Exploring a ‘post-normal’ science-policy interface for Integrated Coastal Management

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Abstract

This thesis is broadly about mobilising knowledge for the governance of the coast and specifically about the introduction of a ‘post-normal’ science-policy interface to Integrated Coastal Management. It begins by acknowledging the unique resource management challenges of the coast and follows the field of Integrated Coastal Management (ICM) as a widely endorsed framework for addressing these challenges. Contemporary developments in this field have seen ICM recognise the uncertainty, plurality and high political stakes characterising many issues on the coast and the attendant need to shift from models of ‘management’ to models of ‘governance.’ This thesis specifically engages debates on the epistemological implications of governance, which within ICM have led to calls to democratise the science-policy interface according to norms of dialogue, inclusiveness, integration and quality. Taking this as its point of departure, this thesis explores the ‘post-normal science’ perspective offered by Funtowicz and Ravetz, as a way of framing the science-policy interface.

This research began by viewing the complexity of coastal management through the particular lens offered by the model of ‘interactive governance,’ as a compelling perspective on ICM that is gaining credence. Interactive governance focuses on certain features of coastal management, and introduces certain measures of ‘quality,’ which were formulated into a novel evaluation framework for ICM. The research went on to explore how a ‘post-normal science’ approach may contribute to ‘high quality’ ICM, framed according to interactive governance. This occurred first via a literature review, and second through cross-scale empirical research. Internationally, the research followed the SPICOSA Project, as a Europe-wide focus on the science-policy interface for coastal management. Nationally, the research explored New Zealand’s coastal management framework, mapping the emergence of new ‘norms of governance’ within the science-policy interface and their contribution to quality institutions, before interrogating three local-scale initiatives that gave effect to a post-normal science approach; in Whangamata, Waikaraka and Gisborne.

This research arrived at three key findings on the meaningfulness of a post-normal science-policy interface. First, that there are many ways to give effect to this approach, contingent on scale and context. Second, that this approach has significant potential for promoting high quality ICM according to measures of institutional quality and stakeholder interactional quality. And third, that the most significant threat to this approach is power; most notably the power of science to subsume other knowledge systems.

Preface and acknowledgements

My motivation for embarking on this research was drawn from a number of years working as a young coastal planner in New Zealand local government, and the problems that I faced. After finishing my degree in Resource and Environmental Planning, I found myself increasingly disillusioned with the messy and muddled decision-making that I faced on the coast, which departed so significantly from the 'scientific' process I had associated with planning. In conversations with other planners, I began to think reflexively on the way we managed the coast. I began to feel a degree of doubt; to what extent was I having any useful influence on the coastline, or the community that lived there? Increasingly I perceived the management regime that I worked within to be detached from the real coastal community and environment. I pictured a hulking 'coastal management machine,' operated by planners, that chugged away behind the locked door of the Council Chamber, and was only noticeable from the outside by the smoke and hot air shooting out the chimney.

I became uncomfortable with the way this machine addressed the uncertainty inherent on the coast, and condensed power within the hands of a few scientifically and legally literate 'technocrats.' I was frustrated by the fragility of the knowledge base on which decisions were built. In auditing Environmental Impact Assessments, I found it was less a question of finding the gaps in the knowledge, and more a case of finding the small islands of solid grounding in a sea of uncertainty. The knowledge foundation resembled rather an aggregate of fragile knowledge fragments, cemented together with gross generalisations. I found I needed to arrive at a hard line in the sand, sometimes quite literally, from very 'soft' knowledge. However, rather than recognise these uncertainties, the tendency was often to down-play them as unimportant. At the same time, I came to realise how many conflicting perspectives presented themselves within a coastal community, and the significant power planners wielded in determining which were admitted as 'legitimate' to the decision-making process. While pretending to some 'scientific determination' of stakeholders, these decisions could in reality be quite arbitrary and exclusive; admitting only those with a 'legally defensible' perspective. This revealed to me the planner's first duty was to uphold the integrity of the scientific and legalistic process, rather than the quality of the decision, or any subsequent outcomes. Those members of society not initiated in the ways of science or resource management seemed to be stripped of their power to turn the wheels of the machine.

However on the other hand, I also came to see that far from scientific, decision-making was fundamentally political. Local government technocrats were influenced by local politicians, who were influenced by their constituents. Because the issue or project was always so uncertain, it could be legitimately framed in any number of ways, with power and political influence often the shaping force behind how the issue was finally defined and addressed. Decisions were more often based in personality and friendships of a local politician than any professional advice on my part. And though the decision could then progress to the Environment Court, this was rarely better because again the process favoured those able to communicate in that litigious court setting, or those with the wherewithal to employ legions of legal and technical expertise. I felt that if decisions were to depart from science, and be debated in a political arena, such arenas ought to at least take a more participatory form.

