Lecture 5
Action and design research

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Contents

- Applied sciences and their methodologies
- Research with intervention and artefact building
  - ”Science of the artificial”
- Action research
- Design science/research

The Stokes diagram (Stokes, 1997)

Research inspired by	Considerations about use: no	Considerations about use: yes
Search for fundamental understanding: yes	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
Search for fundamental understanding: No		Pure applied research (Edison)

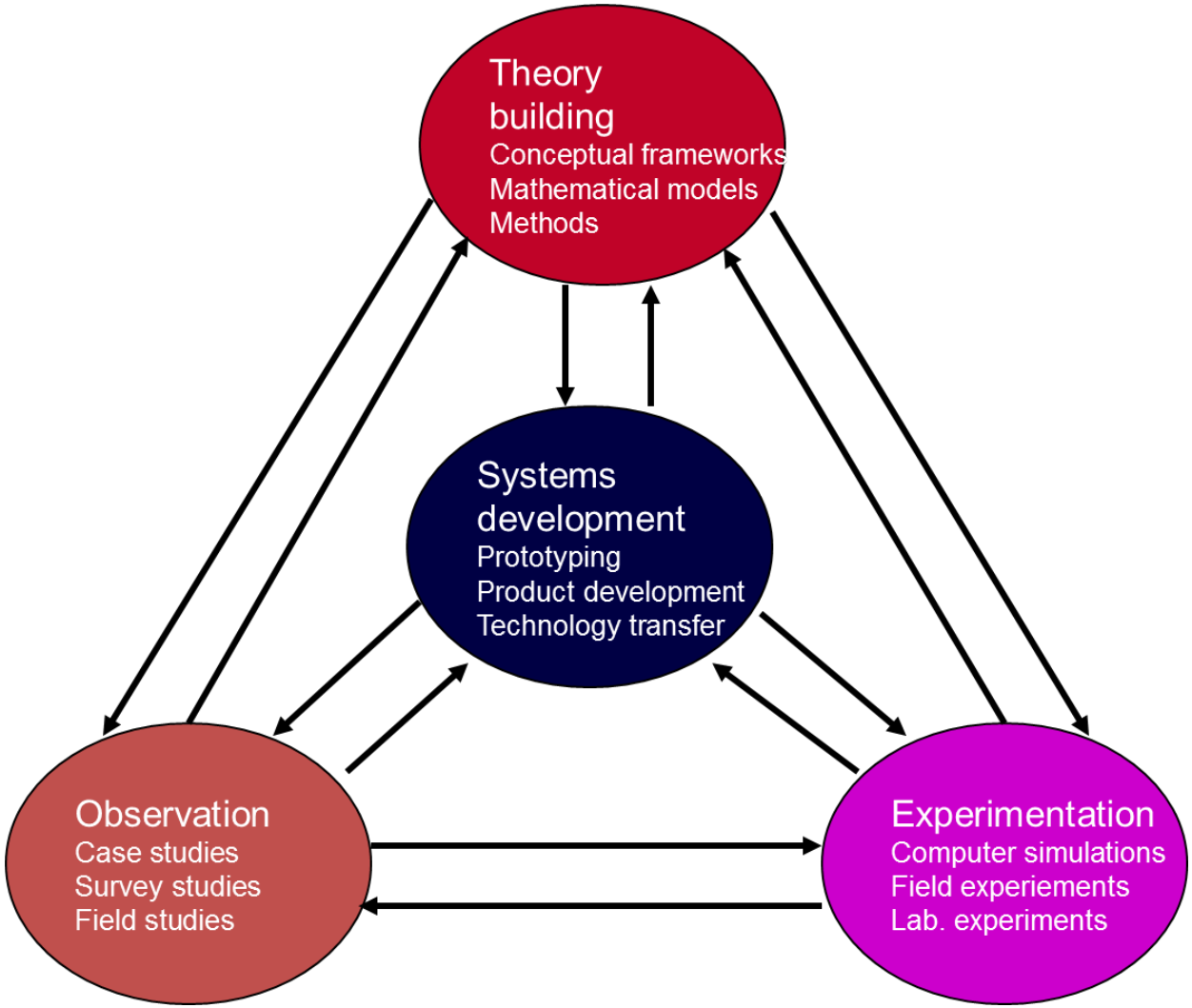
Applied sciences

- Management, engineering, medicine, …
- Knowledge is instrumental for solving problems of the practice
- Weak and strong mode
  - weak: the objective is description and explanation
  - strong: alternative solution concepts are developed
- To operate in strong mode (as in medicine and engineering, and often also in management) requires research methodologies for the purpose

