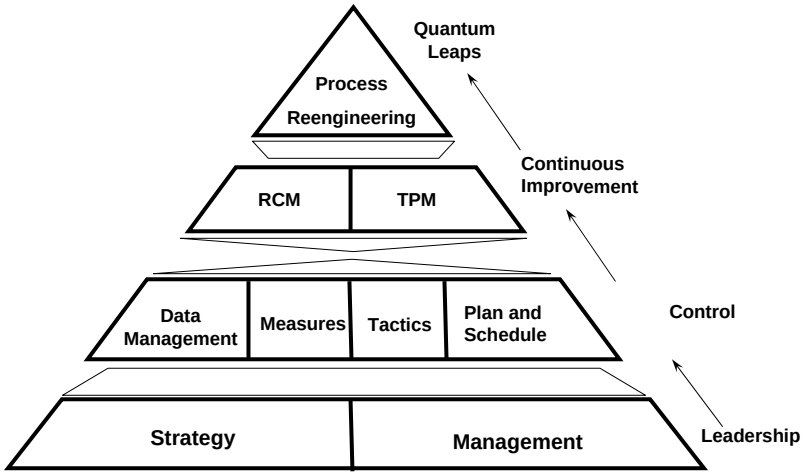

World Class Maintenance

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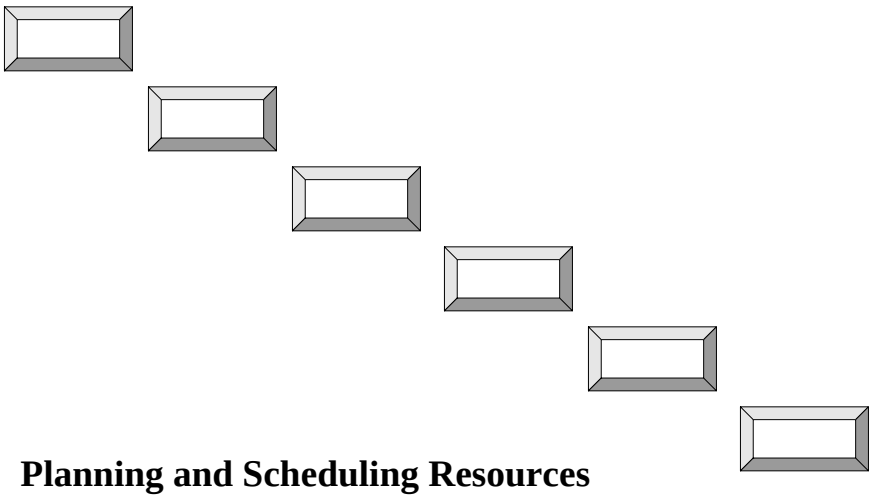

Planning and Scheduling Resources

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PLANNING AND SCHEDULING TOOLS 1/12

- **Most effective tool is the Computerized Maintenance Management System**
- **Most commercially available systems have comprehensive models that include:**
  - **Work order management**
  - **Equipment records and history**
  - **Preventive maintenance tasks and scheduling**
  - **Cost and budgeting**
  - **Materials management**
  - **Labor skills capacity planning**

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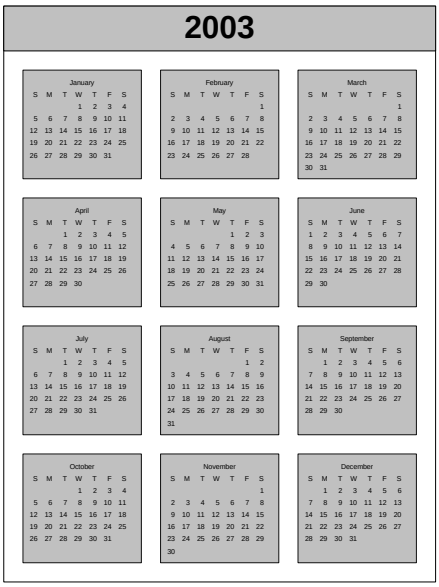
PLANNING AND SCHEDULING TOOLS 2/12

