Hei!!!

4..6 students per table, ideally 5

Research Methodology for Technology

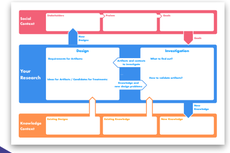
Start thinking about the thesis topic.

Start thinking about the method.

Apply what you learn about the method to your problem.

Read more about the method based on what you need.

Have a good plan about the thesis topic and the method.



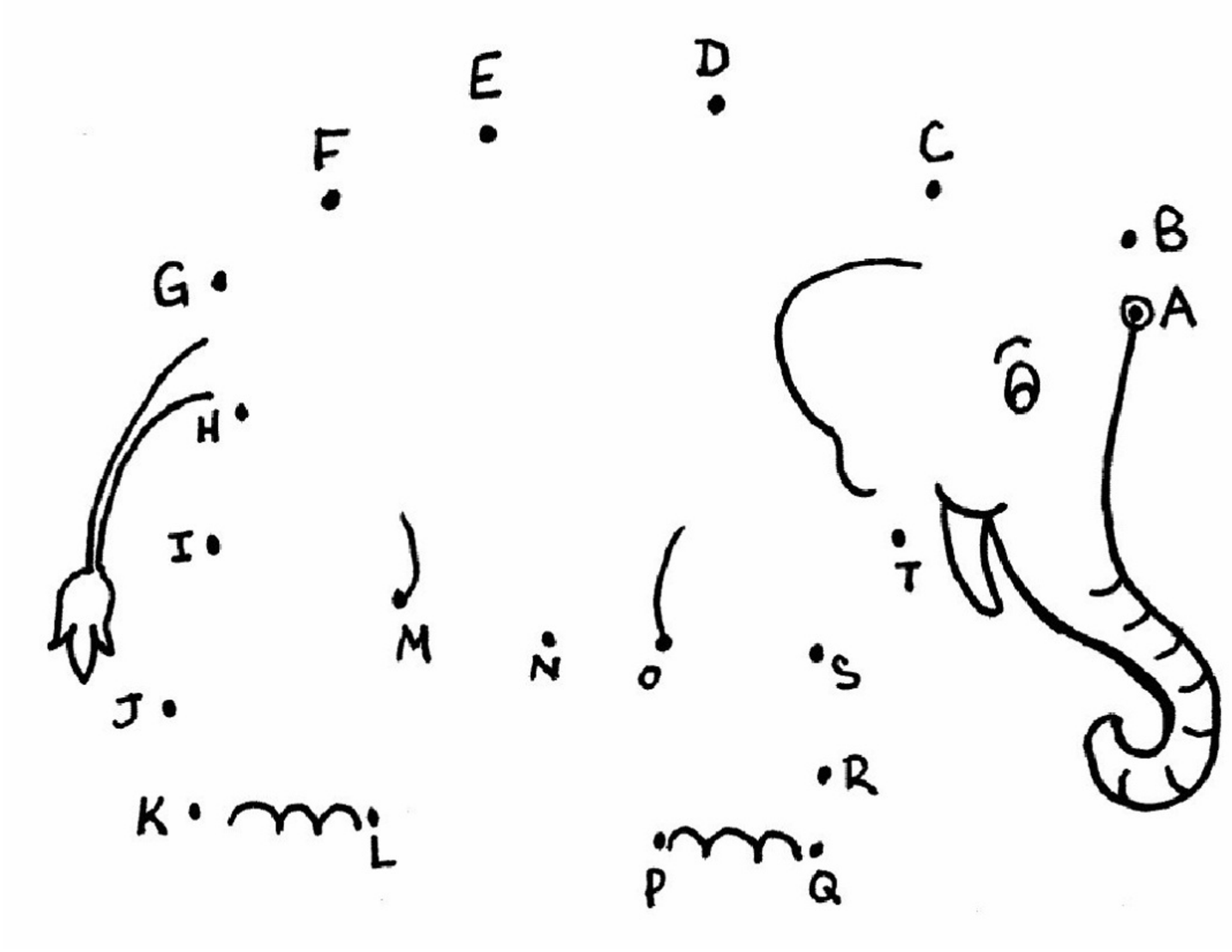
Fill out the design science scheme. (Repeatedly)

Read more and find chapters that are especially relevant for you.

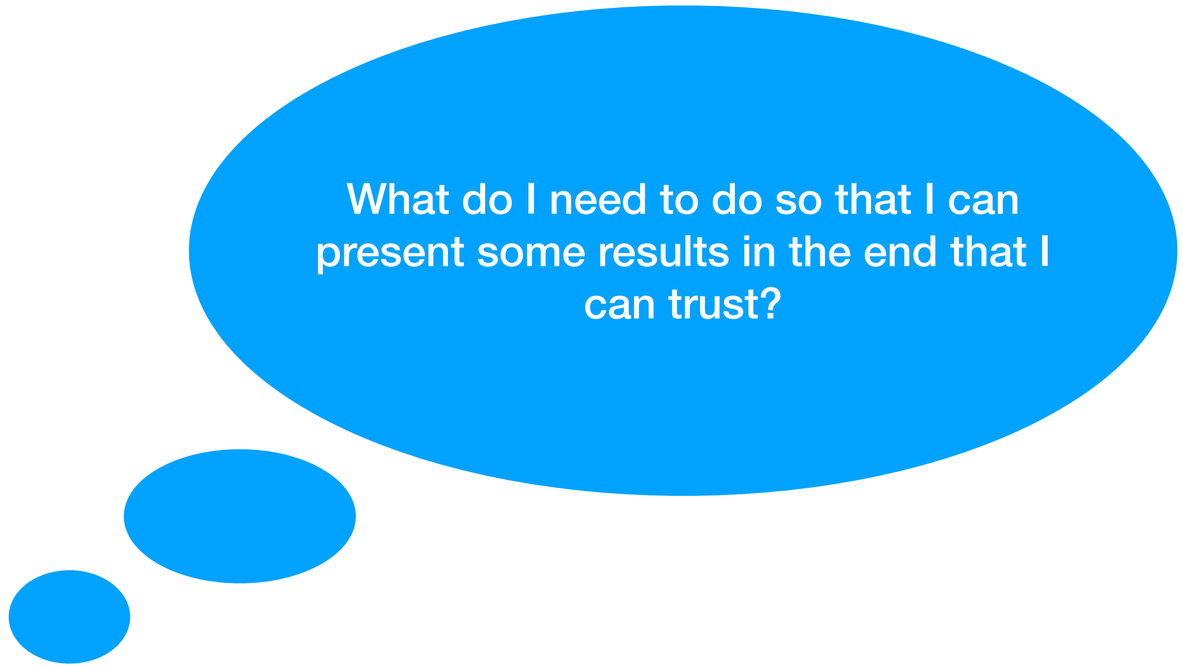
Seminar

Symbol	Description	General, qualitative description of valuation criteria
A	Excellent	An excellent performance, clearly outstanding. The candidate demonstrates excellent judgement and a high degree of independent thinking.
B	Very good	A very good performance. The candidate demonstrates sound judgement and a very good degree of independent thinking.
C	Good	A good performance in most areas. The candidate demonstrates a reasonable degree of judgement and independent thinking in the most important areas.
D	Satisfactory	A satisfactory performance, but with significant shortcomings. The candidate demonstrates a limited degree of judgement and independent thinking.
E	Sufficient	A performance that meets the minimum criteria, but no more. The candidate demonstrates a very limited degree of judgement and independent thinking.
F	Fail	A performance that does not meet the minimum academic criteria. The candidate demonstrates an absence of both judgement and independent thinking.

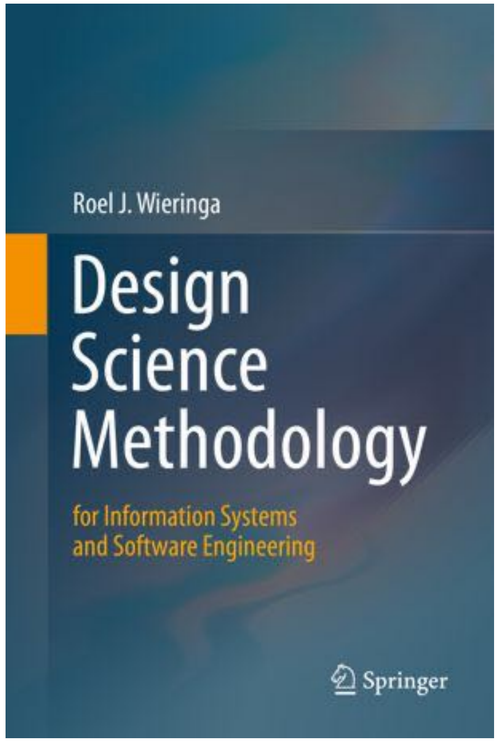
What you would like writing a thesis to be...



How it actually is...


