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ARE 524
Facilities Maintenance Management
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Measuring and Benchmarking Performance Section 5

Uptime
Strategies for Excellence in
Maintenance Management
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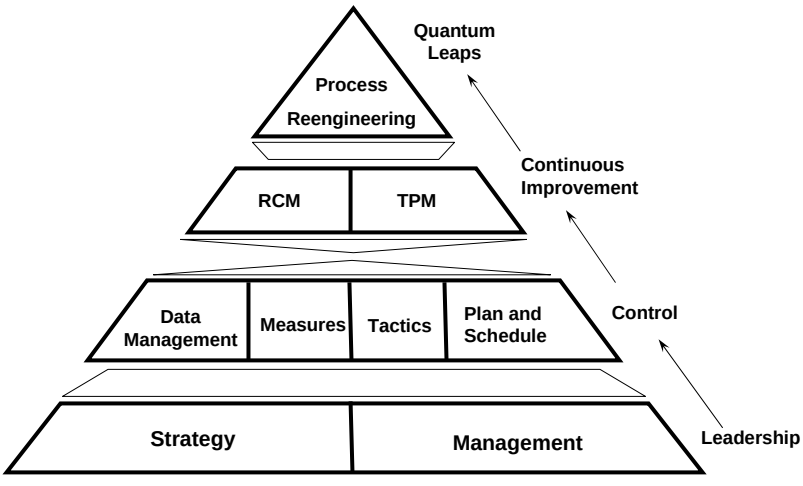

World Class Maintenance

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OUTLINE

- INTRODUCTION
- MEASURING MAINTENANCE PRODUCTIVITY
  - EQUIPMENT MAINTENANCE MEASURE
  - COST MAINTENANCE MEASURE
  - PROCESS PERFORMANCE MEASURE
- BENCHMARKING MAINTENANCE
- FACTS AND FINDINGS

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INTRODUCTION - 1/2

- "What gets measured gets done" Tome Peters (Management Expert). But what is measured and how done it is a critical decision
- For businesses that run on, large sophisticated equipment and facilities, maintenance performance has a dramatic impact on overall capacity and cost
- Measuring that performance, though, is often solely based on:
  - Trade people and materials, or
  - It's wading through a modular of terms (Mechanical system)
  - Ratios like maintenance cost over plant replacement value

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INTRODUCTION - 2/2

- **Therefore:**
  - **For productive maintenance; maintenance productivity should be measured**
  - **To achieve maintenance strategy; strategic objectives and master plan should constantly reviewed**
  - **To be competitive, compare the work done with other's in same fields**
  - **Learn from most successful competitors**

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1. MEASURING MAINTENANCE PRODUCTIVITY

- **Productivity is simply what get out compared to what put in**
- **In maintenance, what you got is better equipment performance. What you put in is money**
- **What's needed is a handy, all-encompassing productivity ratio of equipment performance over cost**
- **Therefore, a breakdown for each component until a reasonable set of parameters to judge whether the performance is good, bad, or indifferent**

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1. 1 Equipment Performance Measures – 1/4

- **First of all, to ensure that an equipment is running, then should check for:**
  - ***(Availability)*** **Available to use**
  - ***(Reliability)*** **Working along before the next failure**
  - ***(Maintainability)*** **Average time it would be down for repair and maintenance**
  - ***(Process rate)*** **Operation compare to what it designed for**
  - ***(Quality rate)*** **Production quality**
  - ***(Effectiveness)*** **Performance improving vs. deterioration**

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1. 1 Equipment Performance Measures – 2/4

1. Availability **– A measure of uptime, as well as downtime. It is calculated as:**

$$\frac{\text{Scheduled time – All unplanned delays}}{\text{Scheduled time}}$$

2. Reliability **- A measure of the frequency of downtime, or mean time between failures (MTBF). It is determined by:**

$$\frac{\text{Total operating time}}{\text{Number of failures}} \quad \text{or} \quad \frac{\text{Total operating cycles (km, tons)}}{\text{Number of failures}}$$

