SpaceTEC®

National Aerospace Technical Education Center

Vehicle Processing Readiness Course

Technical Task Analysis

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Personal note

- Why do I need to know this?

We can't pull a vehicle back to fix problems once it is launched – these test disciplines provide the best odds of successful performance for our 1-shot opportunity.

Job Evaluation

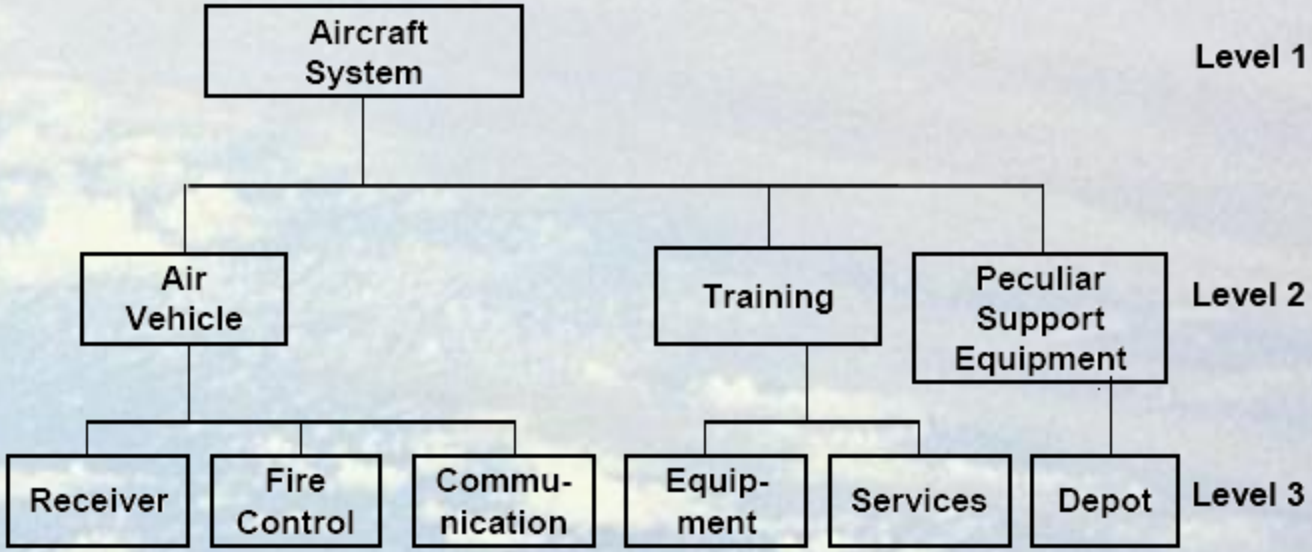
- Standard procedures will usually include Prerequisites, Ref Doc's and detailed work instructions. Always work to official "paper."
- If your training, prior experience or *common sense* conflicts with the official paperwork, stop working and ask engineering to assess the concern and redline the procedure, as necessary.

Job Evaluation (cont.)

- Your stamp is your signature of quality and accountability. Stamp your own work.
- When should you call “All Stop” or “Time Out”
- Examples of Constraints:
  - Weather, schedule, mechanical, communications, personnel, safety, other operations, etc.

Job Evaluation (cont.)

- WBS (Work Breakdown Structure) shows the functional aspects of a task in a diagram form.



Job Equipment

- A Team Briefing is meant to insure that all members know what is to be done per the paper and to verify that all safety considerations have been addressed. It is NOT a training session. (Note the AESOP briefing card that follows)

Job Equipment (cont.)

The Task Leader (who is ultimately responsible for the team's safety) uses some variation of the briefing tool below to ensure the standard contributors to any failure are addressed, in advance.

AESOP™ Model

Review before starting any task:

A*ssignment*

Is it clear to all, **as written**?

What are the risks/hazards?

E*quipment*

What's needed? Available?

Is it working?

Situation

Overall assessment **Go** **Ragged edge** **Stop**

O*bstacles*

What are the potential problems? Look ahead?

