Previous Years' Design Case Studies

or

"The definition of madness is doing the same thing over and over again and expecting a different result"

Pauline Pounds

12 March 2019

University of Queensland

But first…

A valuable message about safety…

Secondly…

Some house keeping

Problem Analysis

- The METR4810 marking elves (ie. the tutors) worked solidly through the night to get you results for today
  - You're welcome

A few comments…

(Honestly, these comments are the same, year after year after year…)

Problem Analysis

- When you are writing, think about:
  - Who is the audience?
  - What does the audience know?
  - What do you need to tell them?
  - What *don't* you need to tell them?
- Time spent on talking about obvious things is time taken from talking about things that show you understand the task

Problem Analysis

General writing skills comments

- Pointless introductions that go on and on…
  - You have two pages – use them wisely
  - Don't spend time on ~fancy~ writing
- Lots of misdirected citation
  - References must bring new, useful information
  - Why not *cite* the design spec doc, rather than regurgitating the numbers that are in it?

Problem Analysis

- Probably don't need a title page, executive summary or table of contents for a two-page report… just say'n
  - Some crazy people submitted 6+ pages

- Appendix abuse was rife
  - Appendices are for pictures, plots, tables, *not text*
  - Don't worry, if they were just more text we didn't read them

Problem Analysis

Problem Analysis common threads:

- Lots of simply restating the problem spec
  - Don’t regurgitate – tell me something new!
  - What are the implications of the spec?
- What about tacit constraints/requirements?
  - Not everything is in the spec.
- Limited translation of spec into challenges
  - Little pre-chewing of the problem

Problem Analysis

Design Analysis common threads:

- Present your analysis before your solution
  - Don’t put the cart before the horse!
- Can’t fit all the words on the page?
  - Maybe you need fewer words?
  - The answer is never 9 point font and tiny, tiny margins – this is very obviously not acceptable and didn’t fly

Problem Analysis

- Oh yeah… and it's not "research" unless you have citations
  - $DEITY help you if you claim to have done research and don't put in useful, meaningful citations that inform your design decisions.
  - *You've been warned*.

Some useful tips

Meditations on self-review

How to identify good work

- All the necessary parts are present
  - Constraints, requirements, deconstruction, etc.
- Supported thinking – aka justified reasoning
  - "*Because X*, thus Y."
- Logical flow; links in a chain
  - "X, therefore Y. Y, therefore Z. Z, therefore win."

How to identify good work

- High level structure
  - You are given enough information to understand each section before you get there
- Intuitive coherence
  - *"Wow, I totally get it!"* – probably good work
  - *"I just don't understand this!"* – probably not
- Analysis
  - "Given a 15kJ battery, using equation 4 we predict a total operating time of 270 seconds."

How to identify bad work

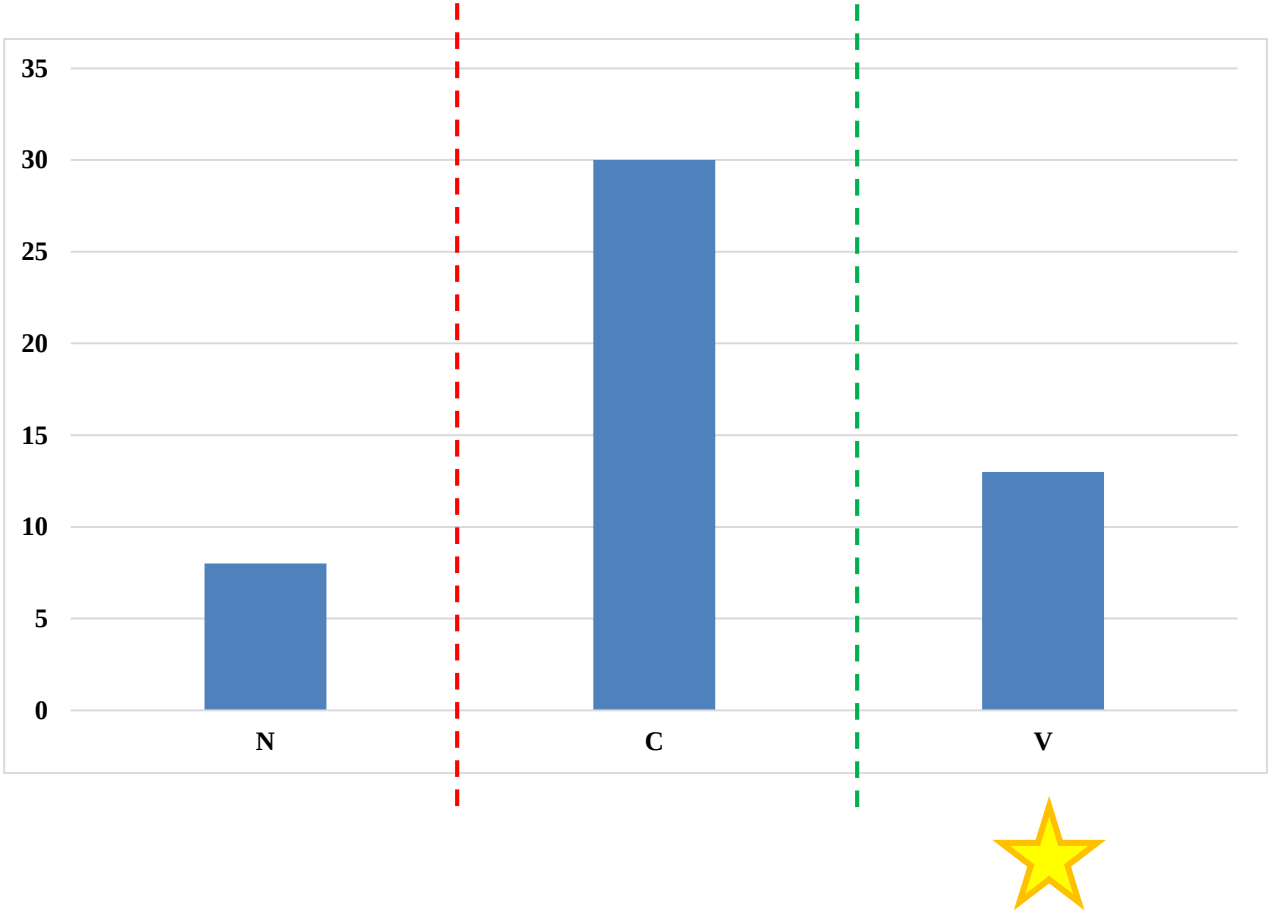
- Key parts are missing
  - Cursory, curt, and often rudely short,
    eg. 3 paragraphs in a two page assignment
- Lack of due care
  - Spelling, grammar, formatting errors; laziness
- Misdirected register
  - “We’re gonna do engineer haha lol”

