



# Managing Human Error in Maintenance

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## What are our current attitudes and approaches to Human Error in Maintenance?



- ✱ Know it's an issue, but don't think it is significant
- ✱ Believe that it is limited to a few individuals
- ✱ Believe that Human Error is intrinsically "bad"
- ✱ Put in place reactive corrective actions after the event often taking the form of Disciplinary Actions or Dismissals
- ✱ Have few proactive measures in place, normally:
  - ✱ Work Instructions/Procedures
  - ✱ Training

Is this adequate?



**“It’s an issue, but not significant”**

# Research over the last 40 years has shown that:



- ✿ In civil aviation, more than 68% of components demonstrate early-life failures
- ✿ In coal-fired Power Stations, 56% of forced outages occur less than a week after a planned maintenance outage
- ✿ In the Nuclear Power industry in Japan and the USA, more than half of all performance problems were associated with maintenance, calibration and testing activities – only 16% occurred under normal operations
- ✿ On Boeing aircraft, maintenance activities contributed to more than 80% of inflight engine shutdowns

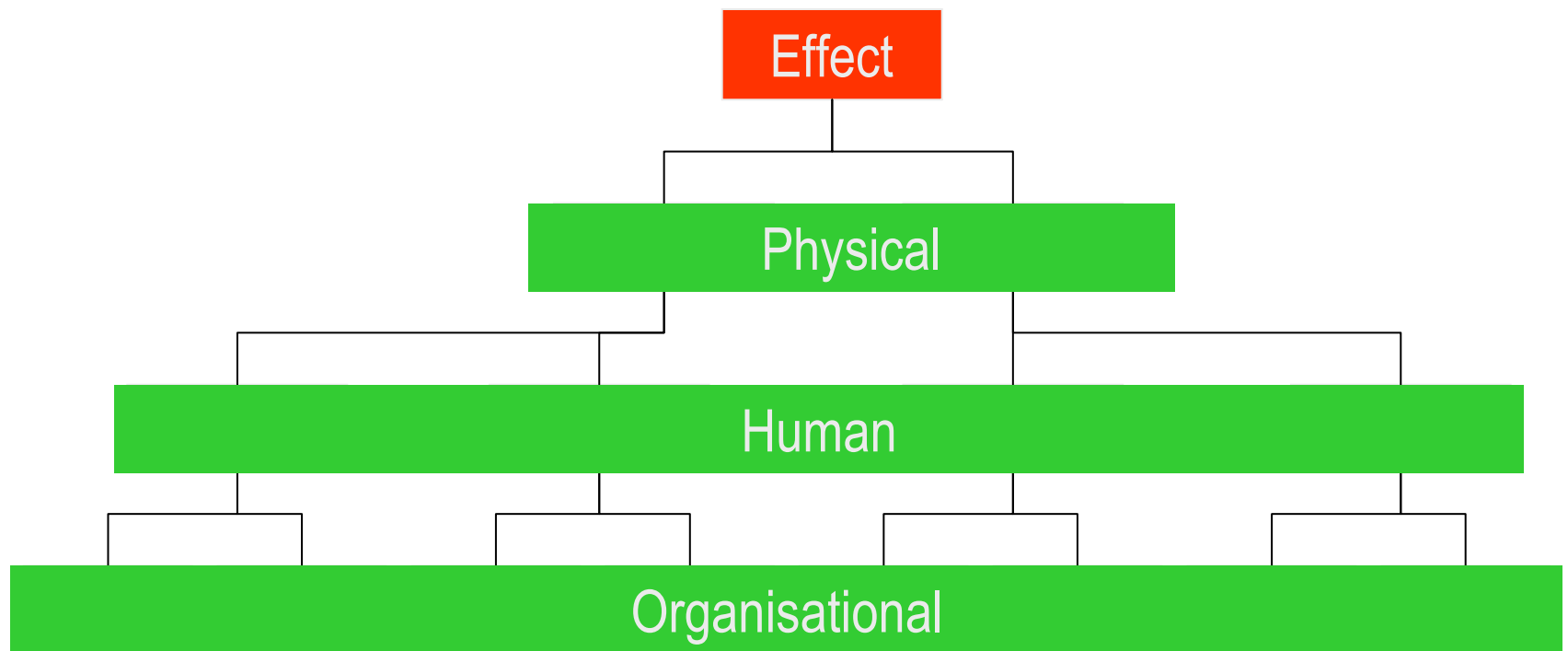
## Maintenance has had a significant contribution in causing many disastrous failures



- ✿ Piper Alpha
- ✿ American Airlines Flight 191
- ✿ Bhopal
- ✿ Japan Airlines Flight 123
- ✿ Clapham Junction

as well as countless other incidents that have impacted negatively on plant output, quality and costs.