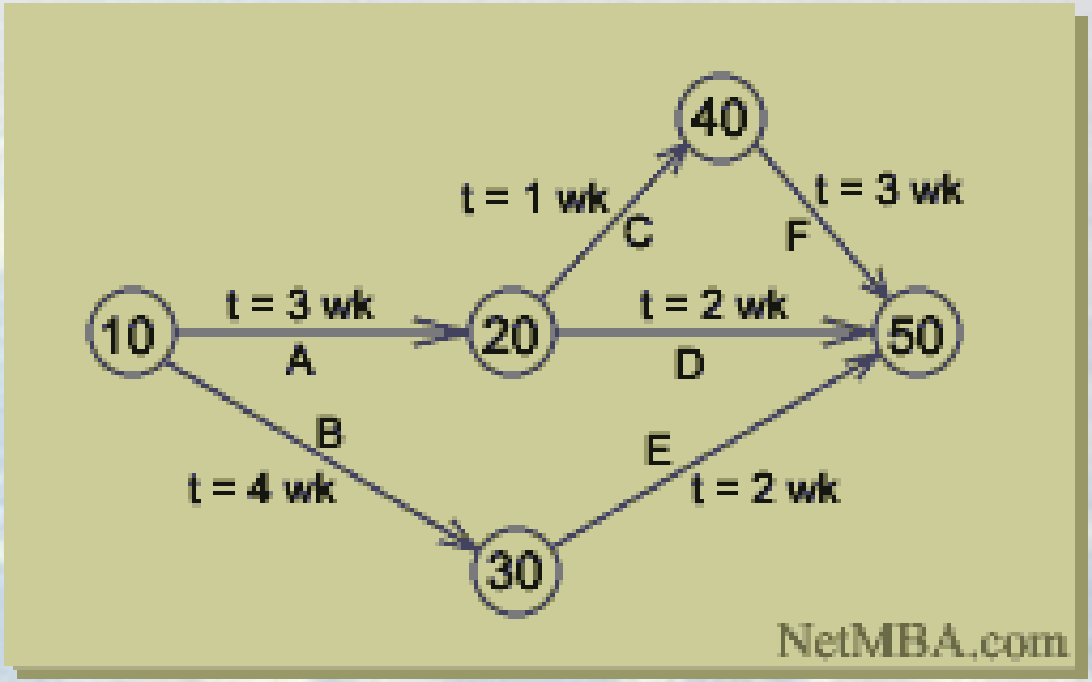
P*ersonnel*

Who's involved? Experience?

Any issues – illness, medication, stress, alcohol, fatigue?

Job Evaluation (cont.)

- Tools of the planner's trade: GANNT / PERT / CPM schedules (handout).



Job Equipment

- Use the right tool for the job (no shortcuts)
  - Tightening an odd size square nut?
  - R&R of a broken bolt?
  - Measuring the alignment of a rotor shaft or plane of rotation?
  - Megger vs. DMM vs. Analog meter
- Torque Wrenches
  - Calibration Sticker
  - Hold properly when torquing
  - Adapters at 90 degrees - ONLY

Job Equipment (cont.)

- Scale resolution vs. dimensional tolerance, explain.
- Calibration stickers for Measuring Tools
- Bond and Hardness verification (minimum and maximum values)
- ESD straps (200 ohm to 1 Mohm)

Job Equipment (cont.)

- General Cleaning Tools (various metals)
- Quality tools (No junk or Vise Grips)
- Move Safe (tools AND materiel)

Task Materials

- Material Requisitions will always maintain traceability to program requirement documentation as will the test plans that utilize them.
- Chemicals will always maintain and transfer MSDS (Material Safety Data Sheet). Always look up any new chemical before using (even if it is said to be a direct replacement for the standard).

Task Materials (cont.)

- Always verify by drawing, etc. BEFORE using alternate solvents, etc. A simple call to engineering can save many headaches.
- Maintain cleanliness and ESD sensitivity. That is, from receipt to use of hydraulic/pneumatic lines, electrical components, etc. This also applies to R&R for return to vendor or clean lab.

Task Materials (Cont.)

- Verify proper grit PRIOR to employing. It is generally safe to use a finer grit (higher number) than called out; of course, it will likely take longer and use more paper.
- The cork ablative applied to the exterior to mitigate heat during flight is very susceptible to gouges and tears.

Personnel Assigned to Task

- Roles:
  - **Technician** – Hands on task
  - **Quality Inspector** /Quality Assurance (QA) – Acts as Check & Balance on technician performing work, may not view every step but will verify proper configuration and completion
  - **Engineer** – Procedural direction and oversight, Task Leader
  - **Government (AF) QA** , additional check and verification that procedures, rules and contractual arrangements are followed.
  - **Safety Representative**: onsite for hazardous operations

Personnel Assigned (cont.)

CRITICALITY CATEGORIES (TYP.)

- **1 Single failure point that could result in loss of vehicle or personnel.**
- **1R Redundant items, where if all failed, the result is loss of vehicle or personnel.**
- **1S A single failure point of a system component designed to provide safety or protection capability against a potential hazardous condition or a single point failure in a safety monitoring system (e.g. fire suppression system).**
- **1SR Redundant components, where if all failed, the result is the same as 1S above.**
- **1P A single failure point which is protected by a safety device, the functioning of which prevents a hazardous condition from occurring.**
- **2 Single point failure that could result in loss of critical mission support capability.**
- **3 All other.**

Personnel Assigned (cont.)

- Task Leader – may be a certified responsible technician
- Cleanroom training
- Critical Skill Requirements: Torque and Safety Wire, Crane Director, SCAPE, NASA 2000 Soldering, etc.

Troubleshooting

Problem solving involves looking at all potential issues or problems (system relationships, etc.); whereas, Troubleshooting is "debugging" a hardware or software failure.

