The Fallacy of MTBUR & MTBF as Reliability Metrics

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October 25, 2005
Traditional Measurement

• Mean Time Between Unscheduled Removals (MTBUR)

• Mean Time Between Failures (MTBF)

Great for measuring rates of removals or failures, but do they actually indicate reliability?
How Are They Calculated?

MTBUR =

\[
\frac{\text{Number of flight hours} \times \text{units installed per aircraft}}{\text{Number of unscheduled removals during that period}}
\]

MTBF =

\[
\frac{\text{Number of flight hours} \times \text{units installed per aircraft}}{\text{Number of shop confirmed failures during that period}}
\]
What Should a Reliability Measure Do?

 Statements:

- Identify reliability issues
  - Premature failures
  - “End of Life” failures
  - Rogue components
  - Shop workscope shortcomings
  - Scheduled maintenance program problems
What Does MTBUR NOT Tell Us?

★ Reliability issues

⇒ Premature failures

⇒ “End of Life” failures

⇒ Rogue components

⇒ Shop workscope shortcomings

⇒ Scheduled maintenance program problems
MTBUR is Extremely Misleading

**Assumption:**
MTBUR indicates the average (mean) time a component spends in service

- So it is often used to set maintenance program intervals
  - If the MTBUR is 30,000 hours, the program is set for 28,000 hours

**Fact:**
MTBUR has **nothing** to do with the amount of time a component spends in service
MTBUR Example

- An operator puts 20 aircraft in service January 1.
- For a particular component, there are 2 installed on each aircraft, which equates to an in-service population of 40 components.
- By December 31, each aircraft has operated 3000 flight hours.
- The total component operating hours = 120,000 hours (40 components x 3000 flight hours).
- If 4 components were replaced, the MTBUR would be 30,000 hours (120,000 hours / 4 removals).
How Can it Be?

How can the MTBUR be 30,000 hours, when the most any component operated during that year was 3000 hours?

→ Because MTBUR is the rate of replacement

For every 30,000 hours of combined component operational hours, 1 unit was replaced

MTBUR has nothing to do with how long each component is in service
MTBUR Disregards Time in Service

(100,000 hours) x (2 units per aircraft)

Number of flight hours x units installed per aircraft
Number of unscheduled removals during that period

(10 unscheduled removals)

These 10 could be:

⇒ 10 different serial numbers removed once each with very high time in service

⇒ 2 different serial numbers removed 5 times each with extremely short time in service

Using MTBUR, there is no distinction in performance

Thomas Carroll, Director of Reliability Engineering
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MTBF is All That - And **Worse**

- Same inconsistencies and inadequacies as MTBUR calculation
- Confirmation of failure is determined by shop technician trying to correlate subcomponent failure to the reported system failure
- Many times shop technicians aren’t proficient with the system operation
The Challenge

• How can reliability be measured without using MTBUR or MTBF?
  – View each Component and End Item individually
    • They all have a stories to tell
  – Don’t cut their lives into pieces
    • Life is continuous, with a beginning and an end
  – Look at all the individuals at the same time
    • See the removed and the installed simultaneously
    • Compare the “good” to the “bad”

• How can it be done?
  – Mapping each individual as a unique life
Mapping the Individuals

• Gather all the factors related to the data
  – Hardware specifics
    • Component serial numbers
    • Component part numbers
    • Reasons for removal
    • End Item ID numbers
  – Stream of time
    • Compile the data in a continuous flow from birth to death

• Arrange the data in a visual display
  – By Component Part Number or End Item population
It Takes New Analysis Techniques

- Visual assessments of problems
  - Batch
  - Seasonal
  - Maintenance programs
  - Rogue serial numbers
  - End of Life

- Multi-layered assessments
  - Overhauls
  - Operational impacts
  - Modification accomplishments
  - Other related system issues
Bottom Line

• With innovative reliability measurement and analysis techniques, less manpower will be spent on sifting data and chasing “ghosts”
  – Problems will be quickly identified and quantified
  – The course toward solutions will be easily charted

• Reliability measurement will no longer be a liability, generating more questions with minimal results
  – It will be a tool to improve the performance of systems and components, as a valuable asset
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