Why Research Methods?
Research Methodology

• The *methodology* is the general research strategy that outlines the way in which research is to be undertaken and, among other things, identifies the methods to be used in it.

• These *methods*, described in the methodology, define the means or modes of data collection or, sometimes, how a specific result is to be calculated.

The **scientific method** is an **empirical** method of acquiring knowledge. It involves careful observation, applying rigorous **skepticism** about what is observed, given that **cognitive assumptions** can distort how one interprets the **observation**. It involves formulating **hypotheses**, via **induction**, based on such observations; **experimental** and measurement-based testing of **deductions** drawn from the hypotheses; and refinement (or elimination) of the hypotheses based on the experimental findings.
# Scientific models in Informatics

<table>
<thead>
<tr>
<th>Scientific origins</th>
<th>Aim</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural science</strong></td>
<td>Discover laws of nature (and mathematics)</td>
<td>Algorithm testing and verification</td>
</tr>
<tr>
<td><strong>Social science</strong></td>
<td>Discover patterns of human behavior</td>
<td>Case studies, Survey</td>
</tr>
<tr>
<td><strong>Design science</strong></td>
<td>Creating and assessing artifacts</td>
<td>Participatory design</td>
</tr>
</tbody>
</table>
Recent HISP Master thesis work

**Action Design Research (participatory App development)**

- Jonas Berg Henie: Developing for usability and user involvement in a low resource context (2018)
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**Exploratory Case Studies (based on participatory observation)**

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Research method

The research method: A strategy of enquiry
A way of finding empirical data about the world

Each research method build on a set of underlying philosophical assumptions, the choice of method influence the way researchers collect the data. Specific research methods imply different set of skills and practices.
Philosophical Paradigms

• Paradigms are philosophical assumptions about the world
  – Positivist research
  – Interpretive research

• These have different epistemologies:
  – what is considered to be knowledge?
  – How do I know the world?
<table>
<thead>
<tr>
<th>Basic beliefs</th>
<th>Positivist Paradigm</th>
<th>Interpretivist Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- The world is external and objective</td>
<td>- The world is socially constructed and subjective</td>
</tr>
<tr>
<td></td>
<td>- Observer is independent</td>
<td>- Observer is part of what observed</td>
</tr>
<tr>
<td></td>
<td>- Science is value free</td>
<td>- Science is driven by human interest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Researcher should</th>
<th>Positivist Paradigm</th>
<th>Interpretivist Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Focus on facts</td>
<td>- Focus on meanings</td>
</tr>
<tr>
<td></td>
<td>- Look for causalities and fundamental laws</td>
<td>- Try to understand what is happening</td>
</tr>
<tr>
<td></td>
<td>- Reduce phenomena to simples elements</td>
<td>- Look at the totality of each situation</td>
</tr>
<tr>
<td></td>
<td>- Formulate hypothesis and then test them</td>
<td>- Develop ideas from induction of data</td>
</tr>
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<table>
<thead>
<tr>
<th>Preferred methods include</th>
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<th>Interpretivist Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Operationalising concepts so that they can be measured</td>
<td>- Using multiple methods to establish different views of phenomena</td>
</tr>
<tr>
<td></td>
<td>- Large samples</td>
<td>- Small samples investigated in depth over time</td>
</tr>
</tbody>
</table>
Deductive reasoning
• The researcher starts top down
• Starts with a theory or some hypothesis she wants to test
• Confirmatory

Inductive reasoning
• The researcher starts bottom up
• Starts with empirical data from which she wants to build a theory
• Explanatory
Theories and Reality: Induction and deduction

Figure 2.1
The relationship between theories and "reality"

Induction
Emperical generalizations
Analysis
Observations of the world

Theory

Hypotheses
Deduction
Operationalization
Quantitative research: A focus on numbers

- Surveys
- Laboratory / field experiments
- Simulations
- Mathematical modeling
- Structured equation modeling
- Statistical analysis
- Econometrics

Qualitative research: A focus on text

- Action research
- Case study research
- Etnography
- Grounded Theory
- Discourse analysis
- Narrative and metaphor
Case study

Empirical studies that:

• Investigating a contemporary phenomenon in detail
• within a real life context
• when the boundaries between the phenomenon and context is not clearly evident
• in which multiple sources of evidence are used

(Yin 1989:23)

They can be used in three modes: Explanatory, descriptive and exploratory
Action research