Then, finally, a realisation that the true power to shape coastal communities lay outside the Council Chamber; far beyond the huffing and puffing of the bureaucratic machine and the political masters. The coastal community was not determined by our rule-book, it was determined by the individual decisions and actions made by all of our constituents. Our coloured zones and coded rules did not have any omnipotent power to shape the destiny of the coastline; that was being constructed incrementally, every moment of every day, by the commercial fishers, the sand-dredgers, the local aquarium, and the family at the beach. No matter how tightly we drew our net of rules, activities would always slip through the gaps. Many people in our small community had no idea that the rules existed, and others did not accept them as legitimate. Our ideas of centralised control were illusory; collective decision-making, real collective decision-making, had to be considered as the collective sum of our community's different actions.

These three reflections served as both the normative motivation and means of orientating my research on better coastal decision-making. It begins from the personal realisation that a purely scientific process is untenable given the significant uncertainty associated with the coast, and undesirable given the exclusivity of a decision-making arena which places power in the hands of planners, consultants, and lawyers. It also begins from recognition of the power structures within fickle local government representative democracy, and the need to arrive at collective decisions a community can agree is legitimate, and not arbitrary. It seeks decision-making that gives equal consideration to principles of rationality and democracy. To this end, the thesis focuses specifically on the way knowledge can be mobilised in support of decisions.

This research was steered significantly by the lens offered by my academic and professional background in planning. As an inherently inter-disciplinary profession, a planner is often labelled as 'jack of all trades, master of none.' Significantly, I see that my professional background, and the focus on ICM as itself an interdisciplinary field, explains the way in which this research brought together a broad array of disciplines and bodies of thought, ranging from political science, to planning and resource management, to the philosophy of science. I see this as a strength, as it

reflects the complexity of coastal management, and cross-germination active in the social sciences and resource management. It constitutes an expression of the interdisciplinary and cross-scale kind of research and action increasingly demanded by coastal management.

However, I could not have completed this thesis alone. That this research has come to a culmination is testament to the huge amount of support that I have had over the past four years, across three different countries and tens of thousands of kilometres.

It began in New Zealand with a serendipitous phone-call to an old lecturer and friend Nigel Jollands, and then through the support of Ecological Economics Research New Zealand. Thank you to my lead supervisor Murray Patterson for his guidance in those early days when all things academic seemed…academic. Also a huge thank you to my co-supervisor Bruce Glavovic, who took me in after I turned up like an orphan on his doorstep, and provided an invaluable and formative influence throughout my tenure. I also need to acknowledge the Ryochi Sasakawa Scholarship, which was extremely generous, and particularly Jackie Koenders for her help. Still in New Zealand I need to thank my family for their patience and support through the high points and low. Thank you mum for actually reading my work, and putting a roof over my head when I needed it, and thank you dad and Lyn for taking a genuine interest in all things 'post-normal.' Also thank you to my friends and flatmates in Palmerston North and beyond.

In August 2007, this thesis took me to L'Université de Versailles Saint-Quentin, and forever broadened my horizons. Thank you to all those at REEDS who helped me to make a life in Paris. In particular, thank you to my two supervisors there, Martin O'Connor and Jean-Paul Vanderlinden, for opening up untold new experiences and opportunities through the SPICOSA Project and scientific voyages along the West African coast. Finally in France, I must acknowledge the generous support of the Eiffel Scholarship.

In August 2010, as I began to write the final chapters, I moved to Bergen in Norway. I went with many hopes but no expectations of what I would find in the cold 'North Way.' What I found at the Senter for Vitskapsteori was such an overwhelming welcome, compassion and support that I could not have imagined. This is truly a centre of excellence in every sense. Thank you Roger Strand for all of your help, and thank you Matthias Kaiser for taking me on and opening up a world beyond the PhD, which is filled with promise and new opportunities.

Finally, and most of all, I need to thank my partner Anne for her unfailing love and support. She is the thread that links these three distant lands, and a future we cannot know. For us to share a life beyond a PhD thesis has been an enormous motivation.

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Part I: Introduction and context

Part I introduces the discussion within this thesis and gives some background to describe the context within which this research is couched. It comprises the Introduction chapter and Chapter 1.