Strong applied science in the social world

- Prediction: what is the outcome of the proposed solution?
- In material world you can measure it
  - Measure the average lifetime and luminosity of the lightbulb wire
- In social world humans make prediction difficult in real-life contexts
- How can you predict the outcome of a process, method, technique, way of working, etc.?
- Applied scientists must have research methods also for studying technological solutions in the social world
  - Action research
  - Design research/science

Nunamaker et al. (1990)
Systems development in research



Explanatory and design sciences

- Explanatory science (physics, sociology)
  - Knowledge as an end
  - A mission to understand and develop knowledge to describe, explain, and predict
- Design science (medicine, law, engineering)
  - Mission to create solutions to problems, to design solutions to field problems
  - Knowledge as a means, but also explanatory knowledge, concepts and models are developed
  - A design process typically starts with explanation

March and Smith (1995)
Design and natural science research on information technology

	Build	Evaluate	Theorize	Justify
Constructs				
Models				
Methods				
Instantiations				

Research outputs (March and Smith, 1995)

- Constructs
  - Conceptualizations used to describe problems within the domain and to specify solutions
- Models
  - A set of propositions or statements expressing relationships among constructs
- Methods
  - A set of steps (an algorithm or guideline) used to perform a task
- Instantiations
  - The realization of an artifact in its environment

Research activities (March and Smith, 1995)

- Build
  - construction of the artifact, demonstrating that such an artifact can be constructed
- Evaluate
  - develops metrics and compares the performance of constructs, models, methods, and instantiations for specific tasks
- Theorize
  - explains why and how the effects came out, i.e. why and how the constructs, models, methods and instantiations work
- Justify
  - performs an empirical and/or theoretical research to test the theories proposed

Action research

Action research

- Kurt Lewin (1946)
  - Social research that combined generation of theory with changing the social system through the researcher acting on or in the social system.
  - The act itself is presented as the means of both changing the system and generating critical knowledge about it.
- Rapoport (1970) :
  - “Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework.”
- Action research can be viewed as a cyclical process with five phases: diagnosing, action planning, action taking, evaluating, and specifying learning

Action research premises

- Ontology related to information systems (and software):
  - Information systems are social systems with technical implications or technical systems with social implications
- Epistemology:
  - Knowledge for action
  - Knowledge for critical reflection
  - Reflective science or philosophy
- Methodology:
  - Active intervention in organizational contexts
  - Qualitative and exploratory way of thinking
- Axiology:
  - Relevance is vital: prime goal is problem solving