- Action research aims to solve current practical problems while expanding scientific knowledge.
- The action researcher is concerned to create organizational change and simultaneously to study the process.
The Action Research Cycle

- Diagnosing
- Specifying Learning
- Evaluating
- Action Planning
- Action Taking

Client-System Infrastructure
Surveys:
Garbage in garbage out
Mixed Methods
When the organization is your laboratory
Field research methods
Approaches to collect data

• Primary collection
  – Which you directly collect from the “field”
  – Example: through interviews of managers responsible for data use

• Secondary collection
  – You use data collected by someone else for another purpose in a different setting time and space setting
  – Example: reading government policy document on “Implementing health data standards”
Types of data you collect

• Qualitative
  – Interviews-> Text, pictures, impressions of meetings etc
  – Understanding trends

• Quantitative
  – Numbers, frequencies of occurrence etc
  – Reveal trends
Techniques to collect data

• Qualitative
  – Interviews, group discussions, observations, impressions/feedback from meetings, training sessions, prototyping presentations
  – Taking photographs
  – Content analysis of text (like policy documents)

• Quantitative
  – Surveys, questionnaires
  – Server logs
  – Financial/infrastructure figures etc
Quantitative data from the DHIS2

Health (service) data

Logging system use

But why is it so?
Where do you collect data from?

- Understanding your “field” based on your research question, your unit of analysis, and the phenomenon you are studying

- Field can consist of people, events, activities – all defined within a certain time and place
Choosing a method...

<table>
<thead>
<tr>
<th>Step</th>
<th>Alternative choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Start with a real-world problem</td>
<td>From own experience</td>
</tr>
<tr>
<td></td>
<td>From IFI project, media, work…</td>
</tr>
<tr>
<td>2. Get an overview of previous research</td>
<td>Identify research area</td>
</tr>
<tr>
<td></td>
<td>Review literature, positioning</td>
</tr>
<tr>
<td>3. Formulate a research question</td>
<td>What is…? Why are…?</td>
</tr>
<tr>
<td></td>
<td>How can…?</td>
</tr>
<tr>
<td>4. Choose a main approach</td>
<td>Investigation, Intervention</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>5. Choose a method</td>
<td>Investigation: Hypothesis testing, Case study..</td>
</tr>
<tr>
<td></td>
<td>Intervention: Action Research, PD…</td>
</tr>
<tr>
<td></td>
<td>Construction: Software Engineering, Design…</td>
</tr>
</tbody>
</table>
The research process

- Research question
- Results
- Discussion

- Data collection
  - Observed events and objects

- Data analysis
  - Findings
  - Records

- Research design
  - Concepts
  - Method
  - Constructs, variables

- Research review
  - Values, world view
  - Epistemology
  - Theories

- Epistemological lens
- Investigative lens

- Validity
  - Internal validity
  - External validity
RESEARCH PROCESS (1)

1. What is the problem area – or areas (not more than very few!!) ?
   - E.g. Open Source SW communities

2. What have others done & written in this area?
   - Do literature searches, start reading (immediately)!

3. What are the relevant research question in this area?
   - Be systematic – summarise the reading …

4. What would be the right research approaches and methodologies? And how to learn them?
   - What could be the hands-on empirical part?
   --- Questionnaires? Testing prototype with users?
RESEARCH PROCESS (2)

5. What are the results?? What have I ’discovered’ or found out?
   - What are the (’journalistic’) points?
   -- do I have key findings I can tell my friends, parents, grand parents??
   IMPORTANT:
   ---- work on your ’points’, findings, results
   – sometimes difficult to see when you are in the middle of it
   – difficult to see the forest when only among trees!)

6. How to tell others? How to write it up?
   - Write the theses !!!
Research design

Is about organizing research activity
- including the collection of data
- in ways that are most likely to achieve the research aim.
Key choices of research design

- Researcher is independent vs Researcher is involved
- Large samples vs Small numbers
- Testing theories vs Generating theories
- Experimental design vs Fieldwork methods
Research Design

• Input: Research Question, Theory, Epistemological lens
• Process steps
  1. Identify key concepts
  2. Choose and justify method
  3. Choose unit of analysis and level of investigation
  4. Connect research interest and problem solving interest
  5. Construct instruments
  6. (Create high-level plan for intervention)
  7. Validate against research question
• Output: Research Design (Investigative lens)
The role of the research questions