Tools for planning

1. **The Gantt Chart**
2. **The Critical Path Method**
3. **The Pareto Diagram**



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PLANNING AND SCHEDULING TOOLS 3/12

1 – The Gantt Chart 1/2

- **Useful yet simple tool for planning and scheduling**
- **Introduced by Henry T. Gantt at the beginning of this century**
- **Lists key steps and activities along a vertical line**
- **Show accomplishment time along the horizontal line**
- **Useful for sequential and independent events**

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PLANNING AND SCHEDULING TOOLS 4/12

1 – The Gantt Chart 2/2

When properly constructed, it show:

- **Sequence of events**
- **Duration**
- **Event start and end time**
- **Project start and end time**

It does not, however, clearly show interdependence among different projects.

ID	Task Name	Start	Finish	Duration
1	Design	10/1/2003	10/2/2003	2d
2	Material quotes	10/3/2003	10/9/2003	5d
3	Excavate	10/3/2003	10/3/2003	1d
4	Form	10/6/2003	10/6/2003	1d
5	Pour concrete/set	10/6/2003	10/7/2003	2d
6	Build frame	10/8/2003	10/14/2003	5d
7	Plumbing/heating	10/13/2003	10/16/2003	4d
8	Electrical	10/13/2003	10/15/2003	3d
9	Gyprok	10/16/2003	10/17/2003	2d
10	Interior finishing	10/20/2003	10/22/2003	3d
11	Siding	10/20/2003	10/21/2003	2d

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PLANNING AND SCHEDULING TOOLS 5/12

Tools for planning

1. **The Gantt Chart**
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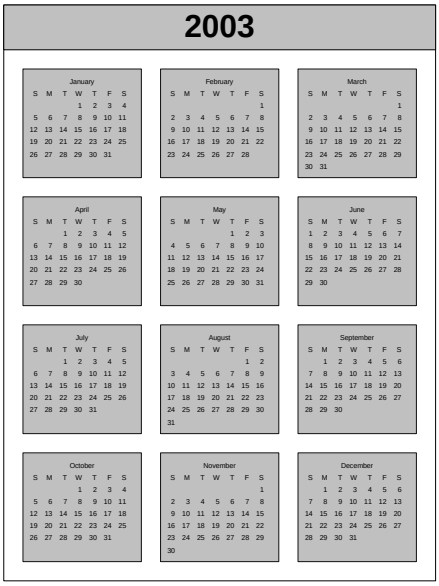

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PLANNING AND SCHEDULING TOOLS 6/12

2 – The Critical Path Method 1/2

- **Used to frame a plan that shows relationships between different activites**
- **It determines minimum time required to complete project**
- **Useful for sequential, independent or interrelated events**
- **Once plotted the path with longer duration is highlighted**
- **There are several microcomputer software packages available to help determine the critical path**
- **They can also plan and schedule resources necessary to execute the plan**

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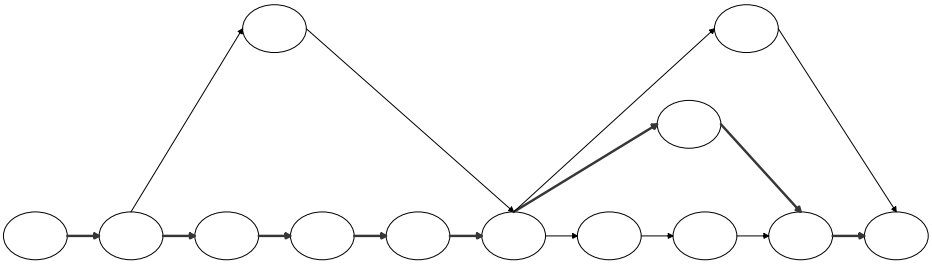
PLANNING AND SCHEDULING TOOLS 7/12

2 – The Critical Path Method 2/2



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PLANNING AND SCHEDULING TOOLS 8/12

