

Causal Mapping of the New Zealand Natural Resources Sector System: A Preliminary Analysis

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ABSTRACT

In September 2013, the seven agencies that comprise the New Zealand Natural Resources Sector agreed a process to analyse and develop strategic advice from a sector, rather than agency, perspective. A group model building workshop (using the qualitative system dynamics approach to systems thinking) was held in November 2013, with the following aim: *Map the wider environmental system that the natural resources sector operates within and better understand the linkages between land, freshwater and marine systems.* To achieve the proposed aim, the workshop was split into three groups that each looked at each sub-system (land, freshwater and marine) to make the approach achievable in a day. The groups met subsequently to refine their work. The systems maps that emerged from this process, together with a climate system map, were subsequently combined to form an integrated systems map covering the wider environmental system in New Zealand. This map was subsequently analysed for feedback connections and leverage points within the system. This paper provides a preliminary discussion of group model building workshops.

INTRODUCTION

In September 2013, the seven agencies that comprise the New Zealand Natural Resources Sector agreed a process to analyse and develop strategic advice from a sector, rather than agency, perspective.

In November 2013, a workshop, the first of a series, was held to begin the analytical inquiry using causal loop diagrams as part of a systems thinking approach. This paper provides a brief background to the Natural Resources Framework in New Zealand (MfE, 2013), sets out the methodology, the workshop and post workshop activities, and offers some reflections on the processes used. Some of the resultant systems maps are included, as are some images of the workshop process. The system maps helped set the boundaries of the analysis and subsequent workshops and are just one input of a number into the overall process.

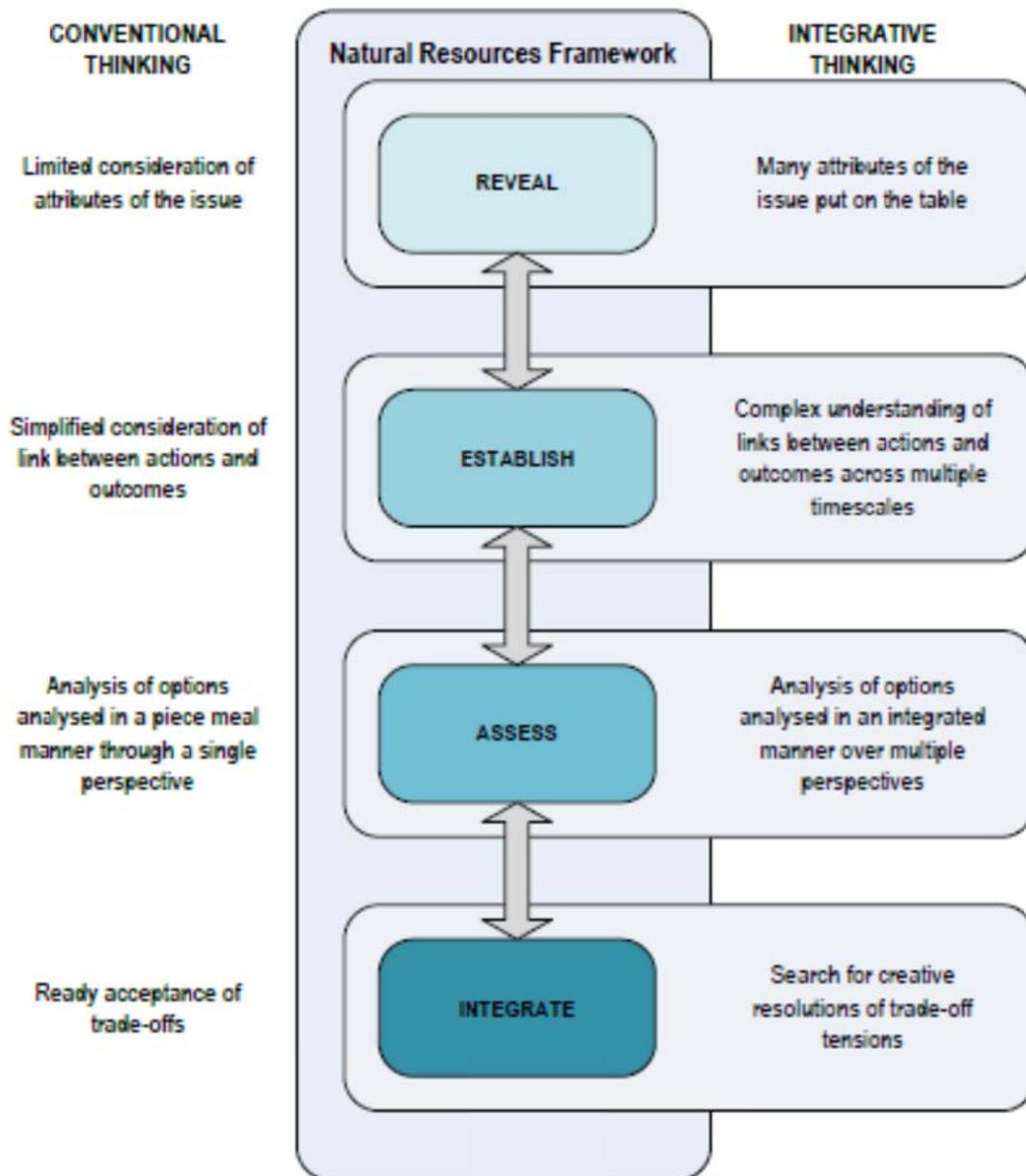
The final version of this paper is likely to be of interest to systems thinking and group model building practitioners, as it will provide some preliminary reflections on a participative process with participants that had little or knowledge of using causal loop diagrams.