- They organize the project and give it direction and coherence
- They delimit the project, showing its boundaries
- They keep the researcher focused
- They provide a framework when you write up your research
- They point to the methods and data that will be needed
Research question

- Researchable
  - investigated scientifically and answered empirically

- Not too wide ranging:
  - to say a lot about a little, rather than a little about a lot

- Research that matters

- Open questions that open up the subject matter
• Theoretical contributions
  1. To advance existing knowledge by incremental adding to a theory or extending a theory
  2. Producing something novel or original, such as providing alternative explanation or understanding of a phenomenon
THE PROBLEM OF STARTING

• Select problem area
• Narrow it down
• Develop research questions – specific issues to investigate
• Select research methodology – approaches and techniques
• Start (continue!) literature studies - reading
  – Read what others are writing - have discovered - are writing - have as particular opinions and hypotheses
  – Research is much about reflecting about what others have done
MASTERS THESIS
Work at 3 levels

1. Writing:
   Reading and critical thinking

2. Planning:
   What needs to be done, when, where & how

3. Action:
   Design systems; participant observation in an organisation; test systems with users, structured interviews; developing software; prototyping; questionnaires
SUMMARY AND ANALYSIS
- How to use literature:
  - Present it, write about it, discuss it

They say arguments:
- Summary of what others have written, including:
  - Facts (from the article) expressed in your own words
  - Quotes

My findings show (I claim) arguments:
- Analyse of what others have written is MUCH more, such as:
  - Interpret the summary you have made as related to your own results and experiences
  - Compare with other authors / articles and different perspectives on the same problem area; different views on same phenomena.
Master theses – "standard" design (1)

1. Introduction
   "Motivation", overview and the specific Research questions, or objectives

2. Theory – literature review
   Summary and analysis of literature you use. Must be relevant for theses & use

3. Method
   How to carry out the research project, and specifying specific methodologies, such as structured interviews, questionnaires, prototyping, testing, etc.

4. Empirical part – data I have generated and collected
   Presenting the full Masters research project– all your data and results
   !!! Relate it to the method chapter !!

5. Discussion
   Discuss your results in relation to the literature you have used and in order to address your research questions

6. Conclusion
   Must relate directly to research questions and objectives in the introduction and your contributions
Exercise

• Which method is best suited to your (tentative) Master project?
Health Information Systems Program - DHIS 2

- HISP a global action research network initiated in collaboration with University of Western Cape in 1994 funded by Norad.
- DHIS 2 is an open source software for reporting, analysis and dissemination of data for all health programs.
- Shared and integrated data warehouse for essential health data: information for action
- Aggregate, events, and patient data
- Generic and generative platform - supports a wide range of uses also beyond the health sector.
- Financed and endorsed by all Global Health agencies, WHO, Norad, Global Fund, PEPFAR Unicef, Gates Foundation, GAVI, CDC
- WHO collaborative senter
- DHIS2 used in 88 countries in the Global South
DHIS2 implementations / initial projects correlated with increase in bandwidth.

Source: AFRINIC
DHIS2 adoption around the world (MoH implementations) – May 2019

Global «footprint» 2.28 billion people

+ 60 NGO’s, 58 PEPFAR countries, 60+ PSI countries, 10 global organizations

Read more on dhis2.org/inaction and facebook.com/dhis2
Brief history of DHIS 2

• 1996: First implementation (MS Access) in South Africa
• 2000 National standard in South Africa
• 2005: DHIS 2 Java web-based development started
• 2006: First DHIS 2 implementation in Kerala, India
• 2010: First national online DHIS 2 implementation in Kenya, then Ghana, Uganda, Rwanda
  – Norad core funding
• 2012: Joint 3-donor (PEPFAR, Global Fund, Norad) effort to strengthen DHIS 2 use in countries
• 2015: June 58 PEPFAR countries reporting through DATIM (DHIS2) 50 countries using DHIS 2, national standard in 16 countries
• 2019: 88 countries using DHIS2, national standard in 47
Action research: Capacity building through innovation

- Develop sustainable information systems that empower communities and decision makers to improve coverage and quality of services.
- Action Research: Building knowledge on implementing HIS while building systems on the ground through partnerships.
- HISP PhD school at University of Oslo: 50 PhDs graduated, 30 active.
- International Masters programs in South Africa, Mozambique, Malawi, Tanzania, Ethiopia, Sri Lanka (400 graduated).
- Regional DHIS 2 Academies, 87 Academies since 2011, 4800 graduated.
- Online Academy: Fundamentals, PEPFAR, In country Data Use (Indonesia).
DHIS2 as a platform