Tools for planning

1. **The Gantt Chart**
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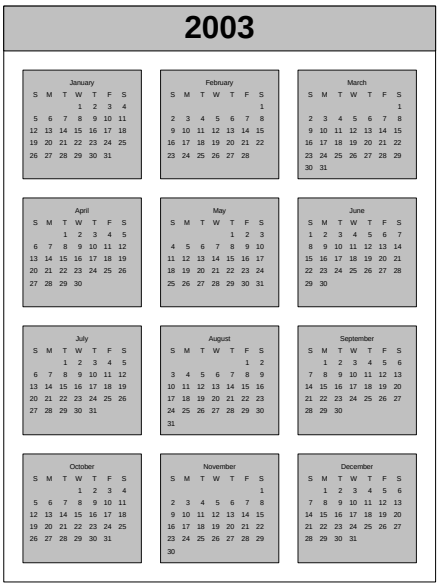

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PLANNING AND SCHEDULING TOOLS 9/12

3 – The Pareto Diagram 1/5

- **The simplest yet most powerful tool**
- **Vilfredo Pareto, Italian economist, came up with 80-20 rule**
- **80% of problems are associated with 20% of equipment**
- **It is a bar chart used to prioritize and help to separate the vital few from the trivial many**

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PLANNING AND SCHEDULING TOOLS 10/12

3 – The Pareto Diagram 2/5

Example:

- **Downtime of bottle-filling shop is analyzed and compared with the available production time**

PLANNING AND SCHEDULING TOOLS 11/12

3 – The Pareto Diagram 3/5

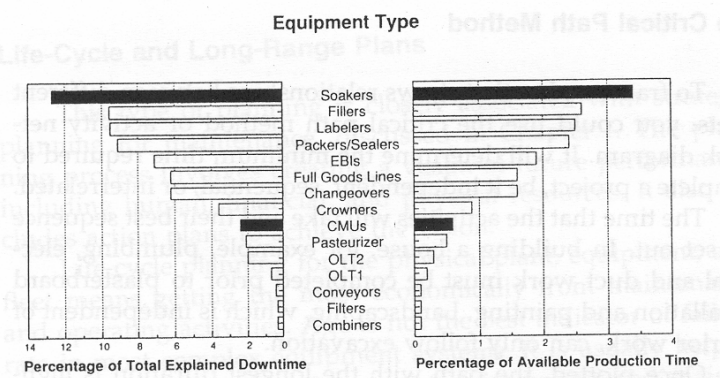

Figure 3-5. Bottle Shop Downtime Histogram

PLANNING AND SCHEDULING TOOLS 12/12

3 – The Pareto Diagram 4/5

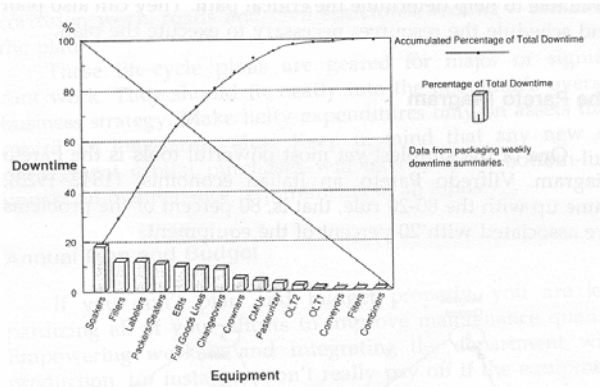

Figure 3-6. Pareto Downtime Analysis

PLANNING AND SCHEDULING TOOLS 10/12

3 – The Pareto Diagram 5/5

Example (Continue):

- **The priority for redeveloping the PM program should be the SOAKER, rather than the COMBINERS, FILLERS OR CONVEYERS**

