UNSW SYDNEY | Australia's Global University

ENGG1000 2018 Session 1

Integration, Verification and Validation

Coming up in ENGG1000

Week 8: Monday – No Lecture

- Design Proposal Presentations – see individual projects for times.
- Report (Friday)

Week 9: No Lecture

Week 10: Technical Drawing Lecture

Week 11: Report Feedback Lecture (Clancy 2-4pm)

Design Proposals

The aim of the presentation is:

- Explain your design solution
- Convince us that this will be a winning design
- Convince us that you have a realistic plan to achieve it

Please refer to Pam Mort's slides on presentations – these guides will help you get a good mark!

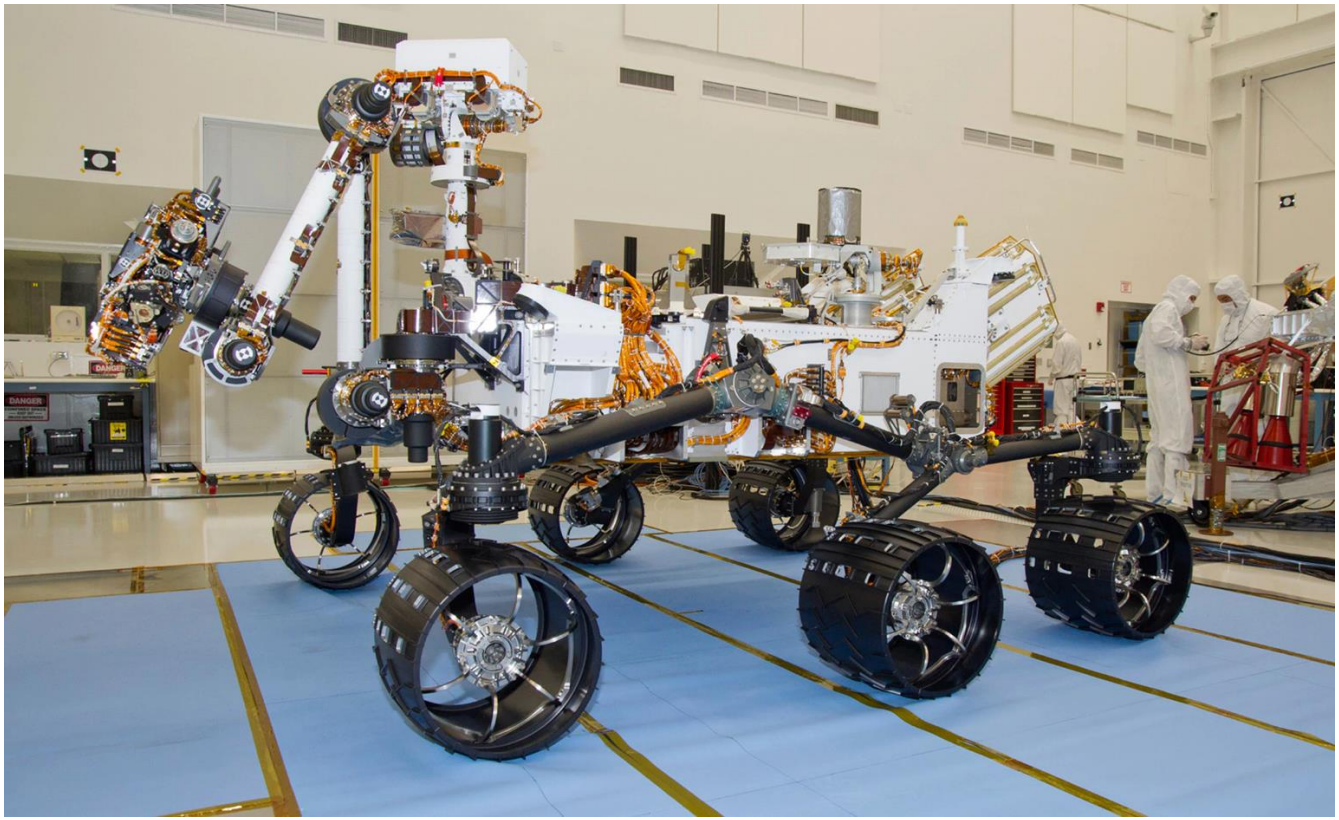
Ideas for today

- How is a complex engineering system designed?
- How are they developed?
- How can the various components be combined together?
- What degree of testing is performed?
- How is this testing planned and managed?

