Design paradigms

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Design methods movement in the 1960s

- Design methods movement in the 1960s
- JC Jones, Herbert Simon, Christopher Alexander…
- Related to research in AI, cybernetics, and decision-making
- Assumed humans act (more or less) rationally, according to pre-defined plans

The ideas of a Design Science came from
Simon (1969): *'The Sciences of the Artificial'*

Based on these ideas one can make a distinction between
- explanatory sciences
  (like physics, sociology, aerodynamics)
- design sciences
  (like medicine, engineering, aircraft engineering)

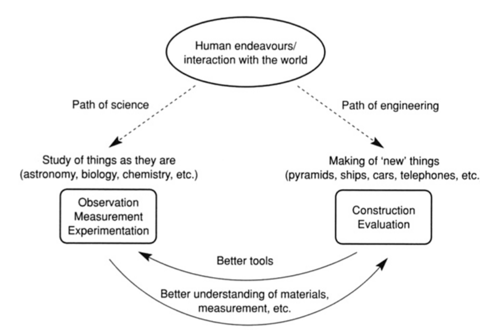
Explanatory Science
- mission: to *understand*
  develop knowledge to describe, explain, predict
- students are trained to become researchers
- typical research product: *descriptive*
  like the causal model

Design Science
- mission: to *improve human condition*
  develop *knowledge* to *design* solutions to field problems
- students are trained to become professionals
- typical research product: *prescriptive*
  like the technological rule

Scientific Disciplines

- Types of research (Herbert Simon, 1969):
  - natural sciences: phenomena occurring in the world (nature or society)
  - design sciences - sciences of the artificial:
    - all or part of the phenomena may be created artificially
    - studies artificial objects or phenomena designed to meet certain goals
  - social sciences: structural level processes of a social system and its impact on social processes and social organization
  - behavioural sciences: the decision processes and communication strategies within and between organisms in a social system

Science vs. Engineering



Engineering and design

- Engineering approach
  - Define problem
  - Look for best solution
  - Assumes problem can be well-defined
  - Divide-and-conquer
  - Based on analytical and mathematical skills
  - True or false
- Design approach
  - Wicked problems
  - Try to understand the situation
  - Explore possibilities to better understand the problem
  - Iterative work
  - Sketching
  - Good or bad

Normative problems

- True-False vs. Good-Bad
- Objective vs. subjective formulation and evaluation of problem/solution

Donald Schön, Technical Rationality
The Reflective Practitioner (1983)

The technical-rational view of professional knowledge is the learn-then-go-and apply model.

A technical rationalist view sees the teacher as the expert, leading the learner from their condition of ignorance to one of knowledge, knowledge which has been selected by the teacher.

- Schön argues that..
- 'the dominant mode of technical rationality is incompatible with the 'swampy lowlands of actual practice. In complex situations the *reflective practitioner* would have to draw on their own knowledge-in-action developed through real practice, not just existing research or theory.'

Extending Technical Rationality

- Since the model of natural science, engineering and medicine has proven to be so successful in its own domains, it is tempting to try to generalize it to other domains
- However, this is dangerous, because implicit assumptions might not hold anymore
- We need to understand the very nature of the problem itself, to be able to approach in a suitable way

Problem setting

- Donald Schön on problem setting:
  - *" In real-world practice, problems do not present themselves to the practioner as givens. They must be constructed from the materials of problematic situations which are puzzling, troubling, and uncertain."*
  - *"When we set the problem, we select what we will treat as 'things' of the situation, we set the boundaries of our attention to it, and we impose upon it a coherence which allow us to say what is wrong and in what directions the situation needs to be changed."*

Categories of Mess

Kurtz, CF and Snowden, DJ (IBM Systems Journal 43, 3 Mar 2003)

Category	Qualities
I	Solution knowledge exists in your domain
II	Solution knowledge in another domain
III	No solution exists. Complex, but responds consistently to same stimuli
IV (Wicked)	No solution exist. Chaotic and adaptive

Wicked Problems

- Defined by Rittel and Webber in 1973
  - Rittel, Horst, and Melvin Webber (1973). "Dilemmas in a General Theory of Planning," pp. 155-169, *Policy Sciences*, Vol. 4.
- A related notion is “ill-structured problems” (Herbert Simon)
- Was a response to the then dominating view of design as essentially a rational, logical activity

