Final Year Project Workshop 2013

Jeremy Leggoe
School of Mechanical and Chemical Engineering
CEED Director
Session 1

Literature Review
Building a Foundation

Thesis Document

Thesis conclusions

Reasoned arguments

Experimental, data gathering, or other creative work

Identified "Knowledge Bases" for thesis

Referenced information

Supposed knowledge (unconfirmed, possibly true)

"Firm" existing knowledge (accepted, published, not necessarily true)
Every statement and conclusion in a professional report must be supported by accepted literature or your results and deductions.
What is a Literature Review?

- The literature review is the first step in any successful research effort, and will continue throughout the project.
- The purpose of the literature review is to establish the state of the art in the area that you are working in.
  - For investigative research, this will mean reviewing the academic literature.
  - For design projects, this will mean identifying current approaches to solving the problem of interest (or similar problems).
  - For industrial projects, this will entail reviewing standards and current operating practices.
  - In CEED projects, this will also require reviewing internal documents to determine the history of the issue within the client enterprise.
Basic Tools

- Internet search engines have greatly simplified the process of identifying information sources.
- Google, Wikipedia and Media sites can and should be used to provide a quick overview of a field
  - Use to identify relevant publications and experts.
  - Can help with basic definitions or even formulae.
- However, it must be remembered that it is generally **UNACCEPTABLE** to reference these sources in a thesis
  - The reviewing and control of posted data ranges from inconsistent to non-existent.
  - It can be difficult to assess the expertise (or motives) of the poster.
Expert Materials

• A research report should rely on peer reviewed and/or edited materials such as
  – Books
  – Scientific Journal Articles
  – Scientific Conference Proceedings

• The UWA library is an excellent research library
  – In addition to the materials in the stacks, there is a wide range of journals available electronically
  – If a particular paper or book is not available, the library can generally locate a copy via inter-library loan relatively quickly. This service (GETIT) is free to students enrolled in final year, honours, and postgraduate projects
Expert Search Tools

• The library website makes available a variety of web-based search engines/databases that can be used to search for scientific publications and books
  – OneSearch is helpful if you know what you are looking for, but it too can be unfocussed.

• Unfortunately, recent website reformatting has made the best tools (“Compendex” and “Web of Knowledge”) less obvious.
  – These tools are much more powerful than the likes of the Google, as they are focused solely on quality scientific publications.
  – They are relatively simple and intuitive to use – you may search by keywords, words in the title, author (essentially the same as when using OneSearch)
Engineering Databases

- Compendex, also formerly known as “Engineering Index” provides a list of papers matching your specified search terms.
  - To access
    - Type “Compendex” into the OneSearch text entry space
    - Click on the “view online” link that appears under the first search result in the list.
    - Compendex finds both journal papers and conference proceedings (Web of Knowledge focuses on journal papers)

- The “Web of Knowledge” provides a similar capability but can be more powerful because it also provides a Citation Index.
  - The number of citations tells you how influential a paper is.
  - You can follow a “citation trail” from an important paper to research the current state of knowledge in a field.
  - To access: Type “Web of Knowledge” into OneSearch, and proceed as for Compendex.
Web of Knowledge

http://www.is.uwa.edu.au/
Approach

• Remember that the word “review” is important – it is not a literature “survey”

• It is essential to read the material you find carefully and critically.
  – Does the material apply directly to your work?
  – What are the limitations of the published material?

• A good paper or book will usually be well referenced – the reference lists can help you find older, more fundamental work in a field
  – A good literature review will evolve and expand from each paper you review.
  – Fundamental papers can often make it easier to understand the topic you are researching
Approach

• **IMPORTANTLY** - do not limit your consideration of literature to recent works.
  
  – Fundamental papers and texts can often make it easier to understand a particular technique or approach.
  – In seminal papers, the jargon of the field has usually not yet developed – so the text is often more comprehensible
  – The basis and limits of a particular approach can also often be more clearly identified in the original papers.

*So don’t ignore the dusty old journals! In many fields, the basis of current thinking was laid out a long time ago.*
“If I have seen farther than others, it is because I have stood on the shoulders of giants.”

Sir Isaac Newton
Session 2

Project Management
80% is NOT Good Enough!

• The biggest difference between a classroom environment and the real world is that you are judged by results instead of marks.
• In the classroom, 80% gets you an A; in practice, something that is 80% right will 100% not work.
• In practice, turning in work with errors (or projects that don’t work) makes you look careless and lowers others’ confidence in you.