What do I need to do so that I can present some results in the end that I can trust?

basis for this seminar



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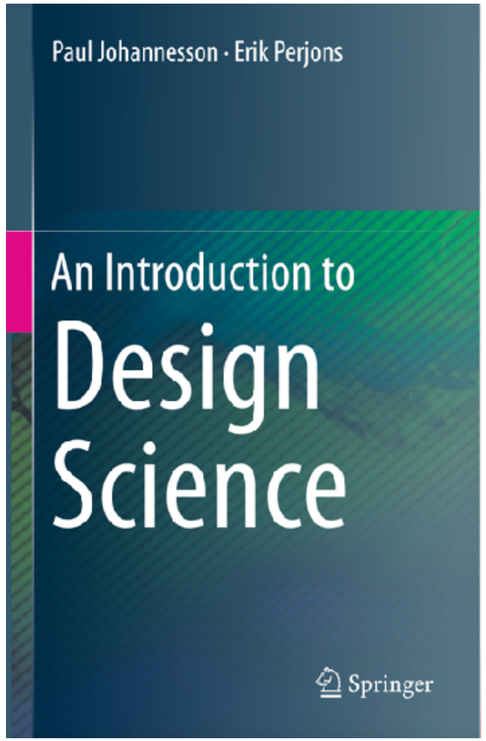

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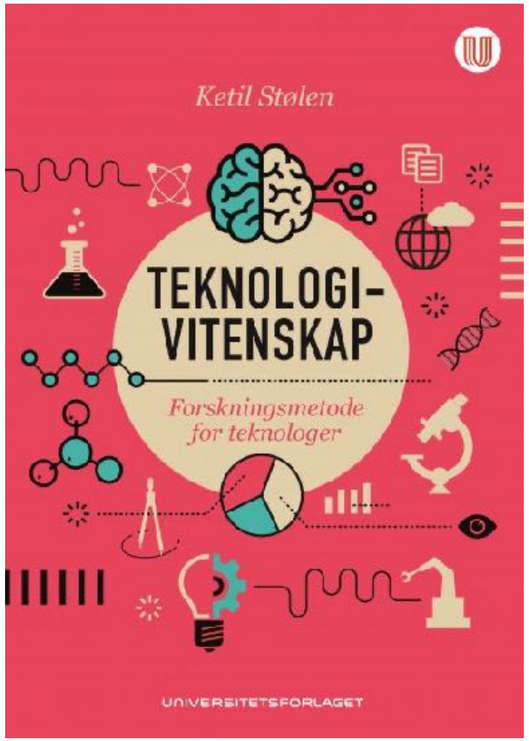

2019

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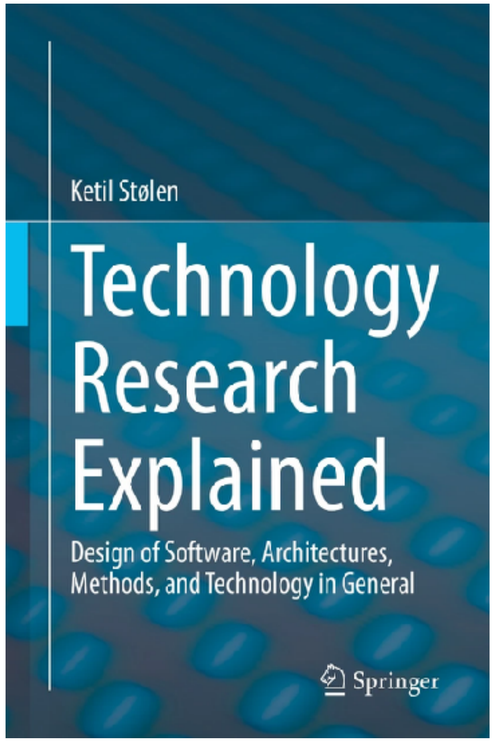

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Readiness Assurance Test - Team

- Find the right answer **in your teams.**
- Choose the answer that fits **best.**
- No helping material.

15:00

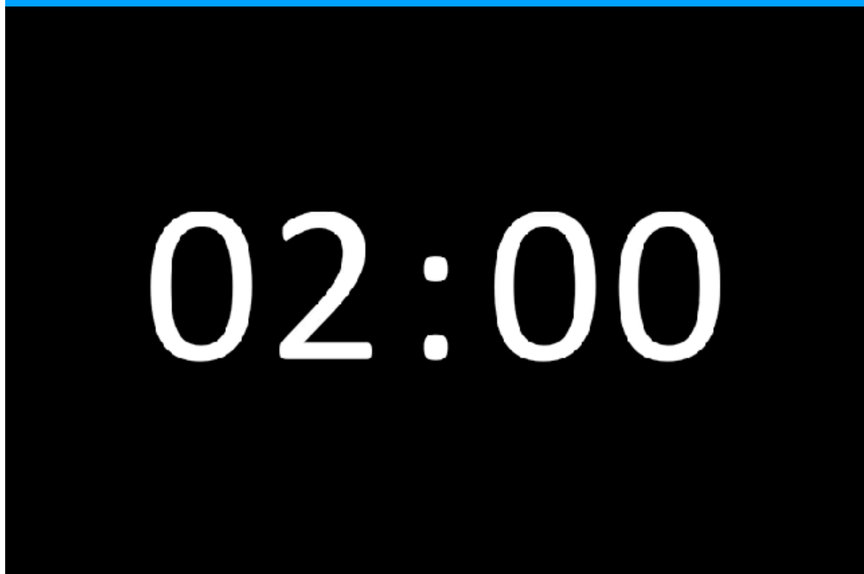
More thoughts…

- We don't want you to just “imitate” scientific working
- Working scientifically is not something we would “like” you to do, it is not an optional “cult” or “tradition” — there is a reason for it.
- Working scientifically means that we ensure a proper process, so that our results are valid and relevant.
- Reasoning about a scientific process is hard, as it depends on the specific area, what is possible, philosophical questions,…
- There is no precise and compact definition of the scientific method.
- This seminar is not intended to give you all answers or detailed instructions, but to understand the motivation, some of the basic terms and get you started.
- Maybe one of the hardest seminars in your studies. Seems simple at the surface, but requires a high level of individual thinking.

Question - Individual

- Think and make notes:

  What is a good definition for ***valuable knowledge****?*

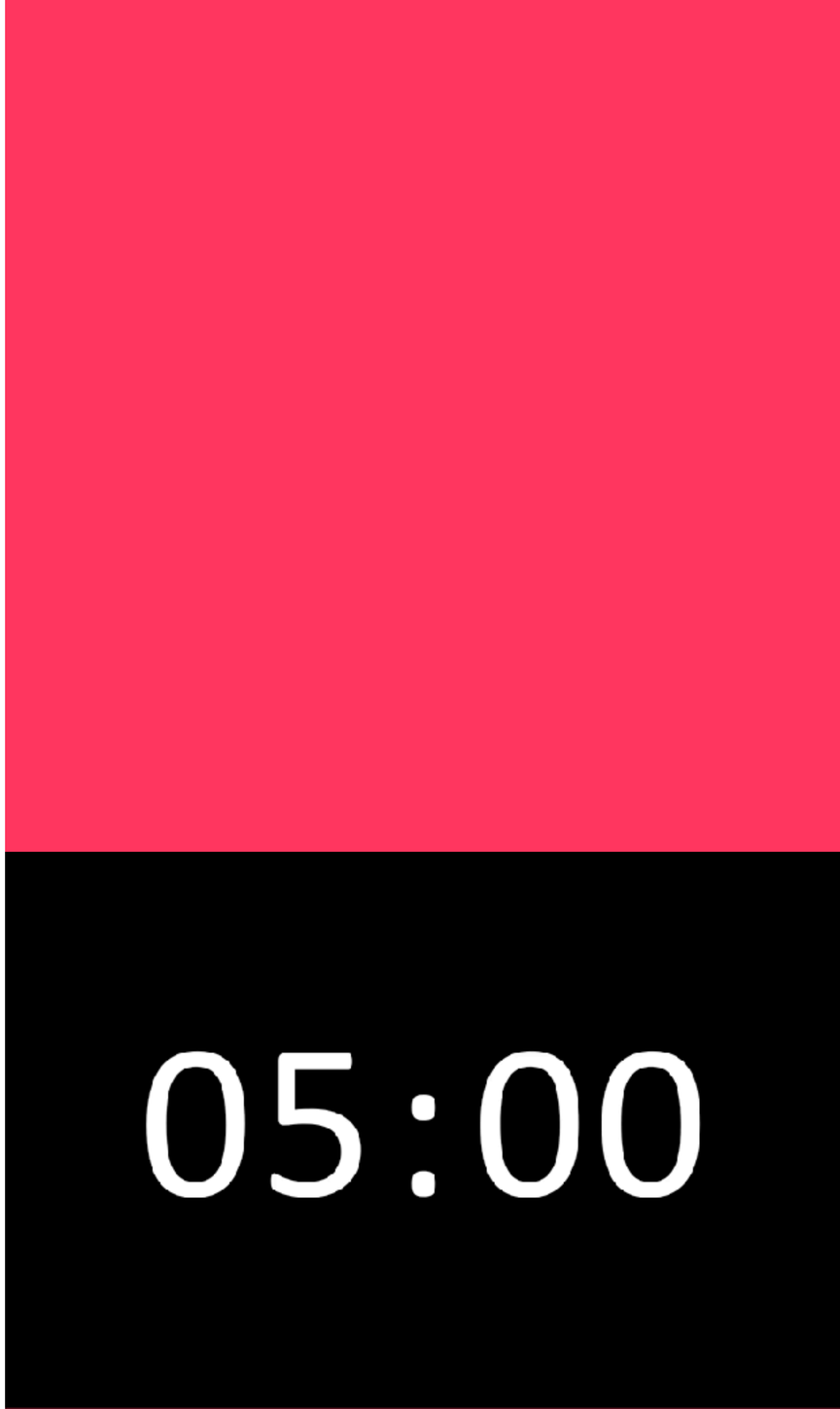


Question - Team

- Discuss and make notes:

  What is a good definition for ***valuable knowledge****?*

Notes:



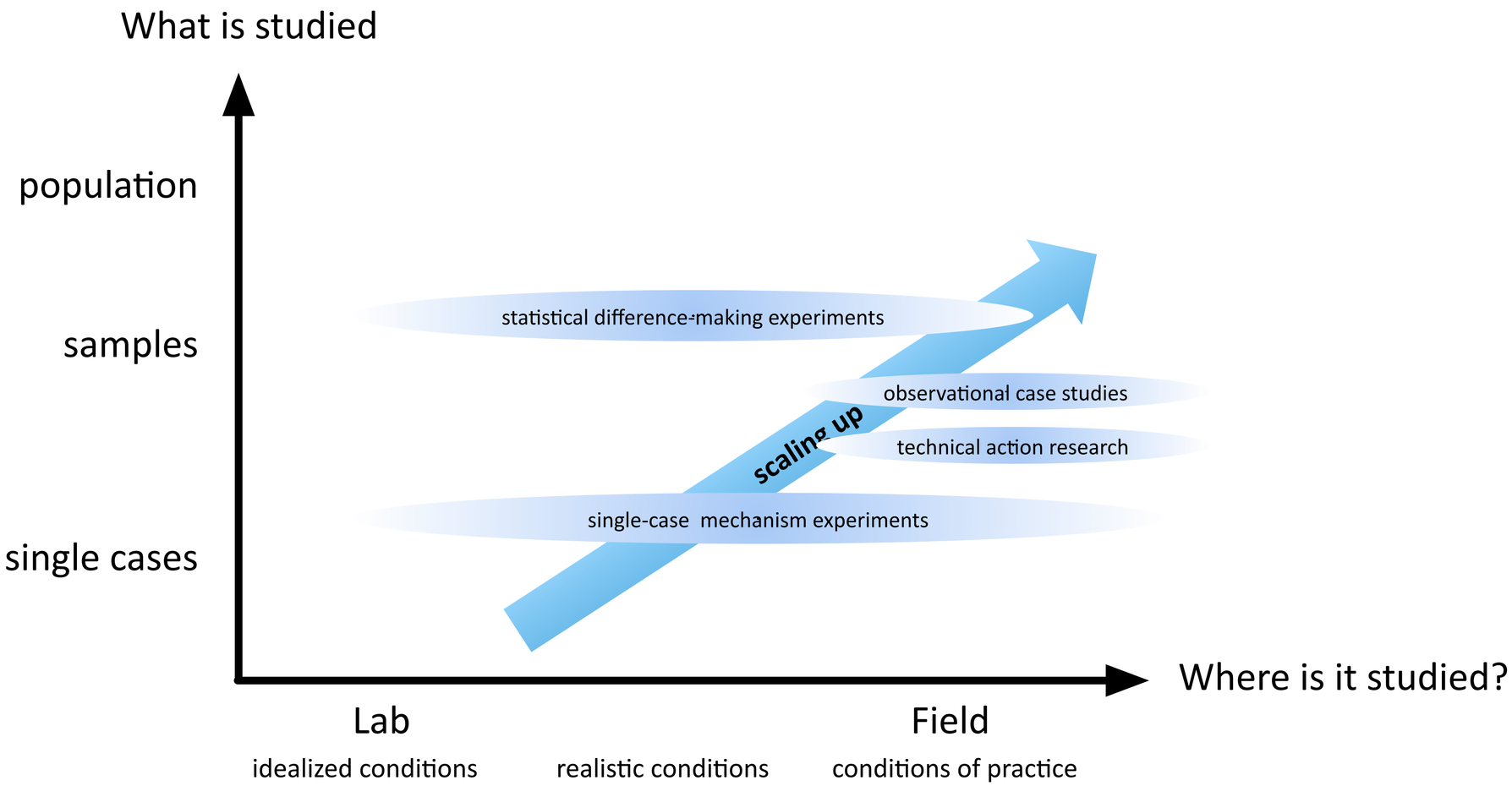
Break

Validation

Validation

- Aim: *“justify that [a treatment] would contribute to stakeholder goals if implemented”* and *“The goal of validation is to **predict** how an artifact will interact with its context, without actually observing an implemented artifact in a real-world context.”*
- *Usually done in a lab, or lab conditions.*
  - *(That means, not the real world.)*
- *You produce results (only) through validation.*

Scaling Up


What is studied
population
samples
single cases
statistical difference-making experiments
observational case studies
technical action research
scaling up
single-case mechanism experiments
Where is it studied?
Lab
idealized conditions
realistic conditions
Field
conditions of practice

Design Cycle
and
Empirical Cycle

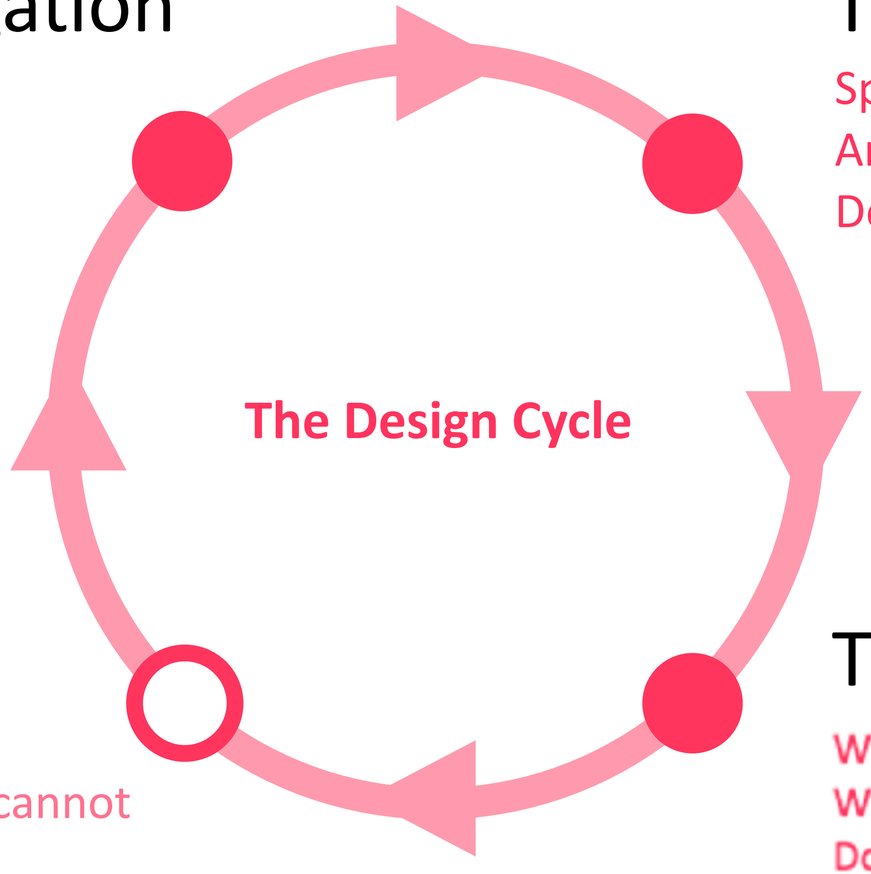
Design Cycle

Problem Investigation

Who are the stakeholder?
What are their goals?

Treatment Design

Specify the requirements.
Are there available solutions?
Design a new artifact.



Treatment Implementation

This step is only part of the engineering cycle, and you cannot do this step in your thesis.

Treatment Validation

What are the effects of the artifact?
What are the tradeoffs?
Do the effects satisfy the requirements?

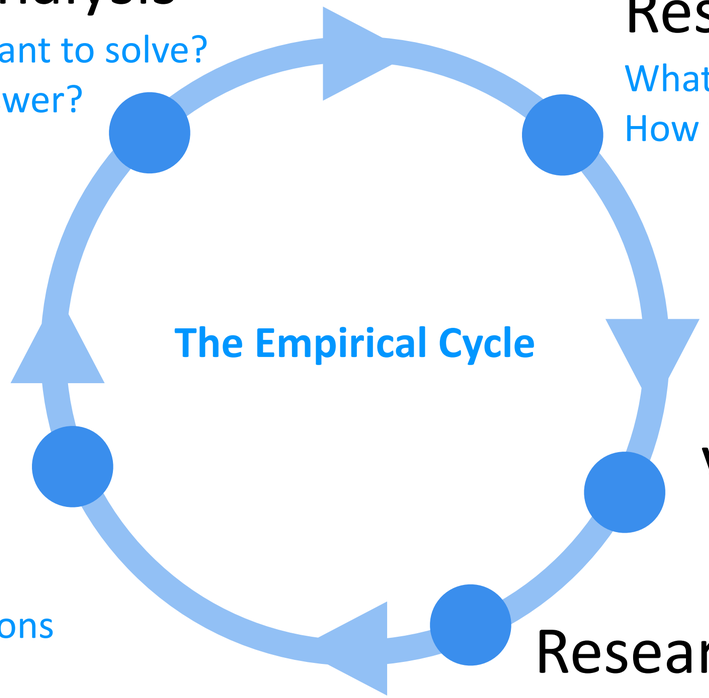
Empirical Cycle

Research Problem Analysis

Which research problem do we want to solve?
Which knowledge question to answer?

Research and Inference Design

What are we going to do?
How to come to conclusions?