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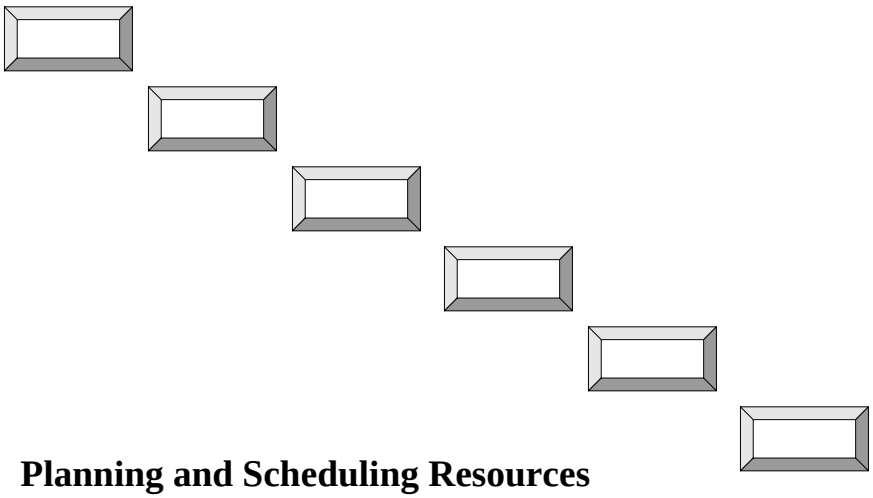

Planning and Scheduling Resources

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PLANNING STANDARDS 1/9

- **Time standards in maintenance have a negative ring**
- **They conjure up images of dogmatic, authoritative organization culture**
- **They remind us of the days where techniques such as Universal Maintenance Standards, Methods-Time-Measurement and Engineered Performance Standards kept employees on a tight leash**
- **These techniques have little place on today's workplace**
- **If you believe in a team approach to continuous improvement, an environment that truly values the total employee, you will see no benefit in time standards that measure and control individual productivity**

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PLANNING STANDARDS 2/9

- **We still need to:**
  - **Know approximately how long a job will take**
  - **Be able to estimate its cost**
  - **Schedule it along with other jobs**
  - **Determine equipment downtime needed to complete the work**
- **In a broader sense, we can apply standard quality operating and maintenance procedures as well as benchmark for equipment performance and cost**
- **Planning Standards include:**
  - **Backlog Time Standards**
  - **Quality Standards**

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PLANNING STANDARDS 3/9

Backlog Time Standards 1/4

- **Two of most practical methods for estimating how long a job will take are:**
  - **Equipment history work-order file times**
  - **Time slotting**

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PLANNING STANDARDS 4/9

Backlog Time Standards 2/4

- **If records are kept you can link**

  Repairs, overhauls, projects, plant shutdowns, etc.

  WITH

  Series of job or work orders
- **These are usually filled in numerical sequence**
- **Document on these orders or accounting records, the employee hours charged**
- **The average actual time is used as the standard**

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PLANNING STANDARDS 5/9

Backlog Time Standards 3/4

- **If records are not available or if equipment is relatively new TIME SLOTTING is the best solution**
- **It is simple method that uses comparison**
- **The planner select several common jobs of varying duration and complexity, then times them from either observation time cards or expert opinion of those performing the job.**
- **They are grouped into categories and used as benchmarks for similar jobs**

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PLANNING STANDARDS 6/9

Backlog Time Standards 4/4

Slot	Time Range	Plan Time	Actual Average (6-Month Moving Average)
A	0-3	1.5	2.2
B	3-6	4.5	3.8
C	6-12	9.0	9.1
D	12-24	18.0	21.7
E	24-48	36.0	35.4

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PLANNING STANDARDS 7/9

Quality Standards 1/3

- **It seams ironic that while the quality standards of products and techniques to produce them are becoming more uniform and precise, the work environment from which it all springs has become less rigid**

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PLANNING STANDARDS 8/9

Quality Standards 2/3

- **Many successful companies are reinventing themselves into lean, flat organization structures**
- **Their employees operate mostly autonomous, self-directed work teams**
- **This has freed them up to develop the best processes and procedures to achieve perfect conformance**
- **So it should be with maintenance procedures particularly repetitive tasks such as preventive care and tool and die maintenance**