Introduction

1. A focus on the coast

This thesis is about mobilising knowledge for the governance of the coast, but what makes the coast a worthwhile focus of attention for this research? Since at least the 1960's there has been an increasing realisation of the value of the coastal marine area, and the unique challenges it poses to natural resource management. These challenges can be summarised across four areas, and distinguish the coastal marine area as worthy of specific attention beyond that afforded to other ecosystems:

1.1 Rich in natural resources, with a diversity of ecosystems

The earth is a coastal planet, with 603,000 km of coastline - fifteen times the circumference of the equator - and 166 states possessing a stretch of coastline (Vallega, 1997). Moreover, the coastal marine area represents an extremely rich basket of natural resources, and accordingly supports a huge diversity of ecosystems. These ecosystems provide essential ecosystem services to support humanity, both as a 'source' of resources and as a 'sink' for receiving waste. Although coastal and shelf ecosystems comprise only 6.3% of the world's surface, they contribute an estimated 43% of the average annual value of global ecosystem services—about US$14.19 trillion or more than half the annual global GNP (Costanza et al., 1997). Because of this abundance of natural resources the coast also represents a significant source of cultural resources, with most ancient civilisations born on the coast (Vallega, 1997).

1.2 The primary habitat of humanity

Coastal ecosystems have become the primary habitat for the human species, with an estimated 45% of all humanity compressed into the 10% of the inhabited land space within 200 km of the world's oceans (Hinrichsen, 1998). Twelve of the world's largest fifteen cities are coastal, with coastal regions containing a significant majority of the infrastructure that supports industry, transportation and trade, energy processing and tourism. In addition, a significant proportion of the world's most productive farmland and fisheries are found in coastal ecosystems. For instance, the majority of commercially important marine fish and shellfish species spend at least a part of their life cycles within estuaries; and oceanic systems yield 80 million tons of seafood per year valued at

$50–$100 billion (Tobey & Volk, 2002). These rich resources have fuelled a continued migration to the coast which is projected to house 75% of the world's population by 2025 (Hinrichsen, 1998), and introduced challenges to the most *efficient* use of the limited coastal resource. On the other hand, despite the richness of the coast, many of the world's poor are crowded in coastal areas, posing challenges also to the *equal* distribution of these resources.

1.3 Managing society's conflicting claims to a common coastal resource

The rich coastal marine ecosystem is under significant pressure from the diverse and conflicting demands of an increasingly coastal population. This, according to Cicin-Sain and Knecht (1998), introduces a number of conflicts including: (a) competition for limited coastal space; (b) adverse effects of one coastal use on another coastal use; and (c) adverse effects of coastal uses on coastal ecosystems.[1] The management of these conflicts is unique along the coast given a significant portion of coastal marine space (certainly of the space seaward of the high-tide mark) is a 'commons;' that is to say it is in the common ownership of the state and its inhabitants, rather than in private ownership. Firstly this means that the coast is more likely to be over-exploited than a private resource, given there are rarely limitations to the personal use of a common resource; as encapsulated in Hardin's (1968) well-known 'Tragedy of the Commons.' Secondly this means that society is at least in part obliged to allocate coastal resources through the structures of the state and political economy, rather than leaving resource allocation solely to the mechanisms of the market.

1.4 A dynamic environment; sensitive to global environmental change and unpredictable

Coastal marine systems represent some of the most dynamic in the world, bringing with them an increasing realisation of the complexity and uncertainty inherent managing the coast. Authors like Costanza (1999) have done much to demonstrate the unique dynamism and complexity encapsulated in coastal ecosystems, leading others to describe coasts in terms of 'complex adaptive systems;' self-organising systems that are liable to 'flip' between different stable states rather than rest in one state of equilibrium (Gibbs & Cole, 2008). The uncertainty associated with the coast is amplified when it is considered within the context of global environmental changes, such as climate change. Indeed, so sensitive is the coast that it is likely to be one of the zones most highly affected by the symptoms of climate change, ranging from sea-level rise to changing freshwater circulation (Vallega, 1997). As coastal populations and investment swells, this increases

[1] To illustrate this last conflict, half of the world's coastal wetlands were destroyed in the 20th century, and 25% of coral reefs have now perished. Moreover, the global oceanic fishing fleet is today 40% larger than what the oceans can sustain. As testimony to this fact, of 200 major fish stocks 35% are currently classified as over-fished, or at their biological limit (Tobey and Volk 2002).

the ‘risk’ to society, leading Cicin-Sain and Knecht to declare, “the integrity of the world’s coastal zones is even more threatened by the surging tide of coastal dwellers than it is by rising sea levels” (Cicin-Sain & Knecht, 1998, p. 303).