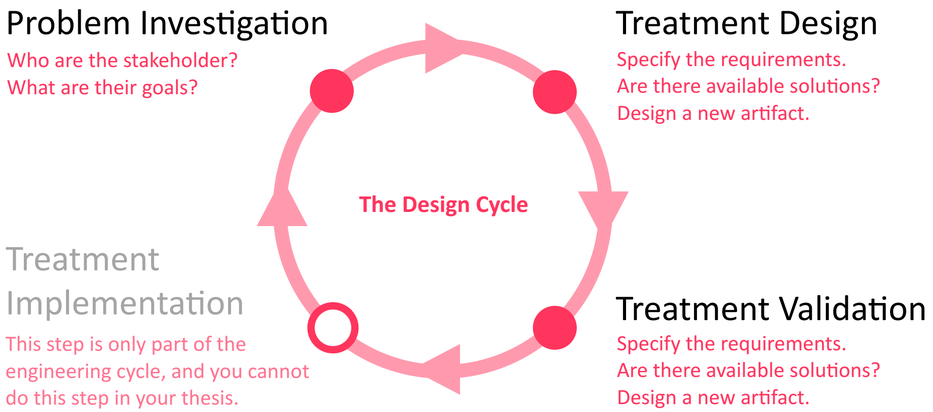
Validation

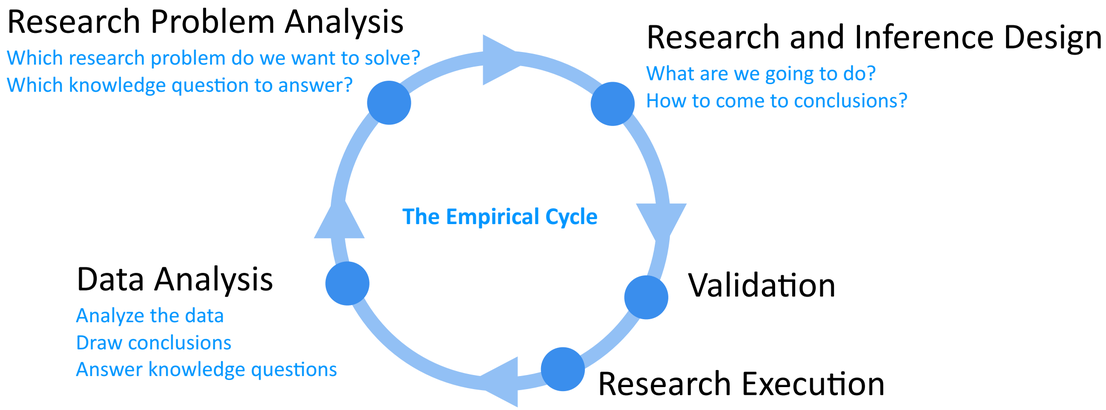
Research Execution

Data Analysis

Analyze the data
Draw conclusions
Answer knowledge questions

Design Cycle and Empirical Cycle

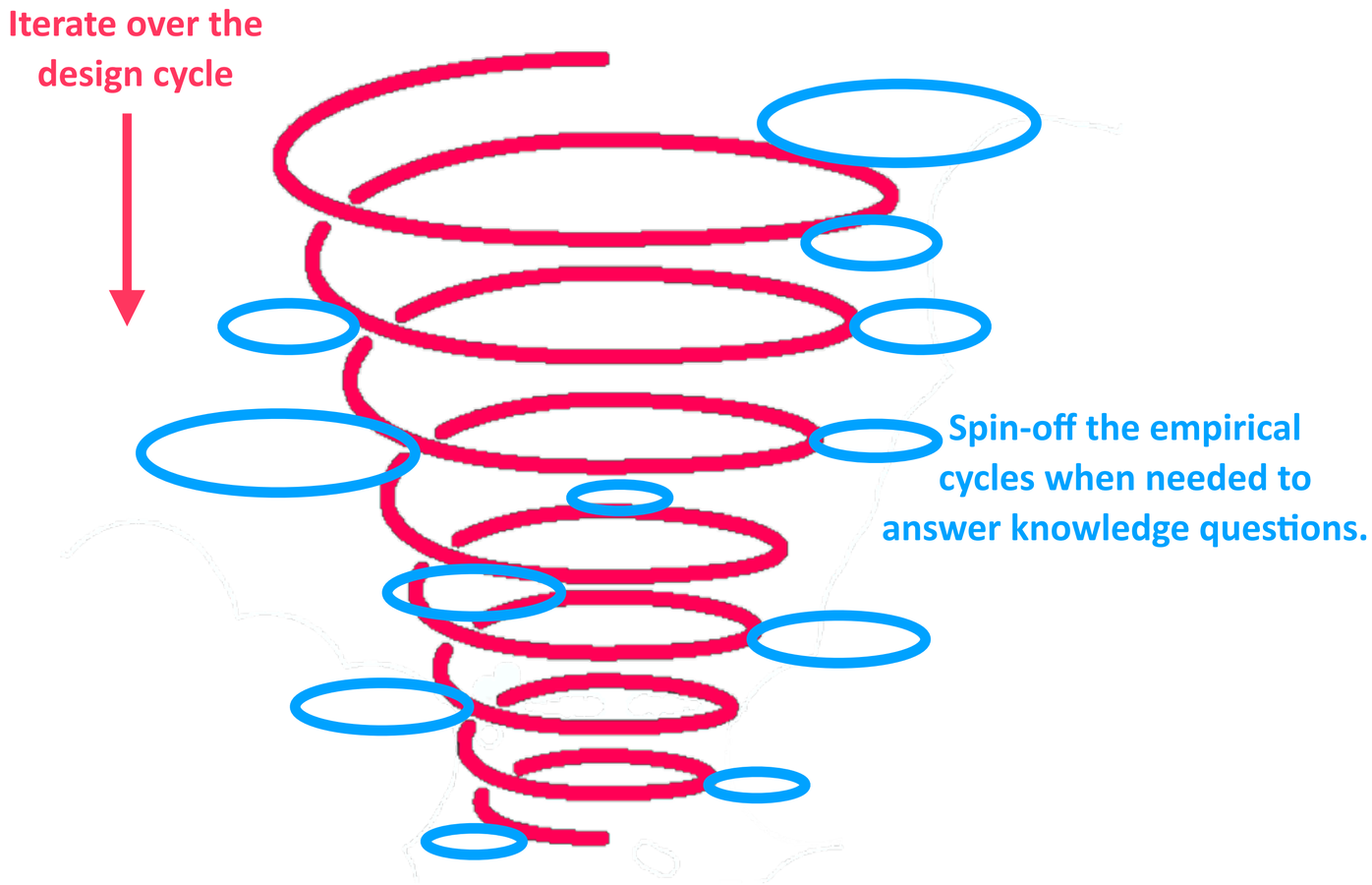




To solve design problems

To answer knowledge questions

Design Cycle and Empirical Cycle

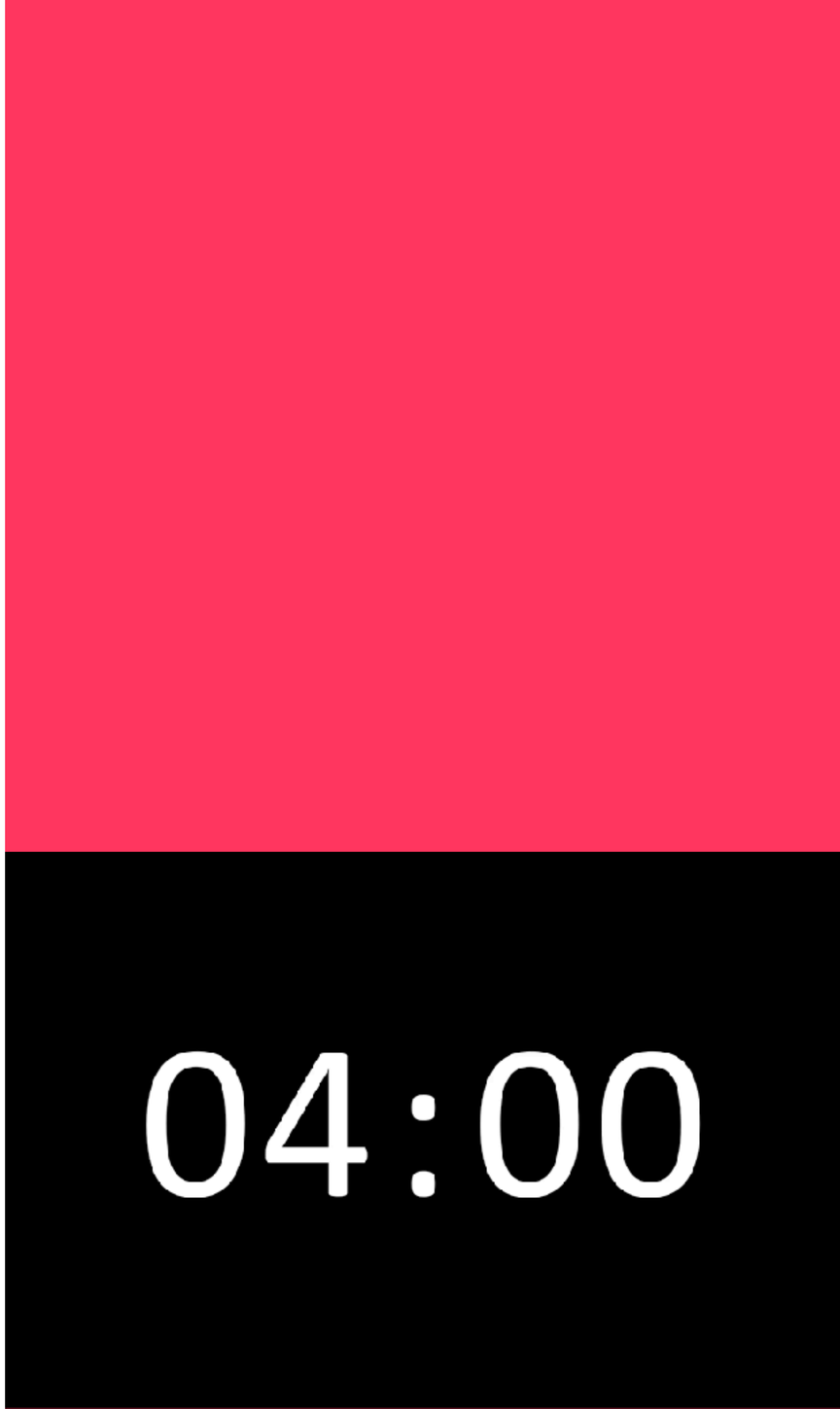


Question - Individual

- Think and make notes:
  How should a thesis map to design and empirical cycles? (one, more,..?)

