Workshop: Choosing, designing and executing a Masters research project

Samraat Pawar

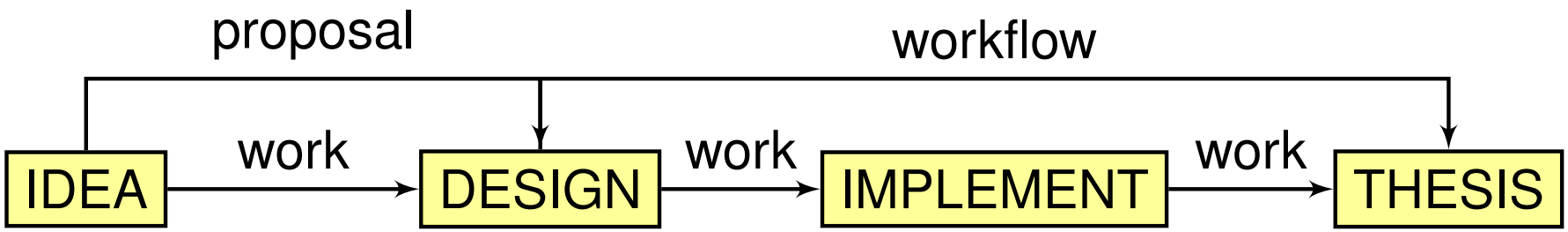
Imperial College
London

October 26, 2016

The conception, gestation and birth of your Master Research Project

We are going to discuss these phases of your research project:

- IDEA and DESIGN (including project proposal)
- IMPLEMENTATION
- THESIS



Don't forget to read your Silwood Masters Guidebook!

What do you want your MSc/MRes Dissertation research to be?

Which kitty-cat is the cutest (AWWW!)?

Go to `www.menti.com` *and enter code shown (phone or laptop)*

[link]

What do you want your MSc/MRes Dissertation research to be?

- Something that I can publish
- Something I find interesting
- Something that will get me the highest marks
- Something that makes me implement new skills
- Something that satisfies my supervisor
- Something that can get me a PhD position
- Something that can get me a position in an NGO / Industry
- Something else

Go to `www.menti.com` *and enter code shown (phone or laptop)* *[link]*

Point: *You can't optimize all of these things!*

THE IDEA PHASE

Anyone who has never made a mistake has never tried anything new *(*Albert Einstein*)*

- Split up into groups of of 3–6 (recommended) each and choose one of the assigned *heavily cited* papers in Ecology, Evolution, and Conservation (at this link: goo.gl/Tm6Xyh)
- *Think about what made your chosen paper such a hit:*
  - Good timing (was in a popular field)?
  - A new idea?
  - A new method?
  - General (or specific to an important system)?
  - Critical — convincing test of an existing hypothesis?
  - Integrative — brought together different disciplines/areas?
  - The surrounding writing made a good story?
  - Something else?

THE IDEA PHASE

So which paper did you choose?

- Schloss et al
- West et al
- Thomas et al
- Pauly et al
- Milo et al
- Trivers
- Holling

Go to www.menti.com *and enter code shown (phone or laptop!)* [link]

THE IDEA PHASE

What made your chosen paper such a hit?

- Good timing (was in a popular field)
- A new idea
- A new method
- General (or specific to an important system)
- Critical — convincing test of an existing hypothesis
- Integrative — brought together different disciplines/areas
- The surrounding writing made a good story
- Something else

Go to `www.menti.com` *and enter code shown (phone or laptop!)* [link]

THE IDEA PHASE

- As a Silwood Masters Student, you have three main options to choose a research project (you can exert your creativity in all three!):
  1. Come up with something and approach a potential supervisor
  2. Go through supervisor interests and propose an idea
  3. Choose an advertised project and modify as needed
- *What's your plan?* (Choose one of the three options above)

Go to `www.menti.com` *and enter code shown (phone or laptop)* [link]

See Loehle 1990 (on bitbucket) for some thoughts on creativity

THE IDEA PHASE: FINDING SUPERVISORS/PROJECTS

Check out Supervisors and Projects:

- Supervisor interests: Links in Guidebook (but you can look elsewhere!)
- Advertised projects: `silwoodmasters.co.uk`

THE IDEA PHASE: APPORACHING A SUPERVISOR

Try not to be vague (sorry for being patronizing!)

