Reaching consensus on water reforms in developing communities: a case of Community Operational Research in Kāpiti, New Zealand

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ABSTRACT

Addressing the problem of reaching consensus on water reforms was the motive for this Community Operational Research (COR). While water is comparatively abundant in New Zealand, a pattern of decline in the quality of water resources has persisted for more than a decade. Living up to its 'clean and green' image is a significant goal for New Zealand, with high economic value derived from the effects of its globally-recognised environmental credentials on key exports like agriculture, forestry, fisheries and tourism. This paper is an account of *Community Operational Research* (COR) undertaken in 2008/9. It examines the challenges and opportunities facing Kāpiti, a rapidly growing coastal community, with water scarcity and quality constraints that had long prevented them from meeting their sustainable development objectives. The Theory of Constraints (TOC) and a Stakeholder typology were used to identify system stakeholders and examine their perspectives. Causal Loop Diagrams (CLDs) from Systems Dynamics were constructed to explore and circumvent potential negative outcomes. Thus, a case study in a community resource management setting is described that tests the effectiveness of the combined, problem-structuring framework, to explicitly inform urban water management, and water reform, in New Zealand. Future research may test the framework in the broader context of environmental management. Conservation management and biosecurity risk management are two potential settings.

Keywords: resource management; problem-structuring; TOC; Stakeholder analysis; Community Operational Research, environmental sustainability, community development

1. INTRODUCTION

The motivation for this study was to consider how an entire community might take a more integrated and systematic approach to meeting the challenges of water management, and achieve healthier, more sustainable freshwater systems. New Zealand's urban communities are facing several challenges due to increasing population density and attendant competition for scarce natural resources. Urban water systems, in particular, are under increasing pressure to meet the expectations of residents and businesses, with water managers required to develop sensible and sustainable management initiatives that will secure water supplies and protect water for its intended use, now and in the future. Fragmented approaches to water policies and plans persist, despite ground-breaking environmental legislation like the *Resource Management Act 1991* (RMA, 1991), intended to advance environmental sustainability and protect community interests in environmental, social, economic and cultural outcomes (Williams, 1997; Sheppard, 2010; Hawke, 2006:1).

New Zealand has made progress in reducing point source pollution (from a single source, like a stormwater pipe) since the introduction of the *Resource Management Act 1991* and also as a result of other, complementary, environmental reforms. The signing of a Clean Streams Accord in 2003 (MfE, 2003) for example, was a collaborative effort by the rural sector aimed at decreasing pastoral runoff. Whilst success should be acknowledged in some areas, non-point discharges, from diffuse sources, like pasture or road runoff, continue to increase unsustainably and urban waterways remain polluted to an unacceptable level (Land and Water Forum, 2010).

Recent efforts in the area of water reform include New Zealand's multi-stakeholder *Land and Water Forum*, which delivered three reports containing a range of recommendations (2010; 2011; 2012). The country's first *National Water Policy Statement* (2011) was released largely in response to the Forum's recommendations. The Forum's findings and level of participation, suggest willingness on the part of communities of interest, to be part of water reform. However, the means to undertake widespread water reform remains the subject of ongoing debate, and at the present time, in early 2013, the overall decline in the quality of water in our rivers, lakes and streams, and related losses in indigenous biodiversity, remains disappointingly evident.
Operational research has been used increasingly, in natural resource sectors like agriculture, fisheries, forestry and mining (Bjørndal, Herrero, Newman and Romero 2011). In the context of these industries, the focus is primarily on meeting productivity objectives and optimising profitability (Midgley and Ochoa-Arias, 2004). A point of difference for this research is its departure from the more commonly applied stochastic programming models, and its concentration on people and their perspectives. This study acknowledges the 'leaky' boundaries between environmental and community matters (Midgley and Ochoa-Arias, 2004), and seeks to comprehensively explore the 'boundaries of knowledge' (Midgley and Ochoa-Arias, 2004) across both categories, by taking a systems approach.

With between one quarter to near one-half of urban rates spent on water and wastewater management in New Zealand, affordability is a key concern for communities. This Community Operational Research (COR) has tested the use of the Theory of Constraints (TOC) systems framework and a Stakeholder typology used with Causal Loop Diagramming (CLD) from Systems Dynamics, to examine ways that communities might gain better outcomes from their investment in urban water management initiatives. Thus, this study is concerned with increasing awareness of the critical constraints to achieving healthier, resilient, more sustainable, and affordable, water systems. The study demonstrates the research methodology by focusing on Kāpiti, a coastal settlement which has been debating water quality and security issues for more than a decade. The Kāpiti Coast District has a current estimated population of 49,000 (KCDC, 2013) and lies approximately 50km north of New Zealand's capital city of Wellington. The following excerpt from Kāpiti's 2009 water supply review, presents some context, in respect of the water security dilemma facing the community and the pressing need for reform:

> ***Effectively, the community is likely to be in breach of consent limits within the next five years. Breaching the consent or running parts of the supply system out of water are not acceptable options* (KCDC, 2009:5/19).**

METHODOLOGY

2.1 Combining the Theory of Constraints and Stakeholder Typology

A brief pilot study was conducted. This revealed that the selection of participants might be assisted through stakeholder analysis. There were layers of complexity in the initial stakeholder analysis process (Elias, Cavana and Jackson, 2002; Freeman, 1984 , and Mitchell 1997) that appeared unnecessary for this community-based research. A simple model that appeared more suited to this context of Community OR, was discovered during a later literature search, in an award-winning paper by Rawlins (2006). Specific stakeholders linked with the strategic issue were identified according to the ten categories that appear in the figure below, following Freeman (1984). Note the bidirectional arrows, illustrating the nature of the relationship between the stakeholder and the system issue.