How to identify bad work

- Unsupported statements
  - "Geared motors are the best solution." *Why?*
  - "Research found that AVRs are effective." *What?*
- Logical incoherence
  - "Lipo batteries are the most efficient." *Snuh?*
- Obvious hogwash
  - "The whole system will weigh 50 g and be completed in 3 weeks."

Problem Analysis Results

Results available via Blackboard after lecture



Calendar at a glance

You are here →

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	25/2 – 1/3	Introduction			
2	4/3 – 8/3	Principles of Mechatronic Systems design			Problem analysis
3	11/3 – 15/3	Previous years deconstruction case studies			
4	18/3 – 22/3	Professional Engineering Topics	Progress review 1		
5	25/3 – 29/3	PCB design tips			
6	1/4 – 5/4	Your soldering is (probably) terrible			
7	8/4 – 12/4	Introduction to firmware design	Progress seminar	25% demo	
8	15/4 – 19/4	Q and A sessions			
Break	22/4 – 26/4				
9	29/4 – 3/5	Q and A sessions		50% demo	
10	6/5 – 10/5	No lecture	Progress review		
11	13/5 – 17/5	Q and A sessions		75% demo	Preliminary report
12	20/5 – 24/5	Monday lecture!!			
13	27/5 – 31/5	Closing lecture		Final testing	Final report and reflection

Progress reviews

- Progress reviews are next week!
  - 15 minute slot per group
  - Each group member presents in turn
  - Should only take 3-4 mins each
- Sign up for session slots via Doodle poll
  - Link to poll will be sent out via Blackboard announcement after the lecture (closes Friday)

Progress reviews

- How to sign up:
  - Have **one and only one** member of your team nominate a time for your team on the poll
  - When they sign up, they must include their **full name and team number**. If they don't put both, the slot will be cleared.
- If you absolutely can't get a slot that works for all of your group, email me ASAP
  - *But this should never happen*

