RHD Afternoon Session
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Comments on RHD Study

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Today’s presentation

Ten slides today:

1. My background, briefly.
2. My PhD, briefly.
3. What my RHD thesis meant to me.
4. Comments on time management.
5. Miscellaneous suggestions.
6. What if things go wrong?
7. Questions/comments.
My background

Currently:

- Post-doctoral research fellow at UQ
- Finished PhD at UQ in 2012 (expansion tubes)
My background

Previously:

▶ Aircraft structures engineer (design and maintenance)

▶ 2005-2007
  Stork-Fokker (The Netherlands)
  *F-35 Joint Strike Fighter*
  *Gulfstream G6*

▶ 2003-2005
  Australian Aerospace (Brisbane)
  *RAAF DHC4 Caribou*

▶ 2002-2003
  GKN (Melbourne)
  *Airbus A340-500/600*
  *Airbus A380*
My PhD Thesis
Configure the X2 expansion tube (wind tunnel facility) to create high Mach number scramjet test flows (11,000–18,000 km/hr).

Involved:

- Mechanical design (piston, tube connection).
- Dynamics (piston motion).
- Hypersonics (predicting facility response analytically).
- Numerical analysis (CFD, FEA).
- Experimentation (running X2 and making flow measurements).
What my RHD thesis meant to me
What my RHD thesis meant to me

- Pass or fail document → there are *minimum* standards, but no *maximum* standards.

- Everyone has an opinion on what makes a good thesis, but since there are no strict criteria, and since it’s not graded, these remain opinions.

- I view my thesis as my single ‘go-to’ document:
  - All my important results, reasoning, explanation, assumptions and methodology are in there.
  - All loose ends accounted for, and no missing information/assumptions.
  - It’s my best attempt to consolidate what I’ve learnt and lock it away before I forget or become more confused.
  - One consequence → big document.
  - Size is a burden for examiners and supervisors, but can be alleviated by good writing, structure and logic.
Time management (basic)

If occasionally you can’t motivate yourself to do a task...

- Do something you enjoy more, which is still thesis-related and will need to be done at some point.
- Some guilty pleasures are occasionally OK, for example:
  - Work on your thesis template, get the preliminary pages correct, start your appendices.
  - Do some Matlabbin’.
  - Do some CAD drawing.
  - Work on that diagram you want to be perfect.
  - If it needs done at some point, then do it now, because it’s better than doing nothing.
Time management (advanced)

Do LOTS of hours:

- Immersion with a task is the key to good research.
- Work smarter, not harder → the surest path to mediocrity.
- A 12 hour day often achieves more than 2× what a 6 hour day does.
Time management (very advanced)

**Weekend Power-Work® sessions:**

- Don’t spend all weekend working. You need to catch up on basic tasks like cleaning the house, shopping, showering, even socialising.

  \[\text{§Do not make a habit of this.}\]

**BUT:**

- Sometimes it can be very efficient to come into Uni for a few hours when you have spare time, when the office is quiet, and get some work done.
- You are probably fully rested, you can be more efficient, and there are less interruptions.
- This is ‘bonus’ productivity, and lets you feel like you are getting ahead.
If you sense you have pushed yourself too hard:

- Palpatations, panic, paranoia, the usual stuff.
- Go home and try to sleep.
- Take the morning off and keep sleeping.
- Take it easy until you are feeling better again.
- This usually only happens after weeks or months of continual excessive effort, and if you push yourself past this point it may take weeks or months to recover.
Miscellaneous Suggestions
Begin writing your thesis from day one

- Write your thesis as you go. Make it a living document. You can discard extra work later, or else use it in something else.

- Alternatively, write your work up in technical reports, to a high standard.

- Continually explain what you are doing in writing. If you can't clearly write it down on paper, you probably don't have clear idea what you are doing.

- For example, if you are doing a calibration: don’t just rush through it according to someone else’s instructions, and ‘figure out’ what you did later. Write up the procedure now, explain and justify what you are doing now, document it properly now. This way it is already in your thesis, you are forced to properly understand what you are doing now, and you don’t have to redo it later.
Begin writing your thesis from day one

- Continually revise your structure, anticipate your experimental results, and anticipate how your thesis ‘story’ will start, play out, and end.