Participants were identified, which is a departure from the generally accepted procedure in qualitative studies. Early in the investigation, approval for the research was obtained from the University Human Ethics Committee. This included

provision for participants to be named. All participants subsequently agreed to their comments being attributed to their name, though not all wished to attribute their comments to an organisation they were affiliated with. The sharing of knowledge and perspectives in a systematic and transparent manner is in keeping with the intention of the research design: to foster a supportive environment for honest stakeholder engagement, revealing deep insights, expert knowledge and critical understandings.

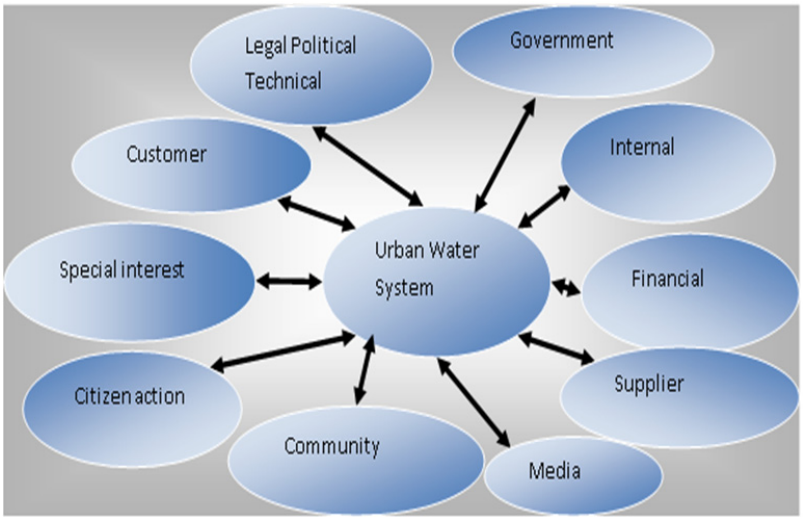

Figure 1. The Stakeholder map

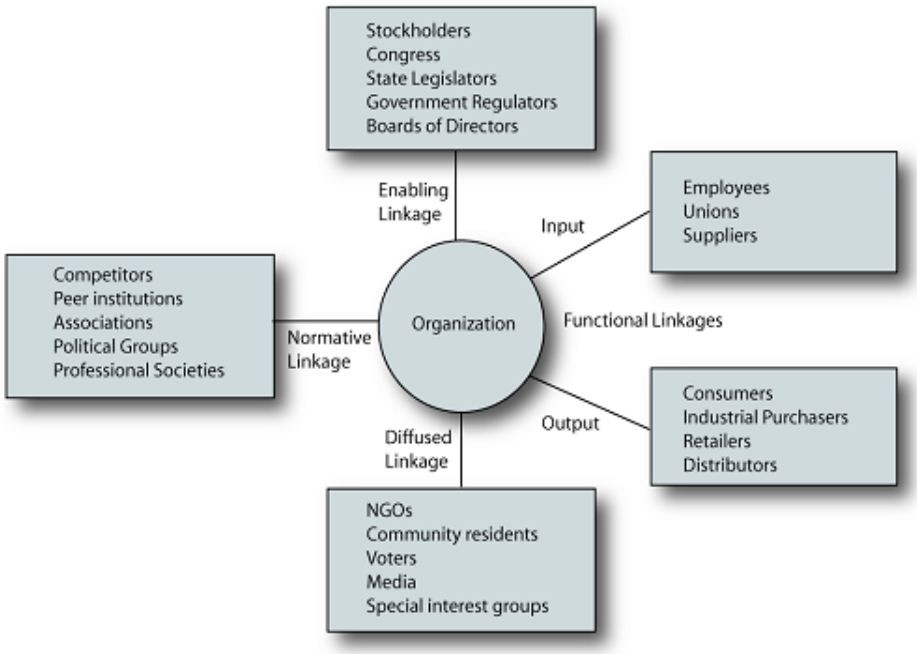

Figure 2. Stakeholder linkage model (Rawlins, 2006:4)

Following the mapping of participants (Figure 1) using the generic stakeholder map (Freeman, 1984), emphasis turned to the linkages (Rawlins, 2006), or the connections between the system and the participant (Figure 2). The participant stakeholders were represented in each of the linkages, with all but two of the participants, closely involved with the system under study. The 'community' and 'consumers', comprising around a third of the participants on the stakeholder grid (see Elias et al., 2002), have either a diffused or a functional (output) linkage, with normative linkages also present in some cases. Kāpiti's District Council (KCDC) has a functional (input) linkage, while the Ministry of Health (MOH), Greater Wellington Regional Council (GWRC) and to an extent, the Department of Building and Housing (DBH), demonstrate enabling linkages.

Though geographically distant from Kāpiti, the two Starborough Flaxbourne participants were selected for their situational linkage to the system problem, described in Rawlins (2006) as a 'normative' linkage. The Starborough Flaxbourne Soil Conservation Group are a collective of farm owners who have changed their farming practices to build farm systems that are healthy, resilient and profitable, in severely drought and erosion prone eastern Marlborough (in New Zealand's South Island).

2.3 Introducing The Theory of Constraints

A suite of TOC tools, collectively known as the Thinking Processes, guides the process of managing change (Scheinkopf 1999, Dettmer 2007). With five main logic diagrams, TOC researchers diagnose what in the system needs to change, what it needs to change to, and how to make the change happen (Mabin and Davies, 2010). TOC tools have evolved to include variants that also diagnose: Why change? How to sustain the change? How to develop a process of ongoing improvement? These are described in Mabin and Davies (2010). Kim, Mabin and Davies (2008) have surveyed applications of TOC Thinking Process (TP) tools, while Watson, Blackstone et al. (2007) have reviewed twenty years of TOC.