Integration, Verification and Validation

- Integration
  - “To assemble the product from product components, ensure that the product, as integrated, functions properly, and deliver the product.”
- Verification
  - “Verification aims to ensure that selected work products meet their specified requirements.”
- Validation
  - “ The purpose of validation is to demonstrate that a product or product component fulfils its intended use when placed in its intended environment.”

Example - Mars Rover



https://www.jpl.nasa.gov/spaceimages/details.php?id=pia14252

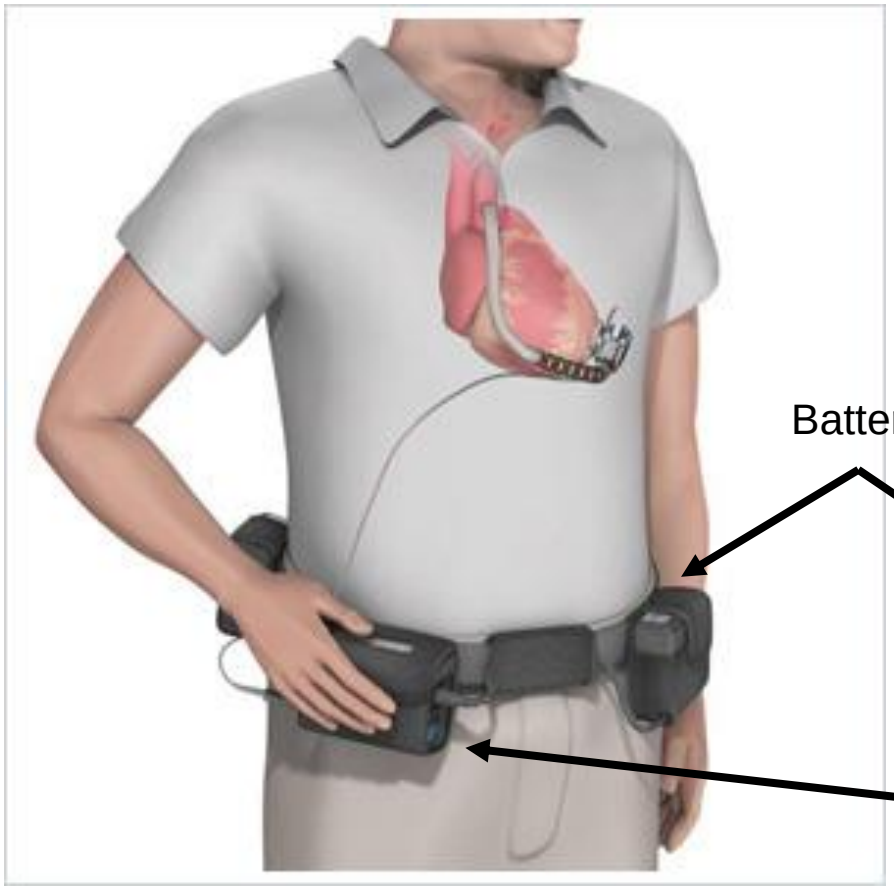
Example - Mars Rover

Integration: Checking that the navigation system is provided with the correct supply voltage from the power sub-system

Verification: Testing that the rover is able to navigate on a set course

Validation: Confirming that the rover is able to navigate through a course with the same soil composition and relative weight as that experienced on Mars.

Example - Ventricular Assist Devices



Tablet PC

Battery

Controller

Example - Ventricular Assist Devices

Integration: Checking the connection of the controller to the laptop, and that data flows back and forth, to enable the clinician to change the pump speed.

Verification: Checking that the pump motor is operating at the same speed set by the user.

Validation: Confirming that the implant functions correctly when implanted in the human body - and serves the main purpose

Planning

Every large engineering project should have (at least):

- Integration Plan
- Verification/Testing Plan
- Validation Plan

Key inputs to these plans include:

- Component dependencies
- Component interfaces

These plans must be alive!!

Key Questions

- Are the interfaces understood?
  - Logical; Physical; Mechanical; Electrical; Human; Environmental
- Are these interfaces controlled and coordinated?
- Are the various elements of the system compatible?
- When combined, will the system perform its function as desired?
- Can the correct operation of sub-system and overall system be verified?
- How will the components be integrated? In what order? When?
- Are special tools or facilities required?