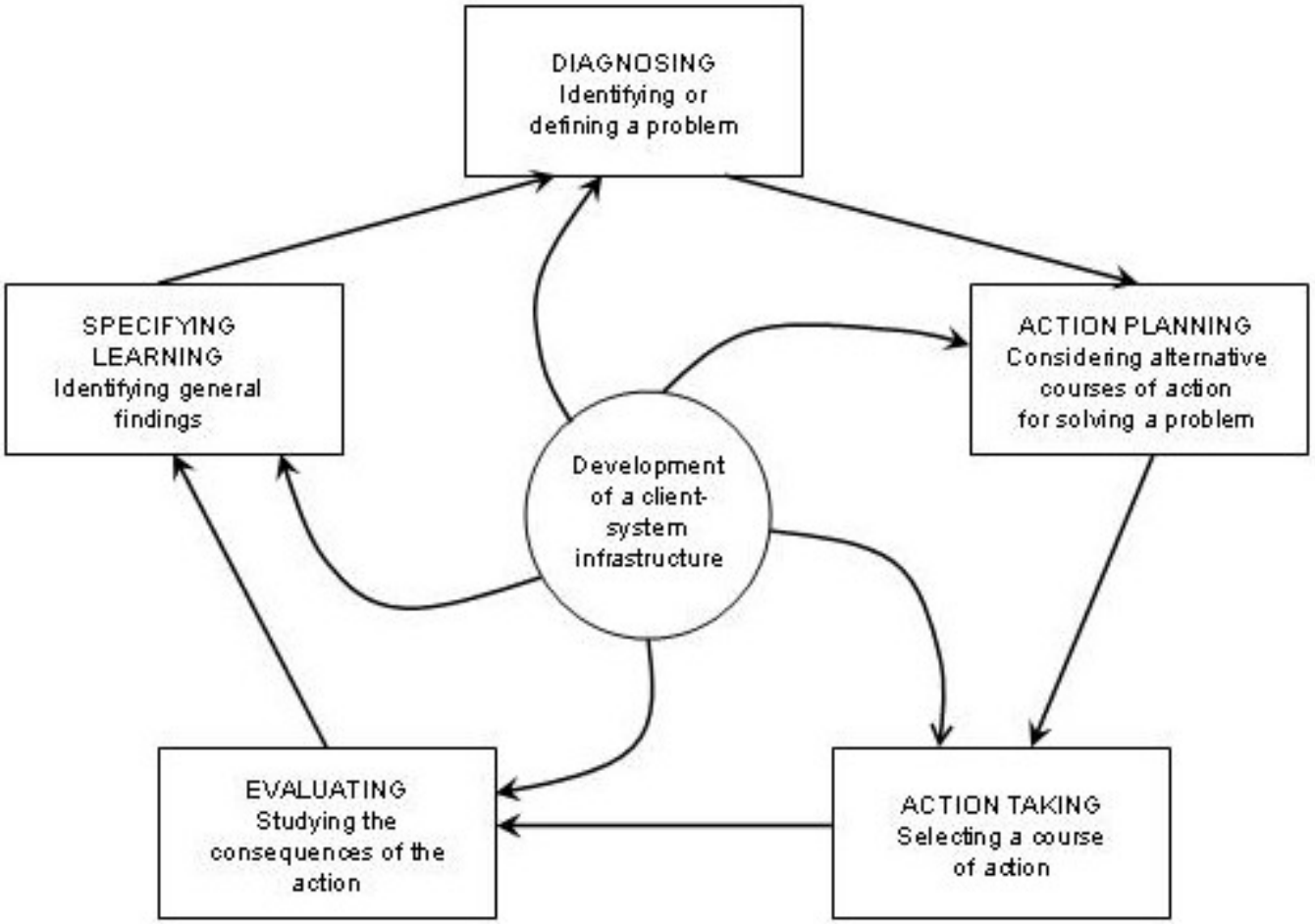
Goals of action research

- The improvement of professional practice through continual learning and progressive problem solving
- A deep understanding of practice and the development of a well specified theory of action
- An improvement in the community in which one's practice is understood through participatory research

Action research basics

- Assumptions:
  - Social settings cannot be reduced for study
  - Action (i.e. intervention) brings understanding
  - Action research is performed collaboratively; Researchers and practitioners are partners;
- Action research is building/testing theory within context of solving an immediate practical problem in real setting
- It combines theory and practice, researchers and practitioners, and intervention and reflection
- Action research is not consulting: it is action, but still research

Action Research process



Susman & Evered, 1978

Process of action research

- Action research process:
  - Diagnosing a problem - develop a theoretical premise
  - Action planning - guided by theoretical framework
  - Action taking - intervention, introducing change
  - Evaluating, reflecting - effects of change, theoretical premises
  - Specifying learning - “double loop”, feed next iteration, theory
- Some key points:
  - A formal research agreement with acceptable ethical principles is important
  - Defined success criteria are needed
    - Where is the objective? e.g., explain practice, bring about change, enhance practitioner learning
  - The research orientation must be explained to practitioners
  - Action research opportunities are often unique and depending on targets
    - It is difficult to have a “program of action research”

Planning in action research

- Identifying the issue to be changed
- Looking elsewhere for information
  - Similar projects
  - Professional reading
  - Scientific reading
- Developing the questions and research methods to be used
- Developing a plan related to the specific environment
  - In software engineering this could mean for example a development process change, an organization change – or any change related to the working environment

Acting in action research

- Intervention: trying out the change defined in the plan
- Collecting and compiling evidence about the change and its success and failure
- Questioning the process/change/intervention and adjusting it as required

Analyzing in action research

- Analyzing the evidence and producing the findings
- Discussing the findings with co-researchers and /or colleagues for the interpretation
- Writing the report
- Sharing the findings with all relevant stakeholders and peers

Reflecting in action research

- Evaluating the first cycle of the process
- Implementing changes to the plan and the intervation or a new strategy based on the findings
- Revisiting the process
  - Iterating through the cycle again

Canonical Action Research Criteria (Adapted from Davison, R. M., Martinsons, M. G., and Kock, N. "Principles of Canonical Action Research," *Information Systems Journal* (14:1), 2004, pp. 65-86.)	
Criterion	**Description**
1. Principle of Researcher-Client Agreement (RCA)	The RCA provides the basis for mutual commitment and role expectations.
2. Principle of Cyclical Process Model (CMP)	The CPM consists of the stages diagnosing, action planning, action taking, evaluating, and specifying learning.
3. The Principle of Theory	Theory must play a central role in action research.
4. The Principle of Change Through Action	Action and change are indivisible research elements related through intervention focused on producing change.
5. The Principle of Learning Through Reflection	Considered reflection and learning allow a researcher to make both a practical and theoretical contribution.

