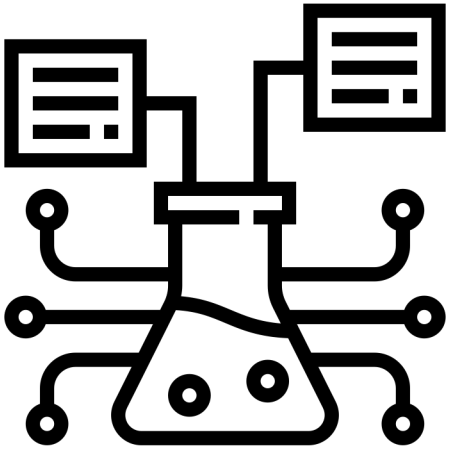


Research Seminar

Research Seminar

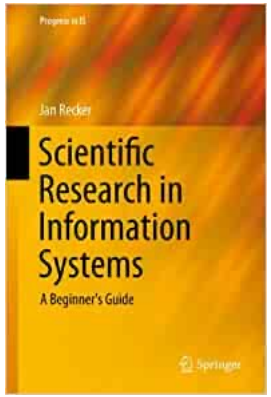
- Goal:
  - Improving the scientific quality of your master theses
- How:
  - Lectures about research methods, literature review, thesis structure, etc.
  - Further papers and books on Moodle
- Deliverable:
  - Thesis Proposal
- Evaluation:
  - Only Pass/Fail

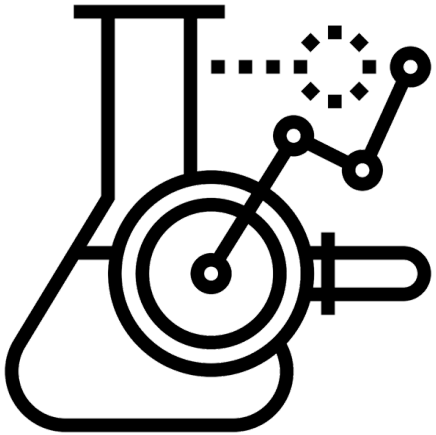
Learning Goals

- Formulate a research question
- Review and synthesize previous research
- Develop a theoretical model
- Select an appropriate research method
- Design a research study to answer your research question

Multi-method Approach

- Different Methods
  - Quantitative research methods
  - Qualitative research methods
  - Mixed Methods
  - Design science (unique to artificial sciences)
- Majority of BIPM master theses use design science
- Main Resource:





What is Research?

What is Research?

“If we knew what it was we were doing,
it wouldn’t be called research, would it?”

- Albert Einstein

What is Research?

- The defining characteristic of research is that it results in new knowledge
- Must answer a question no-one has answered (or possibly even thought of) before
- Fundamentally different to undergraduate study

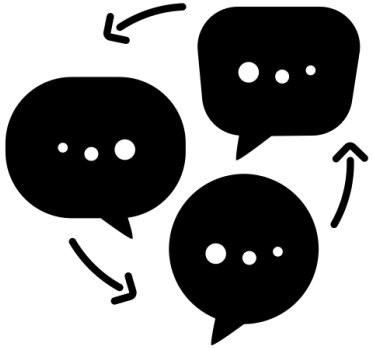
Shifts Required

Undergraduate study	Master and PhD Level
Understand and remember knowledge	Create new knowledge
Apply knowledge to solve known problems	Apply knowledge to solve new problems or solve known problems in new and better ways
Knowledge primarily obtained from textbooks	Knowledge primarily obtained from scientific journals and conferences
Knowledge accepted as valid (unquestioned)	Knowledge critically evaluated

What is Research?

A systematic process for answering questions and solving problems

- More reliable than methods commonly used in everyday life
- Answers based on analysis of facts (data) rather than common sense, experience etc.



What is the Purpose of Scientific Research?

Errors in Personal Experience

Cognitive biases:

- Confirmation bias
- “Halo” effect
- Selective observation
- Over-generalization
- Premature closure
- Cognitive Dissonance
- …

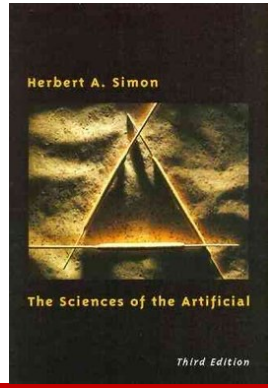
Purposes of Research?