2. Integrated Coastal Management

At the outset of this research, it sought an academic ‘home’ from which to base the exploration of coastal management; a body of literature that would help structure my investigation. To this end, it turned to Integrated Coastal Management. Integrated Coastal Management (ICM)[2] is a field of resource management distinguishable by its focus on the unique features of the coast discussed above. It provides the broad framework within which this thesis is situated. A description of the evolution of ICM is provided in Appendix A, and Chapter 2 provides a more substantive discussion of the field; suffice to define ICM here and the context it presents for the thesis. ICM has been variously defined; however the enduring and comprehensive definition of the GESAMP (1996, p. 2) report remains widely cited:

“A continuous and dynamic process that unites Government and the community, science and management, sectoral and public interests in preparing and implementing an integrated plan for the protection and development of coastal ecosystems and communities. The overall goal of ICM is to improve the quality of life of human communities who depend on coastal resources while maintaining the biological diversity and productivity of coastal ecosystems.”

In contemporary parlance, at least since the 1980’s, the chief purpose of ICM is to promote ‘sustainable coastal development,’ with a view to both inter-generational and intra-generational equity (Cicin-Sain & Knecht, 1998; Glavovic, 2006; Vallega, 1997). Under this umbrella of sustainable development, ICM has pursued a number of the parallel projects. Cicin-Sain and

[2] Integrated Coastal Management has gone by many different names, in large part owing to the different preferences in different contexts, though the principles and features remain the same. For example, it is often known as Integrated Coastal Zone Management (ICZM) in Europe, or Integrated Coastal and Oceans Management (ICOM) in North America. In this thesis the term Integrated Coastal Management has been chosen deliberately. The term ICZM was rejected because the reference to ‘zones’ seems to indicate a preference towards the centralised ‘grand plans’ that was reminiscent of the early epochs of coastal management, but have since been relegated to one tool of many. The term ICOM was rejected because reference to ocean management it widens the scope of coastal management too much. The management of the open ocean, not least for geo-political reasons, differs significantly from the management of the sea-land interface, and therefore ICOM seems to bundle together two unlike concepts.

Knecht (1998) and Vallega (1997) discuss the original motivations of Coastal Zone Management[3] in the 1960's in terms of the betterment of coastal communities through economic development, and through the amelioration of a communities vulnerability to coastal hazards. While these projects remain important, ICM later broadened its role to the holistic stewardship of coastal ecosystems and ecosystems services, with an emphasis on preserving the functional integrity of essential ecosystem elements and processes; promoting ecosystem 'resilience' (Chua, 1993; Cicin-Sain & Knecht, 1998). In a sense then, the over-arching goal of sustainable development has integrated these parallel anthropocentric and ecocentric endeavours, as Vallega (1997, p. 14) noted "Coastal management is integrated where its specific goals are strictly correlated with the pursuit of integrity of the ecosystem, economic efficiency and social equity".[4] Ultimately though, the multiple projects of ICM can be boiled down to one single endeavour, whereby ICM represents a means for allocating and resolving conflicting claims to scarce coastal resources; "the fundamental goal (of ICM) is to reform the objectives, structure and processes of governance that control how coastal resources are allocated…and how conflicts among user groups are resolved" (Olsen, Tobey, & Hale, 1998).

2.1 ICM as conflict resolution and collective decision-making for the coastal commons

From its inception in the 1960's, Coastal Zone Management was a subject of special focus as a means for allocating the scarce coastal-marine commons (Cicin-Sain & Knecht, 1998). In recognition of Hardin's 'tragedy of the commons' (1968), and the inability of the market economy to efficiently allocate a coastline in common ownership, Coastal Zone Management followed the lead of planning, and other disciplines of that epoch; seeking the answer in the political economy, and the mechanisms of the state (Friedmann, 1987; Lindblom, 1977)[5]. The conflicting demands for scarce coastal resources were thus to be resolved through political interaction, such that society collectively arrived at a 'social choice' for the future development of their coastline. This implied a central role for the state, to bring together and aggregate the plurality of values and preferences

[3] ICM traces its origins to the formulation of the Coastal Zone Management Act in the United States of America in the late 1960's; from where it took its early label Coastal Zone Management. Later it became re-labelled 'Integrated Coastal Management' as the field evolved; see Appendix A.

[4] See Appendix A for more detail on the shifting focus of ICM over time.