By engaging with the participant stakeholders identified through the Stakeholder typology, and using the Thinking Processes from the TOC methodology, to represent the logic underpinning their views, the problems with the most undesirable effects on the system were identified. Solutions were sought and tested using TOC's Intermediate Objective (IO), Current Reality (CRT), Evaporating Cloud conflict resolution diagrams (ECs), and Prerequisite (PRT) mapping procedures, coupled with Causal Loop Diagrams (CLDs) from Systems Dynamics. The last in a series of IO maps, a branch of the Current Reality Tree (CRB) and the PRT are shown in this paper.

2.4 Intermediate Objectives (IO) Mapping and Uses

Begin with the end in mind. This is the premise behind using IO Maps from The Theory of Constraints (TOC) to define constraining issues and find solutions to complex and even geographically dispersed problems. Dettmer (2007) argues the Destination (or IO) map is critical to the success of the Thinking Processes and sound decision-making. The maps are logic-based and readily interpreted. Thus, IO Mapping is a useful tool for Operational Researchers working on people-centred problems. Its potential to inform community and environmental research, such as in urban planning and water management, has recently begun to be explored (Moore, 2009a; Shoemaker and Reid, 2005).

The research began with an idea to agree a 'clear, unequivocal goal statement' (Dettmer, 2007) among the participants, using TOC IO (intermediate objectives) mapping. The IO map is essentially a vertical hierarchy of requirements, cascading from an agreed goal. It logically describes the desired state of a system that needs improvement. It is a profoundly simple, yet effective way of identifying gaps, opportunities and critical constraints. Key to the success of this

mapping procedure is that the requirements are always objective, never subjective (Dettmer, 2007). And they must logically connect in more or less general to specific order, down from one agreed end goal or 'goal statement' (Dettmer, 2007).

By simplifying the desired system view and identifying the necessary conditions and critical success factors underpinning one agreed goal, complex and perplexing system states may be readily understood by stakeholders. Critical problems and potential solutions surface by applying the knowledge of what *should be* happening (from the IO map) and what *is* currently happening. The CRT from TOC can be used to map the Current Reality and identify critical gaps, while the PRT (Pre-Requisite Tree) can identify obstacles and potential solutions. A problem shared is said to be a problem halved. The value of IO mapping to Community Operational Research is in its simplicity. Specialist knowledge is not required to understand, share, and therefore, buy into, the vision that is systematically defined in an IO map, clearing the way for the stakeholders to agree the conditions required to support the goal.

Read the IO map in Figure 3 from top down: *In order to…we must (ensure):*

In order to…

Achieve the goal of a more sustainable urban water system for Kāpiti

We must…

Have a secure water supply

We must also…

Live within our means

In order to…

Have secure supply *and* Live within our means

We must…

Have a resilient system, *We must…*Have a flexible system

Etc.

In order to…

Achieve reduced throughputs of potable water

We must…

Have superior (better than average) local government employees and communication

We must…

Have superior communication within the community on water issues…Etc.