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PLANNING STANDARDS 9/9

Quality Standards 3/3

- **Quality standards aren't matter of employees having the freedom to do what they want**
- **Rather, excellence results when everyone involved is responsible for developing the delineated best practice and is accountable for carrying it out**
- **Once the best practice is determined, the time standard can be determined using actual time averages or the time-slotting technique**

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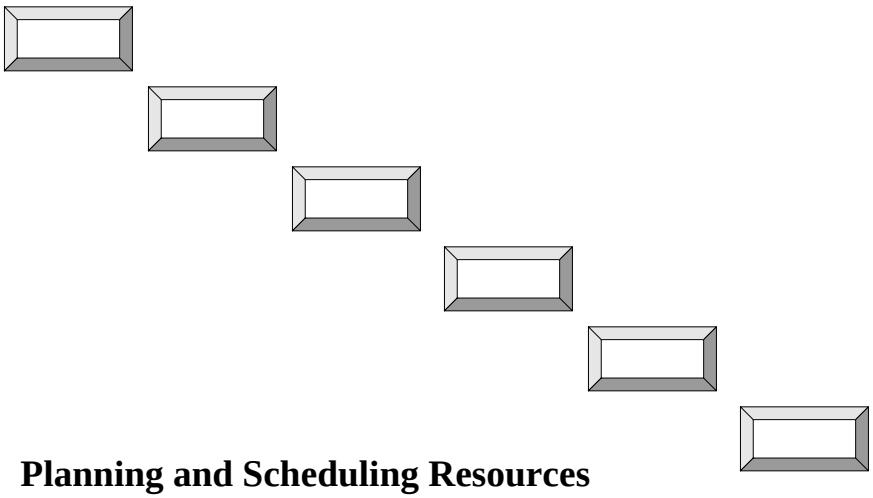

Planning and Scheduling Resources

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MANAGING MATERIALS 1/13

- **Spare parts, components, consumables, lubricants, fasteners and all other maintenance materials accounts for 50% of most companies' maintenance budget**
- **This proportion is increasing**
- **More industrial equipment and fleets are designed for modular parts replacement**
- **In many industries this area is neglected**
- **To manage maintenance materials effectively, begin with basic processes of purchasing, stores and inventory control**

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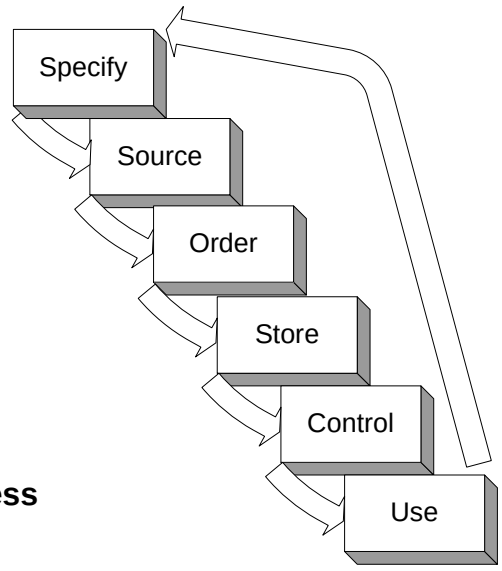
MANAGING MATERIALS 2/13



The Materials Process

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MANAGING MATERIALS 3/

1 - Specify 1/1

- **Specifying what is needed is made much easier if there is an equipment register – an accurate, updated configuration of what you have**
- **Each major equipment assembly is then broken down into the smallest component that you would buy as a unit**
- **Newer equipment have integrated components that are changed out and returned to the manufacturer for repair or simply discarded**
- **If your records are accurate, the rest of the process will be simplified**

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MANAGING MATERIALS 4/13

2 - Source 1/2

- **Vendor management used to be a win-lose situation**
- **Confrontations between buyer and seller were the order of the day**
- **Buying strategy dictated that you go for the lowest price of three or more bids for each purchase**
- **One purchasing agent at a public board of education was required by policy to send out a request for proposal for a $2,000 project to all qualified vendors - sixty-three of them!**