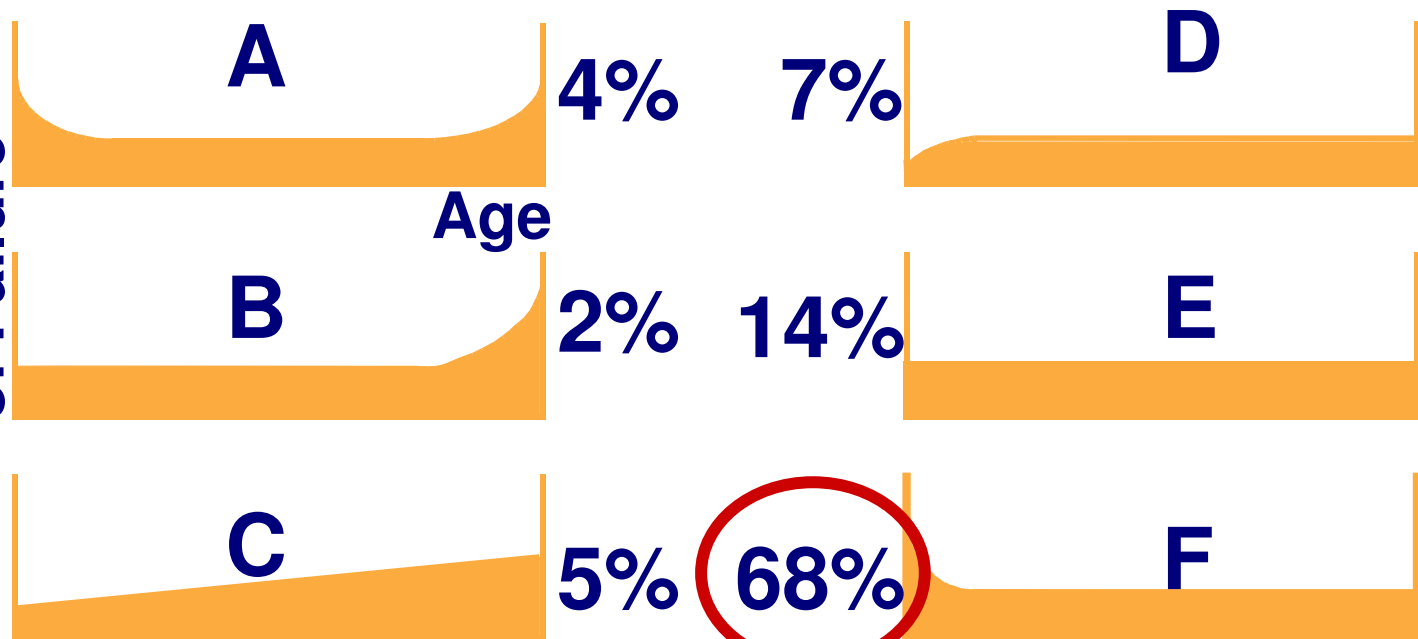
# Types of Causes



# Failure Patterns



Conditional Probability  
of Failure



Why so high?

