# Seminar 1 Week 1

## COS70008 – Technology Innovation Research and Project

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# Acknowledgement of Country

We respectfully acknowledge the Wurundjeri People of the Kulin Nation, who are the Traditional Owners of the land on which Swinburne's Australian campuses are located in Melbourne's east and outer-east, and pay our respect to their Elders past, present and emerging.

We are honoured to recognise our connection to Wurundjeri Country, history, culture, and spirituality through these locations, and strive to ensure that we operate in a manner that respects and honours the Elders and Ancestors of these lands.

We also respectfully acknowledge Swinburne's Aboriginal and Torres Strait Islander staff, students, alumni, partners and visitors.

We also acknowledge and respect the Traditional Owners of lands across Australia, their Elders, Ancestors, cultures, and heritage, and recognise the continuing sovereignties of all Aboriginal and Torres Strait Islander Nations.

# Unit Convenor

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FIE Aust, CPEng, NER, APEC Engineer IntPE(Aus)

Software Engineering Discipline Lead & Director, Internet of Things Training Academy

- ✓ Fellow of The Institutions of Engineers Australia
- ✓ Chartered Professional Engineer (CPEng) in the practice area of Information, Telecommunications and Electronics, Project Management, and Systems Engineering
- ✓ Industry Experience – Design and Testing Engineer (CASA)
- ✓ Engineering Education Expertise – PBL/PJbL, Pedagogies
- ✓ Industry IoT and Augmented Intelligence expertise

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# Innovation & Research

Content

- Research & Innovation – What, How & Why?
    - What is research? Innovation? Design?
    - Why not just use existing knowledge?
- Research *vs* Technical Design
- Research Questions & Objectives
- Seminar & Workshop Structure

# Innovation & Research


Research & Innovation: What, How & Why?



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# Innovation & Research

## Why Research in Innovation Projects?

- Innovation research is a scientific investigation into a phenomenon that is not well understood
- Requires collection and interpretation of evidence
- Can shed light on long-standing problem / new opportunities
- Can generate new techniques / solutions for innovation
- Can be applied to optimize products & processes

# Example of ways to present problem/information

It is critical to identify the problem being solved - not the solution.

If you don't correctly identify the problem, your solution might not be the correct one.

Most common mistake is that people *jump to the conclusion* that the absence of their "solution" is the problem.

# Example Case study – Evaluation of active queue management

## Problem

- Noticeable Delays in home networks using conventional queuing techniques (e.g., FIFO) to manage bottlenecks

## Context

- Home applications; specifically, home gateway routers

## Motivations / Questions / Aims

- Interested in evaluating whether active queuing techniques can provide faster resolution, and under what conditions

## Experiments

- Testbed set-up (for simulated & physical experiment)
- Evaluate FIFO, PIE, FQ-Codel

# Case study – Evaluation of active queue management

Hypothesis

- Active techniques (e.g., PIE and CoDel) will perform better than conventional FIFO under targeted scenarios

Critical assumptions

- Simulation must imitate a realistic home connection settings
- Focus on download and upload bandwidth
- Bandwidth size of 50/20 with 10 connections