Understand

- Research to describe & explain (understand vs. evaluate) the world around us
- Science of the Natural
- Science of the “Not so Natural”
  - Social Science, Business, Sociology, Political Science
- Methods
  - Quantitative
  - Qualitative

Improve

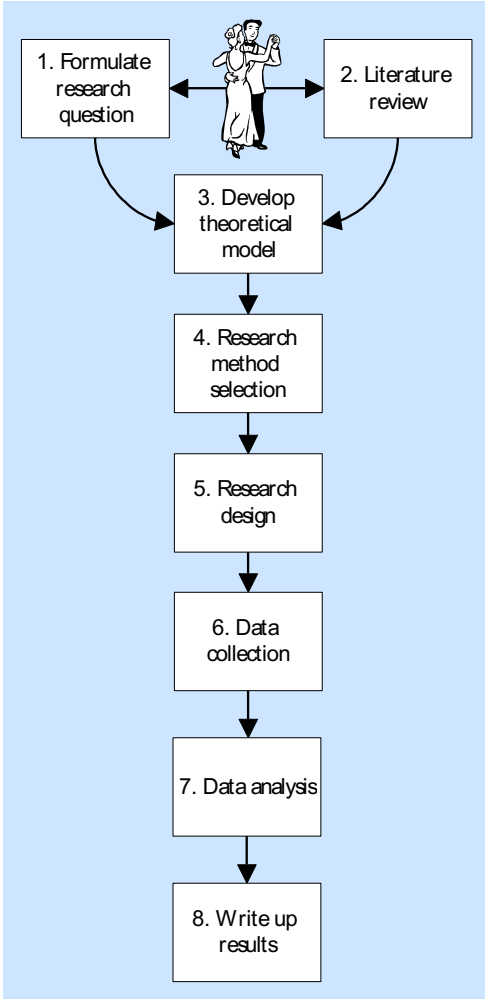
- Research to improve the world
- Science of the Artificial (Herbert Simon)
- Methods
  - Design Science
  - Action Research
  - Action Design Research



The Research Process/Lifecycle

Steps (not strictly sequential):

1. Define research question
2. Review literature
3. Develop theoretical model
4. Select research method
5. Design research study
6. Conduct research study (collect data)
7. Analyze data (draw conclusions, refine theoretical model)
8. Write up results



Formulating a Good Research Question

Formulating a Research Question

- One of the most critical steps in the research process

- Should be able to state your research question in a single, easily understood sentence

The Problem of the Problem

“Defining the research question is probably the most important step to be taken in a research study, so patience and sufficient time should be allowed for this task”

Robert K. Yin

Types of Research Questions

Research objectives:

- Description
  - what happens, how it happens
- Explanation
  - why things happen
- Prediction
  - what will happen in the future
- Improvement
  - how to achieve better results

Types of Research Questions

- What is the success rate of data science projects in Germany?
  - Description
- Why do data science projects succeed or fail?
  - Explanation
- How can we predict the success of data science projects?
  - Prediction
- How can we improve the success rate of data science projects?
  - Improvement

What Makes a Good Research Question?

- Focused
  - Clear and narrow field or "niche”
- Researchable (in general)
  - is possible to collect evidences about the topic (primary or secondary data)
- Feasible (for me)
  - can it be done in the given time
  - has the right scope
  - you have the required resources to conduct the study
  - you have access to the context and target group
- Specific
  - states "exactly" what you want to study
  - who, what, where?

What Makes a Good Research Question?

- Complex (General)
  - leaves enough room for interesting and complex results
  - applicable to a wide range of problems (and over time)
  - cannot be answered with yes or no
  - cannot be answered with a quick Google search
- Relevant (Useful)
  - will improve practice
  - is interesting for a larger community
- Novel
  - has not been answered in depth before
  - addresses a gap in research knowledge

Indicators for Problems in your Research Question 1/2

- The “elevator speech” problem
  - You cannot tell me which question you are asking unless you engage in a 5-min monologue.
- The “so what” problem
  - You have a research question, but it simply doesn’t matter to anyone.
- The “solving-the-world” problem
  - Your research question is indeed important. But it simply cannot be answered given the resource constraints.

Source: Recker (2012), p. 26

Indicators for Problems in your Research Question 2/2

- The “insolvability” problem
  - Your question simply cannot be answered meaningfully.
    - Because of logical problem in the question
    - Because the information needed to answer the question cannot be logically or legally obtained
    - Because the answer is so hard to obtain that feasibility of the research within the constraints is not possible.
- The “multitude” problem
  - You are simply asking too many questions.
  - Most of your questions are too narrow, too irrelevant, too grand, or otherwise deficient.

Source: Recker (2012), p. 26

Bad Research Questions 1/2

- Obvious questions
  - “Are there challenges in using information technology?”
  - Of course there are.
  - Obvious questions have answers to which everyone would agree.
- Irrelevant questions
  - “What is the influence of weather on the salaries of technology professionals?”
  - There is no reason to believe that there is any influence whatsoever.
- Absurd questions
  - “Is the earth flat after all?”
  - Absurd questions have answers to which everyone would disagree.

Source: Recker (2012), p. 27

Bad Research Questions 2/2

- Definitional questions
  - “Is technology conflict characterised by disagreement?”
  - That is simply a matter of creating a concept that says it does.
  - Definition is a mere form of description, not research.

- Affirmation questions
  - “Can a decision-support tool be developed to facilitate decision-making for senior retail executives?”
  - I sure hope so.
  - There is no reason to believe that it cannot be done.

Source: Recker (2012), p. 27