

# Interdisciplinary Capstone Design

## Design Validation Plan

### Assignment Goal

To construct a Design Validation Plan (DVP) for an engineering system, capturing the planned experiments and validation testing planned to confirm the intended design will meet to defined requirements.

### Learning Outcomes

As a result of completing this assignment, you should be able to:

- Design a set of virtual and physical tests to verify the functionality of the design prototype.
- Evaluate the ability of the design prototype to meet all of the defined requirements.
- Plan phases of testing to fit the overall project schedule and inform key decisions.
- Record of the results of each test and Recommend any needed course of action as a result.

### Relevant ABET Learning Outcomes

1. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

### Approach and Rationale

Once the Product Requirements are established, the overall project plan needs to include methodology for how we will validate that the design we will create will actually meet the requirements. As a result, it is important to create this plan in the beginning, as it will become an integral part of our overall schedule, but may also facilitate some key decisions that we make along the way. Fundamentally, we need to be clear about how we plan to test the new design, while allowing time for modifications if a test is not successfully passed the first time.

### Task

Working in your capstone design team, you are assigned to draft a document (using MS Excel) to capture the *design validation plan* (DVP) for the system. Typically, design validation plans consist of at least two phases of testing, although there can be more depending on the nature of the project. However, at a minimum, you should include phases for both 1) virtual testing of the design, and 2) physical testing of the prototype. Conducting virtual testing *before* building the prototype of the design will greatly increase our confidence that the prototype will be successful.

The suggested approach to create a DVP is as follows:

- 1) Itemize the key product requirements of the system. What is it required to be able to do?
- 2) For each of these requirements, identify a methodology for verifying this requirement is met without having a prototype (i.e. virtual testing). Examples of **virtual testing** can be any of the following:
  - Engineering calculations and factor of safety determination
  - Finite Element Analysis (using 3D model)
  - Computational Fluid Dynamics (using 3D model)
  - Interference checking
  - Sensitivity analysis
  - Etc.
- 3) Determine the approximate timing that this testing will be the most useful and informative to the design. Generally, it is helpful to do all virtual testing before you start ordering raw materials to build the prototype.

- 4) Next, define the planned methodology for physically testing the prototype once it is build. Example of physical testing may include:
  - Operating the device as intended to see that it “works”.
  - Overloading the device to ensure it will not break.
  - Repeated performance testing to build statistical confidence in success.
  - Evaluating multiple inputs to the device to optimize its operation.
  - Etc.
- 5) Estimate how long each of these testing phases will take, and build that time into your Project Schedule. Ensure that one team member is assigned to be the “owner” of each test to make it is completed.

Organize all of this information into a single Excel document (template is provided). Update the document as new information becomes available throughout the project, such as when there is:

- a) A change in the requirements
- b) Large changes to the schedule
- c) A test that is completed
- d) An idea for an additional test is added to the list

Once each test is completed, there is a column in the template for recording the results and/or recommendations based on the outcome of the test. This is a great way to document that each test is completed and capture the decisions made by the team as a result of the test.