Question - Team

- Discuss: *How should a thesis map to design and empirical cycles? (one, more,..?)*



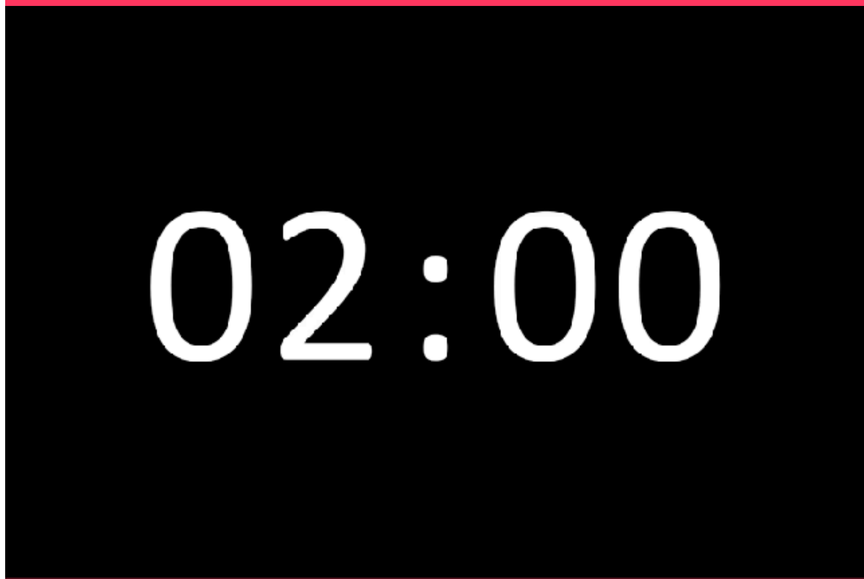
Question - Team

- Choose: *How should a thesis map to design and empirical cycles?*

  A. *For a thesis to be complete, it should contain at least one complete iteration of the design cycle.*

  B. *It is hard to say what can be covered by a single thesis. The thesis can be part of a larger project and only focus on a few elements of a design cycle.*

  C. *For design science to be used correctly, a thesis must go through several iterations of the design cycle.*



The Method Chapter

The Method Chapter

Students often struggle to figure out what the method chapter should contain

> “we used testing”
>
> “we used agile methods”

NTNU

Why I trust my results

The Method Chapter

The Method Chapter

Students often struggle to figure out what the method chapter should contain

- “we used testing”
- “we used agile methods”

Instead, think of the chapter as "Why I trust my results"

How did you gain your results?

- Which form of validation?
- What is the state-of-the-art in the domain to validate?
- Which effects could invalidate the results?

The Method Chapter

This chapter should be specific to your thesis

Don't only write about this seminar or technology science in general, but how you applied it to your specific thesis.

(And don't even mention the seminar.)

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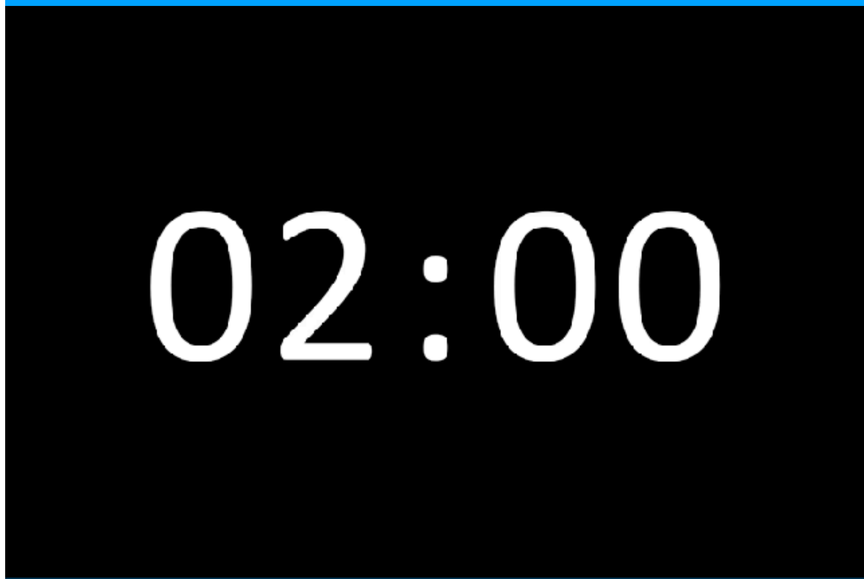
Question - Individual

- What should go into the method chapter?
    - Think of it as
      “Methods: Why I trust my results.”
    - Collect ideas individually first.



Question - Team

- Discuss: *What should go into the method chapter?*

- *maybe: What should **not** go into the method chapter?*

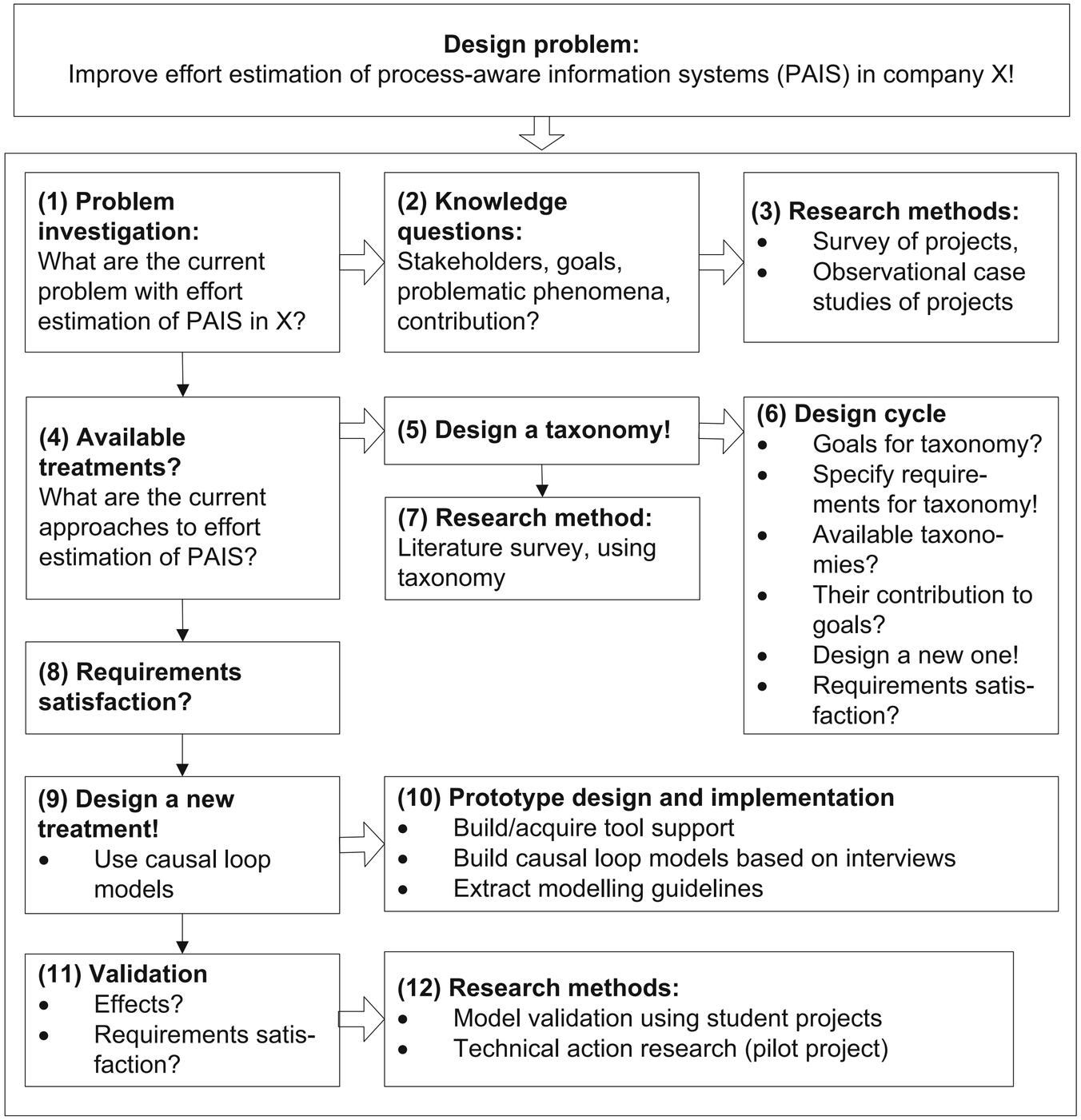
Notes:

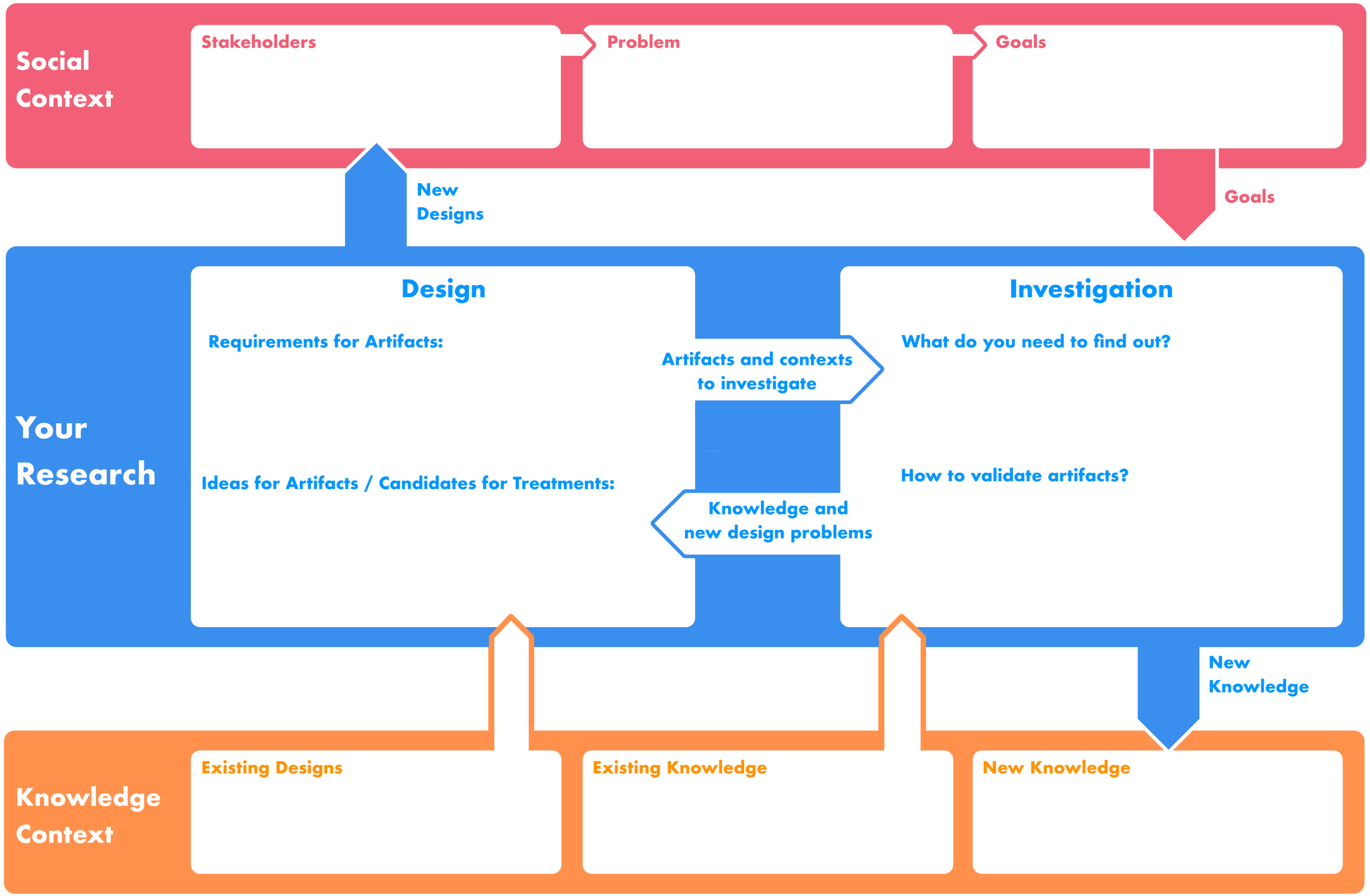
04:00

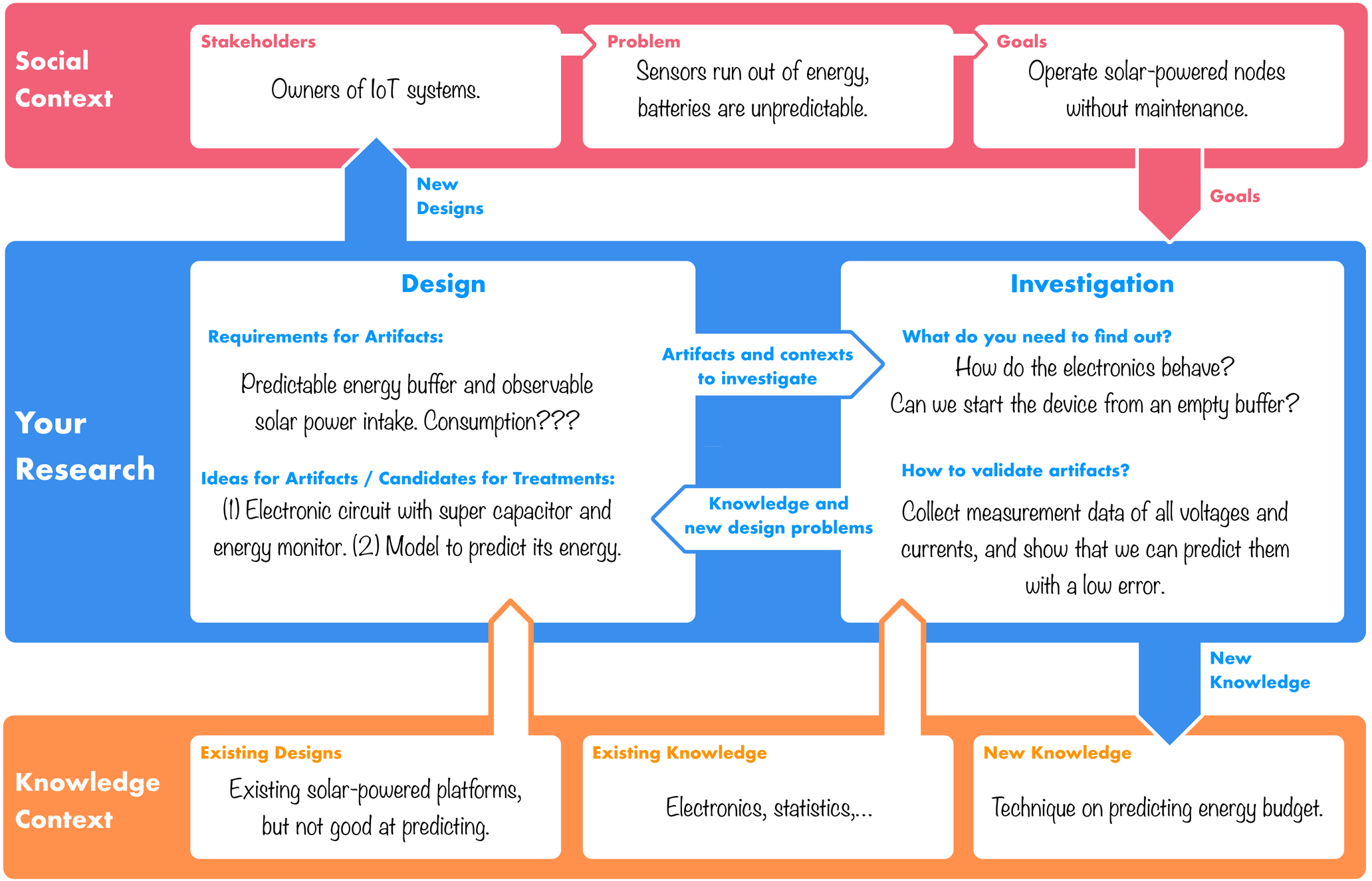
Planning
Your Thesis

Planning your thesis

- Sometimes "planning your thesis" is only done as "planning your report".
- Planning the report is valuable, but it is more meaningful (but maybe harder) to **plan the thesis work first**.
  - Design and research cycles, validations, experiments, discussion items,...
- Once you have the thesis work plan, plan the report
  - What to write where
  - What is needed so the reader understands your work

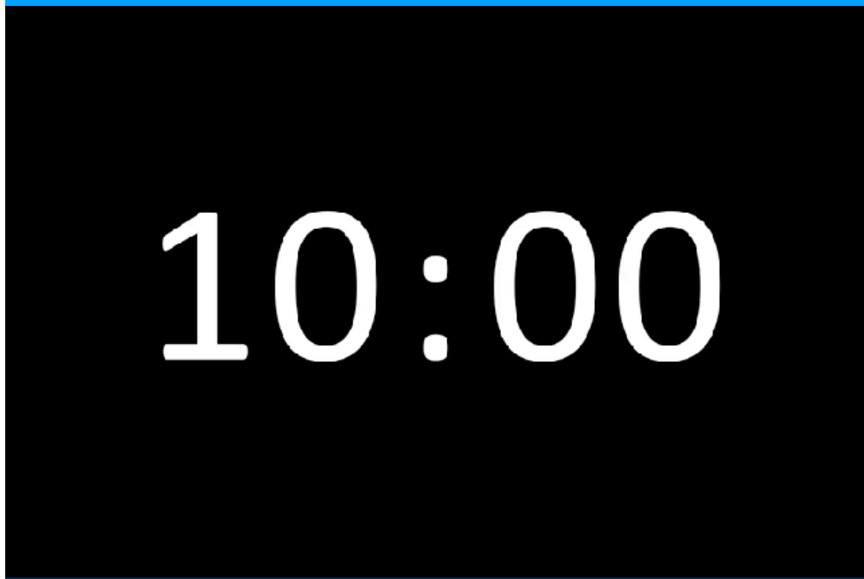

Design problem:
Improve effort estimation of process-aware information systems (PAIS) in company X!
(1) Problem investigation:
What are the current problem with effort estimation of PAIS in X?
(2) Knowledge questions:
Stakeholders, goals, problematic phenomena, contribution?
(3) Research methods:
• Survey of projects,
• Observational case studies of projects
(4) Available treatments?
What are the current approaches to effort estimation of PAIS?
(5) Design a taxonomy!
(6) Design cycle
• Goals for taxonomy?
• Specify require-ments for taxonomy!
• Available taxono-mies?
• Their contribution to goals?
• Design a new one!
• Requirements satis-faction?
(7) Research method:
Literature survey, using taxonomy
(8) Requirements satisfaction?
(9) Design a new treatment!
• Use causal loop models
(10) Prototype design and implementation
• Build/acquire tool support
• Build causal loop models based on interviews
• Extract modelling guidelines
(11) Validation
• Effects?
• Requirements satis-faction?
(12) Research methods:
• Model validation using student projects
• Technical action research (pilot project)


Social Context
Stakeholders
Problem
Goals
New Designs
Goals
Your Research
Design
Requirements for Artifacts:
Ideas for Artifacts / Candidates for Treatments:
Artifacts and contexts to investigate
Knowledge and new design problems
Investigation
What do you need to find out?
How to validate artifacts?
New Knowledge
Knowledge Context
Existing Designs
Existing Knowledge
New Knowledge


Social Context
Stakeholders
Owners of IoT systems.
Problem
Sensors run out of energy, batteries are unpredictable.
Goals
Operate solar-powered nodes without maintenance.
New Designs
Goals
Your Research
Design
Requirements for Artifacts:
Predictable energy buffer and observable solar power intake. Consumption???
Ideas for Artifacts / Candidates for Treatments:
(1) Electronic circuit with super capacitor and energy monitor. (2) Model to predict its energy.
Artifacts and contexts to investigate
Knowledge and new design problems
Investigation
What do you need to find out?
How do the electronics behave?
Can we start the device from an empty buffer?
How to validate artifacts?
Collect measurement data of all voltages and currents, and show that we can predict them with a low error.
New Knowledge
Knowledge Context
Existing Designs
Existing solar-powered platforms, but not good at predicting.
Existing Knowledge
Electronics, statistics,...
New Knowledge
Technique on predicting energy budget.

