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Constructive Research

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Casper Lassenius, Timo Soininen,
Jari Vanhanen

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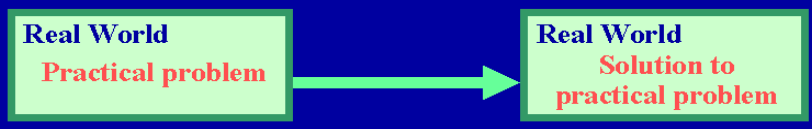
What is Constructive Research?

- Constructive research
  - Aims at producing *novel* solutions to practically and theoretically *relevant* problems
  - Managerial problem solving through the construction of models, diagrams, plans, organizations, etc.
  - Widely used in software engineering and computer science, rarely in management and social sciences
  - The engineering research tradition
  - Often involves other approaches (qual. & quant.)
- Construction
  - An entity, which produces a solution to an explicit problem
    - mathematical algorithm
    - Morse alphabet
    - activity-based costing (ABC)

Research Objectives



- Key objectives
  - > Quality -- utility as well as functional correctness
  - > Cost -- both of development and of use
  - > Timeliness -- good-enough result, when it's needed
- Address problems that affect practical software

Complete Research Result

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The Constructive Approach as a Methodology

- Is a type of applied studies
  - production of new knowledge in the form of normative applications
  - creates a new reality – does not try to understand, explain, classify, etc. the existing one
- Constructive approach vs.
  - basic studies have no explicit normative purposes
  - development of techniques purely aim at improving skills and means
  - analytic model building (applied studies) has unclear practical adequacy
  - scientific problem solving may produce unique solutions
  - consulting does not presuppose use of scientific methods

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Phases of the Constructive Research Process

- Idealized model
  - 1. Find a practically relevant problem
  - 2. Obtain an understanding of the topic and the problem
  - 3. Innovate, i.e., construct a solution idea
    - heuristic process
    - theoretical justification and testing come later
  - 4. Demonstrate that the solution works
  - 5. Show theoretical connections and research contribution
  - 6. Examine the scope of applicability
- In practice the steps do not follow each other in a simple sequence - the process is both iterative and sometimes recursive

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1. Finding a relevant problem
2. Preunderstanding

- Finding the problem
  - Sources of problems
    - Literature
    - Colleagues
    - Own experience
- The problem should be *practically* relevant!

- Preunderstanding
  - Practical
    - get your feet wet
    - empirical work, e.g., interview study or observation (participation)
  - Theoretical
    - scan "relevant" literature
    - talk to other researchers
    - get a big picture of existing knowledge
    - ensure *theoretical* relevance

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3. Innovate
4. Test / Validate

- Innovate and test phases can be and often are intertwined

- Validation is perhaps the hardest part of constructive research
- Validation should be performed in industrial settings, whenever possible – to ensure practical relevance
- Validation employs other techniques, such as action research and case studies

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Market-based Validation of Managerial Constructions

- Weak market test
  - a manager applies the construction in a company
- Semi-strong market test
  - constructions becomes widely adopted by companies
- Strong market test
  - systematic application produces better financial results
- Semi-strong and strong market tests require statistical analysis of a substantial amount of implementation data

Types of Research Validation

• Persuasion	I thought hard about this, and I believe...
• Implementation	Here is a prototype of a system that ...
• Evaluation	Given these criteria, the object rates as ...
• Analysis	Given the facts, here are consequences ...
Formal model	Rigorous derivation and proof
Empirical model	Data on use in controlled situation
• Experience	Report on use in practice
Qualitative model	Narrative
Decision criteria	Comparison of systems in actual use
Empirical model	Data, usually statistical, on practice

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5. Show theoretical contribution & novelty
6. Examine scope of applicability & generalize

- Novelty
  - crucial, but don't be too hard on yourself
  - Lots of possibilities
    - entirely new idea (rare)
    - cross-domain knowledge sharing
    - improved idea / implementation / solution
    - interesting research approach
    - ...
- Knowing the field & positioning is crucial to novelty and theoretical contribution
- Generalize
  - broad = good?
  - hypothesize as ground for further testing

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Evaluation Criteria for Constructive Research

- Construct
  - Relevance
    - Theoretical Relevance
    - Practical Relevance
  - Novelty
  - Practical utility
    - difficult to assess the practical adequacy of any new construction prior to its implementation
    - difficult because of organizational factors
    - technical success != practical success
- Research process
  - rigor