Studying IT artifacts: Design research (part of slides based on Sein & Rossi 2013)

What is an IT artifact?

- An *Ensemble*:
  - ”those bundles of material and cultural properties packaged in some socially recognizable form such as hardware and/or software” (Orlikowski and Iiacono 2001)
- An *emergent* thing:
  - ”Neither fixed nor independent, instead, emerges from ongoing social and economic practices” (Orlikowski and Iiacono 2001)
- Where does emergence come from?
  - Interaction between technology and an organizational context
  - Shaped by the interests, values, and assumptions of a variety of communities of (e.g. developers, users)
- Artifacts are only partly the work of the designer.
  - Numerous local actions (e.g., use, interpretation, negotiation, redesign)
- Cannot be anticipated by reference to any a priori design

The need for a artefact-centric research methodology

- To study IT artefacts, we need a research methodology that can account for
  - Both technological and organizational contexts
  - Shaping of the artifact via design and use
  - Influences of designers and users

- Design research / Design science as the research methodology
  - Ambiguous meaning
    - Research of design
    - Research that designs

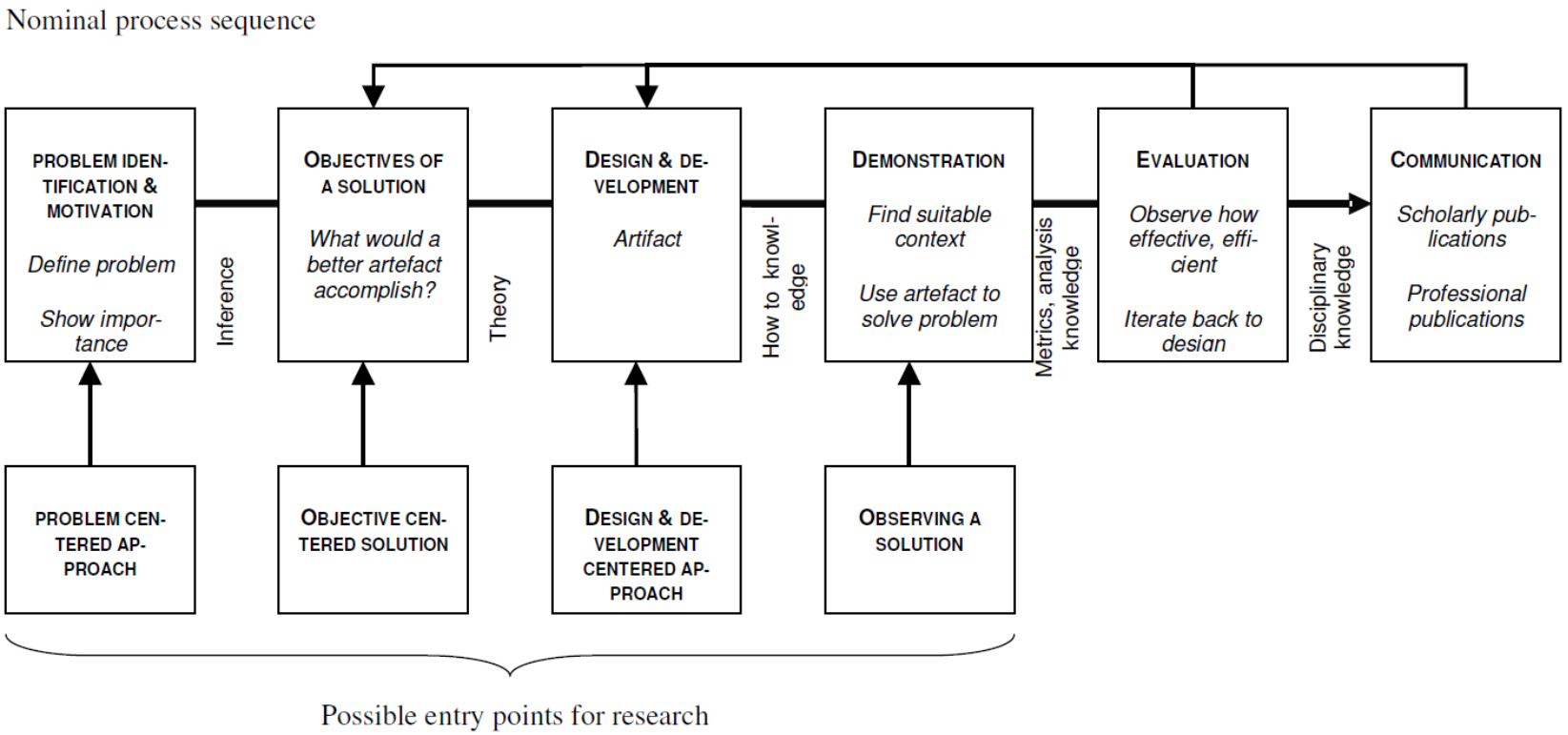
Design Research

- What is it?
  - Construction and evaluation of technology artifacts to meet organizational needs
    - Models, methods, systems (prototypes)
  - Development of associated theories
- Premises:
  - Ontology: Realist (real world exists but we are not seeking it)
  - Epistemology: We can intervene in the world to improve it
  - Methodology: Development/Design of systems, models
  - Axiology: Relevance and utility
    - Relevance evaluated by utility provided to organizations

Design research

- Tries to change the “reality” under investigation with an artefact
  - Relativistic by nature, results are related to the context of the study
- One of the research approaches used for studying unknown areas or new ideas
  - Start from problem/solution/theory and build an artefact
- Builds new things based on ideas, which are at least partly based on earlier research
  - The artefact can be e.g. construct, model, method or instantiation (c.f. March & Smith 1995)
- The difference between action and design research
  - Action research is intervention/organization-centric
  - Design research is artefact-centric

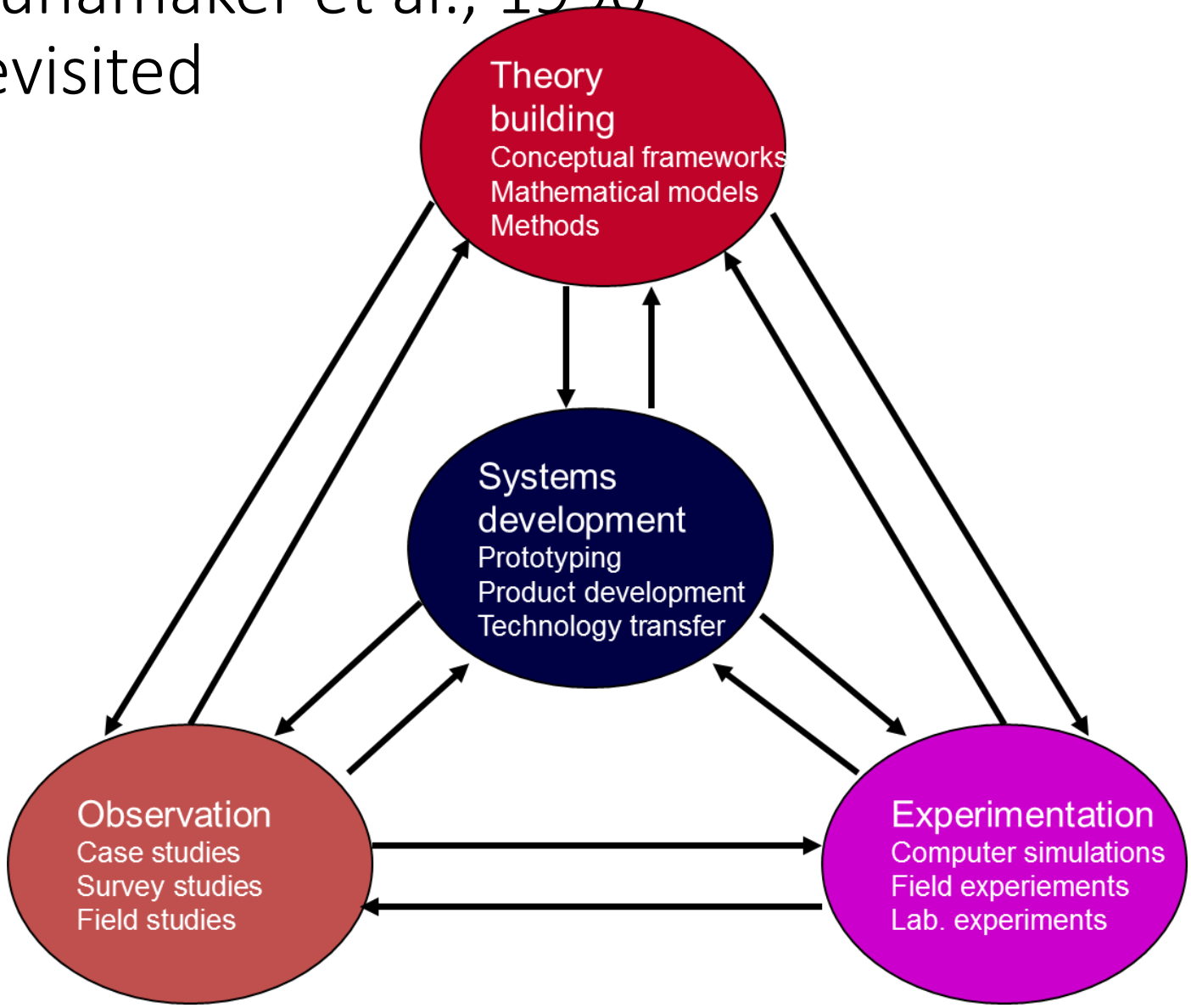
Design research process (Peffers & al. 2006)



