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ARE 524
Facilities Maintenance Management

Maintenance 2000
Section 10

Uptime
Strategies for Excellence in Maintenance Management

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OUTLINE

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INTRODUCTION

- Maintenance management has gone through some amazing changes this century, and so has the equipment- the physical resources used to manufacture, process, transport, and serve.
- Trying to predict the future based on the past is dubious, at best.
- However, equipment design and use are changing, and so must maintenance to keep pace.

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CHANGING ASSETS-CHANGING TACTICS 1/7

- In the first part of this century, machines were relatively simple, sturdy, and long-lasting. When the main moving parts or parts that came into contact with the product wore out, they would be rebuilt.
- Today, equipment is typically a complex hybrid of electromechanical devices; electronically controlled; with hydraulic, optic, or pneumatic subsystems (see Fig. 10.1)
- It is characterized by replaceable components on a base structure. Because of its complexity and precision standards, failure patterns are somewhat random.
- Often, it is built to last for a predetermined use, to balance capital, operating, and disposal costs.

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CHANGING ASSETS-CHANGING TACTICS 2/7

1930s		1990s		2000s (?)
Uncomplicated	→	Complex hybrids	→	Modular
Robust	→	Delicate	→	Robust
Longlasting	→	Built-in obsolescence	→	Flexible
Overhauls	→	Component change outs	→	Module changes
Design for Production	→	Designed for "value"	→	Continuous returns
Wear out failures	→	Burn-in/random failures	→	No failures

Figure 10.1 Changing Equipment Characteristics

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CHANGING ASSETS-CHANGING TACTICS 3/7

- **In the next 25 years, you can reasonably expect equipment to become even more modular and automated to increase its operating flexibility.**
- **With continued marketplace globalization and competitive pressures, it must be both highly precise as well as robust.**
- **The failure rate will likely mimic that of complex equipment systems, but there will be an even stronger need for predictable performance. You'll need online condition monitoring, exacting diagnostics, and lightening-fast response.**

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CHANGING ASSETS-CHANGING TACTICS 4/7

- **An example is the automobile, which has changed tremendously over the past sixty years.**
- **The major oil companies are closing most service stations because there is so little demand for car repairs, despite major increase in the number of automobiles on the road.**
- **The new top-line cars have on-board diagnostics that rival those in jet aircraft.**
- **What does this mean for maintenance management? If you look to the past for guidance, an interesting picture emerges. Fig. 10-2 shows that the first generation of maintenance management had a strategy of run-to-failure.**

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CHANGING ASSETS-CHANGING TACTICS 5/7

Generation	1st	2nd	3rd	4th (?)
Strategy	Breakdown	Prevention	Prediction	Reliance
Structure	➢ Central craft groups	➢ Multicraft teams	➢ Multiskilled trades	➢ Polyskilled technician
Failure Management	➢ Operate to failure	➢ Scheduled overhaul	➢ FMECA and CBM	➢ Self-analysis
Data Management	➢ Card files	➢ Mainframe functions	➢ Fully functional CMMS	➢ Fully networked Stations
Measures	➢ Throughput	➢ Availability	➢ Equipment Effectiveness	➢ Probabilities

Figure 10.2 Maintenance Management Generations

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CHANGING ASSETS-CHANGING TACTICS 6/7

- **Today, there is great interest in predictive maintenance-using condition-based monitoring to warn of impending failure, and analytical tools such as failure mode effect and criticality analysis (FMECA).**
- **With CMMS, information is much easier to store, manipulate, and review.**
- **Businesses now also want more from their equipment; the ability to produce high-quality products, at minimum cycle times.**

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CHANGING ASSETS-CHANGING TACTICS 7/7

- **The watchwords in the future will likely be flexibility and reliability. You'll need to clearly understand dominant failure mechanisms, to know instantaneous performance. If something does go wrong, you must have immediate expert advice on how to fix it.**
- **In chapter 4, you saw some basic condition-monitoring options. These will become broader in scope and more comprehensive to match increased equipment performance demands.**
- **The higher operating temperatures, speeds, and uptime for round-the-clock production dictate increased CBM.**
- **The interpretation of this information – the fault diagnosis and repair advice – is a little more challenging.**

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EXPERT SYSTEMS 1/5

- It takes a real expert to understand problems in complex equipment today.
- Often, it takes a team of specialists when it comes to most complex equipment systems – such as those in the aerospace telecommunications, and nuclear fields.
- These experts will use all information on hand, not just data from CBM sensors, They review data from equipment histories and manufacturing design and information from similar equipment in like environments.
- They also use their personal wealth of experience, which is essential to interpret all this data, from all these sources.

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EXPERT SYSTEMS 2/5

- Today, leading-edge maintenance management diagnostics include:
  - Condition monitoring using vibration, lubrication and thermo-graphic analysis for generating data.
  - CMMS for pulling all the data together.
  - An expert system applied to one of the condition-monitoring techniques to recommend ways to diagnose the input data.

