Research Method

Research method

- Master-level courses have a research component:
  - architectures, applications to news, privacy issues
  - framing your programming project as (the start of) a *design science research* project
  - more in INFO300 in the spring
- Two articles in the wiki:
  - Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. MIS quarterly, 75-105 [link in the wiki + paper in mitt.uib.no]
  - Hevner, A. R. (2007). A three cycle view of design science research. Scandinavian journal of information systems, 19(2), 4 [pdf in the wiki]

Research method

- Approaches to knowledge:
  - authoritarian, mythical, *rational (formal), and empirical («scientific»)*
    - but also «formal sciences» («formalvitenskap»)
  - empirical approaches:
    - inter-subjective/realist ideals (often quantitative, but not necessarily)
    - empathic/«verstehen» ideals (often qualitative, but not necessarily)
    - *information science* needs to build on both
    - ...also critical traditions (that may reject the above distinctions)
  - objects of study:
    - natural or artificial («sciences of the artificial»)
    - material (alive or not), cognitive, or social («social sciences»)
    - *information science* as a social/cognitive study of technical artefacts

General source: Frankfort-Nachmias & Nachmias: Research Methods in the Social Sciences.

Research approaches

- Purpose:
  - description
  - explanation
    - *prediction*
    - *understanding*
  - exploration
  - *ability*
    - *creation*
- Data:
  - qualitative
  - quantitative
- Extent:
  - intensive (few study units)
  - extensive (many study units)
- Standard types (examples):
  - experiments
  - surveys/interviews
  - archival
  - histories
  - case studies
  - action research
  - *design (science) research*

General source: Yin. Case Study Research.

Research cycle (examples)

- Theory-before-data:
  - problem
  - existing theory (& practice)
  - propositions (e.g., hypoteses)
  - research method
  - data collection
    - *can involve development*
  - data analysis
  - generalisation
  - discussion
- Hypothetic-deductive style

- Data-before-theory:
  - problem
  - surrounding theory (& practice)
  - goals, success criteria
  - research method
  - data collection
    - *can involve development*
  - data analysis
  - theory building
  - discussion
- Exploratory style