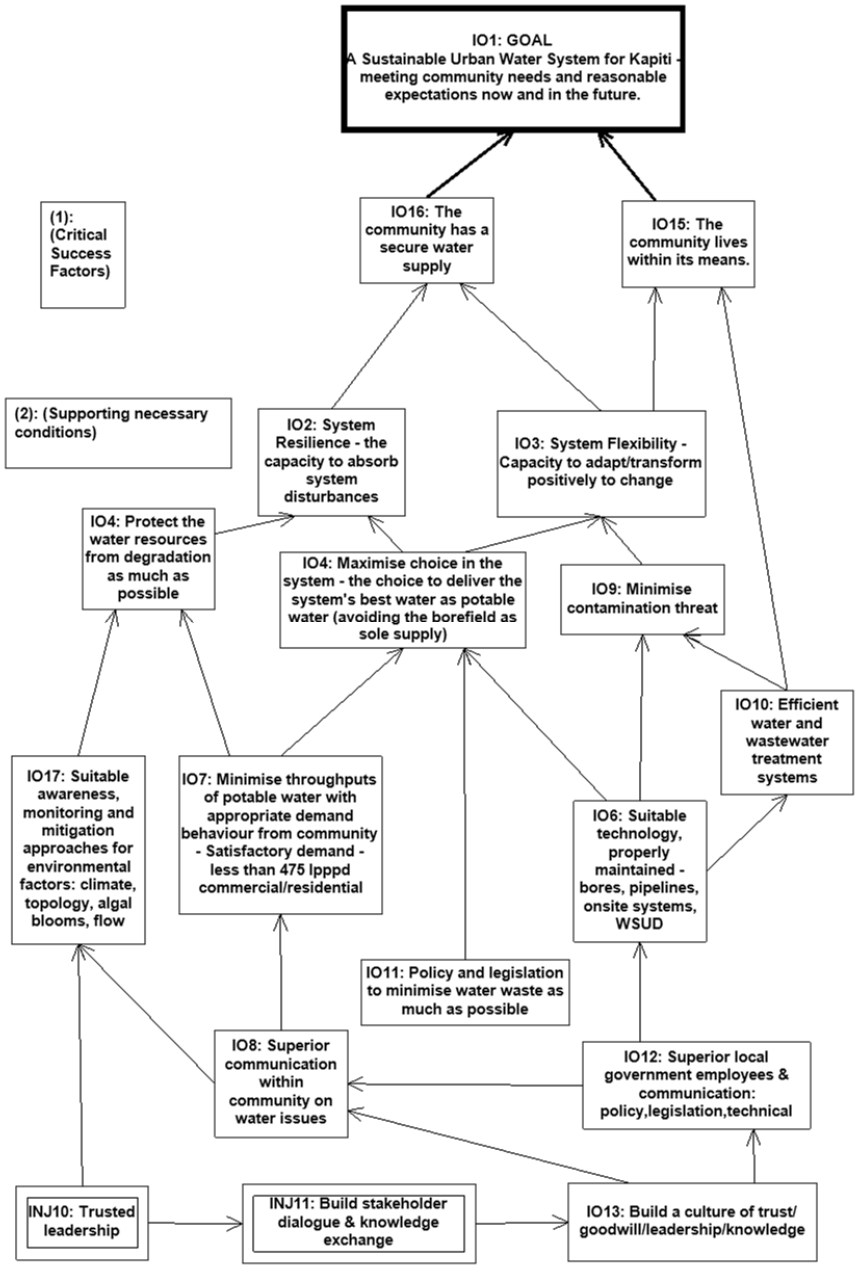

Figure 3. The final IO map

2.5 The Current Reality – What really is happening?

Current Reality Trees (CRTs) are sufficiency-based (*if…then*) logic trees used to compare reality with what is happening in the system now, principally, what is stopping the system from reaching its goal, as shown in the IO Map, in order to isolate what needs changing. A Current Reality Branch (CRB) focuses on one part of a system, reflecting only that part, which is unfavourable (Dettmer, 2007:92). The objective of the CRT/CRB is to isolate what needs changing by helping to identify the things that are clear indicators of system deficiencies, tracing them back to one or more basic causes (Dettmer, 2007:95).

Thus, Figure 3 maps the system destination (the Intermediate Objectives), while Figure 4 shows the Current Reality Branch (CRB) that focuses on the dilemma facing the Waikanae/Paraparaumu sub-region of Kāpiti, reflecting that part of the system most likely to impede the attainment of the agreed system goal. The CRB (*what to change)* was prepared in conjunction with a series of Evaporating Clouds EC's (Dettmer, 2007). UDE signifies an undesirable effect. MAG (the bowtie connector near base of Fig 4.) shows four entities combining in a magnitudinal way to influence UDE2. One or more of these acts as a *critical constraint* to achieving the goal. Comparing the CRB (depicting participants viewpoints on a critical part of the system) in Figure 4, with the IO map in Figure 3, the reasons why the current reality differed from the preferred system, were able to be determined.

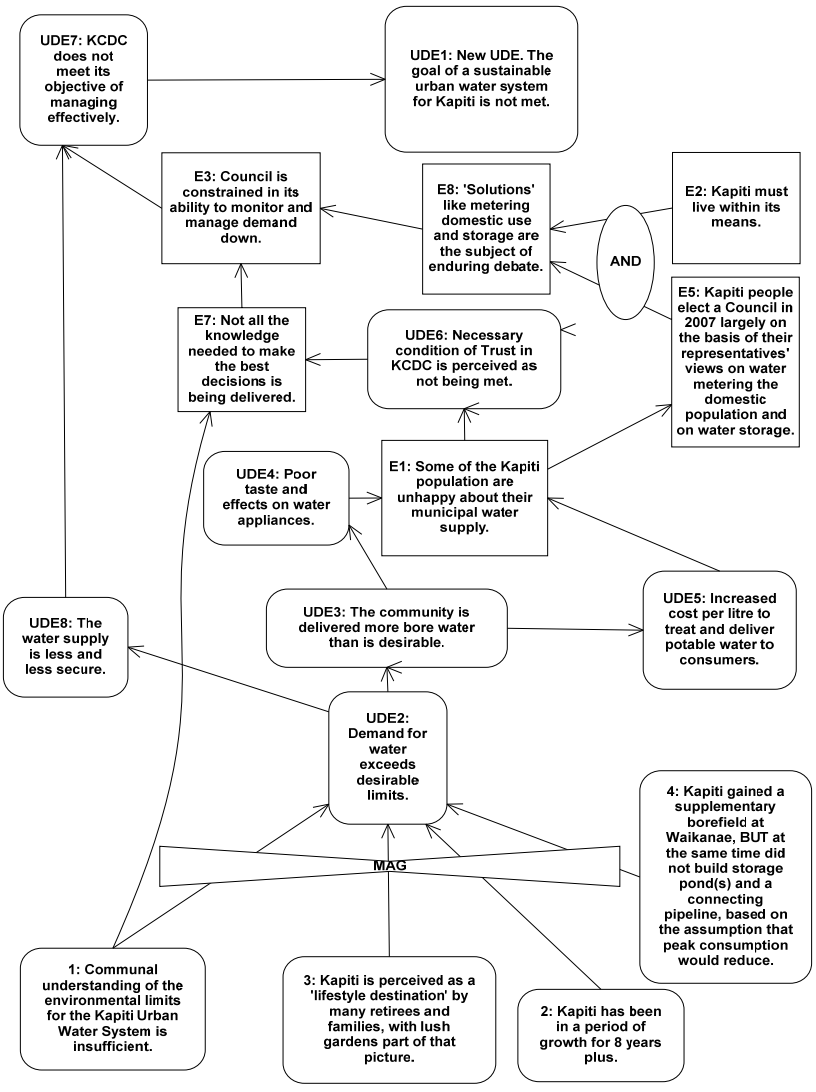

Figure 4. The CRB depicting what is happening in one part of the system

Read the CRB bottom up: *If…then*

If…

Entities 1, 2, 3 and 4 exist together

Then…

Demand for water exceeds desirable limits

*If…*Demand exceeds desirable limits

Then…

The community is delivered more bore water than is desirable

If…

The community is delivered more bore water…

Then…

Costs increase (for treatment at the Waikanae Water Treatment Plant)

AND…

Water has poor taste and has effects on appliances

Etc.