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EXPERT SYSTEMS 3/5

- **Expert systems have been developed to capture an individual's expertise.**
- **Simply put, these systems operate under a set of rules. They ask, you answer, and they lead you to the root cause of a symptom. Form example, spectrographic oil analysis data for wear debris, additives, and contaminants, combined with data on viscosity and dilution can be entered into a database.**
- **The expert system has a resident knowledge base built by people who understand the engine design and operation and the failure mechanisms.**
- **It also has set of rules to decide what to do with the oil data, given the knowledge base. (see Fig. 10.3)**

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EXPERT SYSTEMS 4/5

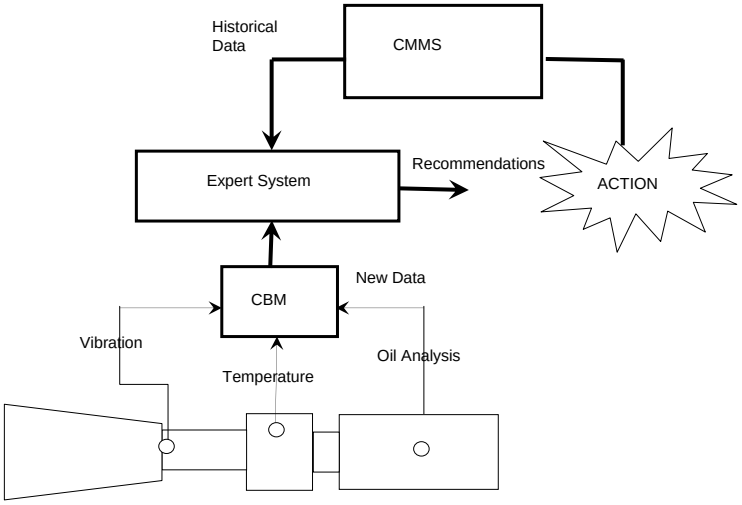

Figure 10.3 Expert System Data Flow

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EXPERT SYSTEMS 5/5

- Research is now being conducted on expert systems that can do even more.
- For example, they can deal with situations beyond those covered by a strict set of rules for an equipment model.

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THE COMPLETE TECHNICIAN 1/2

- What you are likely to see is more self-analysis built into equipment and less reliance on individual experts within each maintenance area,
- And a much greater capability of expert systems to provide the reliability needed.
- The maintenance technician will be multi-skilled with the crafts and cross-skilled with the operating personnel.
- The technician are expected to manage all aspects of an operation process and the tasks recommended by the expert systems for both maintenance and operations.

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THE COMPLETE TECHNICIAN 2/2

- Maintenance management is rapidly becoming an engineering specialty, like civil, mechanical, metallurgical, and electrical engineering.
- Several universities now offer undergraduate and postgraduate courses in maintenance engineering.
- Many emphasize a life-cycle approach to physical asset management: getting the people responsible for operating and maintaining the equipment involved in its design, manufacture, installation, and modification.
- The performance of any machine is largely inherent in the design. Therefore, it will become more common to see the roles blurred between those who design and those who maintain.

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EMERGING STRATEGIES 1/2

- So what will be the definitive maintenance management strategy of the twenty-first century?
- Fig. 10.4 shows the trend away from simple repair after failure to complex blends of engineering and the human element.
- One thing is certain. The sophistication and complexity of how the equipment is made and what it can do must be matched by the same level of expertise in maintenance strategy and tactics.

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EMERGING STRATEGIES 1/2

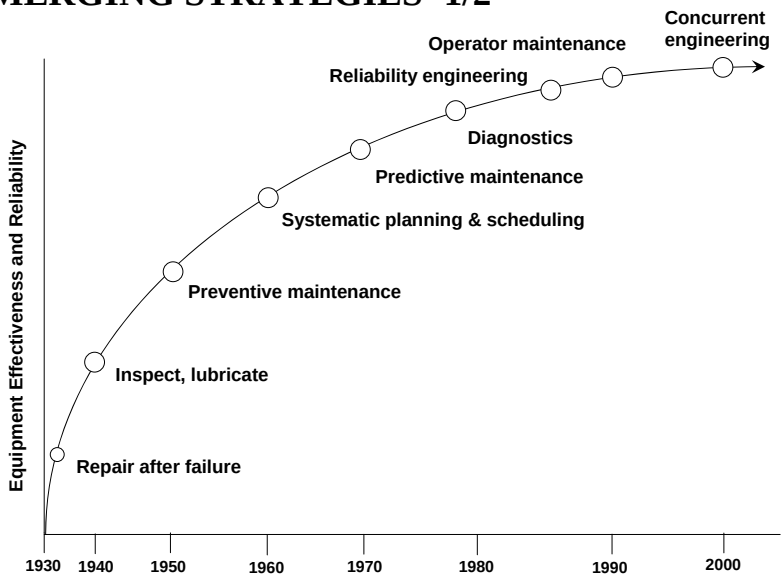

Figure 10.4 Emerging Strategies for Maintenance Management

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Thank You

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