[5] For classical planning authors such as Lindblom (1977) and Friedmann (1987) for instance, a dichotomy was drawn between the two means for society to allocate natural resources: (a) through the market economy, as the aggregation of a multitude of individual choices within the market; or (b) through the political economy, as the collective choice of society through political means, usually steered by the state. Planning was therefore seen as a political economic alternative to market economics. Where a resource was not able to be properly allocated by the market, or where the market was not present, then the political economy would operate. Rather than operating according to the rationality of the market, planning corresponds to criteria of social rationality to steer decision-making.

within a coastal community into a single '*integrated plan'*; as the expression of a community's collective decision-making.[6]

Subsequently Coastal Zone Management has evolved to Integrated Coastal Management, and the stark dichotomy between allocating resources according to the market or the political economy has dissolved. On the contrary, through the influence of concepts of 'governance,' (Kooiman, 2003) (see Section 2.4 below) including the governance of the commons (Ostrom, 1990), as well as ecological economics (Costanza et al., 1999; Daly, 1996), and institutional economics (Kasper & Streit, 1998; Tool, 1993), market institutions are deemed to sit alongside and interact with state-centred institutions, as two facets of society's management of the coast. Market and political economies have shifted from substitutes to compliments, alongside other collective means of allocating resources studied by Ostrom (1990); what have been called traditional or local means of allocation. Throughout this evolution though, ICM has retained collective decision-making as its central project or *raison d'être*, according to many contemporary accounts of ICM (Costanza, 1999; Forst, 2009).

The central focus of ICM on nurturing collective decision-making for the coast can be summarised according to a very simplistic three-stage didactic model (see Figure 1), which forms a foundation on which much of the later discussion in this thesis is built. This model asserts that within (a) a given 'coastal context,' there are (b) socially-constructed institutions that provide the 'means' to enable and support, (c) political interactions between societal actors in pursuit of collective decisions to societal problems, as 'ends.' *Therefore, within a coastal context, the institutions of ICM can be represented as 'means' to foster collective decision-making as the ends'*[7]. Below (see Section 2.4) there is a brief discussion of what is meant by 'institutions' and what constitutes 'collective-decision-making' in the context of this thesis.

[6] See Appendix B for a more in-depth discussion on the 'social choice problem.'

[7] Please note that here, the 'ends' of ICM are discussed in terms of the collective decision itself, rather than any action that follows from the decision, or any resultant change in the state of the environment. There is division within the field of ICM on the representation of 'ends;' while many authors limit their discussion of ICM to the process of collective decision-making, others discuss ICM relative to its outcomes 'on the ground,' while yet others attempt to link the decisions made through ICM initiatives to their outcomes (please see the discussion in Chapter 2). In this research, the focus is on the way knowledge is mobilised in support of decision-making for coastal governance, and therefore the decision itself is taken as the 'ends' rather than any outcomes that follow from the decision.

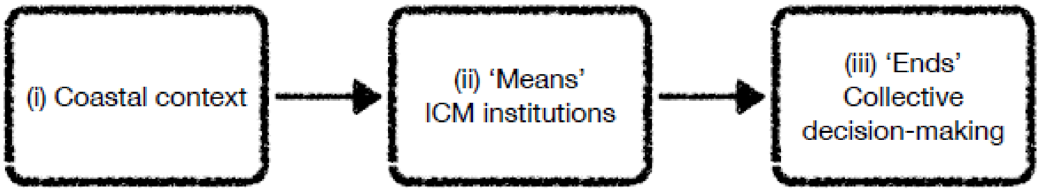

Figure 1: A simplified three-stage didactic model demonstrating ICM institutions as nurturing collective decision-making.

2.2 The evolution of ICM scholarship and practice as a robust framework

ICM represents both a rich terrain of scholarship and an active area of practice; with a reflexive and mutually influential relationship between the two shaping the evolution of ICM over the past 40 years. This has seen ICM emerge as its own unique field, with its own body of theory and approaches, significant practical expression, and accrued social legitimacy (see Appendix A).