Try not to say things like:

- X I want to work on sexual selection
- X I want to go to Honolulu (even if you want to)
- X I want to work on whales in the open ocean (not in SeaWorld ™)

Some better statements:

- ✓ I want to test the sexual conflict hypothesis in birds
- ✓ I want to test the island-effect hypothesis (secretly: In Honolulu!)
- ✓ I want to test optimal foraging theory using whale movement patterns

THE DESIGN PHASE

- Feasibility is important – the "Medawar zone"
  https://en.wikipedia.org/wiki/Medawar_zone

A guide to increased creativity in research—inspiration or perspiration?

There are four requirements for a successful career in science: knowledge, technical skill, communication, and originality or creativity. Many succeed with largely the first three. Those who are meticulous and skilled can make a considerable name by doing the critical experiments that test someone else's ideas or by measuring something more accurately than anyone else. But in such areas of science as biology, anthropology, medicine, and theoretical physics, more creativity is needed because phenomena are complex and multivariate.

Innovative scientists are held in high regard, but the means by which they achieve innovation are not spelled out in any manual for graduate students. Courses on the scientific method (which few biology students take anyway) do not mention the

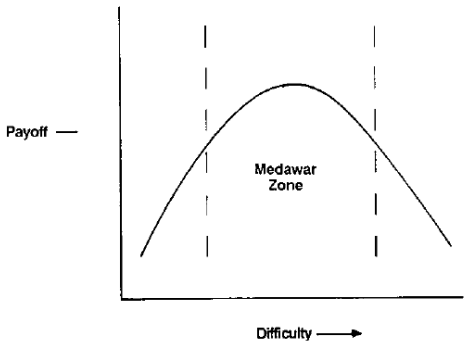


Figure 1. Relationship between degree of difficulty and payoff from solving a problem. Solving problems that are too easy does not advance science, whereas those that are too difficult may be impossible for other scientists to understand, i.e., they are premature. The Medawar zone refers to Peter Medawar's (1967) reference to science as "the art of the soluble."

and work intensely. After you have finished writing your paper, you can go back and remove the comments about what an imbecile the other person is. The effort to refute someone can even lead to evidence supporting them or to a different topic altogether. Intensive rivalries, as in the race to discover DNA (Watson 1968), can also provide this essential intensity. Thus whereas the finished product may appear dispassionate, truly creative work is often driven by strong passions.

Where there's smoke. A good strategy for finding an interesting problem is to follow the fire trucks, because "Where there's smoke there's fire." When there is intense debate on a topic, inconclusive or contradictory experiments, or terminological confu-

- Where does each of the four papers you discussed lie in the Medawar zone?

THE DESIGN PHASE

- Which of the following components would worry you the most in terms of project feasibility?
  1. Fieldwork
  2. Laboratory experiments
  3. Developing and implementing statistical analyses – fitting to a model
  4. Developing and analyzing mathematical model
  5. Writing up
  6. Something else

Go to `www.menti.com` *and enter code shown (you can use your phone)*

THE DESIGN PHASE

- **Everybody must write a project proposal!** (read your Gudebook!)
- Have an internal (IC Department of Life Sciences) supervisor or co-supervisor (Required (*Why?*))
- Have a plan B (and C, if possible) – what if your primary objective is a dead end?
- Make your project modular (Have distinct hypotheses) – these could become plans B and C
- Use a Gantt chart (required in your project proposal)
- Get feedback from supervisor
- Fill forms for external supervisors (links will be emailed to you)

THE DESIGN PHASE

A Gantt chart example

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5
Objective 1 (Ecoinformatics)					
Initial database development, including literature data compilation					
Database management, augmentation and interface development					
Thermal response model fitting + results write up					
Objective 2 (Interaction Mechanics)					
Development of movement and interaction theory					
Empirical parameterization and computer simulations of theory					
Refinement of theory + results write up					
Objective 3 (Community assembly)					
Development of consumer-resource models					
Parameterization and analysis of assembly dynamics					
Calibration of theory for specific scenarios/data + results write up					