Significance

- Reliable internet experience without additional cost

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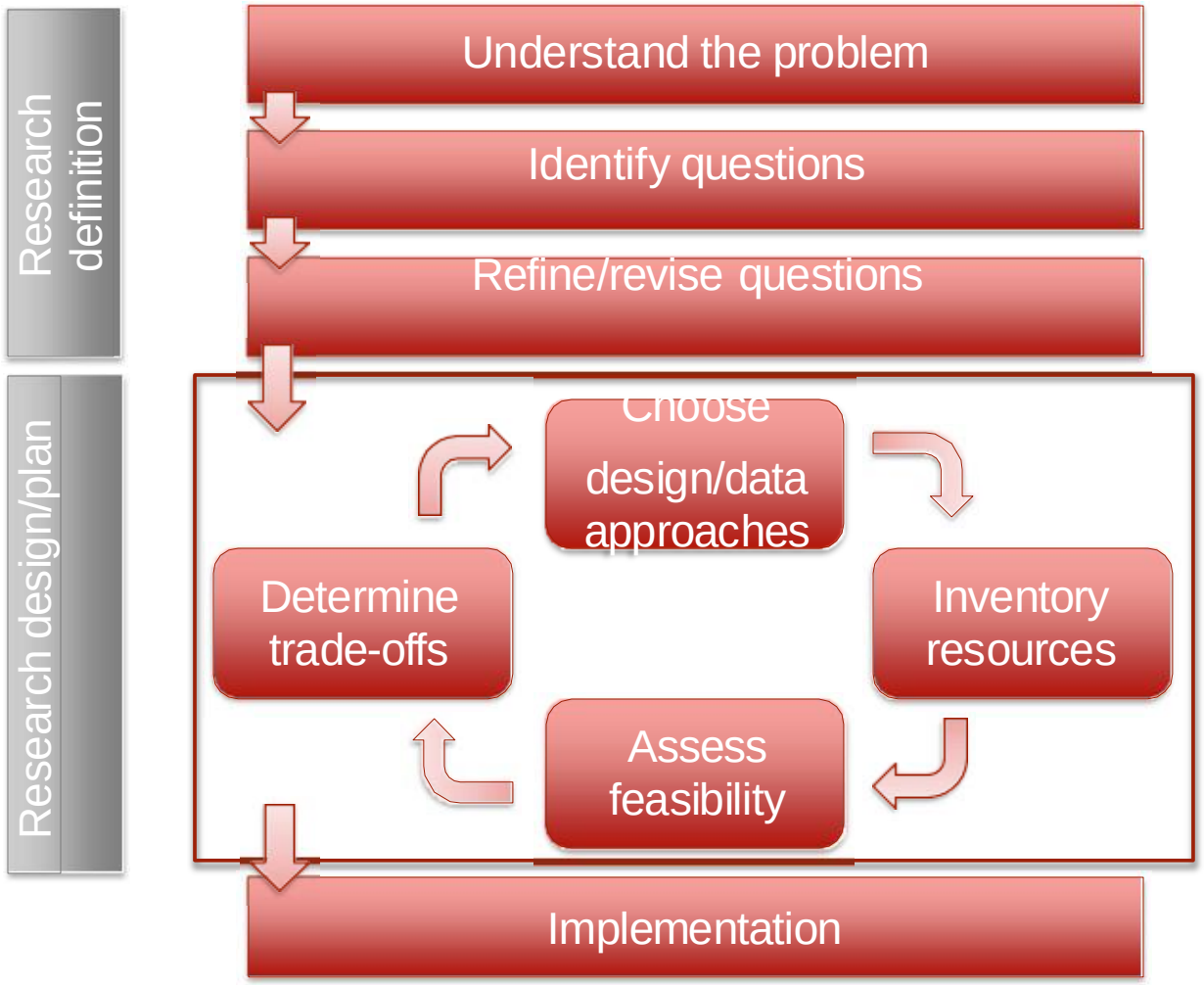
# Innovation & Research




Hedrick et al.

# Innovation & Research

## Research & Professional Attributes

- Thinking skills – critical, lateral, independent, judgement
- Literacy skills – reading, synthesis, sense-making
- Analytical skills – big picture and detailed picture analysis
- Communication skills – technical, written and verbal
- Professional skills – independence, teamwork, negotiation
- Project management – time, risks, resources, expectations
- Problem solving skills – design, technical, stakeholders

# Research versus Design

## Design Projects

- Design aims to provide a solution to a given problem
- Design requirements / outcomes are usually pre-defined at the onset of a design process

## Research Projects

- Research aims to shed light on a problem
- Research outcomes are typically not pre-defined at the onset of a research process, although there might be some hunch about what the outcome could be (hypothesis).