BACKGROUND

The Natural Resources Framework (MfE, 2013) was used to structure the wider project work that this participatory process sits within. The Framework emphasises systems, people's behaviour, the importance of taking a medium/long term approach, and explicitly identifying tradeoffs, gaps, uncertainties and assumptions. Its purpose is to support the creation of robust and resilient policy that promotes effective stewardship of natural resources in New Zealand (Hearnshaw et al, 2014).

Consistent with understanding a problem within the context of its containing whole (Ackoff, 1999), the framework represents a form of systemic thinking using an integrative approach to structure and help inform analysis. Figure 1 shows the four stages of integrative thinking in the framework.

Figure 1: Integrative Thinking and the Natural Resources Framework



Source: Adapted from Martin and Austen (1999), Ministry for the Environment, 2013, Fig 2, p9.

The workshops outlined in this paper relate to the first of the four analytical components in the framework (Figure 1); the ‘Reveal’ component. The Reveal component is largely a descriptive exercise to understand the relationships between and within a wider environmental system that includes social and biophysical systems. For the purposes of this project, the wider environmental system was equated with the operating environment of the seven natural resource sector agencies.

The causal loop diagram approach was chosen as it had been trialled before and it offers a practical way for participants to make connections and sense of complex policy areas across differing disciplines and perspectives.

METHODOLOGY

Systems thinking, involving group model building (e.g. see Richardson et al., 1994; Richardson & Andersen, 1995; Vennix, 1993; Vennix, 1996; Vennix et al., 1997; Rouwette & Vennix, 2006; Scott et al., 2013), embraces a range of facilitating processes, by which stakeholders are encouraged to describe an issue or organised structure in terms of sub-issues and significant features. The general methodological approach used for this study is called systems thinking (e.g. see Senge, 1990; Sterman, 2000; Maani and Cavana, 2007) using the qualitative system dynamics approach (e.g. see Wolstenholme and Coyle, 1983; Vennix, 1996; Coyle and Alexander, 1997; Wolstenholme, 1999; Cavana et al, 1999 & 2007).

Briefly, the chosen methodology was to use systems thinking, in the form of causal loop diagrams, to understand the wider environmental context of the NRS, in keeping with the Reveal component of the Natural Resources Framework (MfE, 2013). The diagrams and approach are to be used as an input into the wider analytical process of the Natural Resources Framework. The diagrams are being used to identify the boundaries of the work and identify linkages between systems, as well as identify particular areas of interest to investigate further using the framework.

Sixteen participants from the seven agencies attended the workshop. Six weeks before the scheduled workshop, a systems specialist (ie the 1st co-author) was engaged to lead the causal loop diagram component of the workshop. The following aim was set and the content agreed the week before the workshop:

Map the wider environmental system that the natural resources sector operates within and better understand the linkages between land, water and marine systems

The wider environmental system could have been mapped a number of ways. To achieve the proposed aim, the work was split into three groups that each looked at a three sub systems (land, freshwater and marine) to make the approach achievable in a day. A decision to split the system into three was a pragmatic choice so that participants could build on their knowledge in a novel way that was consistent with a systems thinking approach.