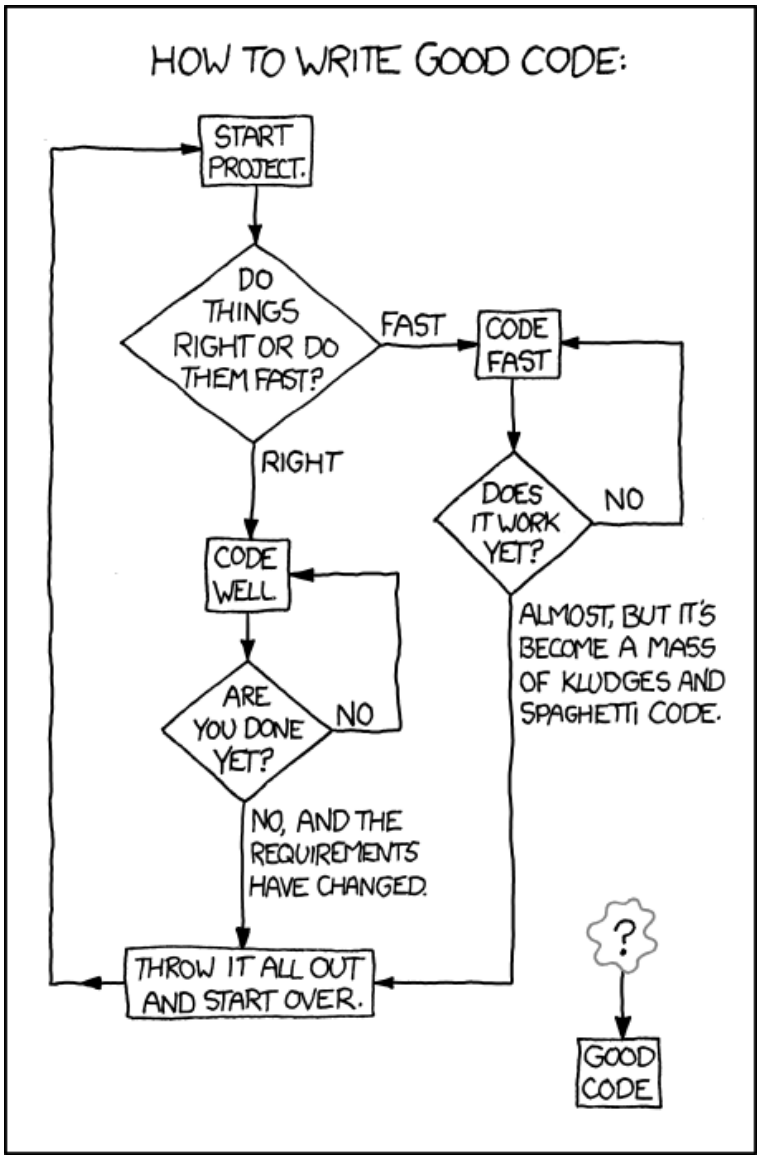
THE IMPLEMENTATION PHASE

- Make your dissertation work modular (minimize multi-tasking across different hypotheses/questions)
- Keep your dissertation under version control – organized under `code`, `data`, `results`, `thesis`... or at least try to!
- Make your analyses reproducible – you should be able to rerun at touch of a button
- Benchmark (perhaps using synthetic data) to estimate how long simulations/analyses are likely to take
- Keep results from all analysis/simulation runs, tag them with a code version number
- Get feedback from supervisor at key junctures
- Change project design iteratively
- Revisit your Gantt chart

THE IMPLEMENTATION PHASE

- Explicit is better than implicit.
- Simple is better than complex.
- Complex is better than complicated.
- Readability counts.
- Special cases aren't special enough to break the rules.
- Although practicality beats purity.
- Errors should never pass silently.
- In the face of ambiguity, refuse the temptation to guess.
- There should be one– and preferably only one –obvious way to do it.
- If the implementation is hard to explain, it's a bad idea.

THE IMPLEMENTATION PHASE



http://xkcd.com/

THE THESIS WRITING PHASE

- Start early
- Get working on the background and intro early – will make you think and rethink
- Writing skills improve more slowly than technical (coding) skill – but keep improving for longer
- Don't leave everything for the "last month"!
- Get feedback from others – give presentations!