# Possible Causes



- ✱ Human Error
- ✱ System Error
- ✱ Design Error
- ✱ Parts Error



# One way to avoid early life failures: Avoid Unnecessary Maintenance



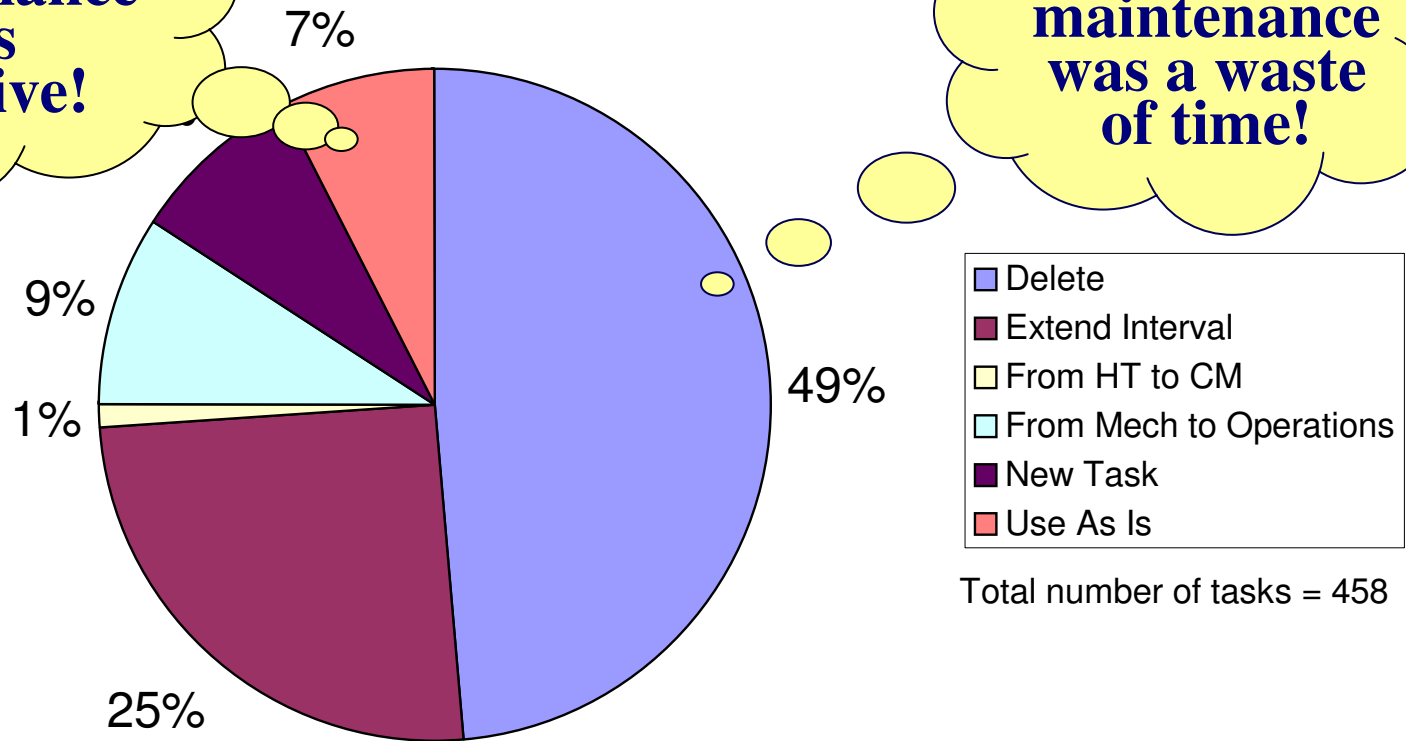
- ✱ If maintenance can potentially cause failures, rather than prevent them, then it is vital to make sure that all of our Routine Maintenance program is fully justified.
- ✱ Techniques such as RCM and PM Optimisation are vital tools to assist in this area.

# Outcome of PMO Analysis.... Butt Stripping Machines



**Only 7 % of previous maintenance was effective!**

## Changes to Tasks



**Nearly half of the maintenance was a waste of time!**

Total number of tasks = 458



**“Most Human Error is limited to a few individuals”**

# Human Error is inevitable



- ✿ Who here has never made a mistake?
- ✿ There are numerous physiological and psychological characteristics that contribute to human error – and these are held by **all** people, not just an error-prone few.

# Types of errors occurring in Maintenance



- ✱ Recognition failures
- ✱ Losing our place in a sequence of actions
- ✱ The "time-gap" experience
- ✱ Forgetting the intention to do something
- ✱ Omissions following interruptions
- ✱ Terminating a job before all the actions are complete
- ✱ Branching errors
- ✱ Overshoot errors
- ✱ Misapplying a good rule
- ✱ Applying a bad rule
- ✱ Knowledge based errors
- ✱ Violations – routine, thrill-seeking and situational

Have you ever made one (or more)  
of these errors?