possibly iterative

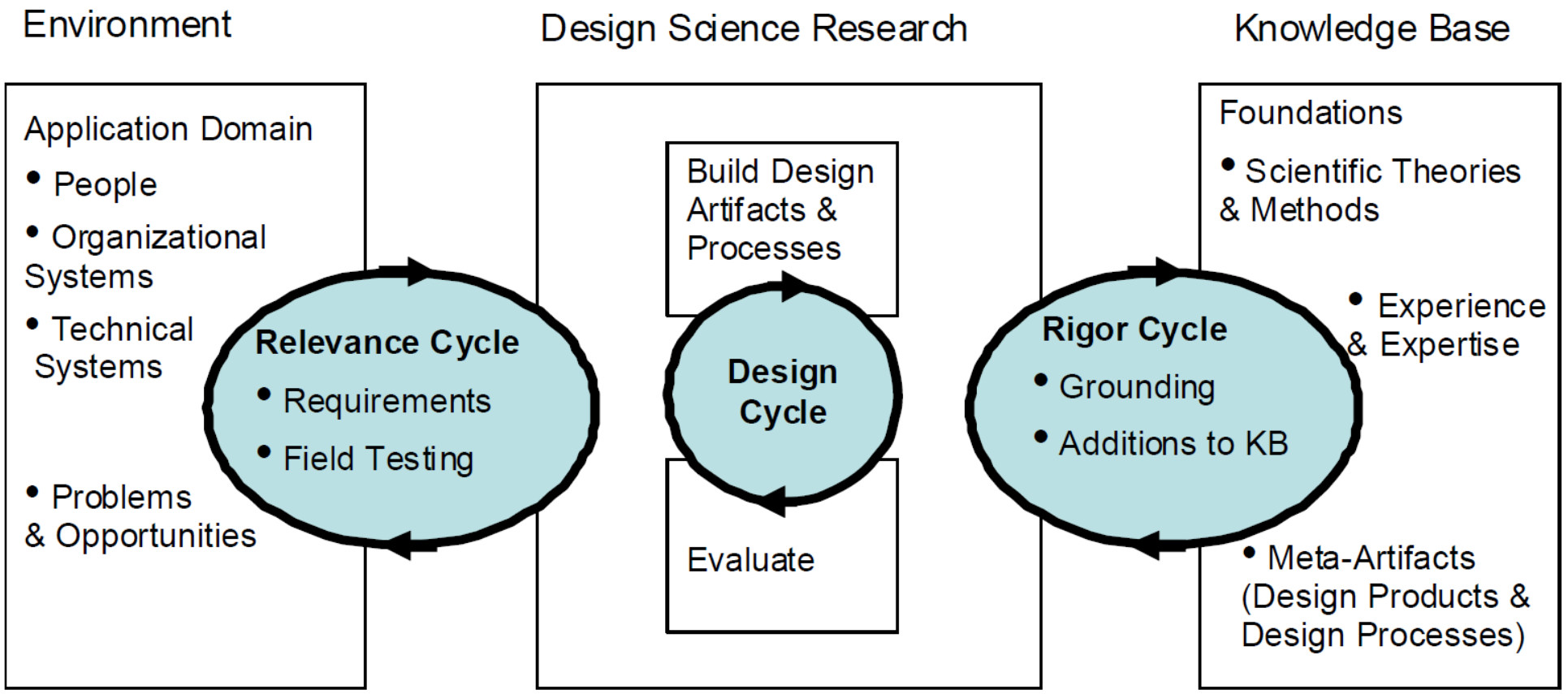
Data science

- Data science
  - extract and extrapolate knowledge from big, noisy, structured and unstructured data sets
  - an interdisciplinary research approach
  - combines scientific methods, statistics, and information science, including machine learning and big data
- A "fourth paradigm" of science:
  - empirical, theoretical, computational, and now data-driven
- Data-before-theory approach:
  - data science methods used exploratorily to propose theoretical models
  - the models are further developed and validated using other methods
- Data-bypasses-theory approach:
  - data science methods used for atheoretical prediction (Kitchin is critical)

Design science research

- Design science research (DSR):
  - involves the *development of (IS/IT) artefacts*
  - typically *iterative*
  - *validates the artefacts empirically* against *clear goals/success criteria*, e.g.,
    - validations against technical goals/requirements
    - evaluations with users in increasingly realistic settings
- Goal:
  - improve the understanding of different parts/aspects of information systems (IS) through developing and evaluating IT-artefacts for use
- Artefacts (and other outputs):
  - can take on different forms depending on research problem/goal

Three-cycle view of DSR



Source: Hevner (2007)

