Guidance and Examples MSG-3 Decision Logic Trees

A **decision logic tree** in the MSG-3 methodology is a tool used to evaluate failure modes and determine the appropriate maintenance actions for aircraft systems and components.

It systematically guides maintenance planners through a series of questions and decisions, ensuring tasks are selected based on operational, safety, and economic considerations.

Structure of a Decision Logic Tree

1. **Identify the System or Component**
   Start with the specific system or component under analysis (e.g., hydraulic pump, avionics module).
2. **Define the Failure Mode**
   Specify the potential failure mode (e.g., leakage, software glitch, overheating).
3. **Assess the Impact of Failure**
   - **Safety Impact**: Does the failure compromise safety?
   - **Operational Impact**: Does it disrupt normal operations?
   - **Economic Impact**: Does it lead to increased costs?
4. **Evaluate Detection and Prevention Methods**
   - Is the failure evident (can it be seen or detected during operation)?
   - Can the failure be prevented through condition monitoring or inspections?
5. **Select the Maintenance Task**
   Choose the task type based on the failure mode and its criticality:
   - Preventive task (scheduled maintenance)
   - Predictive task (condition-based monitoring)
   - Corrective task (run-to-failure)
6. **Determine the Task Interval**
   Establish how often the task should be performed, based on historical data, failure probabilities, and regulatory requirements.

Example 1: Decision Logic Tree for a Hydraulic Pump

Failure Mode: Leakage from hydraulic pump seals

Decision Logic Tree:

1. **Is the failure safety-critical?**
    - **Yes:** Proceed to next step.
    - **No:** Consider operational or economic consequences.
2. **Can the failure be detected during operation?**
    - **Yes:** Schedule frequent operational checks.
    - **No:** Implement periodic inspections.
3. **Is there a condition-monitoring system available?**
    - **Yes:** Use sensors to monitor hydraulic pressure and fluid levels.
    - **No:** Increase inspection frequency.
4. **Select Task Type:**
    - Preventive: Replace seals periodically.
    - Predictive: Monitor system for early signs of wear.
5. **Determine Interval:**
    - Every 500 flight hours based on historical data and FMEA results.

Outcome:

Perform preventive maintenance every 500 flight hours and install sensors for predictive monitoring.

Example 2: Decision Logic Tree for Avionics System

Failure Mode: Software malfunction in navigation system

Decision Logic Tree:

1. **Is the failure safety-critical?**
    - **Yes:** Immediate software patch or replacement.
    - **No:** Proceed to next step.
2. **Can the failure be detected by pilots or crew?**
    - **Yes:** Include operational procedures for reporting.
    - **No:** Implement periodic system diagnostics.
3. **Is a software update available to prevent recurrence?**
    - **Yes:** Schedule updates quarterly.
    - **No:** Monitor performance logs for anomalies.
4. **Select Task Type:**
    - Preventive: Perform routine software updates.
    - Predictive: Analyze performance logs for early warnings.
5. **Determine Interval:**
    - Software diagnostics: Every 3 months.
    - Update schedule: Quarterly.

Outcome:

Implement quarterly software updates and monitor system logs monthly for anomalies.

Example 3: Decision Logic Tree for Composite Wing Inspection

Failure Mode: Delamination of composite material

Decision Logic Tree:

1. **Is the failure safety-critical?**
    - **Yes:** Immediate inspection and repair.
    - **No:** Proceed to next step.
2. **Is the failure evident during visual inspection?**

- **Yes:** Add visual inspections to scheduled checks.
- **No:** Implement advanced NDT methods (e.g., ultrasonic testing).

3. **Can the failure be detected through condition monitoring?**
   - **Yes:** Use structural health monitoring systems.
   - **No:** Increase inspection frequency with NDT.
4. **Select Task Type:**
   - Preventive: Ultrasonic inspection every 1,000 flight hours.
   - Predictive: Structural monitoring system integration.
5. **Determine Interval:**
   - Scheduled ultrasonic inspections: Every 1,000 flight hours.
   - Structural monitoring system checks: Monthly.

Outcome:

Schedule ultrasonic inspections every 1,000 flight hours and integrate structural health monitoring for real-time updates.