If…

KCDC does not meet its objective of managing effectively

Then…

The Goal of a sustainable urban water system for Kāpiti is not met…Etc.

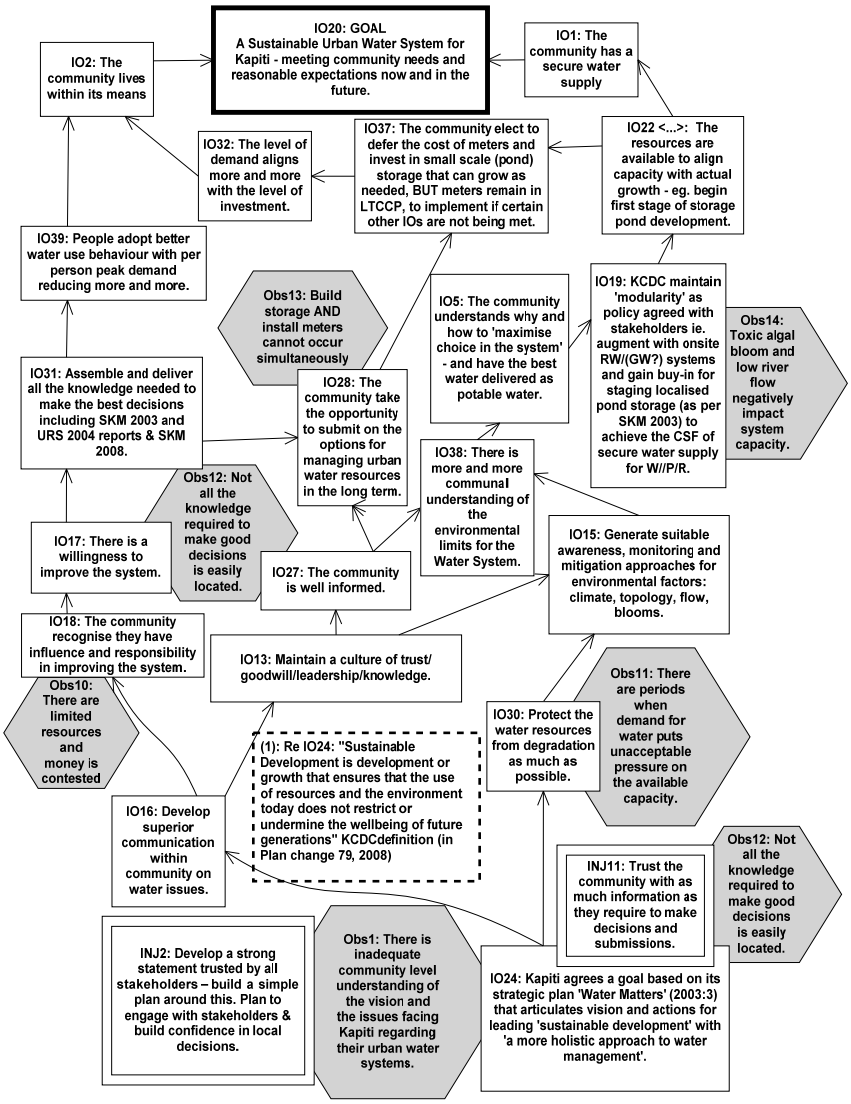

Figure 5. The PRT depicting what is happening in one part of the system

2.6 The Future – What must happen to achieve the community's goals?

Once the core problem has been recognised, the question is how to remove it? Consistent with Schragenheim (1999) and Dettmer (2007), the TOC tools selected were appropriate to this community research context. With two Councillors, a key conflict regarding water storage was explored, and broken, using ECs. CLDs from Systems Dynamics were then used to capture the dynamics of proposed system solutions and identify potential interactions and unintended consequences. CLD's were also used to show participants how a past 'quick fix' had turned into a 'fix that fails' (Senge, 1994). Agreement was reached on necessary interventions to prevent 'fixes from backfiring' (Senge, 1994:126). Using the EC and CLD in combination helps to devise robust solutions to avoid such negative side effects, as has been described in Mabin, Davies and Cox (2006). The CLDs are shown in Moore (2009:92/94).

The next step was to formulate the 'roadmap' for change. This was set out in a Prerequisite Tree (PRT), which intends to answer the question: *What must we do to achieve…*? The PRT and IO maps use *necessity* logic, whereas the Current Reality Tree (CRT) is a *sufficiency* structure (as is a Future Reality Tree). The aim of the PRT is to identify the minimum that must be done, to move from one step to the next.

Read the PRT backwards from the goal, thus:

In order to…

Achieve the goal of a sustainable urban water system for Kāpiti

We must…

Live within our means

We must…

Have a secure water supply

In order to…

Have a secure water supply

*We must…*Have the resources available to align capacity with actual growth

In order to do that…We must…

Ensure the community understands why and how to 'maximise choice' so KCDC can affordably deliver the best water in the system as potable water (in other words, protect the system's 'best water' – currently the river resource – as much as possible

And because of the obstacle…

Toxic algal blooms and low flow impact on consents and on the capacity of the river to provide the system's best water

We must…

Ensure KCDC maintains 'modularity' as policy…eg. onsite systems and other small scale storage/recycling systems to augment capacity (onsite systems may also encourage closer connection with the water cycle to increase understanding)

Read other obstacles as follows:

In order to…

Adopt better water use behaviour, with per-person peak demand reducing more and more

We must…

Assemble and deliver all the knowledge needed for people to make the best decisions…

Because we must overcome the obstacle…

Not all the knowledge required to make good decisions is easily located

And, in order to…

Cultivate a willingness to improve the system

We must…

Ensure the community recognise they have an influence and a responsibility in improving the system

Because…

There are limited resources and money is contested

Etc.