Progress reviews

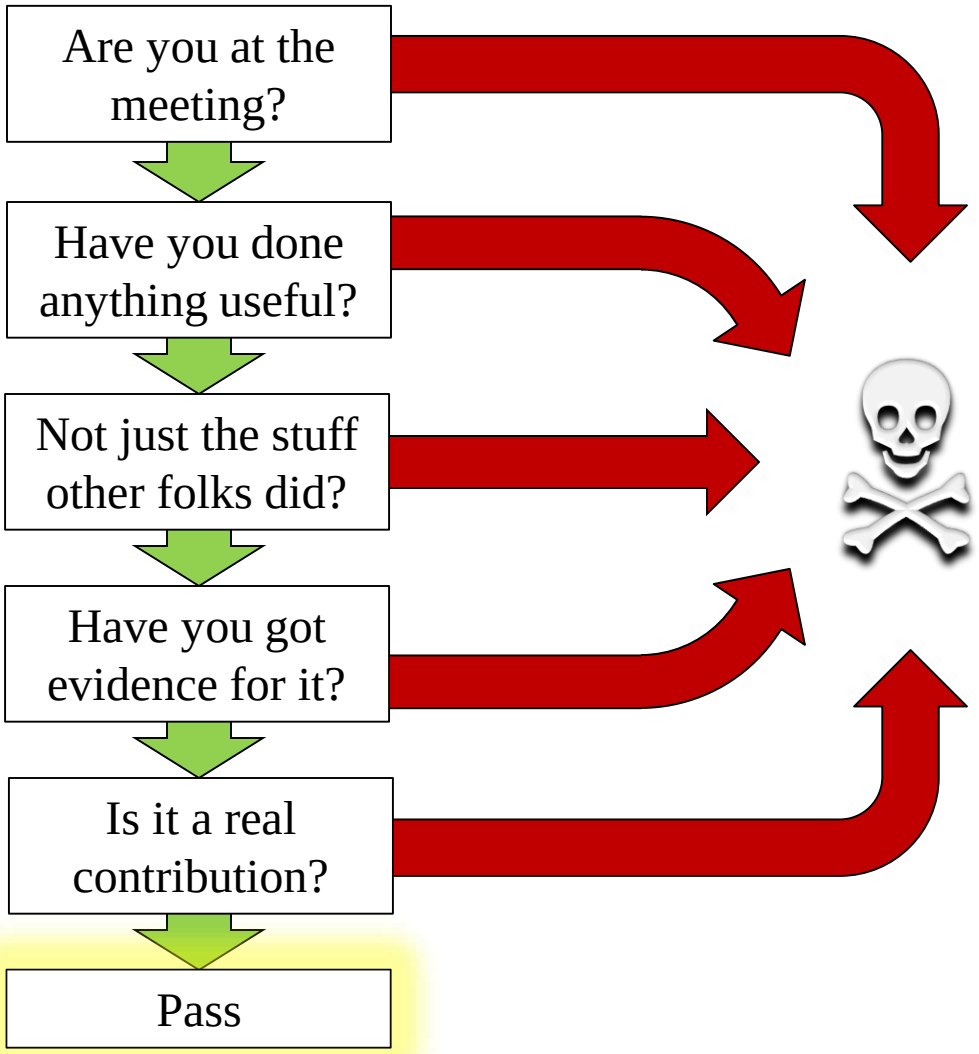
What is expected for the progress review?

- Need to show that you've made a decent start to the project: **tangible evidence**
  - Desired: rigorous analysis, detailed simulations working compiled code, breadboarded electronics, mockups of mechanical design
  - Inadmissible: scrawled pictures, isolated printouts of code, lousy rushed CAD or circuit diagrams, datasheets of that one part you found

Progress reviews

- Don’t panic: we are reasonable
  - The progress review is entirely to motivate you to get started early, and check your progress
- We can tell very easily if you’ve actually made an effort – if you have, you’ll be fine!

Progress Review flow chart



And also…

- You will be doing PAFs for each of your team members
- The PAF will contribute towards the final scaling of your final product score
  - This really counts!

And also also…

- You must submit (as a team) a signed (by every member of your team) document stating what the roles of each person (in the team) are
- We will refer back to this document in subsequent reviews
- It's not an immutable contract, but it is expected to be broadly adhered to

FAQ Roundup

- **When can we get STL files?**
  - Right now! On Blackboard!

- **Do we have to use Altium? Can we use KiCAD/Eagle/etc?**
  - Use whatever you like – I'm not the boss of you. I use Eagle at home, and don't really like Altium, but I can help you out whatever you use.

- **No seriously, do we have to go to all the lectures/contacts/pracs?**
  - Only if you really want to – the pracs are there for the tutors to help you, and the contact sessions are times for your team to meet. Use those times to best effect, per your judgement. I really do recommend coming to the lectures and pracs, though!

Spec update

- The spec has been updated now to v0.2, on Blackboard and the splashy webpage
- Minor changes and tweaks, mostly
  - Wired power now ok
  - Slightly longer tool bits
  - Makes both our jobs easier
- Also, mo’ money! $400 per team. ☺

Back to the deconstruction…

Design Case Studies?

Lolwut?

The process

1. Identify the requirements (design brief)
2. Create specification
3. Deconstruct the problem
   - Functional decomposition
   - Causal dependency tree
   - Parameter space, performance space, metric
4. Synthesize a solution

Let’s do it!

To the visualiser, Batman!

Two examples

- 2016 “Mineshaft” borehole rescue robots
- 2018 “Hunt for Sir Nils Olav” sunken submarine recovery robots

Questions?

?

Tune-in next time for…

Professional Engineering Topics

or

"Stuff they should have taught you at university, but didn't"

Fun fact: Just the design specification for the Lockheed Martin F-35 strike fighter was over 600 pages long.