Marks are ultimately meaningless. In professional practice, you will only be successful if you deliver something that works!
It’s your project!
It’s your project!

• **You** must take “ownership” of the project for it to be successful.
  – You will receive support from your supervisor, school and workshop staff, and your fellow students,
  
  **BUT**
  
  You’re the person primarily responsible for the success or failure of the project.

• **You** must take the initiative to keep the project moving in the absence of immediate deadlines or external pressure.

• If you get moving on your project earlier, you will have more opportunity explore your project. The more you explore, the better your project will turn out.
If you get moving on your project earlier, you will have more opportunity explore your project.

The more you explore, the better your project will turn out.
Execution - Methodology

• Early in the project, it’s essential to work with your supervisor to set out the process by which the objectives will be accomplished

• Break down the project into specific tasks, and describe the approach that will be taken to accomplishing each.
  – Experimental/Field tasks: describe equipment and techniques
  – Modelling tasks: identify software and computing resources
  – Theoretical tasks: identify approaches under consideration
  – Design tasks: identify tools or approaches
  – Financial tasks: describe tools and analytical techniques
  – Survey Tasks: describe approach and target populations

• Identify any constraints imposed on the methodology

• Weak planning leads to weak projects. You must identify specific tasks – vague ideas are not enough
Execution - Timeline

• Scheduling the project elements is an essential part of research plan development
• A Gantt chart should be prepared – in doing so, consider the following key questions;
  – How long will each task take?
  – How variable is the predicted time for each task?
  – Which tasks can be done concurrently?
  – Which tasks have prerequisites?
  – Which tasks lie on the critical path?
• Identify any key constraints on the proposed timeline
Execution - Timeline

• Make sure you set out definite deadlines for individual tasks.
  – Identify regular milestones that will help mark your progress, especially in longer or more complex tasks

• **Stick to your deadlines!**
  – Don’t let weekly pressures (or the absence of imminent project submissions) reset your priorities.
  – Make time for your project every week – it’s the most important unit you’re undertaking over the next year.

• Keep your Gantt chart updated as the project evolves
  – Take particular care to identify tasks on the critical path, and keep them on schedule.
Stuff Happens

- Project activities NEVER go smoothly
  - Anything that you leave to the last minute WILL get delayed when you can least afford it.
  - Sometimes things that are beyond your control will go wrong (this is why we do risk management).

- Get your research going as early as possible;
  - This will give you the chance to overcome difficulties
  - You may identify ways to enhance your project (remember—you are effectively in competition for resources).

- Use the holiday breaks—don’t let your project stall during teaching breaks.
  - Workshops, libraries and labs are quieter over the break – it can be easier to get things done.
  - More importantly, you don’t have other classes in the break.
Be Pro-active!

• Resolve issues as soon as they arise.
  – Procrastination is fatal in a one year project
  – Problems will not become easier to fix next week (in fact – there will be less time available to address any issues).

• Don’t assume that your supervisor or mentor will be available on your timetable – so get material to them early.
  – They are busy; you may be one of many students or employees that they are supervising, and they may have other job responsibilities to attend to.
  – You have to give your supervisor and mentor time to review and respond thoughtfully to submissions.

• Clients and Supervisors respond to your enthusiasm.
  – If you’re interested and getting things done, they will take more interest in your work and contribute more.
Session 3

Communication & Technical Presentations
Presentation

• First impressions are more influential than you suspect – presentation is an important element of a recipient or counterpart’s first impression
  – Be aware of the consequences of “Diagnosis Bias” and “Value Attribution”!

• If you or your work are presented poorly, colleagues will (subconsciously) assume that your work is equally poor
  – Dress and act professionally
  – Take care in checking spelling and grammar
  – Take care in the arrangement and presentation of figures

References


Preparation is the key to good presentations.
Delivery and Personal Presence

- Speaking Volume
- Speaking Rate
- Mannerisms
- Eye Contact
- Activity and Engagement
- Avoiding Redundancy
- Professional Expression
- Professional Dress
- Meeting Time Limits
Confidence!

Confidence derives from preparation.
Slide Content
Initial Slides

- The first 3 slides **must** establish;
  - **What** the project is about, and what your objectives are
  - **Why** the project is important
  - **How** you are going to achieve your objectives (in a general sense)

- If the audience is thinking “WTH??????” after the first 3 slides, then you have lost them

- Slides that list the order of the sections of your presentation are worthless.

