Capstone Design

Engineering Test and Validation I

Outline

- Engineering Test Plan [1]
  - What is it?
  - What is it NOT?
  - What does it require?
  - Types of tests
  - Pass/fail criteria
  - Report template

Engineering Test Plans

• A plan is a detailed scheme for accomplishing a goal
• It is laid out in advance, specifying:
  – What is to be done
  – How the goal will be accomplished
• In addition, an engineering test plan:
  – Indicates why each task is to be undertaken
  – Specifies resource utilization (time, money, equipment, facilities, and people)

Engineering Test Plans

• A simple list of tests is NOT an engineering test plan
• An engineering test plan includes:
  – Why the tests are being performed
  – How the tests are to be conducted
  – Assessment of the resources needed
Engineering Test Plans

- Always refer back to the project proposal and subsequent documents
- Your proposal includes:
  - Project goals
  - Criteria you will use in evaluating your design
- Your test plan should:
  - Address all the goals and specified criteria
  - Support your claims and assumptions from the project proposal
- Testing, if done thoroughly, not only discovers errors, but also assists in understanding and refining (correcting) design specifications

Engineering Test Plans (Test Requirements)

- Tests typically require:
  - A model or device to be tested
    - Device Under Test (DUT), Unit Under Test (UUT)
  - A testing facility
  - Instrumentation suitable for test measurements
  - A test plan
- Some (most early) tests do not require construction of the entire prototype
- Only those portions important to the evaluation of particular assumptions or claims are needed for many tests
Engineering Test Plans (Types of tests)

- Performance tests
  - Show whether a design does what it is supposed to do
  - Demonstrates the validity of the design
  - Relates back to specifications given in project proposal and subsequent project documents

- Quality assurance tests
  - Validate that the design will perform with the least desirable (weakest) material or sub-assembly or…
  - Insure that only premium material or sub-assemblies are used

- Life cycle, endurance, and safety tests
  - Investigate behavior over time or repeated operation
  - Keep in mind that two combined operations may have a much more serious effect on the part than the arithmetic sum of the separate effects of the two operations (synergistic behavior)
  - For example, consider a combination of pressure, temperature, humidity, vibration, noise, etc.
Engineering Test Plans (Types of tests)

- **Human acceptance tests**
  - Does the design meet the physical, mental and emotional requirements of the user?
  - Anthropometrics...Audio vs. visual...Colors

- **Environmental tests**
  - How is the design influenced by its environment? (dust, temperature, pressure, humidity, salt air, etc.) Again, note the synergistic phenomena.
  - How does the design influence its environment? (pollution, noise, vibration, etc.)

Engineering Test Plans (pass/fail criteria)

- You and any readers of your test plan should have a clear understanding of the pass/fail criteria for each test
- Provide specific measures/standards for success
- It is often just as important to note under what conditions a DUT fails as it is to note that the DUT passes the test under specific operating conditions
- A device (unit) should be tested across a range of expected operating conditions to establish likely points of failure for the design
  - At a minimum, test at the expected operating point and extremes of the expected operating conditions
## Engineering Test Plans (Report template)

<table>
<thead>
<tr>
<th>Type of Test: (performance, environmental, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Used:</td>
</tr>
<tr>
<td>Location(s):</td>
</tr>
<tr>
<td>Date(s)/total time:</td>
</tr>
<tr>
<td>Personnel:</td>
</tr>
<tr>
<td>Test Objective:</td>
</tr>
<tr>
<td>Criteria for success:</td>
</tr>
<tr>
<td>Test Fixture/Setup:</td>
</tr>
<tr>
<td>Procedure:</td>
</tr>
</tbody>
</table>

- This format may be supplemented with “Test Results” and “Conclusions” paragraphs
- This is appropriate after tests have been completed and the findings are being reported