The intellectual origins of ICM are complex, with the field emerging from a multi-disciplinary melange of disciplines including; (i) planning; (ii) resource/environmental management; (iii) resource economics; (iv) the management sciences (including public administration); (v) policy analysis/science; (vi) geography; and (vii) institutional economics (see e.g., Cicin-Sain and Knecht (1998), Olsen *et al* (1998) and Stojanovic, Ballinger, and Lalwani (2004)). Over time, the academic scholarship of ICM has been seen to evolve alongside the disciplines that influence it (its constituent disciplines), and according to the introduction of new intellectual influences (Clark, 1998; Forst, 2009; Vallega, 1997).[8] Concurrently with advances in the theory, the practice of ICM represents decades of adaptive and reflexive 'learning by doing.' As an applied field of study, ICM has as much been shaped by the lessons learned from closely monitored ICM initiatives, as by the academic theories that underlie them (Stojanovic, et al., 2004). Moreover, as ICM has established credibility and a constituency, the number of ICM-devoted initiatives has increased markedly, resulting in an ever stronger baseline of data from which to draw lessons (Sorensen, 1993; 2002).[9] Since the late 1980's, ICM has increasingly become 'internationally accepted practice,' with Vallega (1997) noting two key turning points. First, in 1988, the Intergovernmental Panel on Climate Change was created, with the coastal zone management sub-group supporting ICM as, "…the most

[8] As to the former, the pervasive influence of post-modernism since the 1980's, which has been so important within disciplines such as planning, has been similarly prominent in shaping ICM. As to the latter, the introduction of thinking from ecology, systems science and nature conservation to ICM in the 1970's has encouraged an ecosystem-based perspective of the coast, and elevated goals of ecosystem 'resilience.' See Appendix A for more detail on the evolution of ICM as a multi- or inter-disciplinary field.

[9] Sorensen noted 57 nations engaged in ICM or quasi-ICM programmes in 1993, by 2002 Sorensen had identified hundreds of initiatives across 140 nations, both developing and developed.

appropriate process to address current and long-term coastal management issues." Second, in 1992 at the Rio Earth Summit, ICM was endorsed by Chapter 17 of Agenda 21, with a goal set that by 2000 all coastal nations would have an ICM-based programme in place.

The evolution of ICM is manifest in its own comprehensive suite of principles, institutions, methods and tools, and evaluation frameworks, though it is beyond the scope of this introduction to provide a detailed account of these here. In essence, ICM seeks to overcome fragmented and *ad hoc* sector-based management, through "the creation of institutional mechanisms to coordinate the activities of different spheres of government as well as the otherwise fragmented efforts of different sectors and actors involved in diverse coastal activities" (Glavovic, 2006, p. 113). This acknowledges the multitude of institutional settings within which society interact with the coast, and the need to ensure 'harmonised and consistent' action across these settings according to some commonly agreed principles or norms (Cicin-Sain & Knecht, 1998; Vallega, 1997). As a dynamic and strategic process, ICM seeks 'integration' of management in terms of:

a) an integrated, ecosystem-based perspective of the coast and its issues;
b) 'horizontal' integration of governance between parallel sectors of human activity;
c) 'vertical' integration of governance from the national to the local scale;
d) integration of science with decision-making across a science-policy interface; and
e) participation of all categories of coastal stakeholders toward conflict resolution, the mobilisation of non-scientific knowledge, and ultimately collaborative management.

(Christie, 2005; Chua, 1993; Cicin-Sain & Knecht, 1998; Glavovic, 2006; McFadden, 2007; Olsen, 2002; Tobey & Volk, 2002)

This brief account of the evolution of ICM serves to demonstrate that *ICM has acquired an academic rigor, an empirical robustness and a social legitimacy that makes it a strong framework within which to conduct research on the governance of the coast.* But ICM is not without criticism.

2.3 Critiques of ICM

Some authors have been critical of the way in which ICM programmes have come to be revered as 'sacred cows;' beyond question and assumed to have some intrinsic worth (Bille, 2008; McKenna & Cooper, 2006). Since at least Rio in 1992, there has been an emphasis on implementing ICM-labelled programmes, without necessarily giving any attention to how they influence coastal communities. Prominence has often been afforded to the quality of the ICM process relative to certain indicators, rather than the outcomes of the process (see Chapter 2); such that ICM programmes present awkward 'add-ons' rather than a 'permanent fixture' (McKenna & Cooper, 2006). As Bille (2007) argues, the true goal of ICM should not be to improve the integration of the

ICM-labelled programme, but the *de facto* integration of the many decisions and actions taken within a coastal context.