3. FINDINGS

This paper presents the findings from eighteen interviews with twenty-two participants, identified using the Stakeholder typology adapted from Rawlins (2006) and Elias et al. (2002). The researcher selected the Theory of Constraints (TOC) Thinking Process (TP) tools, in order to find out what to change, what to change to and how to cause the change. As part of this process, the researcher constructed IO maps to show the destination, as envisaged by the participant stakeholders. A Current Reality Branch (CRB) was prepared to visualise the current situation and to suggest where the core tensions lie. Conflict was captured, and broken, using the TOC Evaporating Clouds (EC), with the participation of two Kāpiti Coast District Councillors and selected participants, who revealed some weak assumptions and gaps between the current and desired reality. This was central to understanding how to resolve critical problems affecting the system goal to find what to change to.

Causal loop diagrams (CLDs) in the form of a systems archetype (Senge, 1994; Senge 2008) from systems dynamics (SD) explored the potential negative effects of a suggested solution from the EC, highlighting the need to implement a sound strategy for communication with the public. Finally, a Prerequisite tree (PRT) was used as a means of finding out how to cause the desired change. The PRT identified current and future obstacles, highlighted misconceptions, and provided a formula for deciding the action steps needed to achieve the goal. For this community resource management problem, the PRT showed that technical or economic solutions are not enough. A 'will to improve the system' must exist. The IOs 17, 18 and 39 indicate that achieving the objective that the 'community live within its means' depends on harnessing that will. The system goal, therefore, depends as much on changing the behaviour of people, of the community, as it does on fulfilling economic and technical requirements. The need for changing behaviours creates a challenge in which people-centred Community OR could hold some advantages over more theoretical approaches. Further research is required to understand and quantify any potential advantages for community and environmental sustainability.

3.1. Thinking 'out loud'

The methodologies worked synergistically to give structure and clarity to situations, problems and perspectives, evoking a rich and valid picture of the system issues and possible solutions. Stakeholders' contributions represented in TOC trees and maps were analysed and refined with the involvement of willing participants. Constructing the participants' 'conversations' into a systematic series of TOC trees and maps evoked the sense of an 'ongoing conversation' between system participants, even though most of them never met one another. This 'conversation' was the source of a 'roadmap' for necessary change that participants could, and invariably did, take ownership in. The TOC mapping procedures are akin to the stakeholders sharing their thinking 'out loud'. This has value as a process for community development, where complex resource management dilemmas exist, and consensus is sought.

The participatory way that TOC was operationalised with the Stakeholder typology and CLDs, ensured that a variety of stakeholder perspectives and ideas came to light. Using a Stakeholder typology with TOC to 'justify' stakeholders in an analytical way, ensured that stakeholders with important historical or experiential perspectives were not unintentionally discounted or marginalised. The Starborough Flaxbourne Soil Conservation Group, with long experience farming under drought conditions, was identified using the Stakeholder typology. This group would seem to have a tenuous link to the Kāpiti urban water system, under a narrow systems definition (Moore, 2009a). In reality, group members were able to provide valuable experiential perspectives. Their experience working, and making profits, within severe water (and other) resource limits, brought a new layer of thinking and insight to Kāpiti's problems.

The methodologies of TOC, stakeholder mapping, and CLD's, combined to provide a means for the researcher to systematically work with a variety of key stakeholders, including Councillors and local *kaitiaki* (Māori term meaning steward or guardian of the environment – this and associated definitions in Environment Waikato, 2009), and government agencies, without the need to have them all in the same room, or even in the same town. The value of this approach is not only to gain some deeper insights into how to protect urban investment in water assets, but also to conserve other scarce resources, notable among them, time. One or two practitioners can gather and articulate the viewpoints, which can be checked with all the stakeholder participants, and from them, gain consensus on, and ultimately ownership of, the desirable 'future reality' and the 'roadmap' needed to reach it.

4.CONCLUSIONS

Operational research is becoming increasingly common in natural resource sectors, with agriculture, fisheries, forestry and mining, typical targets of OR. Water reform is a relatively new area for OR (Shoemaker and Reid, 2005). The combined methodological framework provided a source of deep insights into the challenges, dilemmas, potential solutions and side effects facing resource managers and other stakeholders in an urban water system under pressure from population growth, lifestyle choices and climatic/topographical conditions.

This research project developed into what was essentially a 'conversation' on the subject of how we might manage our fresh water for better outcomes. The researcher engaged with a number of willing individuals, all stakeholders in a New Zealand urban water system, and asked them for their perspectives about the system destination, what to change, what to change to, and how to make the changes necessary for more sustainable urban water systems.

The overarching message from the participants in this study is that for the urban water system to serve our communities and businesses better, the range of stakeholders must develop a deeper understanding of the system's limits and opportunities. If limits are not understood and agreed, it is difficult to live within them. If opportunities are not revealed, it is hard to grasp them. Planting drought-resistant lucerne in Eastern Marlborough instead of rye-grass and clover, is one example, with its obvious parallel in the Kāpiti context, of creating landscapes and gardens that that need little or no watering, of mandatory supplementary water tanks and greywater systems, and other less obvious implications.

TOC provides a constructive and non-threatening way to encourage a kind of deep level reflection. In communities where many options and perspectives are raised, TOC provides a logical and collaborative framework for reviewing these, identifying the most favourable future reality and galvanizing action. However, the Pilot Study suggested that the TOC tools alone could not achieve the research objectives. There had to be a way of opening up the field of enquiry, and facilitate ongoing reflexivity (Basset, 1995) for system improvement. The stakeholder engagement process proved invaluable in this

regard. Causal loop diagrams were part of the reflexive process, developed with key decision makers as a dynamic representation of the system.