Wicked Problems

- Identified by Horst Rittel in late 1960s as characterizing social problems, in city planning
- Contrasted relatively easy challenges of public health engineering in late 19th & early 20th centuries with late 20th century urban planning
- Also compared puzzle-solving in mathematics & natural science with complexities of social policy (hard/soft science)

Tame and Wicked Problems

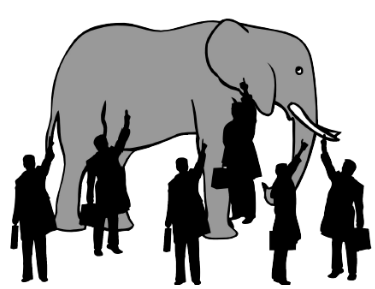
Tame problems	Wicked problems
Solution set describable	Problem definition incorporates solution
Determinate solutions	Indeterminate solutions
Optimised solutions	Satisficed solutions
True solutions	Good solutions
Solution achievement definable	Solution can always be improved by further work

Characteristics Wicked Problems

- The Problem is difficult to define.
- Multi-causal. May itself contain problems.

No definitive formulation

- Problem specification is hard
- Separation between problem specification and solution difficult to achieve
- Specification and understanding bound up with ideas for solution



Characteristics
Wicked Problems

- No rules or markers for where to stop.
- Each wicked problem is essentially unique.
- Attempts to address may open cause unforeseen consequences.

Symptom of another problem

- Resolving one issue may pose another
  – Typical example – You find a great tool for some part of the job, but it only works with certain other tools

Characteristics
Wicked Problems

- No opportunity for trial and error learning with immunity.
- The planner is held accountable.

No stopping rule

- No criteria for identifying ***the*** best solution
- Only one (or several) satisfactory solutions
- You can never know (or prove) which solution is the best
- Solutions related to natural science and engineering problems can typically be evaluated in terms of true or false, and it is in principle possible to tell which is the best solution

Solutions are not true or false

- Solutions are good or bad, better or worse

No test of a solution

- Too many criteria
- Too many features
  - Many design projects “stop” and call it a “solution” because they believe it is good enough

Essentially unique

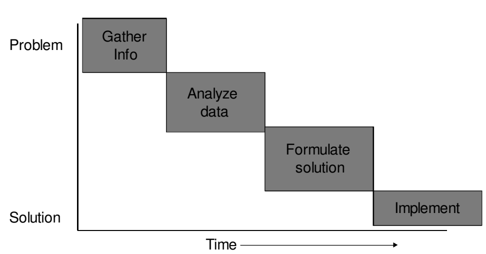
- Some reuse is possible, but interpretation is required
- Design patterns can be applied, but there is no universal rule like in natural science

Defining characteristics (Rittel)

1. There is no definitive formulation of a wicked problem.
2. Wicked problems have no stopping rule.
3. Solutions to wicked problems are not true-or-false, but better or worse.
4. There is no immediate and no ultimate test of a solution to a wicked problem.
5. Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial-and-error, every attempt counts significantly.
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan.
7. Every wicked problem is essentially unique.
8. Every wicked problem can be considered to be a symptom of another problem.
9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.
10. The planner has no right to be wrong (planners are liable for the consequences of the actions they generate).

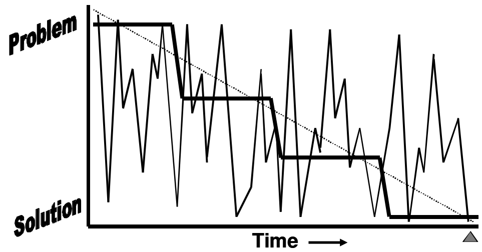
Typical Approaches to
Tame Problems:
Linear

Waterfall Lifecycle

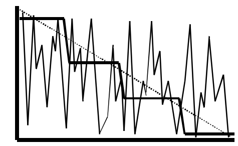


Typical Approaches to
Wicked Problems:
Chaotic

How Humans Really Approach Complex Problems



"Wicked Problems"



- You don't understand the problem 'til you have a solution
- Many stakeholders
- Changing constraints
  - $$, time, players
- Run out of resources

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Project work, such as Exjobbs

- Things to think about
  - Be honest about the way the work proceeds
  - No after-rationalization (but new insights that you realized late are fine!)
  - If it is a wicked problem, it is natural that you cannot define it from the beginning
  - Describe how your understanding of both problem and solution has become clearer along the way of your work

The end

- Discussion…?