3. Maintenance **– A measure of the ability to make equipment available after failed, or mean time to repair (MTTR). It is measured by:**

$$\frac{\text{Total downtime from failure}}{\text{Number of failure}}$$

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1. 1 Equipment Performance Measures – 3/4

4. Process rate – **A measure of the ability to operate at a standard speed or cycle. It is measured by :**

$$\frac{\text{Ideal cycle time}}{\text{Actual of failures}}$$

5. Quality rate - **A measure of the ability to produce at a standard product quality. It is determined by:**

$$\frac{\text{Quality product}}{\text{Total product produced}}$$

6. Equipment Effectiveness– **An overall measure that considers uptime, speed, and precision. It is measured by:**

Availability X process rate X Quality rate

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1. 1 Equipment Performance Measures – 4/4

- **The value of any of these measures has a lot to do with how equipment was designed and built.**
- **Thus, the best test of an equipment performance is often its performance trend over time.**
- **This will provide the feedback or changes in operating and maintenance practices**

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1. 2 Cost Performance Measures - 1/3

- **In most businesses, it is difficult to obtain accurate and relevant maintenance cost information. Labor is charged through cost centers and only significant materials expenditures are charged to the equipment. Overhead cost bear little resemblance to reality, since they're allocated based on direct or operating labor**
- **Accurate maintenance cost information is used for two reasons:**
  1. **Maintenance productivity can measured and managed**
  2. **It promotes rational equipment decisions such as whether to repair or replace**

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1. 2 Cost Performance Measures - 2/3

- **Maintenance cost accurse in the following categories:**
  - ***Labor* – All the wages and benefits of the trades and temporary helpers**
  - ***Materials* – All the supplies, parts, components, repairable, consumables, and other items used by maintenance**
  - ***Services* – All shops, engineering, facilities, and store warehousing**
  - ***Outside services* – All contracted services for HVAC maintenance, specialty services, training and consultants**
  - ***Technical support* – Supervision, planning, materials coordination, clerical, data entry**
  - ***Overhead* – Other support functions such accounting, MIS, personnel, and for general utilities, facilities, and other general expenses normally allocated**

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1. 2 Cost Performance Measures - 3/3

- **It doesn't always help to use maintenance cost in such generalized cost. Instead, It could be broken down in to:**
  - ***Specific areas* - such as labor, materials, services and technical support, all of which influenced by area management and staff**
  - ***Job or work order – For labor, materials, and services so the cost can be designated to a particular piece of equipment and staff***
  - ***Expense type* – For labor, materials, and services to monitor trends in key parts, consumables, and services**
- **As with equipment performance, tracking cost trends is more sensible than looking at individual numbers or single averages**

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1. 3 Process Performance Measures - 1/3

- **Maintenance management is a business process. The inputs are costs, the output is equipment performance. Between the two comes the complex job of making top performance.**
- **To manage an equipment right, following are some suggestions:**
  - ***Emergencies – If a situation immediately and negatively affects the safe, or customer value, both amount and impact of emergency should be measured***
  - ***Planned versus unplanned*– There should be little for unplanned work. With accurate equipment histories, recurring repairs, and overhauls can be planned in advance, particularly for critical equipment**

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1. 3 Process Performance Measures - 2/3

- ***Schedule compliance – A good indicator of fire fighting in the plant***
- ***PM schedule compliance* – Doing the PM activities in probably the best and quickest way to improve equipment performance**
- ***Work orders generated form PM – This can tell a lot about the thoroughness and effectiveness of the PM program. During inspection, some work related should be expected, or the inspection is useless***
- ***Urgent versus normal purchase requisitions* – Another test of maintenance planning. Maintenance knows a head what parts are required**
- ***Stores inventory turnover – Dividing the value of annual issues by the on-hold value of stores. Any thing over 2 is likely good***
- ***Stores stockouts* – Indicated what are stocking and the service level provided for the investment**