Dettmer (2007) urges that simplifying approaches is the key to finding out what we know, and that it is better to be approximately right than precisely wrong. This premise of simplicity was fundamental to the design of this research and to the process of ongoing engagement upon which this enquiry was constructed. In a range of areas, communities, industry stakeholders, and iwi are taking steps to implement water reform and manage scarce water resources within necessary limits (Land and Water Forum, 2011). The Land and Water forum (2011) concluded that continuing, collaborative, action is imperative for progress on water reforms to be made. The Parliamentary Commissioner for the Environment (2000, 2001) had predicted more than a decade ago that reaching consensus between stakeholders on environmental, social and economic goals for urban water systems would become one of the greatest challenges facing communities New Zealand-wide. The Land and Water Forum (2012) continue the theme, noting in their third and final report that reaching consensus is never easy and not always possible. The truth of this is reason to value a methodological approach that might recognise the perspectives of diverse or divergent stakeholders, and at the same time provide the means to logically evaluate system issues and opportunities, and reveal suitable leverage points for motivating change.

Water reform is arguably most effective when people are prepared to champion the need for change and the conditions that underpin the change. KCDC created a new position of Water Supply Project Manager in 2009, with Phillip Stroud appointed to the role. Mr Stroud read the research findings this paper describes, and met with the author to learn more about TOC, and particularly IO mapping. In addition, he invited review of the new Water Communications Strategy and appointed an expert communicator who “brought to Council's Water Supply Project strategic thinking that improved how the project communicated with the public. Implementation of a 'core script' helped the project succeed where others had failed” (Stroud, personal comment, 26 May 2010).

Since 2009, some of this study’s most critical findings have been championed. These include investing in the afore-mentioned Water Communications Strategy to keep the public well-informed and encourage new water use behaviours. Multi-modal supply options, like roofwater/greywater/borewater for outdoors, are encouraged by Council (and mandated for new buildings), while system transparency and the sharing of knowledge has been bolstered by the appointment of The Kāpiti Technical Advisory Group, led by former State Services Commissioner, Don Hunn. A proposal for water meters, which will cost the majority of individual households and businesses more than at the present time, appears to have met with only marginal resistance. The findings of this study also suggested this acceptance, with two of 20 participants surveyed, not supportive of water meters as a tool for demand management. One participant was undecided, whilst all others surveyed, showed support for metering in some form or other.

5. CONTRIBUTIONS

A point of difference for this Operational Research is its concentration on people and their perspectives and its departure from the more commonly applied mathematical programming models. Instead, a series of conversations with diverse participants drawn (using stakeholder analysis) from an entire community, was developed into an action plan that was verified and tested using TOC’s Thinking Process tools and CLDs from Systems Dynamics. This community approach to dealing with resource management matters is implied in the Treaty of Waitangi (1840, see Young, 2001; Williams, 1997), and has been enshrined in New Zealand’s contemporary environmental legislation (RMA 1991), a compelling motive to investigate approaches to COR in this country. This paper was further inspired by commentary a decade or so apart (PCE

2000 and 2001; Land and Water Forum 2012) that suggested reaching consensus on environmental matters was one of the most pressing issues for communities. Thus, an application of Community Operational Research is presented that uses problem structuring to aid multi-stakeholder and multi-criteria decision-making for community development, by providing a transparent platform where perspectives could be aired and validated. Issues of environmental degradation, market competitiveness, lifestyle choice, water storage, and affordability were among those captured and analysed. By breaking a key conflict over water storage, a degree of consensus among stakeholders was achieved. This led to new solutions being suggested and tested.

Results to date show the community at large accepting they have a role to play in urban water reform. A perceivable lack of resistance to the suite of measures to curb water demand is suggestive of the public accepting some responsibility for water reform, alongside Council staff, Councillors, and legislators.

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5.2. Figures and Tables

1. The Stakeholder map
2. Stakeholder linkage model
3. The final IO map.
4. The CRB depicting what is happening in one part of the system
5. The PRT depicting the minimum that must be done to achieve the goal

6. ACKNOWLEDGEMENTS

With particular thanks to the 22 participants of this study. Thank you to Arun Elias and Bob Cavana who provided feedback and critical suggestions.

REFERENCES

Bassett, K. 1995. On reflexivity: further comments on Barnes and the sociology of science, *Environment and Planning,* 27, 1527-38.

Bjørndal1, T., Herrero2, I., Newman3, A., Romero4, C. and Weintraub5, A. 2011. Operations research in the natural resource industry. *International Transactions in Operational Research.* International Federation of Operational Research Societies. Retrieved October 2012 from http://onlinelibrary.wiley.com/doi/10.1111/j.1475-3995.2010.00800.x/,

Dettmer, H. W. 2007. *The logical thinking process: a systems approach to complex problem solving*. Milwaukee WI: Quality Press.

Elias, A. A., Cavana, R. Y. and Jackson, L. S. 2002. Stakeholder analysis for R&D project management. *R&D Management* 32 (4), 301-310. Malden, Mass.: Blackwell Publishers Ltd.

Environment Waikato. 2009. *Appendix VI: Glossary*. Retrieved May 2009 from http://www.ew.govt.nz/policy-and-plans/Regional-Coastal-Plan/Regional-Coastal-Plan/APPENDIX-VI-Glossary/.

Freeman, R. E. 1984. *Strategic management: a stakeholder approach.* Boston MA: Pitman.

Hawke, R. (2006). Resource Management in New Zealand: Environment Court Decisions. *Agenda.* (13) 1, pp. 85-96. Retrieved 24 June 2011 from http://epress.anu.edu.au/agenda/013/01/13-1-na-1.pdf

Kāpiti Coast District Council. 2009. *Kapiti water supply LTCCP review: water supply options for the Waikanae Paraparaumu Raumati area* (2 April 2009). Retrieved 15 May 2009 from http://www.kapiticoast.govt.nz/NR/rdonlyres/

Kāpiti Coast District Council. 2013. *Our district: Statistics and demographics*. Retrieved January 2013 from http://www.Kāpiticoast.govt.nz/Our-District/The-Kāpiti-Coast/Statistics-and-Demographics/.