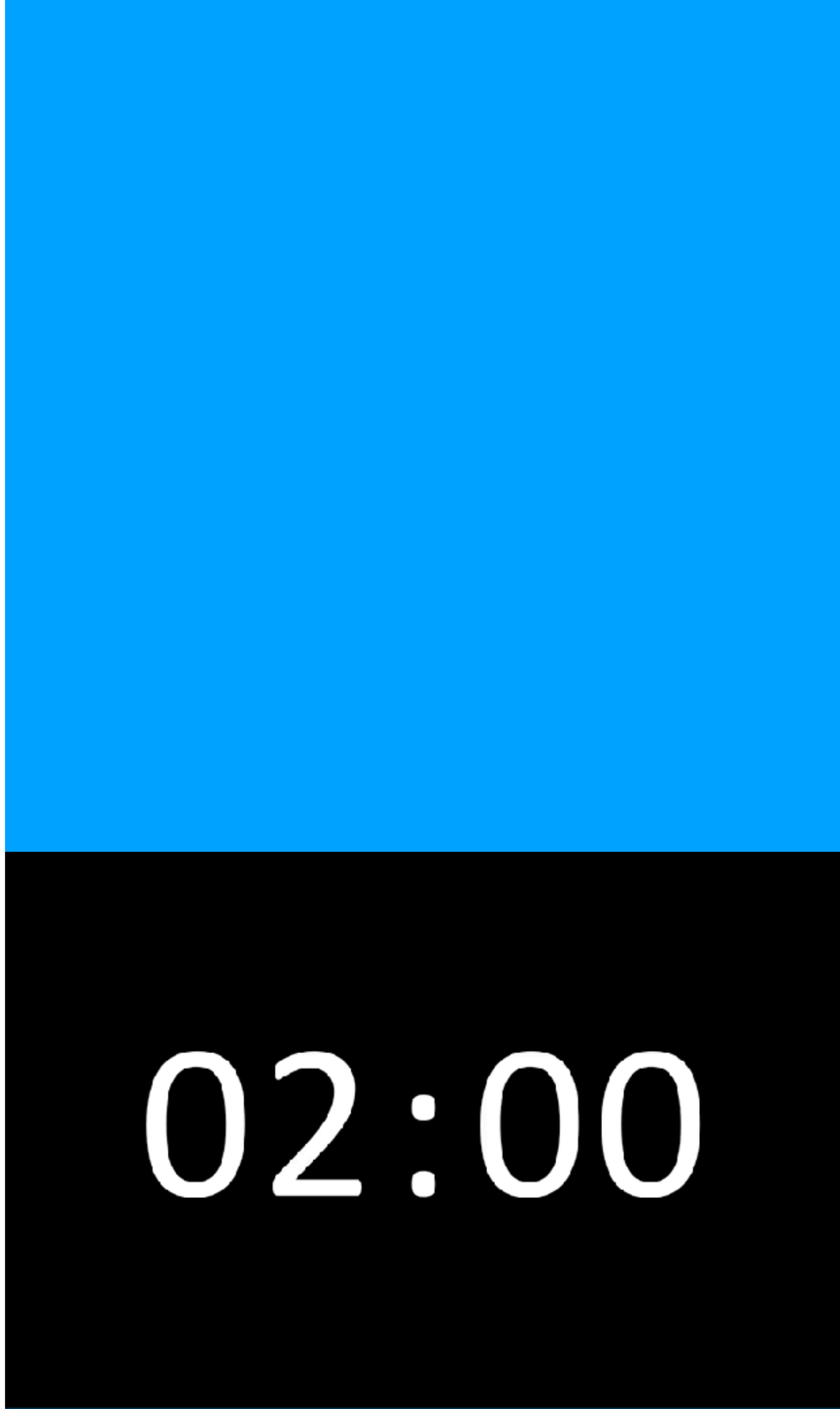
Task - Individual

- Fill out the scheme for **your** master thesis.
- You may not know all details about your thesis yet. Make assumptions.



Task - Individual

- Read the scheme from your neighbour



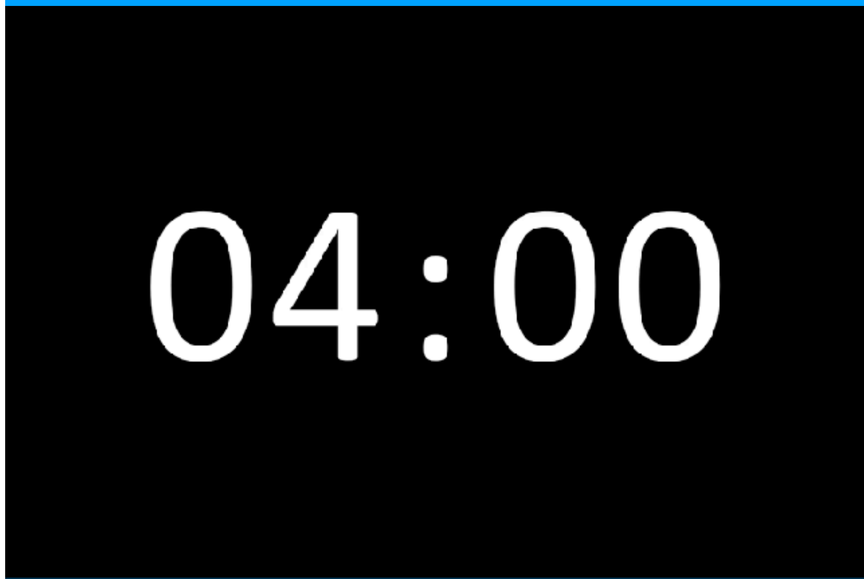
Task - Team

- Explain the scheme to your neighbour, then switch (3 min. each)

03:00 03:00

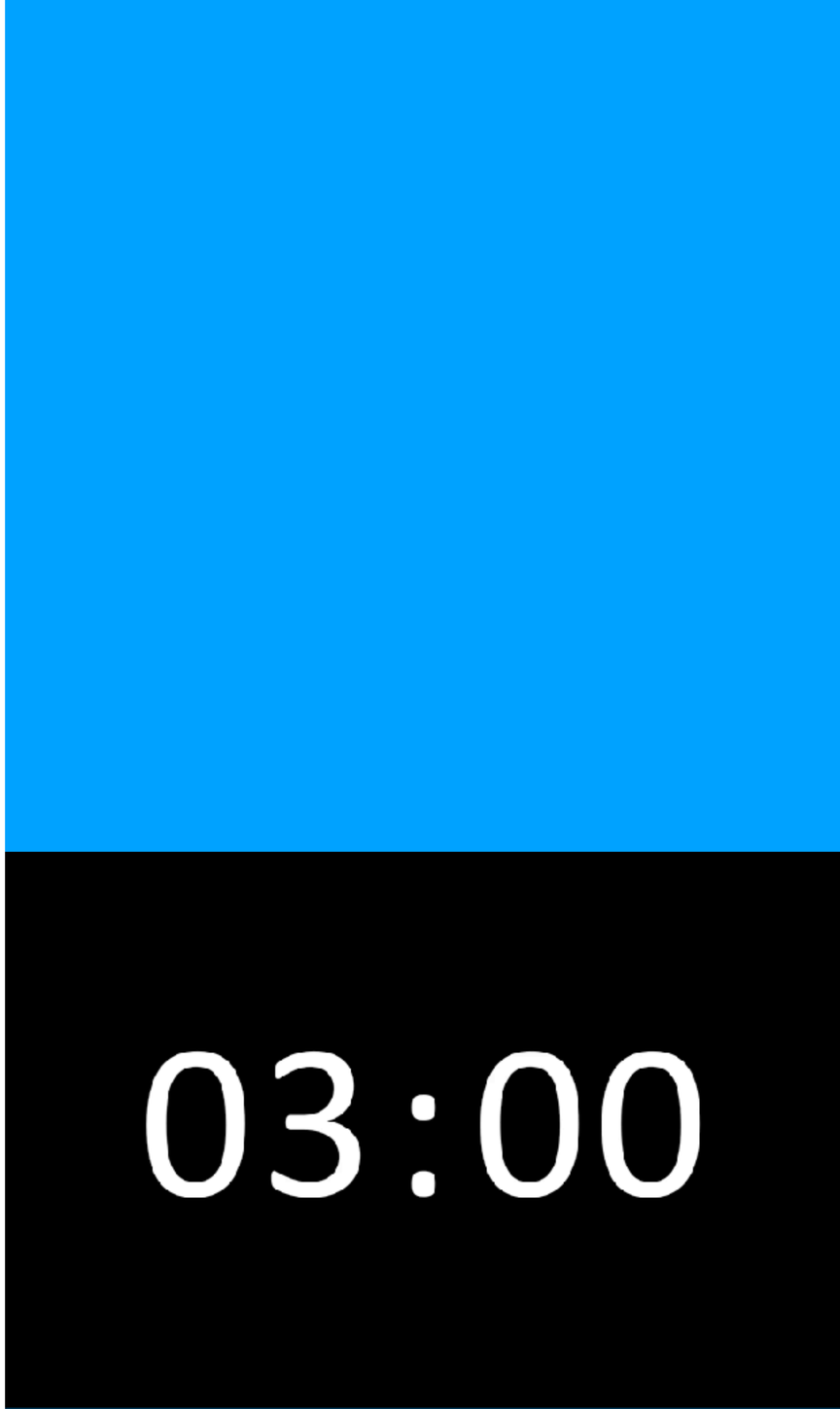
Task - Individual

- Provide **written** feedback to your neighbour
  - Focus: What should be improved, so that the quality of the thesis will be better?
  - Be constructive.