Bille (2008) has written on four common ‘illusions’ that often pervade ICM programmes and prevent them from affecting change in coastal contexts. The ‘illusion of the coastal manager’ is the persisting notion that a centralised and specialised coastal management agency, directed by a coastal manager, can ‘manage’ the coast, insofar as manipulating the many systems of the coast to produce desired future outcomes. Related, the ‘positivist illusion’ assumes that more science necessarily leads to better decisions and better management, though there are many notable instances when this is not the case. Thirdly, the ‘community illusion’ relates to the way that coastal managers define ‘the community’, specifically with regard to advocating collaborative management. This can introduce a long and often intractable debate on whether society should be viewed as an intertwined and (semi)homogenous whole, or an aggregation of individuals. The fourth, ‘round table illusion’ stems from the participatory and subsidiary principles that have been so strong in ICM, and promoted collective decision-making via consensus at the local scale. For some, this focus on ‘all or nothing’ consensus does not account for the inherent plurality within society, whereby there can never be one solution that is equally acceptable to all (Bille, 2007; McKenna & Cooper, 2006) (see the ‘social choice’ problem in Appendix B). Consensus politics ignores the need for compromise and trade-offs, the influence of power around a debating table, often speaks around controversial topics to avoid inevitable ‘stalemate,’ and can lead to a ‘participatory paralysis’ on taking action (McKenna & Cooper, 2006).

Questions of how to affect meaningful change in an established *de facto* coastal management context, with its own unique historical background and political environment, continue to perplex ICM scholars and practitioners alike and demand more humble expectations for ICM programmes as only one small influence alongside many others.

2.4 Viewing ICM through the lens of ‘interactive governance’

This thesis takes as its point of departure more contemporary perspectives on ICM as governance. A decade after Rio, the September 2002 World Summit on Sustainable Development in Johannesburg brought renewed interest in the accomplishments and experiences within ICM worldwide, including the critiques noted above. The Summit recognised two significant intellectual developments within ICM; (i) that the coastal context is framed as a complex, humans-in-nature ecosystem; and (ii) that society’s management response is farmed as ‘governance.’ To use terminology introduced by Jentoft, (Jentoft, 2007; Jentoft & Chuenpagdee, 2009) this has implications for the way in which ICM practitioners and researchers understand the *'system-to-be-governed'* and the *'governing system.'*

A growing awareness of the complexity and multi-faceted issues within the coastal 'system-to-be-governed'[10] has, for some ICM scholars and practitioners signalled a departure from the dominant 'management' model in favour of alternative 'governance' models (see e.g. Glavovic (2008a) and Olsen (2003b)). Unlike uni-lateral management, directed by the illusory 'coastal manager,' governance models recognise a multi-lateral tangle of parallel approaches, undertaken at multiple scales (Duit & Galaz, 2008; Jentoft, 2005; Kooiman, 2003; Pierre & Peters, 2000). It conceives of society's collective response to an issue as the joint responsibility of (i) the state, (ii) the private sector, (iii) civil society, and (iv) the scientific community; operating simultaneously and independently according to their own institutions and guiding principles. The challenge for governance is to create new means for coordinating and harmonising these otherwise fragmented responses, and encouraging cooperation (Kooiman, 1999), according to a philosophy of humility. As Kooiman notes, "In diverse, dynamic and complex areas of societal activity no single governing agency is able to realise legitimate and effective governance by itself" (Kooiman, 2003, p. 3). For governance authors, collective decision-making ceases to represent the discussion around a single, notional 'decision-making table,' and becomes the collective sum of all decisions made across all institutional settings (Kooiman & Bavinck, 2005).

There are of course many different models of governance which can provide an interesting lens through which to make sense of the complexities of collective decision-making for the coast (see Chapter 1). Each focuses on different features and offers its own unique insights. However the model of 'interactive' or 'social-political' governance developed in large part by Kooiman (1999), has found support in ICM (see e.g. Chuenpagdee, Kooiman, and Pullin (2008), Glavovic (2008a), and Jentoft (2007)) and is argued in this thesis to offer an interesting and revealing perspective by which to explore and learn about ICM. Kooiman and Bavinck (2005), define it as:

"Governance is the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them."[11]

[10] See Chapter 1 for a fuller account of the literature on complexity, and Chapter 2 for a discussion on how it applies to ICM.

[11] See Chapter 1 for a detailed description of the interactive governance model, as it is employed in this research. It is enough to note here that interactive governance introduces three 'orders' of governance:
(i) 'First order' governance describes the interactions between two or more stakeholders or stakeholder groups, 'to solve problems and create opportunities.' Interaction is the 'core' of governance, and it is not limited to face-

This research views the complexities of the coastal 'system-to-be-governed' and 'governing system' through the lens offered by 'interactive governance.' Here interactive governance represents both a descriptive model for making sense of the complexities of governance, and a normative model for arguing what form ICM ought to take. Importantly, adopting an interactive governance perspective necessitates reflection on the complete ICM project, from its ontological foundations, all the way through its epistemology to its institutions and methods, and to its measures of quality:

(i) *Ontologically:* it necessitates a new framing or representation of 'the coast' in recognition of the inherent complexity and adaptability of its inter-twined social-ecological systems. This includes a 'post-modern' appreciation for the plurality of unique perspectives and value-systems within society, and the unpredictability inherent in social systems.