# Research versus Design

Research versus Design

## Design or Research Problem?

- Project aims to develop an error-correcting code (ECC) for improving speed and accuracy of keyboards (design)
- Project aims to show how an ECC-software can improve typing speed and accuracy of a keyboard design (research)

# Research & Innovation in Technology Projects

- Technology innovation project can be of an analytical, experimental, design or computational nature
- Requires clear problem framing for the research component of the project
  - Research questions (hypothesis, if appropriate)
  - Specific aims & objectives
  - Scope (delimitation) & constraints (limitations)
  - Practical / theoretical implications of work

# Research Questions & Objectives

- Research question should be a well-articulated line of query derived from a good understanding of the problem
- Should be backed up with clear justification that argues for its theoretical and practical significance
- Can be supported by clearly stated objectives or hypotheses relating to the research question or aim

**Example format:**

- Research aim or question 1.0 (with justification)
  - Objective 1.1 (with explanation)
  - Objective 1.2 (with explanation)

# Research Questions & Objectives

## Samples of Poorly formed Research Questions

*What is the best routing algorithm or technique for home router applications?*

- Parameters not identified in the question
- Not clear if “best” means the technique that outperforms others across all relevant parameters

*What factors affect the speed of an underwater robotic fish?*

- Can be answered through literature review
- Better to identify a set of factors and then evaluate the impact of those factors (e.g., tail size) on speed

# Samples of Good Research Question / Objectives

## Samples of Poorly formed Research Questions

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# Innovation & Research

Research Question:

To what extent does changes in tail size affect the speed of an underwater robotic fish?

- Objective 1.1: To identify the speed of movement of the robotic fish w.r.t tail sizes (explain).
- Objective 1.2: To develop a mathematical model for predicting the speed of a robotic fish based on its tail size (explain).
- Objective 1.3: To determine the range of sizes that are most appropriate for a given underwater operation (explain).

# Innovation & Research

## Highlighting the Assumptions

### Assumptions:

- Highlights the need to be open about preconceptions and biases relating to the research problem

### Some example assumptions in research:

- The phenomenon can be measured reliably
- The parameter is a good measure of what is being tested
- The techniques applied will produce a realistic and reasonably valid result
- Controls applied are good enough to stop errors in results

# Innovation & Research

## Clarifying the Scope & Constraints

### Delimitations (Scope):

- Explains the boundaries of the proposed study; that is, what to do and what the proposed study will not cover

### Examples

- Study will focus on only one type of gamification technique
- Study will not investigate the relative performance of various gamification techniques
- Study will not examine whether quality of video / digital contents influences engagement

# Innovation & Research

Clarifying the Scope & Constraints

## Limitations (Constraints):

- Explains the constraints on the researcher to influence or change important variables in the proposed study

## Examples

- Natural variations in student motivation and computer- related skills may sway the results
- The results may not hold for different gamification techniques