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MANAGING MATERIALS 5/13

2 - Source 2/2

- **A much more productive approach is to develop a supplier partnership**
- **You lock in with a trustworthy supplier for one, two, or more years, and work together to try to improve the overall value of the transaction**
- **You gain lower cost, higher quality, and better service**
- **This approach has been highly successful for the North American car industry, helping it compete on a cost, quality, and time-to-market basis with Japanese manufacturers**

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MANAGING MATERIALS 6/13

3 - Order 1/1

- **Once the specification and the supplier are known, the part can be ordered.**
- **Two things to consider:**

  1- Items kept in inventory holding account are normally ordered once the order point has been reached. The final user isn't involved. The authority to order was established when the order point was approved

  2- Items not kept in maintenance stores can be ordered by user.

  To simplify, Many businesses have only one or two maintenance people placing orders with buyers to avoid duplication and allow for grouping of requests

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MANAGING MATERIALS 7/13

4 - Store 1/1

- **Core job involve receiving, stocking and issuing**
- **Numerous factors effect efficiency from stores layouts to use on enabling technology**
- **If the source step is done correctly, a lot of staff inspection for quality and complete order receipts is not needed**
- **One company's solution for a 35% rejection rate was to add more receiving inspectors!**
- **The problem needs to be fixed at source**
- **A direct-order area, for users directly ordered parts, is normally a necessary evil. It should be aggressively managed otherwise parts can get obsolete soon**

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MANAGING MATERIALS 8/13

5 - Control 1/3

- **Companies normally tie their maintenance stores inventory to the number of active trades-people they employ**
- **The prime issue is its efficiency and productivity**
- **Is it fast moving, turning over at reasonable rate? Say twice per year**
- **Or is it mostly for "insurance spares" with one-third of investment still parked (no issue) after 24 months**

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MANAGING MATERIALS 9/13

5 - Control 2/3

- **Inventory shall be measured and managed rigorously**
- **It needs the same scrutiny as raw material, work-in-process and finished goods inventory**
- **Although shrinkage is not normally a major issue, free access is not advantageous**
- **Free access shall be given only to fast-moving, common items such as fasteners, piping, steel fittings, and the like and ideally at the workplace where they are used**

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MANAGING MATERIALS 10/13

5 - Control 3/3

- **Repairable and rotables-components taken out of service, rebuilt, and returned through the inventory control system are often a contentious issue**
- **Usually it is the cost accounting of repaired component that causes the problem**
- **Free or no-value issue, with a chargeback of actual repair cost to the last user, is often the easiest way to handle it**

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MANAGING MATERIALS 11/13

6 - Use 1/1

- **In recent view of manufacturing operation, the lag in trades productivity was primarily attributed for waiting for the parts**
- **The time taken while the part was looked up, requisitioned, spotted, issued and brought to workplace was considerable**
- **Once it arrived, installation was speedy**
- **Give some thought to "kitting" parts, especially for repetitive work like preventative maintenance or scheduled discard of components**
- **Parts delivery to site may sound expensive but compared to lost trades productivity and extended equipment downtime, it can be cost-effective**

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MANAGING MATERIALS 12/13

Analyze the Data 1/1

- **One of the simplest ways to judge the effectiveness of your maintenance planning is to:**
  - **Review the number of urgent or emergency requisitions received by the buyers**
  - **Check the number of stockouts in the stores, to see if inventory control is working**
- **The objective of maintenance materials management is to balance the investment with the value**
- **Look for ways to continuously improve this ratio**

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MANAGING MATERIALS 13/13

- **In this chapter we have looked at two components that work in tandem to keep your organization moving forward**
- **With out one -proper maintenance planning- you cannot have the other –efficient material management**
- **A hole in your inventory control can flatten your maintenance productivity**
- **Keep these teams working together to ensure smooth operation**

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THANK YOU