- Your thesis needs a coherent ‘narrative’. You don’t want to be trying to piece this together afterwards. If what you are working on has no obvious relevance to your final goals, then why are you doing it?

- Your experiments may not go according to plan. That’s fine, modify the narrative, but maintain a consistent focus on your end deliverable document.
Produce good diagrams

- A good diagram is the most important piece of communication in your thesis.
- A good diagram is very kind to the reader.
- A good diagram requires you understand what you are trying to explain.

- A good diagram is always good. Likewise a crap diagram is always crap. Just do it properly first time.

- A really good, unique diagram can get you lots of citations in other people's work.

- Start producing your final diagrams from day 1.
Produce good diagrams

- Download a free vector graphics package, such as Inkscape, or buy a commercial one such as Illustrator.

- The moment you want to start sketching anything seriously, create a file and do it on your computer, not in your lab book.

- Your initial sketch will eventually evolve into your final diagram.

- ‘But it takes too long to do it on the computer’ → once you learn to use the software proficiently, it’s quick or quicker than doing it by hand. There’s no repetition. There’s cut and paste. The result is better. And your investment will pay off forever after.
Take lots of photographs

- Learn how to use the group’s digital SLR.
- Take lots of photos, and take good quality photos.
- Photograph your apparatus etc *before* you break it, while it is still shiny and new.
- Good photographs liven up talks, your thesis, and can end up in publications.
- Good photographs arouse curiosity the way pages of text do not.
- Good photos get referenced by other people.
Don’t waste technician’s time

- Technical support is a limited, expensive, resource which you need to share with other people.

- Don’t waste technician’s time with poor drawings and bad instructions. Don’t assume they can read your mind.

- Make sure your drawings and instructions are as clear, correct, and unambiguous as is humanly possible. Minimise work by using tools like the waterjet cutter etc.

- It may take hours extra work and oversight to eliminate communication problems. This is a very small price to pay to avoid mistakes.

- If a technician makes a mistake, it is quite likely your fault for giving lazy instructions. Blame yourself, not everyone else.
Design for adjustment

- Don’t assume things will easily fit together, or that measurements are perfect.

- Try to envisage the eventual use of your mechanical design, and to imagine everything that could go wrong.

- Use 3D CAD, and include surrounding geometry to get your interfaces correct.

- Allow for adjustment and alignment.

- Don’t just make things statically strong enough, also make them stiff enough.
Example: X3 Test Section Door
Example: X3 Test Section Door - Slotted Holes
Example: X3 Test Section Door - Slotted Holes
Example: X3 Test Section Door - Shimming
What if Things go Wrong?
How can things go wrong?

- Equipment breaks.
- Unexpected experimental results.
- An arduous analysis path leads no where.
- Misinterpreting the goals/aims of your research... i.e. measuring the wrong thing.
- Original goals prove to be untennable.
- Just to name a few ways...
You cannot eliminate this risk, but:

▶ Anticipate what can go wrong, and try to eliminate risks. Just like with OHS.

▶ Don’t put all of your thesis eggs in one thesis basket, diversify:
  ▶ Experimental
  ▶ Analytical
  ▶ Numerical

▶ Do some preliminary experiments to test proof-of-concept ASAP. A single experiment can show you that your entire analysis needs reconsideration. Make sure you are not sitting at your desk polishing a turd for 2 years before ultimately finding out you were way off track all along.
You cannot eliminate this risk, but:

- Do your experiments in stages:
  Safer experiments first = money in the bank
  Leave the riskier ones for the grande finale.

- Deal with uncertainties at the start:
  - Don’t begin your risky experimental campaign at the 3 year point.
  - Spend a few months persevering with a concept, but then stop and reconsider if it’s worthwhile.
  - Keep in regular touch with your supervisors etc.
  - Don’t keep problems to yourself.

- Make sure you are banking useful findings along the way, and not hoping for a big discovery at the end.
Misinterpreting the goals/aims of your research:

- You will clarify your thinking by starting your write up early.

- You will understand the purpose and context of your experiments, and what you are trying to measure, if you have taken the effort to define your entire thesis ‘story’ from the very beginning.

- Likewise try presenting papers on your work early on, and there’s a better chance you’ll find any problems early too.
Questions/Comments?