Design for Testing and Maintainability

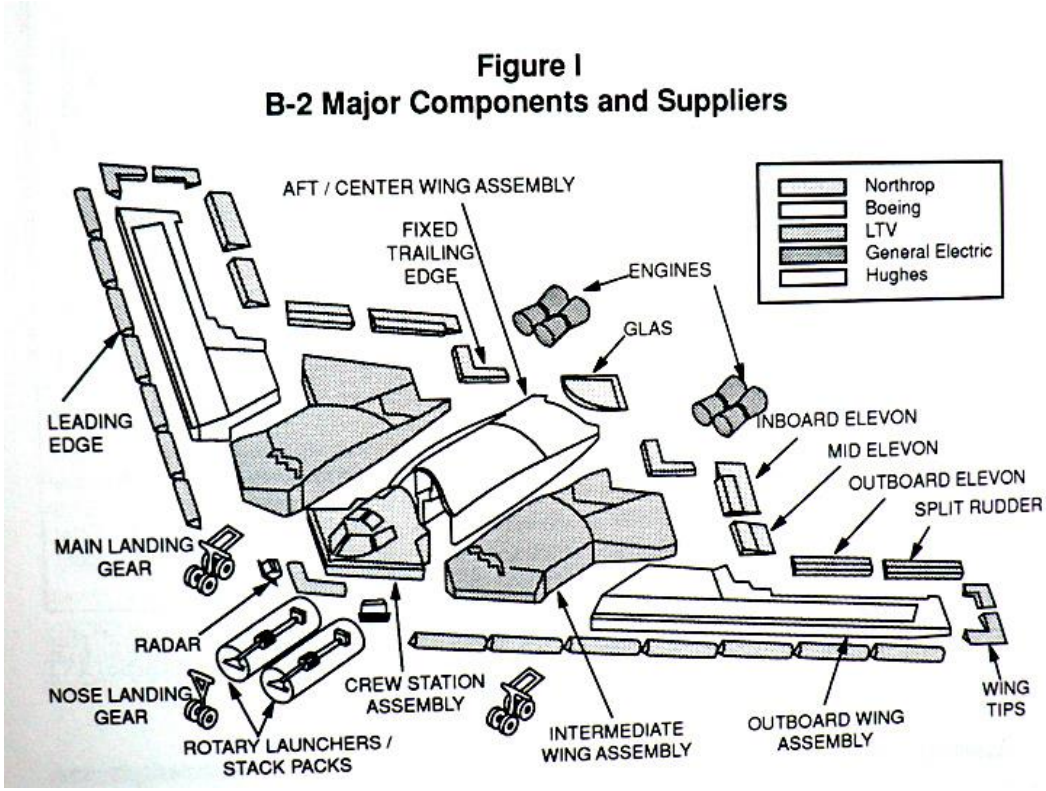
Good Engineering Designs:

- Provide an easy way to identify what component is at fault

Design for Testing and Maintainability

Good Engineering Designs:

- Modularity - ability to replace a faulty component



Design for Testing and Maintainability

Good Engineering Designs:

- Handle failure of sub-systems gracefully

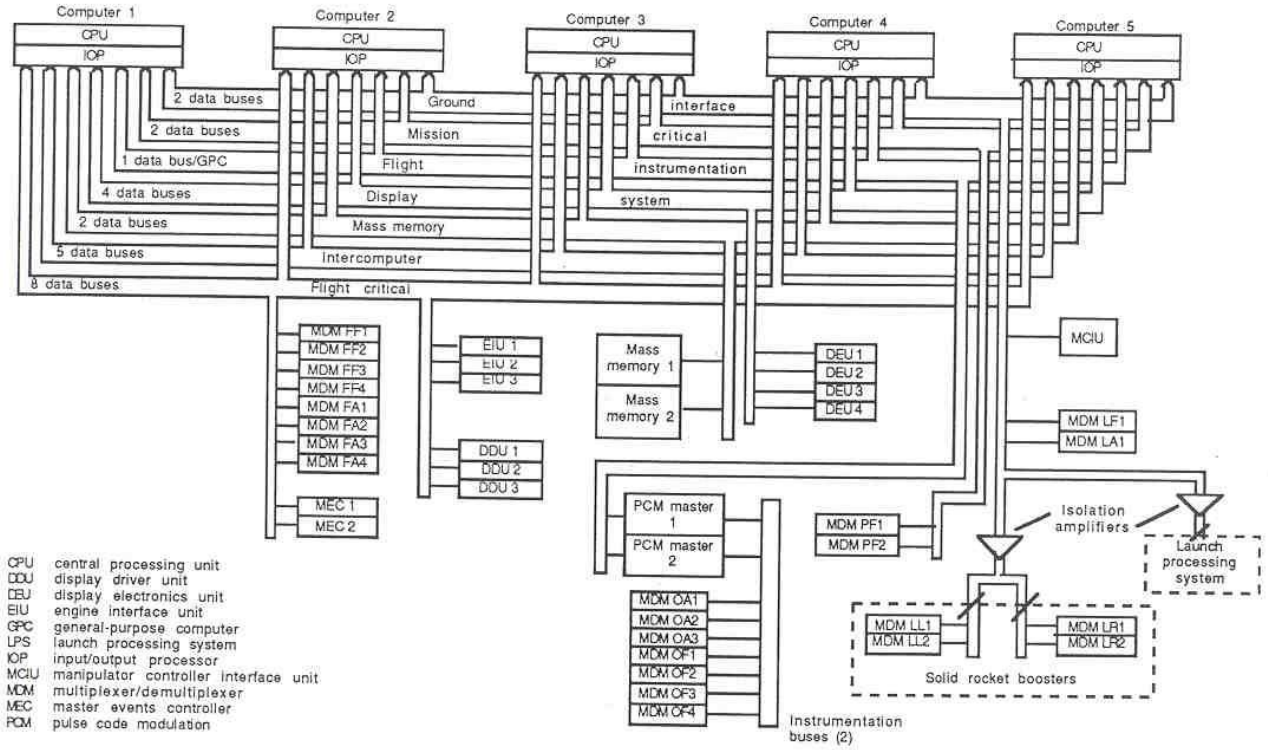


FIGURE 4-15.—Data bus architecture.

Goals for Design for Testing and Maintainability - From NASA

1. Reduce training requirements of crew.
2. Reduce certain skill requirements of crew.
3. Reduce time spent on preventive and corrective maintenance.
4. Increase maintenance capabilities during mission (especially corrective maintenance).

https://msis.jsc.nasa.gov/sections/section12.htm#_12.2_DESIGN_FOR

How do they achieve these goals? Some examples

Relative Accessibility - Items most critical are easiest to access.