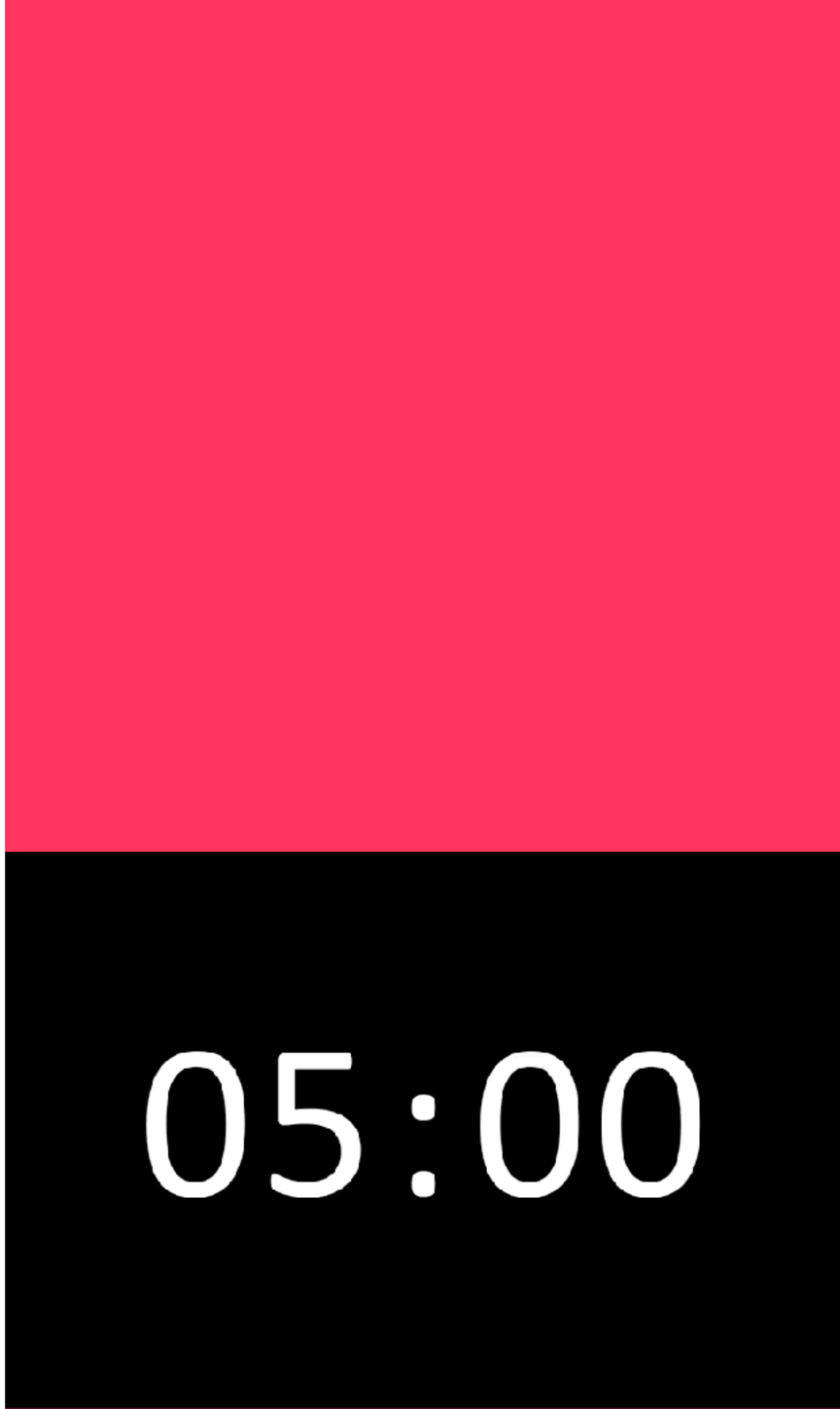
Task - Individual

- Read the feedback.
- Which steps will you take?



Task - Team

- Around the table:
  - What did you learn from this round, what will you do?

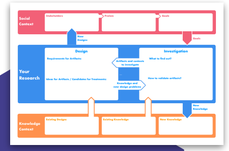


How to proceed

Start thinking about the thesis topic.

Start thinking about the method.

Apply what you learn about the method to your problem.



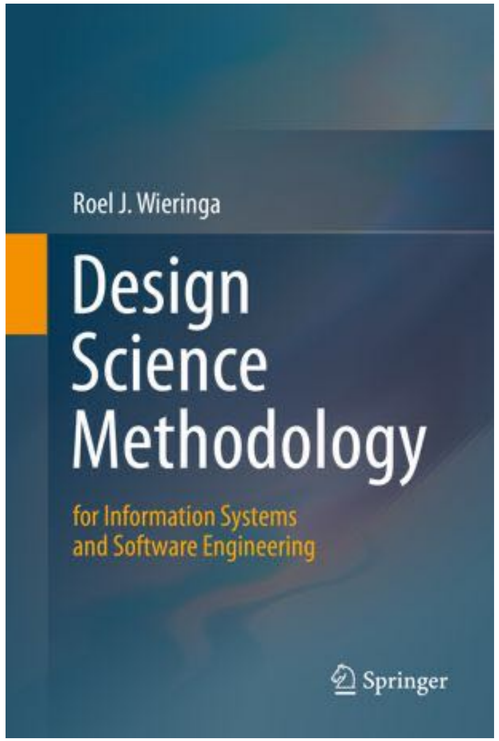
Fill out the design science scheme. (Repeatedly)

Read more about the method based on what you need.

Read more and find chapters that are especially relevant for you.

Have a good plan about the thesis topic and the method.

basis for this seminar



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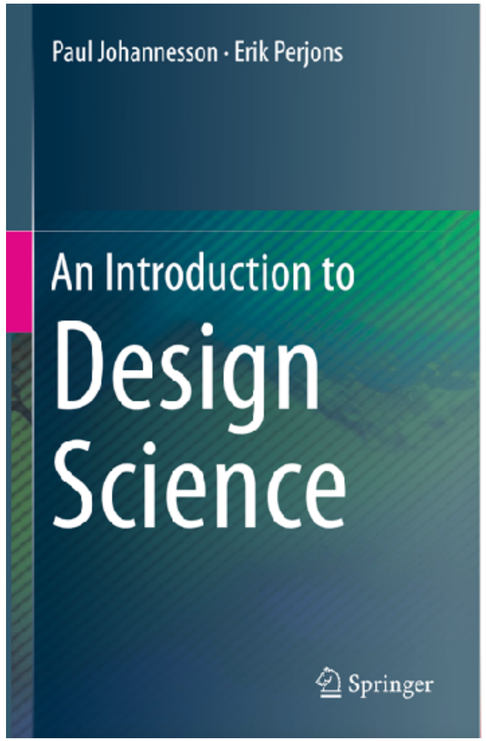

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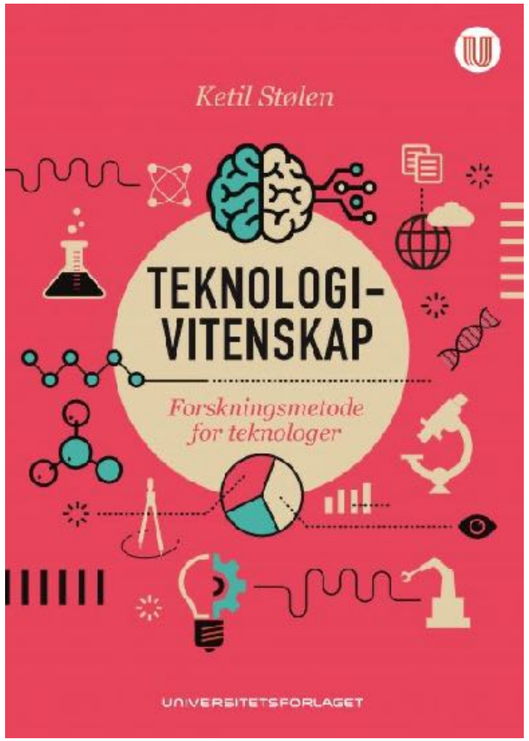

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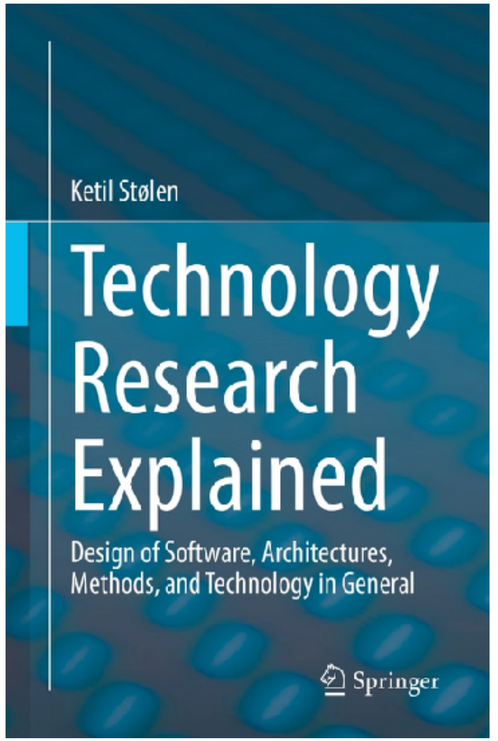

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Tips

- Focus on knowledge
- You need to think for yourself, this is not a complete instruction you can just apply.
- Read those chapters of the book you need
- Talk to your supervisor