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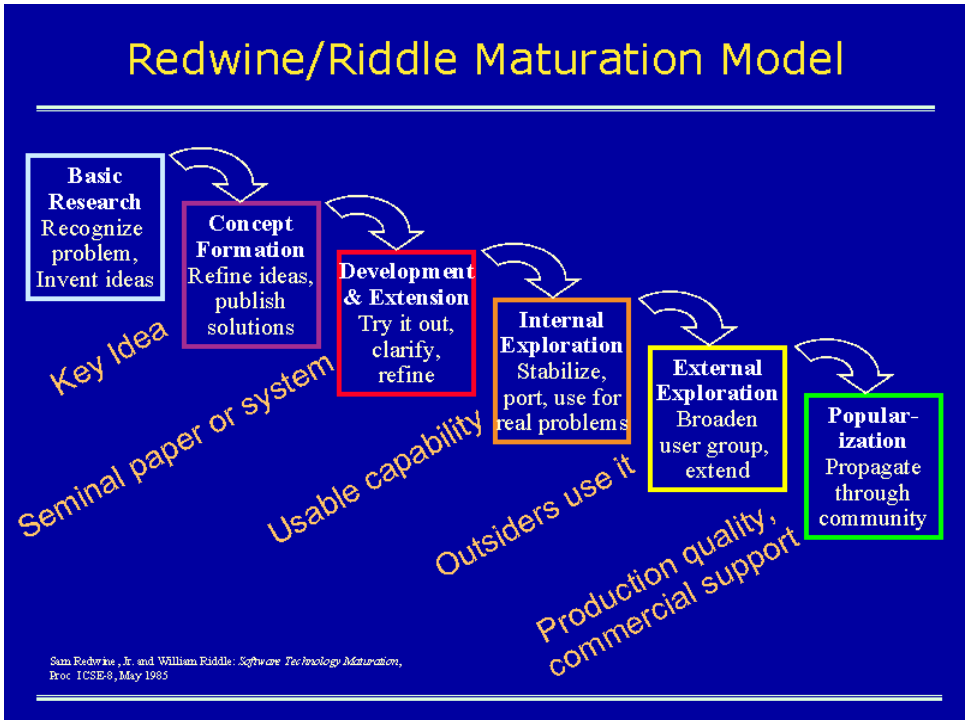
Is the Constructive Approach Scientific?

- Charasteristic features of the constructive method
  - step-by-step procedure, where steps can be checked
  - serves some definite purpose, is goal-driven
- Objectivity, criticalness, autonomy
  - checking the steps
- Progressiveness, criticalness
  - shows concretely, which solutions work, and don't work
  - working constructions tend to lead to new questions
- Relevant, simple, easy to use
  - inadequate solutions become eliminated by users
  - often the simplest idea is the most adequate one