- It is essential to use high impact graphics in your initial explanatory slides – help the audience visualise the issue and its importance.
Slide Presentation

• Spelling and (gross) grammatical errors are unforgiveable.

• All graphs and images must be appropriately labelled
  – Axis titles, legends, units

• You must use appropriate (professional) language on your slides, as well as in your verbal expression

• Your slide content should reflect the expected level of shared knowledge with the audience
  – You MUST tailor your presentations to the audience.
It is essential that all technical content presented be accurate; any obvious errors will lower the audience’s opinion of your work, and diminish its potential impact.
Question Time

• Prepare in advance – think about the questions you would ask, and prepare answers for those
  – What were the limits of your model or experiment? Why did you settle on particular assumptions? Which choices were arbitrary? Which aspects of your hypothesis are open to challenge?

• Listen to questions carefully.
• Don’t rush – take a moment to think about your answer.
• Don’t take questions personally
• Don’t be defensive
• Accept that the questioner may be raising a valid point.
• You don’t always have to have an answer – but you should have an idea of how to get the answer.
Font Size

• All text and image labels must be visible from the back of the room.

• Rule of thumb – never use less than 16 point font, and try to stay at 20 point and above for important text.
  – This is 20 point
  – This is 16 point
  – This is 12 point

• Note that these limits can vary for different types of font

• Be sure to use crisp, clear fonts;
  – Georgia (this presentation), Times, Arial, Helvetica, Geneva
Image Size

- Make sure that all image features, symbols and labels are visible at the back of the room
  - Lines and text are often “thinned” by the projector – so lines that look good on your screen may not show up well when projected.
  - Color definition can also be lost in projection – it can be hard to tell Blacks from Dark Blues, etc

- Use judgement in deciding whether to squeeze multiple images or graphs onto a single slide
  - Is the point you are trying to make still clear with the smaller images?
  - Do you really need to compare the images – or is the point still clearly made with larger images on separate graphs?
Inhibition Ratio $\rho_n$

Three-dimensional ERS arrays of Monodisperse Spheres

$V_f = 0.01$

$V_f = 0.20$

$V_f = 0.40$
Effect of short range order on Inhibition Ratio;
Three-dimensional ERS monodisperse particle arrays
Session 4

Thesis Preparation
Why Prepare a Report?

• To communicate your project’s motivations, objectives, methods and findings to others

• Obviously, your report will be marked, but you will find that if you focus on effective communication, the mark will take care of itself

• When making decisions on whether your report is effective, place yourself in the reader’s shoes;
  – Would someone reading this text understand what you are thinking?
  – Does this figure or graph convey the information that you wish to convey to the reader effectively?

• The reader is NOT a mind-reader; all they have to work with is what you provide in the report
Report Audience

• When preparing any report, you must take into account the expertise and motivations of the target audience

• For your thesis, the audience will include
  – Academic Staff in your school; experienced researchers and teachers
  – Future students; experience similar to your own
  – Engineering staff at companies that you are or will be working with; these staff may have extensive experience, but may not be familiar with specialized techniques
  – Management staff at companies that you are or will be working with; these individuals may or may not have technical expertise
  – Recruiting officers at potential employers; these individuals may or may not have technical expertise
Audience Motivations

• MARKING
• Following up or extending your research
• Comparing your research with research done elsewhere
• Implementing your recommendations, or evaluating your recommendations for implementation.
• Deciding whether to support continuing research on the subject
• Determining whether to hire you
• Determining where you should be assigned in an organisation
Project Summary

• In some respects, the most important element of any report

• For busy readers, the summary may be the only thing they read – it will ALWAYS be the first thing they read

• The summary must capture the reader’s attention – so take care in preparing it.

• The summary must provide a clear, concise description of
  – The reasons for undertaking the project
  – The project objectives
  – The methods by which the objectives will be achieved
  – Key conclusions and recommendations (highlighting costs of implementation and benefits, advances in the state of the art, novel capabilities or features of a new design, as appropriate)

• The summary should usually be limited to 250 words (always less than one page)
Every statement and conclusion in a professional report must be supported by accepted literature or your results and deductions.
Introduction and Project Objectives

• The introduction sets out:
  – The nature of the issue being addressed
  – The importance of the issue
  – The past history in the area and the current state of the art
  – The objectives, and the reasons for pursuing those objectives.