- "Houston, we have a problem"
  - "Failure" = When hardware or software does not perform the function for which it was intended
- If the task is not hazardous, Stop, maintain configuration, await direction. Help determine the cause by documenting configuration, personnel, etc.
- In a hazardous operation, SAFE the system **First.**

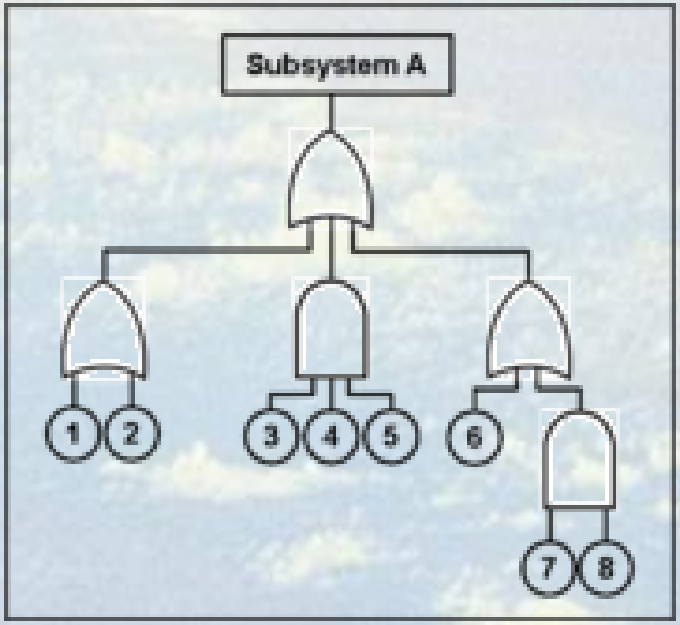
Troubleshooting (cont.)

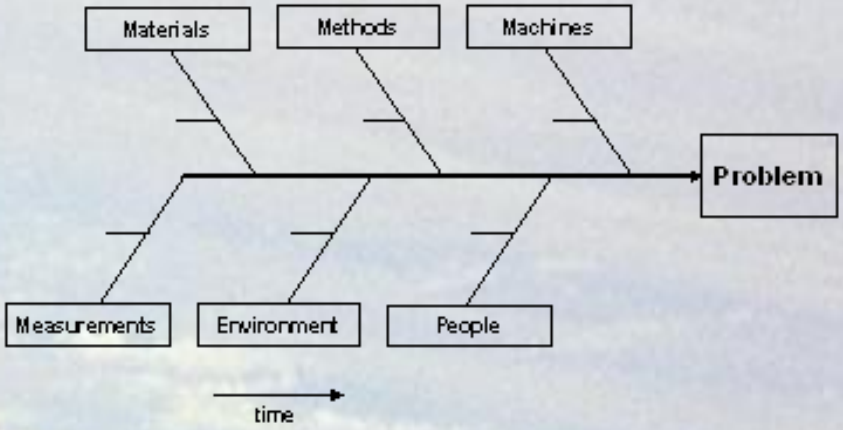
- Perform basic Task Analysis by collecting data, describing and representing it (see Fishbone next slide) and analyze.
- OK, something's not working up to par
  - Identify, prioritize and select alternative solutions
- Change ONLY 1 variable at a time

Implement the best solution that solves the problem today and mitigates reoccurrence.

Troubleshooting (cont.)

- Root Cause Analysis
  - Fault Tree
  - FISHBONE





Troubleshooting (cont.)

- What constitutes an Unverified Failure?
  - A functional anomaly encountered during testing which cannot be duplicated using the same test equipment, environment, hardware, requirements, and procedures; or where evidence does not support a defined cause of the anomaly.

This is a BAD thing!

Troubleshooting (cont.)

- Typical Failure Points:
  - Electrical Connections:
    - corrosion, breakage, improper crimp, intermittent test leads
  - Fluid Hose:
    - Excess operating Pressure
    - Outside recommended temperature parameters
    - Fluid incompatibility

Troubleshooting (cont.)

- Typical Failure Points (cont.)
  - Hydraulic Relief Valve:
    - Springs – broken, fatigued, incorrect
    - Drain Line or Return line restricted or plugged
  - Pneumatics:
    - **Ullage** is the space within a fuel tank above the liquid propellant. Loss of ullage pressure on a pneumatic system, would most likely be due to the valve failing "Open".
    - A crossover valve opens to allow gas flow, it is nominally closed.

Troubleshooting (cont.)

- Typical Failure Points (cont.)
  - Pneumatic Hand Regulator:
    - Inlet poppet not seating properly
    - Faulty valve-to-base gasket
    - Cylinder leaks
  - Pneumatic Valves:
    - seals, varnish build-up, water or oil contamination
    - air pressure too low, low pilot or signal pressure
    - poor lubrication

Corrective Action

- By far, the number one cause of anomalies is HUMUN EROR.
- The final step in a corrective action plan is follow-up to verify it was implemented properly and actually solved the problem without creating new issues.
- An external auditor (not the process owner) should verify CA success.

Corrective Action

- FOD
  - A technician drops a small piece of _____ in the vehicle and cannot reach / find it. What is the proper procedure for documentation and resolution?