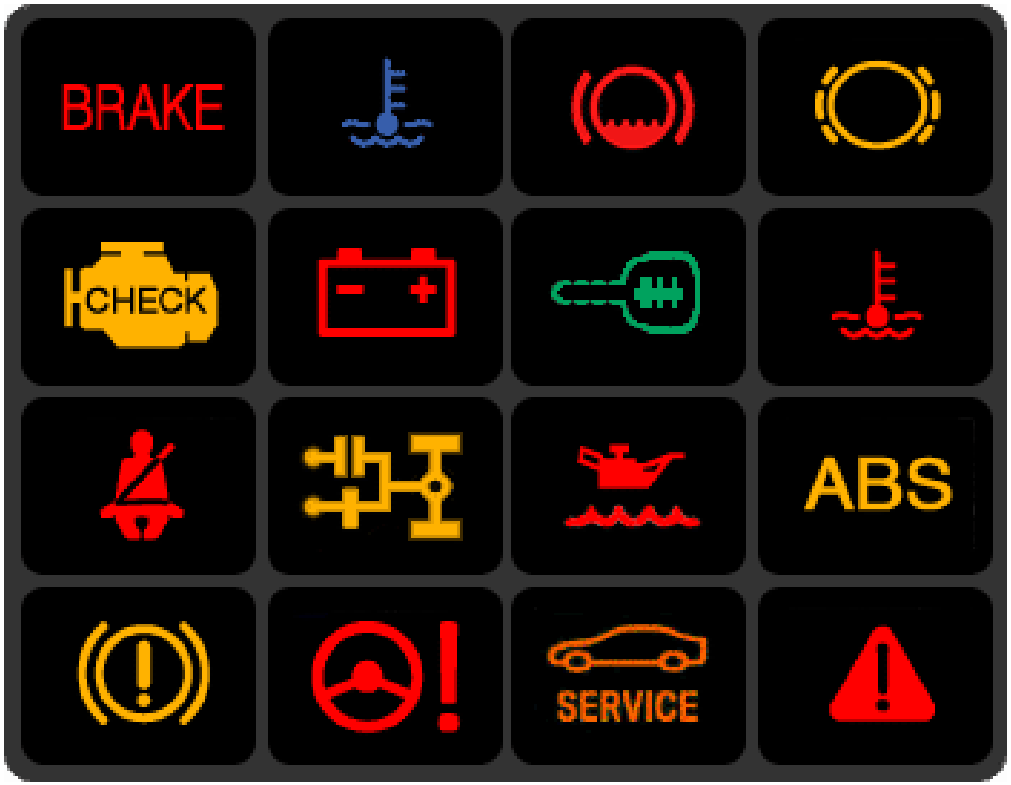
https://pxhere.com/en/photo/760556

How do they achieve these goals? Some examples

Quick release connectors.

How do they achieve these goals? Some examples

Automate fault detection.



https://www.modo.coop/blog/fix-it-with-farrell-fault-conditions/

How do they achieve these goals? Some examples

Maintenance requiring special skills to be minimised.

https://www.geek.com/tech/geek-basics-what-type-of-ram-do-i-have-in-my-computer-1465999/

Integration Plan - Think about this for your projects

- When will the subsystems will be ready?
- What information/input will a subsystem require from others during its development?
  - Can you ‘stub’ the interface?
- What testing/verification is to be done on individual subsystems before they are integrated?
- Can you verify the interface beforehand?
- What testing shall be done with the two subsystems together?

Verification Plan

- Plan for testing
- Formally this is related to requirements
  - Does each component meets its individual requirements/specification?
  - How about when integrated to form the complete system?
- How will you perform this for your system???

Verification Plan

- Detailed Testing Plan
  - What functions are you testing?
  - What does the test involve?
  - What metric will we use to assess performance?

Validation Plan

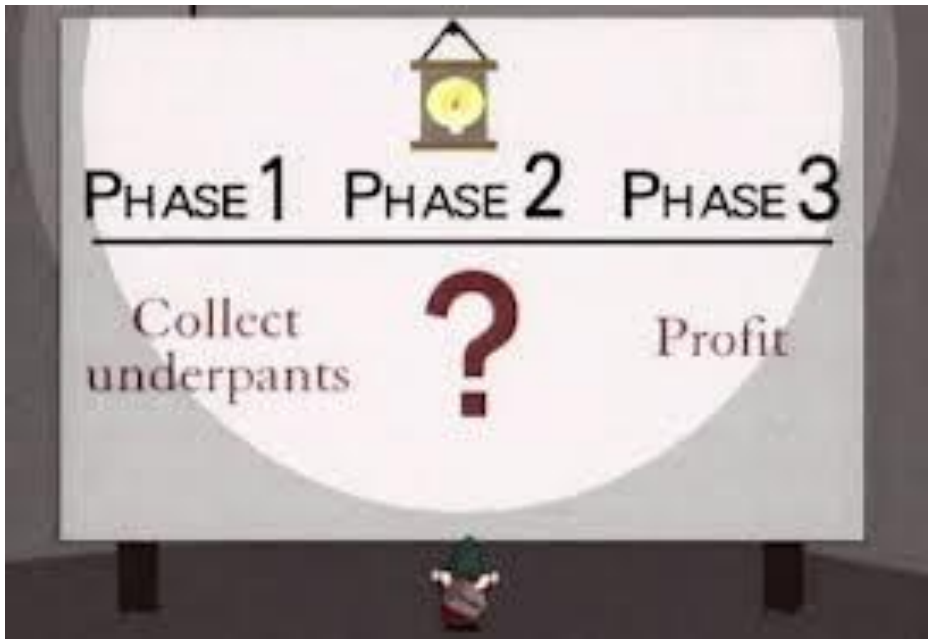
- Verification – Did you build it right?
- **Validation – Did you build the right thing?**
- Do you meet user needs? Solve the design problem faced?
- How will you validate your design before the big day???

Testing should be quantified!

Test Number	Description	Pass criteria	Results				
			1	2	3	Average	Pass?
1	Walk around the room balancing an egg on a spoon	Egg does not break Lap < 30 seconds	31 s	15 s	29 s	25 s	Pass

A Closing Thought

We hope we've exposed the mystery of how good engineering happens…



GOOD LUCK!!!