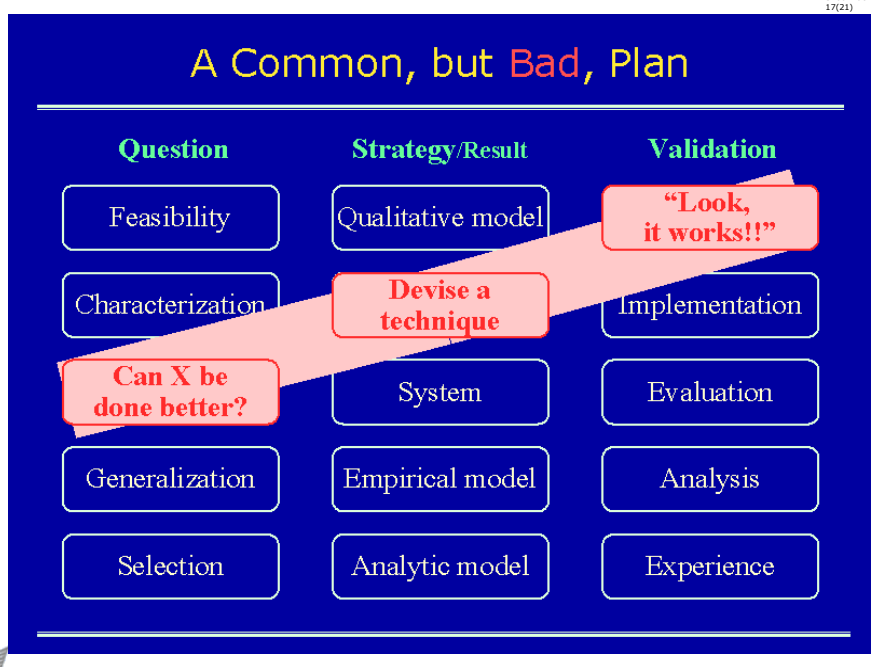


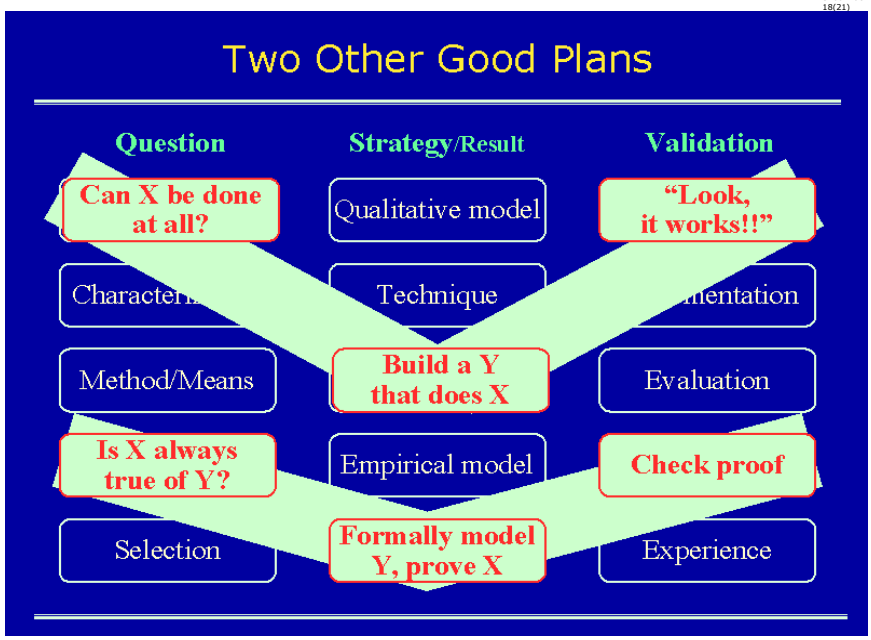
Building Blocks for Research

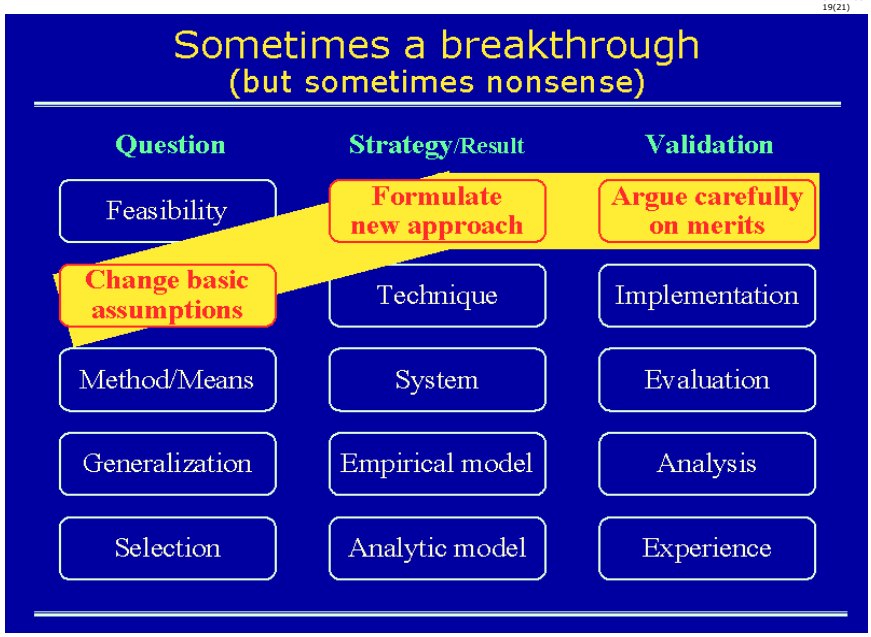
Question	Strategy/Result	Validation
Feasibility	Qualitative model	Persuasion
Characterization	Technique	Implementation
Method/Means	System	Evaluation
Generalization	Empirical model	Analysis
Selection	Analytic model	Experience

A Common Plan

Question	Strategy/Result	Validation
Feasibility	Qualitative model	Persuasion
Characterization	Technique	Implementation
Can X be done better?	**Build a Y**	**Measure Y, compare to X**
Generalization	Empirical model	Analysis
Selection	Analytic model	Experience


A Common, but Bad, Plan
Question
Strategy/Result
Validation
Feasibility
Qualitative model
"Look, it works!!"
Characterization
Devise a technique
Implementation
Can X be done better?
System
Evaluation
Generalization
Empirical model
Analysis
Selection
Analytic model
Experience


Two Other Good Plans
Question
Strategy/Result
Validation
Can X be done at all?
Qualitative model
"Look, it works!!"
Technique
Method/Means
Build a Y that does X
Evaluation
Is X always true of Y?
Empirical model
Check proof
Selection
Formally model Y, prove X
Experience



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