1. Introduction to Systems Thinking
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What are Systems?

(Elliott & Deasley, 2007)

• “A system is a set of parts which, when combined, have qualities that are not present in any of the parts themselves. Those qualities are the emergent properties of the system.”
• “We are increasingly concerned with complex systems, in which the parts interact with each other and with the outside world in many ways”
• “The relationships between the parts determine how the system behaves.”
• “Intuition rarely predicts the behaviour of complex systems.”
What is Systems Thinking?

(Mingers & White, 2010)

• “Viewing situations holistically, as opposed to reductionistically, as a set of diverse interacting elements within an environment
• Recognising that the relationships or interactions between elements are more important than the elements themselves in determining the behaviour of the system
• Recognising a hierarchy of levels of systems and the consequent ideas of properties emerging at different levels, and mutual causality both within and between levels
• Accepting, especially in social systems, that people will act in accordance with differing purposes or rationalities”
What is Systems Thinking?

• “a discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static snapshots...systems thinking is a discipline for seeing the ‘structures’ that underlie complex situations, and for discerning high and low leverage change”

  (Senge, 1990)

• “…an epistemology which, when applied to human activity is based upon the four basic ideas: emergence, hierarchy, communication, and control as characteristics of systems. When applied to natural or designed systems the crucial characteristic is the emergent properties of the whole.”

  (Checkland & Scholes, 1999)
The “Hard” and “Soft” systems traditions compared

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<tr>
<th>Hard systems tradition</th>
<th>Soft systems tradition</th>
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<td>Assumes the world contains systems that can be engineered</td>
<td>Assumes the world is problematical but can be explored with systems models</td>
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<td>Assumes systems models to be models of the world (ontologies)</td>
<td>Assumes systems models to be intellectual, conceptual constructs (epistemologies)</td>
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<td>Modelling is oriented to goal seeking, optimisation, and prediction</td>
<td>Modelling is oriented to learning, exploration, and commitment</td>
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<td>Talks the language of “solutions”</td>
<td>Talks the language of “issues”</td>
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**Advantages**

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<th>Hard systems tradition</th>
<th>Soft systems tradition</th>
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<td>Allows use of powerful quantitative techniques (simulation, visualisation...)</td>
<td>Is open to all stakeholders and keeps in touch with human interests</td>
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**Disadvantages**

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<th>Hard systems tradition</th>
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<td>May loose touch with the actual problem situation; ownership and control issues</td>
<td>Does not produce final answers, accepts that inquiry is never ending</td>
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Systems paradigms

(Pidd, 2004; Kotiadis & Mingers, 2006)
Why Systems? Messes, swamps and wicked problems…

- Aim is *intervention* in a problem situation, not knowledge gathering for its own sake
- No definitive formulation of the problem situation
- There is no stopping rule, the problem situation is on-going
- Interventions are not right or wrong, there is no immediate/ultimate test of an intervention, but only viewed as good/bad
- Interventions are ‘one-shot’, no trial-and-error (experiments), every intervention counts significantly, they are essentially unique
- No enumerable, exhaustively describable, set of interventions
- Problem situations can be considered as symptoms of other problems
- Interventions can be contested at the level of explanation, there is likely to be conflicting evidence/data

Adapted from (Rittel & Webber 1973)
Why Systems? Messes, swamps and wicked problems…

- Problem situations involving many interested parties with different perspectives (worldviews)
- Problem situations that are not well defined
- There is difficulty in agreeing objectives of interventions
- Success of interventions requires creating agreement amongst parties involved
- There are many uncertainties and lack of reliable (or any) data
- Almost certainly trying to work across the boundary between human activity and the artefacts of engineering

Adapted from (Mingers 2011)
Taking Action: Problem Structuring Methods (PSMs)

- Methods, not mathematical, but structured and rigorous and based on qualitative, diagrammatic modelling
- Allow for a range of distinctive views to be expressed/explored/accommodated and allow for multiple and conflicting objectives
- Encourage active participation of stakeholders in the modelling process, through facilitated workshops and cognitive accessibility
- Can facilitate negotiating a joint agenda and ownership of implications of action
- Significant uncertainty is expected and tolerated
- Operate iteratively
- Aim is for exploration, learning, and commitment from stakeholders

Adapted from (Mingers, 2011; Mingers & Rosenhead, 2004; Rosenhead, 1996)
Example PSM: Soft Systems Methodology (SSM)

Adapted by John Davis from (Checkland & Scholes 1999)
Generic properties of PSMs – summary

1. Action to improve
2. Systemic approach
3. Adaptation and creativity
4. Methodological lessons
5. Worldviews
6. Wicked/messy problem situation
7. Interactive, iterative and therapeutic
8. Subjectivity
9. Limits

Adapted from (Yearworth & White 201x)
Theoretical underpinnings – see handout

(Yearworth & White, 201x)

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<th>Aspect</th>
<th>Definition</th>
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<td>Improvement Activity</td>
<td>A structured way of approaching systemic intervention has been taken, which was designed to lead to improvements in a problematic real-world situation through a set of purposeful activities.</td>
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<td>Systemic Approach</td>
<td>The problem structuring approach used systems ideas (including boundary, hierarchy, communication and control), which i) are appropriate to context, ii) theoretically adequate, and iii) supported by appropriate systems modelling.</td>
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<td>Adaptation/Creativity</td>
<td>Conscious thought and creativity must have gone into how the problem structuring approach was adapted or elements combined for the particular problem situation.</td>
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<td>Methodological Lessons</td>
<td>Use of the problem structuring approach yielded methodological lessons, extracted by conscious reflection.</td>
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<td>Worldviews</td>
<td>The process of problematisation recognised that problems are construct of an individual’s mind, they do not exist independently of human thought. These constructs are defined by an individual’s “worldview”, the problem structuring approach acknowledged these and worked with them.</td>
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<td>Messiness</td>
<td>The problem context in which the problem structuring approach was used was recognised as messy/wicked/swampy following definitions such as contained in (Ackoff, 1979, 1981; Rittel &amp; Webber, 1973; Rosenhead, 1992; Vennix, 1999).</td>
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<td>Interactive/Iterative/Therapeutic</td>
<td>The intervention in the problem situation has come about through sharing of “perceptions, persuasion and debate” in a participative group setting using an interactive and iterative approach. The facilitator or owner of the problem structuring approach adopted a stance that was “interactive/therapeutic, not expert”.</td>
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<td>Subjectivity</td>
<td>In the approach taken it has been recognised that the stakeholders of the problem situation are not “divorced from the problem” and that they could not act as objective “outsiders” as in the ‘hard’ systems tradition.</td>
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<td>Limits</td>
<td>Approaches to problem structuring might unwittingly suffer from inter alia bounded rationality, inadequacy of organizational language to supply adequate conceptual terminology, application of non-appropriate methodology, “spurious saliency” etc. The approach used demonstrated that it dealt with such conceptual limitations including building expertise in the use of problem structuring methods.</td>
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Exercise – Restating the problem situation

• In groups
• Quick 5 minute brainstorm to identify
  – Key issues
  – Stakeholders involved
  – Assumptions you are making

as you approach the “definition of integrated and comprehensive urban plans addressing the efficient energy flows across various sectors, focusing on the long term”
References


References