- Generic and generative platform - supports a wide range of uses also beyond the health sector
- Allows for **distributed innovation** in a wide network
- Flexible configuration and **customization** for a range of organizations and use cases
- Allows for new functionality through **open APIs** and app development
DHIS2 design lab

• Aims to strengthen the usability of the generic DHIS2 software, and ensure that the software is locally *meaningful* to the various end-users.
• We do this by exploring design-methods and technical tools and approaches that are appropriate during implementation of the software, and how we better can support these in the DHIS2 ecosystem.
• Currently, several master students are working on different aspects of design in India (design-methods, prototyping tools, Design Systems, app-development frameworks)
• Master-projects typically involve elements such as
  – Conducting real use-oriented design processes during DHIS2 implementations
  – Developing prototypes (i.e. with React or other web-frameworks) for applications to be used by end-users or software implementers
  – Reflect and analyze the process and result of such activities to make design principles and/or methods that can be used by others.

See the list of available master theses within IS for specific topics within the design lab

Or contact Magnus Li to discuss potential projects ([maql@ifi.uio.no](mailto:maql@ifi.uio.no))
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PEPFAR

• The U.S. President's Emergency Plan for AIDS Relief (PEPFAR) is the U.S. Government initiative to help save the lives of those who are HIV+ around the world
• PEPFAR is since May 2015 using DHIS2 for reporting from all Implementing Partners in 55 countries
• For example the number of Implementing Partners in Kenya are 400
PEPFAR Fiscal Year 18 Results

- 4.65 billion bilateral budget + 1.35 Global Fund Budget
- 14.6 Million people on Antiretroviral treatment
- 2.68 Million people initiated on Antiretroviral treatment
- 11.9 million pregnant women with known HIV status
- 303 thousand pregnant women newly identified as HIV +
- 3.58 million male circumcisions performed
- 94.9 million persons tested for HIV
- 3.17 million persons received HIV+ results
- 24 thousand health workers trained
- 6.3 million orphans and vulnerable children active or graduated
### Which pages do users access?

<table>
<thead>
<tr>
<th>Page</th>
<th>Page Views</th>
<th>% Page Views</th>
</tr>
</thead>
<tbody>
<tr>
<td>/hmis/dhis-web-dashboard-integration/index.html</td>
<td>137,028</td>
<td>20.01%</td>
</tr>
<tr>
<td>/hmis/dhis-web-dataentry/index.action</td>
<td>123,414</td>
<td>18.02%</td>
</tr>
<tr>
<td>/hmis/dhis-web-commons/security/login.action</td>
<td>110,511</td>
<td>16.14%</td>
</tr>
<tr>
<td>/hmis/dhis-web-event-capture/index.html</td>
<td>97,891</td>
<td>14.29%</td>
</tr>
<tr>
<td>/hmis/dhis-web-reporting/index.action</td>
<td>42,322</td>
<td>6.18%</td>
</tr>
<tr>
<td>/hmis/dhis-web-reporting/showDataSetReportForm.action</td>
<td>38,265</td>
<td>5.59%</td>
</tr>
<tr>
<td>/hmis/dhis-web-commons/security/login.action?failed=true</td>
<td>25,535</td>
<td>3.73%</td>
</tr>
<tr>
<td>/hmis/dhis-web-pivot/</td>
<td>23,523</td>
<td>3.43%</td>
</tr>
<tr>
<td>/hmis/dhis-web-reporting/displayViewDataCompletenessForm.action</td>
<td>9,150</td>
<td>1.34%</td>
</tr>
<tr>
<td>/hmis/dhis-web-event-reports/index.html</td>
<td>8,087</td>
<td>1.18%</td>
</tr>
</tbody>
</table>
How do they use analytics?
How do usage patterns differ?
How often do users access the system?
What time do users typically access the system?
IN5320
Development in Platform Ecosystems

Teaching and projects

- Lectures and help with individual and group assignments twice a week.
- Group-based project involving development of a web-based application for DHIS2 (4 per group)
- Course capacity: maximum of 100 students – Design students get priority
- 10 ECTS

Themes and curriculum

- Fundamental concepts of platform ecosystems in the context of information systems and socio-technical complexity.
- Practice and theory of software development within such platform ecosystems focusing on aspects of innovation, design, and programming
- Practical: HTML, CSS, JavaScript, APIs, and React for front-end web-development.