Kim, S., Mabin, V. J. and Davies, J. 2008. The Theory of Constraints Thinking Processes: Retrospect and Prospect. *International Journal of Operations & Production Management* 28 (2): 155-184.

Land and Water Forum. 2010. *Report of the land and water forum: a fresh start for freshwater.* Retrieved 8 October, 2010 from http://www.landandwater.org.nz.

Land and Water Forum. 2011. *Land and Water forum recommendations – Implementation.* Report published 5 April 2011. Retrieved 25 January 2013 from http://www.landandwater.org.nz/includes/download.aspx?ID=118917.

Land and Water Forum. 2012. *Third report of the land and Water forum*. Retrieved December 2012 from http://www.landandwater.org.nz/includes/download.aspx?ID=124767.

Mabin, V., Davies, J. and Cox, J., 2006. Using the Theory of Constraints Thinking Processes to Complement Systems Dynamics' Causal Loop Diagrams in Developing Fundamental Solutions. *International Transactions in Operational Research* 13 (2006), 33-57.

Mabin, V. J. and Davies, J. 2010. The TOC thinking processes: Their nature and use – reflections and consolidation. Ch 23 in *Theory of Constraints handbook*. J. F. Cox and J. G. Schleier (Eds.). New York: McGraw-Hill, 631-669.

Midgley, G. and Ochoa-Arias, A. (eds). 2004. *Community Operational Research: OR and Systems Thinking for Community Development*. Kluwer, New York.

Ministry for the Environment (MfE). 2003. *Dairying and Clean Streams Accord between Fonterra Co-operative Group, Regional Councils, Ministry for the Environment, and Ministry of Agriculture and Forestry*. (2003). Retrieved 28 January 2013 from http://www.mfe.govt.nz/issues/land/rural/dairying-accord-may03.pdf.

Ministry for the Environment. 2011. *National Policy Statement Freshwater Management 2011.* Retrieved October 2012 from http://www.mfe.govt.nz/publications/rma/nps-freshwater-management-2011/docs/nps-freshwater-mgnt-2011.pdf

Mitchell, R. K., Agle, B. R. and Wood, D. J. 1997. Towards a theory of stakeholder identification and salience: defining the principle of who and what really counts. *Academy of Management Review*, 22 (4), 853-886.

Moore, R. M. 2009. *Shaping more sustainable communities: a case study in urban water management.* A thesis submitted to Victoria University of Wellington in partial fulfilment of the requirements for the degree of Master of Management Studies. PDF 3.1MB http://www.j.co.nz/robyn/Robyn_Moore_%20Shaping_More_Sustainable_Communities.pdf

Moore, R. M. 2009a. Shaping more sustainable communities: a case study in urban water management. Conference paper. In *Operations Research Society of New Zealand, Proceedings of the 44th Annual Conference ORSNZ 09*. December 3 – 4th 2009. University of Canterbury, Christchurch, New Zealand. http://www.j.co.nz/robyn/Robyn_Moore_ORSNZ_2009_conference_paper.pdf

New Zealand Landcare Trust 2011. *Review of the Starborough Flaxbourne Soil Conservation Group Project*. Retrieved December 2012 from http://www.landcare.org.nz/files/file/566/Starborough%20Flaxbourne%20Review%20Dec2011.pdf.

Parliamentary Commissioner for the Environment. 2000. *Aging pipes and murky waters. Urban water system issues for the 21st century*. Wellington: Parliamentary Commissioner for the Environment. June 2000.

Parliamentary Commissioner for the Environment. 2001. *Whose water is it? The sustainability of urban water systems on the Kāpiti Coast.* Wellington: Parliamentary Commissioner for the Environment. May 2001.

Rawlins, B. L. 2006. *Prioritizing Stakeholders for Public Relations*. Retrieved from http://www.instituteforpr.org/research_single/prioritizing_stakeholders. Published by the Institute for Public Relations, www.instituteforpr.org.

Resource Management Act (RMA). 1991. *Resource Management Act 1991.* Public Act 1991, no. 69. Date of assent 22 July 1991.

Schragenheim, E. 1999. *Management Dilemmas: The Theory of Constraints approach to problem identification and solutions.* Boca Raton: CRC Press LLC.

Senge, P. M. 1994. *The fifth discipline fieldbook: strategies and tools for building a learning organization.* London: Nicholas Brealey Publishing Ltd.

Senge, P. M. with Smith, B., Kruschwitz, N., Laur, J. and Schley, S. 2008. *The necessary revolution: how individuals and organizations are working together to create a sustainable world.* London: Nicholas Brealey Publishing.

Sheppard, D. F. 2010. Reaching sustainable management of freshwater. Conference Paper. NZ RMLA Conference 2010: *Sustainable freshwater management: Are we there yet?* 30 September – 2 October 2010. Christchurch Convention Centre.

Shoemaker, T. E. and Reid, A. 2005. Applying the TOC Thinking Process: a case study in the government sector. *Human Systems Management,* 24, 21-37.

Watson, K. J., Blackstone, J. H., et al. 2007. The evolution of a management philosophy: The theory of constraints. *Journal of Operations Management,* 25: 387-402.

Williams, D (editor). 1997. *Environmental and Resource Management Law* (2nd edition). Wellington: Butterworths of New Zealand

Young, D. 2001. *Values as Law - the History and Efficacy of the Resource Management Act.* Wellington: Institute of Policy Studies.