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1. 3 Process Performance Measures - 3/3

- **Process performance measure should be tailored to the unique circumstances for each situation**
- **For example; what are the causes of overruns and poor equipment performance? There are many; from emergencies resulted from poor PM to quality problem due to lack of training**

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1. MAINTENANCE PRODUCTIVITY - SUMMARY

- **Measuring maintenance productivity should carried though;**
  1. **Equipment Performance Measures**
  2. **Cost Performance Measures**
  3. **Process Performance measures**
- **Finally, there could be another way to improve maintenance productivity, through customers by measuring response time. This affect ,generally, the maintainability and may result from; organization structure (i.e. centralized) or could be getting the right parts form the warehouse**

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2. BENCHMARKING MAINTENANCE – 1/7

- **Definition: Is a tool with which an organization compares its internal performance to external standards of excellence, and then act to close whatever gaps exit**
- **Objective: To achieve the situation best in-class performance through continuous improvements**
- **Contrary to popular belief, it is not just appraising how competitors measure their performance**
- **Rather it is looking behind those measures to the practices that produce them. It is about understanding which of those measures and practices are critical to success and finding out how performs best, regardless of industry sector**

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2. BENCHMARKING MAINTENANCE – 2/7

- **The basic philosophy behind benchmarking is:**
  1. **Operation acknowledgment, both its strengths and its weaknesses**
  2. **Acknowledge of those industries excel at the maintenance process used in operation, including competitors, sector leaders and others**
  3. **Set challenging targets; incorporate best the practices**
  4. **Measure results and strive continually for superior performance**

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2. BENCHMARKING MAINTENANCE – 3/7

- **Example: A European microelectronics company manufacturing chips for calculators for it self to improve a production line's reliability from 24 hrs to 48 hrs within one year.**
  - **The process could tolerate for extended production shutdowns but nor frequent interruptions**
  - **Quality losses expected at both shutdown and at startup**
  - **Availability, or the time for shutdown, was less significant than how often they occurred**
  - **The company expected tall order**
  - **The company benchmarked with similar process at Japan and found reliability there at 200 hrs**
  - **The goal of 48 hrs was suddenly irrelevant. With that, the company couldn't even attain parity**

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2. BENCHMARKING MAINTENANCE – 4/7

- **Benchmarked must be critically important to customers, and the factors that affect the organization's success**
- **Benchmarking maintenance makes sense only if it will bring real gain to the company**

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BENCHMARKING PROCECCES – 5/7

- **During benchmarking process several factors should be kept in mind:**
  - ✓ **Required information must be available**
  - ✓ **Availability to glean enough from others innovations help competitive position**
  - ✓ **Industry sector leaders could be excellent model**
  - ✓ **Putting the obtained information in use**
  - ✓ **It should be the driving force to improve maintenance continuously and use it to help to achieve a shared vision of excellence**

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BENCHMARKING PROCECCES – 6/7

❖ **Following is an example of benchmarking process**

Strategy
• Maintenance has a service attitude, with production being the customer • Maintenance has an evolving, strategic improvement plan • Production and maintenance are seen as partners • Ongoing analysis of contractor services ensures competitiveness • Focus on business measure of maintenance effectiveness
Management
• Training needs and programmed are matched and evaluated • Maintenance teams are decentralized and autonomous • Group incentives and individual recognitions are in place • Performance for everyone is evaluated • All employees are involved in maintenance improvement
Systems
• CMMS is implemented fully and upgraded frequently • Maintenance use the system regularly on the shop floor • There are no duplicate or private system • Effectiveness and efficiency measures are understood by all

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BENCHMARKING PROCECCES – 7/7

