

Reflections of Teaching the Causal Loop Modelling approach to Systems Thinking in New Zealand

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ABSTRACT

In this presentation I will discuss various aspects of the special issue of the MDPI online journal *Systems* on “Systems Education for a Sustainable Planet”, and briefly outline the Integrative System Dynamics approach to systems thinking. Then I will

summarise my approach to causal loop modelling based on the literature and my experiences with systems thinking and qualitative system dynamics. Finally, I will provide some insights and reflections about causal loop modelling derived from my teaching, consulting and executive development work in New Zealand.

1. INTRODUCTION

“Because the world is so highly interconnected, complexity characterises all human endeavours. The issues facing humanity have become increasingly complex due to the fact that they are embedded in a global web of ecological, economic, social, cultural and political processes with dynamic interactions. Such complex problems and challenges cannot be addressed and solved in isolation, or, by applying the single dimensional mindsets and tools of the past. Systems thinking and dynamic approaches offer a holistic and integrative way to assess the major dimensions of complex problems.” (Bosch & Cavana, 2018, vii).

‘Systems thinking’ and ‘computer modeling & simulation’ appear at the intersection of all these domains. These are often referred to as soft and hard systems modelling. A model is defined as being a representation of the real world. Models can take on different forms, physical, analog, digital (computer), mathematical, and so on. Soft modelling refers to conceptual and contextual approaches that tend to be more realistic, pluralistic and holistic than ‘hard’ models. In this presentation, I will focus on causal loop modelling, ie a soft systems thinking approach.

2. INTEGRATIVE SYSTEM DYNAMICS FRAMEWORK

The integrative system dynamics framework outlined in this presentation is based on the system dynamics methodology developed by Jay Forrester (1961) and extended by many others including Coyle (1996), Senge (1990), Richardson (1991), Vennix (1996) and Sterman (2000). The development of integrative system dynamics (Cavana & Maani, 2000; Maani & Cavana, 2007) involves five major phases as summarised in Table 1.

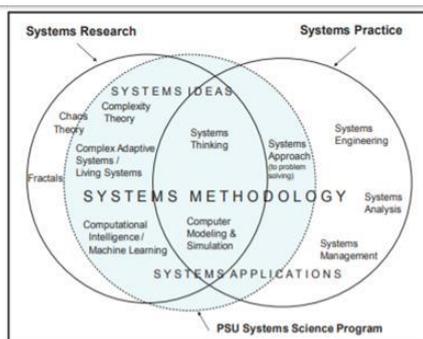
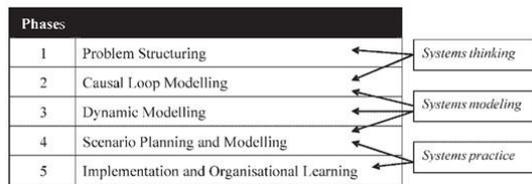


Figure 1. Graphic depiction of the field of Systems Science and the PSU Systems Science Program.

In Figure1, Wakeland (2014) provides a Venn diagram of the links between the Portland State University systems science program, and the domains of systems ideas, systems applications, systems methodology, systems research and systems practice.

Table 1. Integrative System Dynamics Framework



3. CAUSAL LOOP MODELLING

My approach to causal loop modelling is based primarily on material adapted from Cavana et al. (1999, 2007), Maani & Cavana (2000, 2007), Senge (1990), Coyle (1996), Sterman (2000) and others. This involves the following 10 steps: 1) Briefly summarise the situation of interest

- 2) Establish an issue or 'organizing question' for analysis
- 3) Prepare a stakeholder map & stakes/interests of the main stakeholders
- 4) Identify the main variables
- 5) Prepare a behaviour over time (BOT) chart (Reference Mode)
- 6) Develop a causal loop diagram (CLD)
- 7) Identify feedback loop types & analyse loop behaviour
- 8) Identify & discuss system archetypes (if present)
- 9) Identify key leverage points
- 10) Develop intervention strategies (revise CLD & BOT chart)

4. REFLECTIONS

In the presentation, I will focus on a number of reflections and insights I have gained teaching causal loop modelling on various undergraduate and graduate level systems thinking and system dynamics courses, consulting projects and executive development courses in New Zealand.

These include insights related to:

- Formulating organising questions;
- Constructing behavior over time charts;
- Preparing causal influence matrices (tables);
- Developing causal loop diagrams (CLDs);
 - Analyzing CLDs;
- Use of systems cases in teaching and assessment;
- Limitations of CLDs.

Finally, I will provide some overall summary comments about teaching causal loop modelling on

systems related courses and the links to critical systems thinking (Jackson, 2019).

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