# Innovation & Research

## Clarifying the Research Problem

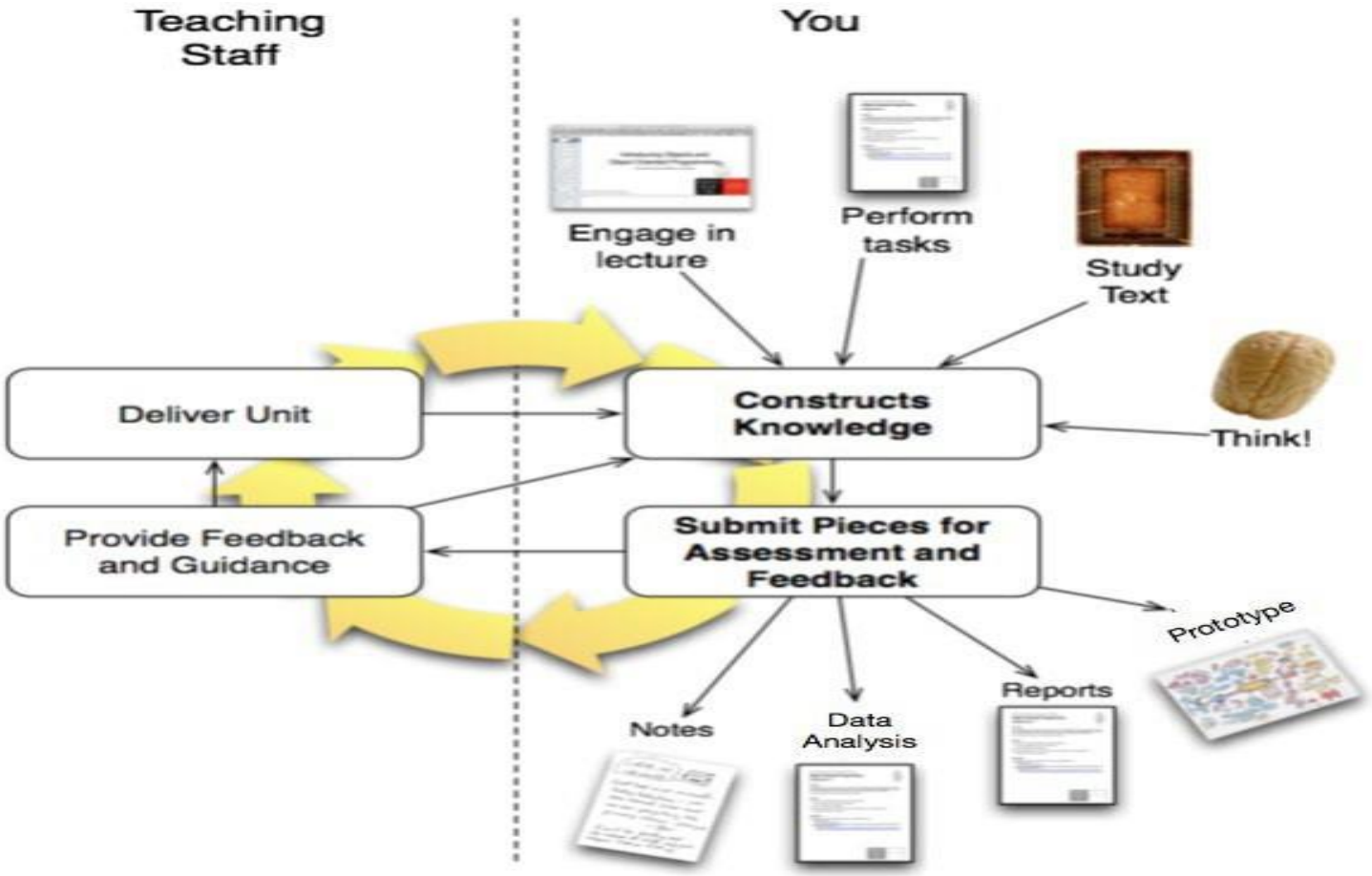
### Significance / importance of research:

- Highlights both the theoretical and practical implications of the proposed study

### Examples

- This study will shed light on the factors that contribute to student learning (theoretical)
- Enable us to accurately measure the impact of gamification on student engagement (theoretical)
- Useful for understanding where and what to invest in when optimising student engagement students (practical)

# Seminar & Workshop Structure



# Teaching & Learning Structure

## Professional Seminar 2 (Wednesday 4:30 – 5:30pm)

## Professional Workshop 2

- Wk2/04 Thursday 8:30 -10:30 am EN202
- Wk2/03 Thursday, 10:30 am - 12:30 pm BA801
- Wk2/01 Friday, 10:30 am - 12:30 pm BA801
- Wk2/02  Friday,  12:30 - 2:30pm EN308
- Exercises based on lessons from seminar 2
- Consultations on research & professional matters

# Teaching & Learning Structure

## Learning activities

**Weeks 1-3:**

- Developing Research skills
- Developing Literature review skills

**Weeks 4-9:**

- Professional Writing
- Professional communication
- Reflection & Reflective practice
- Academic integrity & Plagiarism

**Weeks 10-12:**

- Professional Ethics
- IP, Legal & Professional Issues
- Professional Presentations

# WRAP-UP

By the end of this Week:

1. You should be able to clarify the research aspects of your technology innovation project.
2. You should be able to clarify the research question and a set of objectives for your project.
3. You should be able to discuss the expected research outcome and deliverables with key stakeholders.
4. You should start thinking about your first assessment – Research report

# NEXT WEEK

In the Professional Seminar & Workshop classes:

1. We will explore Library search techniques and databases.
2. You will learn how to critically appraise scholarly articles for quality and reliability.
3. You will be trained on how to find relevant articles for your technology innovation project.