# The reality of Human Error



- ✱ Human error is both universal and inevitable
- ✱ The best people can make the worst mistakes.
- ✱ Safety-significant errors can occur at all levels in the system.



**“Human Error is Intrinsicly Bad”**

## Wanting to “push the boundaries” is natural, and the only way that we make progress



- ★ We can **think** about doing things differently for as long as we like, but it is not until we actually **do** something different that there is tangible change
- ★ It is not until we **do** something different that we know all of the resulting effects – positive and negative
- ★ If we **never** do anything differently, then there will be no change, no progress
- ★ Making mistakes is the most powerful way to learn, and improve

Informed risk taking, and the possible resulting mistakes, should be encouraged, not discouraged



**“Disciplinary Actions are an effective way  
of dealing with Human Error”**

## More reality regarding human error



- ✱ Errors are consequences, rather than causes.
- ✱ People cannot easily avoid those actions they did not intend to commit.
- ✱ You cannot change the human condition, but you can change the conditions in which humans work.
- ✱ Error Management is all about managing the manageable.



**“Work Instructions are an effective means  
of controlling human error”**

# The three phases of human learning



- ★ Rule-Based
  - ★ Unfamiliar with routine task
  - ★ Need guidance/procedures to follow
- ★ Skill-based
  - ★ Can do task “on auto-pilot”
- ★ Knowledge-based
  - ★ Think carefully through new or novel problem for which no procedure exists

Work instructions will only assist with reducing error for those in the first phase of learning

# Writing Effective Work Instructions

- ✦ Omissions account for more than 50% of all maintenance errors, but good work instructions can reduce this



# Characteristics of a Good Maintenance Work Instruction



- ✿ Are written with the person who is going to read the instruction in mind
- ✿ Group complex work instructions into phases, with each phase consisting of many, related tasks
- ✿ Are written clearly, and use simple and consistent language
- ✿ Focus on the key risks that may prevent the job from being performed safely and to the required quality standard
- ✿ Are written in the first person, not the third, and use the active voice, not the passive
- ✿ Are written in both upper and lower case, not upper case only
- ✿ Make appropriate use of pictures and graphics
- ✿ Incorporate adequate independent inspections at key points in the instruction
- ✿ Incorporate appropriate, conspicuous reminders in order to ensure that critical steps are not omitted



**“Training helps avoid human error”**

# What type of training do we normally give?



- Will this training help people to avoid:
  - Recognition failures
  - Losing our place in a sequence of actions
  - The “time-gap” experience
  - Forgetting the intention to do something
  - Omissions following interruptions
  - Terminating a job before all the actions are complete
  - Branching errors
  - Overshoot errors
  - Misapplying a good rule
  - Applying a bad rule
  - Knowledge based errors
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**So what CAN we do?**

# A holistic approach to managing maintenance quality is required



- ✱ Person Measures
  - ✱ Awareness training
  - ✱ Encourage mental rehearsal of tasks
  - ✱ Control distractions
  - ✱ Avoid place-losing errors
- ✱ Team Measures
  - ✱ Teamwork and Communication training

# A holistic approach to managing maintenance quality is required



- ✱ Workplace/Task Measures
  - ✱ Ensure personnel perform tasks only when appropriately qualified and skilled
  - ✱ Proactively manage fatigue
  - ✱ Assign tasks appropriately
  - ✱ Ensure equipment and tasks are properly designed
  - ✱ Enforce good housekeeping standards
  - ✱ Ensure Spare Parts and Tools are managed well
  - ✱ Write, and Use, Effective Maintenance Work Instructions

# A holistic approach to managing maintenance quality is required



- ✱ Organisational Measures
  - ✱ Put in place effective processes for analysing, and learning from, past failures
  - ✱ Put in place proactive processes for assessing the risk of future maintenance errors

## Conclusion



- ✿ The impact of human error on maintenance quality and costs, safety and equipment reliability is huge.
- ✿ What will you be doing to address maintenance error in your workplace?