Assignments and exam

- Two mandatory assignments to practice front-end web-development of platform apps (HTML, CSS, JavaScript, AJAX)
- Individual theoretical written exam (4 hours)
- Grade: Scale from F to A. (40% project, 60% written exam)

Contact person:
Magnus Li
magl@ifi.uio.no

Olav Poppe
olavpo@ifi.uio.no
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   --- Questionnaires? Testing prototype with users?
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      IMPORTANT:
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# MASTERS THESES

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<th>Description</th>
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   Presenting the full Masters research project— all your data and results
   !!! Relate it to the method chapter !!

5. Discussion
   Discuss your results in relation to the literature you have used and in order to address your research questions

6. Conclusion
   Must relate directly to research questions and objectives in the introduction and your contributions
1. Introduction
   Research questions, objectives

Research Questions and conclusion
relate as ‘question and answer’

4. Empirical Data – basis for discussion

5. Discussion
   Used to address your research questions
   and approaching your conclusion

6. Conclusion
Research Design

- A: area of concern
- P: real-world problem
- F: framing
- M: method
- C: contributions

Research Design
(common configuration)

F: Theory
A: Stream of literature
RQ: Real world problem
Research
C: Contributions (to A and P but also to F and M)

M: Research method
DHIS2 as a platform

- Generic and generative platform - supports a wide range of uses also beyond the health sector
- Allows for **distributed innovation** in a wide network
- Flexible configuration and **customization** for a range of organizations and use cases
- Allows for new functionality through **open APIs** and app development
Customization of DHIS2

You can set up a system without being a programmer

• Organization hierarchy with any number of levels
• Specify any kind of data to be collected
• Define any type of indicator to be calculated
• User profiles and roles
• Management of data
• Configure many types of output, including charts, tables, maps and dashboards
• Define analysis and reports along any number of categories and dimensions
• On different devices and….
Software development philosophy

• Open-source software and frameworks
• Interaction with users
• Clean and generic solutions to local problems
• Web API and Apps for local add-ons
• Avoid exotic features and nice-to-have
• Release often: fixed time - flexible scope
• Prototyping and incremental solutions
Software governance

• 4 releases per year, last 3 fully supported
• Feature requests:
  – Mailing list, Academies, Implementations
    => Blueprints
• Prioritization criteria:
  – Impact, Benefit, Effort, Complexity, Funding
• Main direction and roadmap set by Oslo management group
• Roadmap: https://www.dhis2.org/roadmap
Enabling the innovation cycle

- Beyond capacity building at educational level
- Open source software development done in a global network
- Enable App development for local innovation
Apps can be selected from DHIS2 App store

...Or be developed

We encourage people to make apps generic and share

Mobile Data Visualizer

The mobile data visualizer is an app which lets you visualize and explore your data as a wide range of chart types, including bar, column, line, area and pie. It is optimized for touch-screen devices and lets you advanced analysis straight from your phone or tablet. You can do dynamic analysis which can later be saved as favorites and easily loaded later.

Author: Yuriy Ivanovich | Version: 1.0
Requires: DHIS 2.13

Download » | Demo »
Extending the DHIS reach through mobiles

Districts / Hospitals

Clinics

Community Health Workers

Community / Villages

SMS

Java

Browser

Android

PC/laptop/tablet
The importance of backbone for scaling

Data warehouse DHIS 2

Data capture from paper forms

Data from Mobile devices

LMIS

HR

EMR

Extract Transform Load

DHIS 2

Data mart

Meta data

Visualising tools

Web Portal

Dashboard

Graphs

Maps

Getting data in - Data warehousing

Getting data out - Decision support systems

Data from Mobile devises

Annual measles coverage %

Measles under 1 year coverage by district 2006

(Measles doses given to children < 1 year / total population < 1 year)

74.7
81.3
79.0
80.7
89.5
94.4
80.0
79.9
93.6
93.8
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0

Chake Chake District

Micheweni District

Mkoani District

Wete District

Central District

North A District

North B District

South District

Urban District

West District

Pemba Zone

Unguja Zone

Data from Mobile devises

Data mart

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Dashboard

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Maps

Getting data in - Data warehousing

Getting data out - Decision support systems