• Context is important: why is the project important to the field, sponsor or community? How does the project advance the state of the art?

• What benefits accrue from the achievement of the objectives?

• A brief description of the structure and contents of the thesis may be included
Literature Review

• The literature review may be blended into the introduction or presented as a separate chapter.

• The purpose of the literature review is to establish the state of the art in the area that you are working in.
  – For investigative research, this will mean reviewing the academic literature.
  – For design projects, this will mean identifying current approaches to solving the problem of interest (or similar problems)
  – For industrial projects, this will entail reviewing standards and current operating practices.

• Remember – it’s important to REVIEW the literature critically. It’s not a literature “survey”.
Plagiarism

- Monitoring plagiarism in theses is a point of emphasis for the faculty
- Examples of plagiarism encountered in theses include:
  - failure to reference source material or unpublished work of other people;
  - copying text or graphics without quoting the original work and attributing the work to its rightful author;
  - Copying extensive tracts of text verbatim from a reference, even if the reference has been properly cited
  - one or more students cooperating to complete a project and then handing in wholly or partly identical submissions (unless the project has been identified as a group project);
  - one student copying any part of another person's project.
- Methods for acknowledging or citing sources can be found on the library website. The Harvard style is usually one of the easiest to work with.
The guiding principle for this section is that it should provide any information that would be necessary for someone to repeat your work.

The nature of this section will depend on the project
- Experimental Method
- Model Formulation
- Design Approach
- Data Collection

Providing detailed information is critical
- Your findings are meaningless if the reader cannot tell how you obtained them.
- Figures are essential.
- Design criteria MUST be defined for design projects
Illustrations

• In most cases, a photograph of a test rig by itself is completely and utterly worthless
  – Equipment diagrams should be presented in the form of well labelled and dimensioned schematic illustrations and/or engineering drawings
  – When printed in black and white, as theses very often are for marking, colour photographs often become unclear

• It is important to draw original illustrations, to ensure that relevant and accurate information is included.
  – You should not lift “lifting” schematic illustrations and figures directly from texts, papers, other students’ theses, or web sites. In many cases, this borders on plagiarism.
  – The “lifted” diagrams are often poor quality and inaccurate.
Illustrations - Examples
Illustrations - Examples

[Diagram showing a laser system with components labeled: Sample Objective, Beamsplitter, Spatial filter, Beam expander, Laser, Detector pinhole, Detector. The diagram illustrates in-focus and out-of-focus light rays.]
Results & Discussion

• The guiding principle for this section is that it should describe what has been done, and demonstrate how well the findings are understood.

• Focus on presenting “analysed” results
  – Raw data may be provided in appendices
  – Use graphs and tables as appropriate

• For design studies, the final design, and its performance of the design will represent “results”.

• Take care to evaluate how well your presentation communicates the results to the reader
  – Graphic comparisons are particularly powerful
  – When comparing results, select a form that keeps the items being compared on a single page
Results & Discussion (cont.)

- The purpose of the discussion is to place your results in context.
  - Compare the findings with any original expectations.
  - Compare the findings with the pre-existing state of the art.
  - Compare the proposed approach with alternatives.
  - Discuss the limitations of the current project.

- It is important to assess the limitations of a technique, in order to properly apply results.

- Arbitrary choices should be identified, and alternative approaches should be considered in the discussion.

- Remember – all statements and arguments in your report must be supported, either by your results, or information available in the literature.
Conclusions and Future Work

• Conclusions should state concisely the most important findings of the project.
  – Assess whether or not the objective of the project have been achieved.
  – Identify any future work arising from the project (unresolved issues, or steps for implementation).
• While the conclusions will generally brief, care should be taken in writing this section.
  – Remember, it will be the last thing that the audience reads, so it will be the last thing on their mind before they make a decision on the future of your project (in professional practice), or on your grade (right now)!
• Last impressions are important too!
Your thesis must stand on its own as a document!

- The markers will read the thesis without you being present to explain anything that’s missing – and your supervisor will not be present either.

- In practice your reports may have a life within your organisation that extends far beyond your participation in the project
  - The report must make sense even when you’re not around to explain it.
  - The methodology and recommendations in particular must be clear to people who were not original participants.
  - You never know who may end up seeing your report – they are often circulated widely, including to senior personnel within partner organisations.