❖ **Following is an example of benchmarking measures**

Maintenance	Typical
• Equipment	65%
• Availability	95%
• Reliability	45 days
• Emergency response time	10 minutes
• PM schedule compliance	92%
• Supervision: Trades: Support ration	1:15:2
• Coverage	24 hrs/5 day
• Planned/Unplanned hours	65:35
• Cost/Total operating cost	12%
Stores	**Typical**
• Value	$ 6,000,000
• SKUs	12,000
• Turnover	1.8
• Service level	91%
• Coverage	8 hrs/5 day
• Staffing	4
• Stores issue/ total maintenance materials	48%

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3. FACTS AND FINIDINGS - 1/6

- E.I. Di Pont De Nemours &Co. has been benchmarking maintenance performance since 1987
- There are now more than 65 Du Pont plant in North America, South America, Europe, Japan involved
- Du Pont believes that benchmarking sharpens its focus for improvement and quantifies its goals
- Maintenance management in the company has been elevated to the importance it deserves

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3. FACTS AND FINIDINGS – 2/6

- Recently, the benchmarking found:
  - Japan and Europe use substantially more contractors than US
  - Japan spends less to maintain its investment, and its productivity is higher
  - Japanese companies have less store investment with higher turnover than Europe and US companies

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3. FACTS AND FINIDINGS – 3/6

- General Motors Advanced Engineering group is another example. It conducted maintenance benchmarking study in several industries.
- The objectives was to determine both the average as well as the world class measures for key parameters.
- Some of the interesting findings are:
  - More than half of all maintenance performed was reactive. Whereas the world class perception was only 18% should be reactive
  - PM averaged about 1/3 of the effort, with world class at just under 50% of all activities
  - PM 13% of the total. Perceived world class was 35% predictive activities, representing another major gap on actual performance to a vision of the world's best

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3. FACTS AND FINIDINGS – 4/6

- The International Iron and Steel Institute (ISSI) produced an interesting benchmark study involving 17 of its members
- It concluded that maintenance in steel industry is the third highest cost after raw material and labor
- Key recommendations to reduce these costs and improve effectiveness, based on best practice surveyed in the study, were:
  - Apply computerized maintenance mgt. systems to control and analyze all aspects of performance
  - Ensure full and active participation of maintenance people in the design , selection, and installation of new equipment
  - Set higher maintenance standards for all work
  - Institute comprehensive conditioned-based monitoring and analyzing
  - Employ a well-trained, multi skilled work force, following schematic planning and control of work

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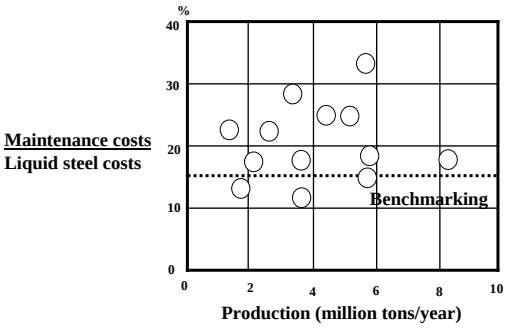
3. FACTS AND FINIDINGS – 5/6

- The figure summarizes how each of the survey participants compares against a maintenance cost benchmark
- The benchmark was set as the mean minus one standard deviation



ISSI Maintenance Costs Benchmark

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3. FACTS AND FINIDINGS – 6/6

- A Coopers & Lybrand consulting study of the hydroelectric generating industry in North America camp up with benchmark statistics based on thirty utilities. As with IISI study, it averaged their results and subtracted 1 standard deviation for the benchmark
- Among the top five utilities, the average for each parameter shows:
  - Maintenance costs $1,500 per megawatt installed capacity each year
  - Generation availability of 95%, with forced outage at 2% and planned outage at 3%
  - Emergency work at less than 3%, with preventive work at over 60%

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CONCLUSION

- **These examples illustrate that benchmarking produces impressive results. Better to say "What's get measured and benchmarked, gets done best**

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Thank You

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