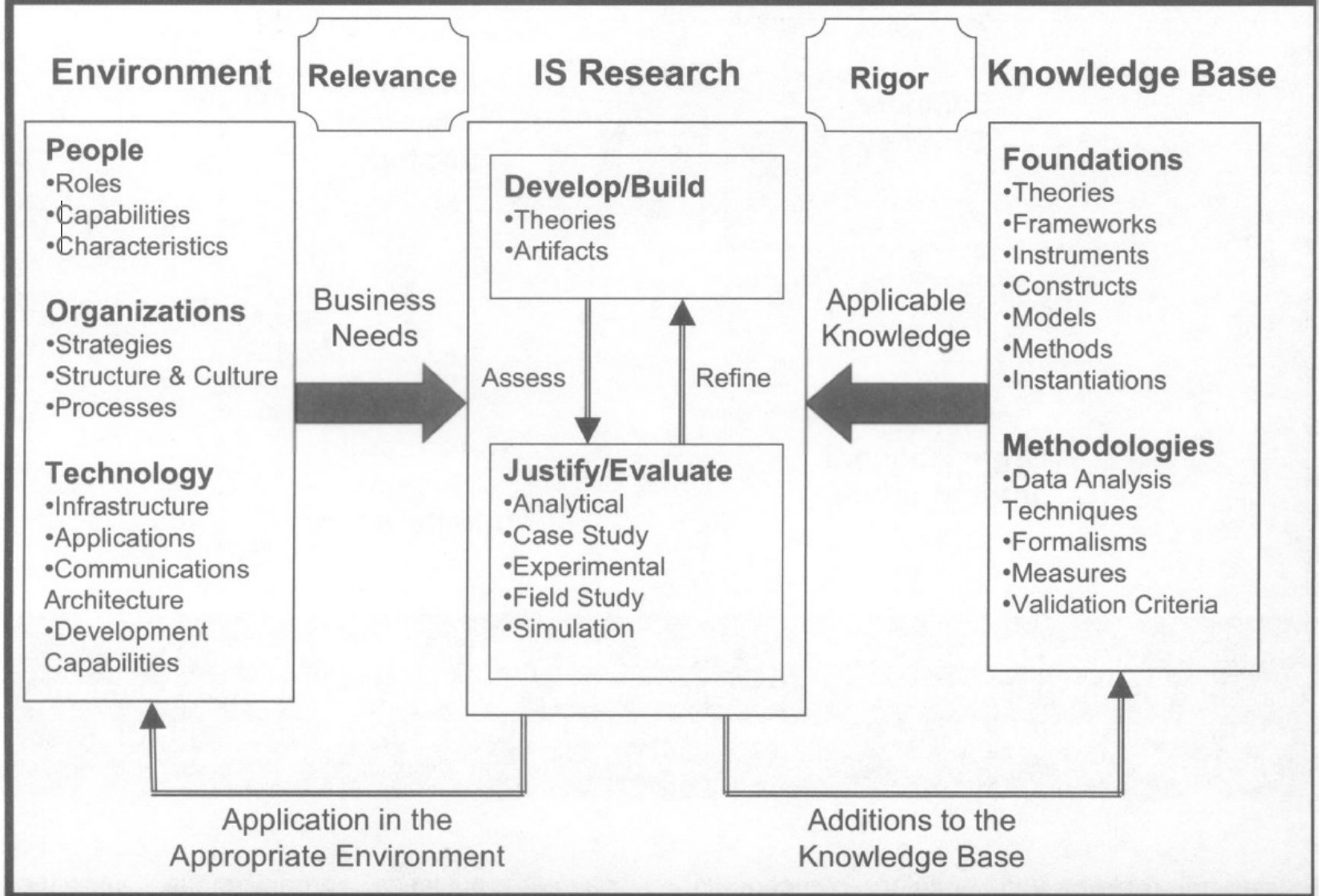


Figure 2. Information Systems Research Framework

Source: Hevner et al. (2004)

Artefacts / outputs of DSR

- *Instantiations:* situated implementations in specific environments
  - can *operationalize* construct, models, methods, other abstract artifacts...
  - or such knowledge can remain *tacit*
- *Constructs:* the conceptual vocabulary of a domain
- *Models:* sets of propositions that express relationships between constructs
- *Methods:* sets of steps used to perform tasks - how-to knowledge
- *Frameworks:* real or conceptual guides to serve as support
- *Architectures:* high-level structures of systems
- *Design principles:* core principles and concepts to guide design
- *Design theories:* a prescriptive set of statements on how to achieve a certain objective; usually includes other abstract artifacts, e.g., constructs, models, methods, frameworks, architectures, and design principles

Table 1. Design-Science Research Guidelines

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Iterations

- Design research is iterative
  - fits well with *iterative systems development*
  - research and development iterations *can be sync-ed*
    - *for example* 6-8 weekly iterations or 3-4 bi-weekly ones
- Minimum viable product (MVP):
  - delivery of each iteration
  - build the minimum number of features that is required for the system to fulfill a (partial) goal
  - evolve iteratively from there (with more and more extensive goals)
  - promotes adaptable systems:
    - fewer but more essential features
    - old features are thoroughly tested before new ones are added

Reporting your iterations

- To report each iteration:
  - name, brief introduction, goals, tools and techniques, project management(?), development process, validation, results
- Final iteration(s):
  - in a "full" research project, final validations(s) would be more elaborate
  - a *broad range of empirical research methods are available* here:
    - technical, interviews, experiments, case study, action research...
- Your projects can have simple validations, e.g., running test cases, demonstrating intended behaviours, discussing particular system properties
- Your essay *can* be a more elaborate final evaluation of a particular aspect of your system

Reporting your projects (tentative)

- Things to include in your presentations:
  - your problem/idea
    - why is the problem/idea important?
  - your research question
  - your iterations
    - see the previous slide
  - your final system
  - your group members
    - who has done what?
  - brief mentioning of final evaluations that you will present in your essays (if some group members plan to do that)