Each group was to substantially complete a system, before peer reviewing the other systems and suggesting changes where needed. A volunteer from each group was to stay at the original table to describe the system to the next group and take notes, as required, ensuring that the system could be understood by all. By the end of the individual group work, each group would have seen all the system maps, as well as any subsequent changes to the initial map. The workshop was to conclude with a final session that brought together the three maps to physically link the maps into a 3-D representation of the wider environmental system.

The Workshop activities

The workshop began with a short introduction on the NRS and the context for the day's work, noting an ambitious agenda for the day. Participants then introduced themselves by names only (not agency) and briefly set out what they wanted from the day. A short introduction to systems thinking and causal loop diagrams was provided by the systems specialist before the group work on each system commenced. Each group was facilitated by a person from a different agency and the systems specialist was available as an expert resource to all the tables throughout the day.

Each participant received a pack that had a detailed agenda, Q&As, a one pager that outlined key concepts and some tips, an example climate systems diagram, as well as more detailed examples on causal loop diagrams for later use. Participants were pre-assigned to each table to ensure that there was expertise on a system from a range of agency perspectives. Each table was set up beforehand with paper, post its, pens, and additional example system diagrams. Each group had two working surfaces available - a wall (or window) and the group table - to undertake the work. In addition, there was a comments area, where people could post comments on either the content or process during the day.

Each group chose their own boundaries and the scale/detail of the map. Maps for each system were completed on the day to be captured later on 'Vensim' (Ventana Systems, 2002). Pictures were also taken through the day capturing the process from the initial brainstorming of concepts, to the clustering and production of the variables for the final systems maps.

Figure 2: Photograph of the Freshwater group at the Workshop



Post workshop activities

The day after the workshop, participants were emailed the images of each system map and thanked for their help.

The system maps were transcribed into an electronic form (using the Vensim simulation software package) for people to review and comment on before the next two hour session in mid-December. Individual maps were then analysed to identify key nodes and system loops to investigate the influence of people's behaviour, in line with the natural resources framework's approach.

System maps have been prepared for the freshwater, marine, land and climate subsystems of the New Zealand natural resources sector system. Linkages between systems offers a unique perspective into the wider environmental / NRS system as a whole, as distinct from the particular system characteristics of individual systems or agencies. Linkages between these subsystem maps are currently being analysed and will be reported in a subsequent paper.

REFLECTIONS & LESSONS LEARNT FROM THE WORKSHOP

Although the workshop did not achieve the full aim, it did achieve most of the work needed to bring the analysis together in a way that can fulfil the aim within the required time frame. The workshop could have been lengthened, however, energy and enthusiasm was beginning to fall and instead an additional two hour session was scheduled to complete the work. As with much of the work within the NRS, the work was difficult and demanding at times, reflecting the complexity of environmental policy in general. This should be no surprise and there is unlikely to be any one tool that will offer a simple solution.

The workshop highlighted a number of areas that worked well and a number of improvements that could be made to the process and content. Overall the workshop was ambitious but largely successful with a better picture now available of the wider context that the NRS operates within, as opposed to individual agencies. The 3-D representation of the environmental system is a novel and hopefully useful construct for future communication across the sector. No comments were received on the day, although people indicated later that they found the workshop useful. More details on things that worked or didn't work so well will be outlined in a further paper.

CONCLUSIONS

The use of causal loop diagrams is a sound tool for investigating environmental systems and getting a shared understanding of the systems amongst a range of individuals with different perspectives. The process should be well designed and if a one day approach is used then the simplified process used on the day for this workshop rather than the one designed for the day should be investigated.

Using an independent systems specialist to manage any subject area, agency or programme tensions that could have the potential to affect the process or workshop outcome(s) is very useful. Emphasising the sectoral, rather than agency approach to the work, provided a broad foundation for fully exploring the issues without being constrained by existing programmes. However, there is a need to ensure that each agency is fairly represented to avoid the perception of potential biases.

Having a range of perspectives is necessary to getting a good product and it is the quality of the interactions between people rather than quantity of the people at the workshop that is critical to the success of the day.

The system maps represent a view of a group of people at a specific point in time – as such they are not ‘right’ or ‘wrong’. This can be difficult for highly analytical people who seek the ‘right’ answer. In some groups, subsequent significant reworking of the maps by individuals did not have support from the wider group, as the new map was not seen as a legitimate representation of the group’s work. In this instance, the group reverted to refined versions of the original system map.

Finally we would like to emphasise that this systems mapping project has not yet been completed, as we have yet to finalise the linkages and connections between the four natural resource sub-systems we were considering: land, freshwater, marine and climate systems in New Zealand. This additional work will be reported in a subsequent paper.

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