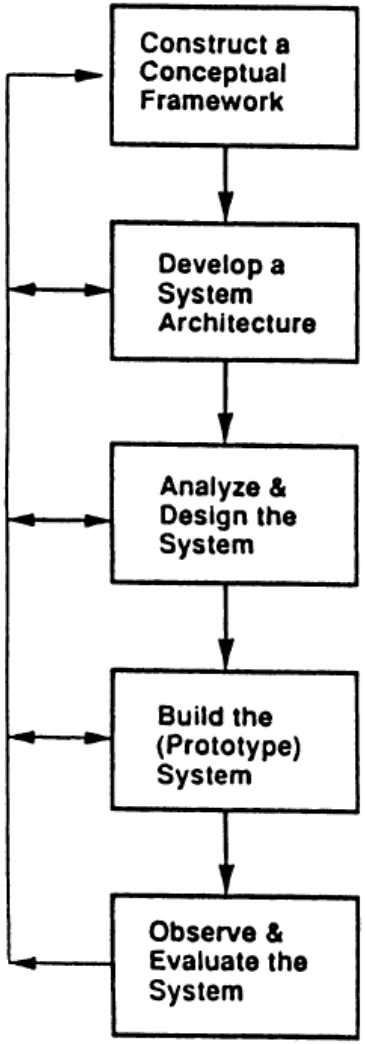
Design-Science Research Guidelines Hevner et al. (2004)

Guideline	Description
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.
2. Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
3. Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
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.
5. Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
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.
7. Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Nunamaker et al., 1990 revisited



Nunamaker et al., 1990
Systems development research process



Very near to the idea of design research

Nunamaker et al., 1990
Systems development research process

Construct a conceptual framework	State a meaningful research question Investigate the system functionalities and requirements Understand the system building processes/procedures Study relevant disciplines for new approaches and ideas
Develop a system architecture	Develop a unique architecture design for extensibility, modularity, etc. Define functionalities of system components and interrelationships among them
Analyze & design the system	Design the database/knowledge base schema and processes to carry out system functions Develop alternative solutions and choose one solution
Build the (prototype) system	Learn about the concepts, frameworks, and design through the system building process Gain insight about the problems and the complexity of the system
Observe & evaluate the system	Observe the use of the system by case studies and field studies Evaluate the system by laboratory experiments or field experiments Develop new theories/models based on the observation and experimentation of the system's usage Consolidate experiments learned

Design Research
When to use and when not

- When to use this approach?
  - New unexplored areas or ideas
  - There are theories, but they cannot be tested with conventional empirical research methods
  - There are clear deficiencies in former systems
  - Example: Development of a visual programming environment for large-scale Kanban projects
- When not to use this approach?
  - The area is well known
  - Theories and implementations are available in the field and it is possible to test them with conventional empirical research methods
  - You do not have tools or skills to build the artefact
  - Example: Development of a visual relational database modelling tool

Thank you!

Questions? Comments?