(ii) *Epistemologically:* it forces ICM scholars and practitioners alike to question our epistemic access to the coast; to what extent can we claim to 'know' a stretch of coast, once we accept a complex and adaptable ontological representation? This demands new epistemological conventions that account for significant uncertainty, even ignorance, and the plural points of epistemological access that this legitimates. This also asserts the non-tenability of accessing the common public interest via 'scientific' means of aggregation.

(iii) *Methodologically*: it demands new means of collective decision-making that foster participation and deliberation; that have regard for our epistemological limitations, and that give effect to society's plurality. In particular, we can discuss the relevance of institutional settings within a 'governing system.'

(iv) *Measures of quality*: reconsidering the ontological, epistemological and methodological foundations of ICM relative to an interactive governance perspective necessitates re-visiting the

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to-face dialogue; interaction can be described wider in terms of social network theory as the flow of 'information, resources and power.'

(ii) 'Second order governance' institutions as social constructs that both enable and constrain interaction between actors, and are formed over a history of interactions, according to overarching principles such as 'democracy' or 'the free market. Institutions may range from government departments, to cultures or habits, and define a 'logic of appropriateness' in terms of rules, rights, roles and responsibilities to enable actors to know what is expected of them within the governance network. Thus in this thesis, institutions are not to be confounded with government agencies, or as limited to formal state settings like the court. They represent a much wider collection of settings.

(iii) 'Meta-governance' represents the broad 'procedural principles' which form the normative framework in which institutions and interactions take place. Such principles are "the mortar to keep the construction together," providing a common thread linking otherwise distinct institutions. As noted, such principles may range from 'democracy' to 'precaution,' to 'sustainability.'

criteria by which the 'quality' of ICM programmes is evaluated. While models of coastal management are supposedly evaluated instrumentally, according to their qualities for affecting predicted future outcomes, coastal governance models suggest new norms of evaluation, according to the quality of stakeholder interactions for instance (see Chapter 2).

As the field of ICM sits on the cusp of a paradigm shift from a management-based paradigm to a governance-based one, a number of debates have opened up among ICM practitioners and scholars alike, with some resistance from those initiated in management traditions.[12] One particular debate is on the way in which knowledge can be mobilised in support of high-quality collective decision-making. Central to this is the question of how to arrive at a rational social choice.[13] That is, how do we arrive at collective decisions that are justified by some kind of reason, rather than being purely capricious? It is to this debate that this thesis turns.

3. Rational decision-making in the face of uncertainty, plurality and high stakes

A growing recognition of the complex and contentious issues facing coastal communities has opened a debate over the features of scientific practice for ICM. The 'modernist' tradition of coastal management believes that robust decision-making is informed by robust scientific ouputs; seeking to achieve 'instrumentally rational' social choices through a linear and scientific process[14] (e.g. see those writing on the philosophy of science (Funtowicz & Strand, 2006), and the policy sciences (Colebatch, 2005; Schulock, 1999)). Typically final decisions are made according to models of 'representative democracy,' by elected politicians, with these decisions drawing rationality and legitimacy from the robustness of the scientific decision-making process and the 'impartiality' of its technicians (De Marchi & Ravetz, 1999). This shifts the emphasis of decision-making from 'soft values' to 'hard facts,' in the assumption that 'objective knowledge' trumps the fickle politics of society. However, while accepting that there is a certain category of problems that warrant a scientific management approach, the introduction of a complex 'system-to-be-governed' has seen the recognition of a new category of issues.

[12] The conflict and debate that signals a shift in paradigms is described as inevitable in the seminal work of Thomas Kuhn (1962), who indeed invented the term 'paradigm.'

[13] See Appendix B for a more detailed account of the broader debate on rationality in social choice, and the distinction between environmental management and environmental governance.

[14] See Appendix B: stereotypically it follows that through this linear and scientific process; (a) objective knowledge of the environment is accessed through robust science; and (b) society's diverse values and preferences are aggregated according to a number of quantifiable denominators; to (c) enable a comparison of defined policy options and a decision that 'optimises' society's utility, before (d) 'managing' the future trajectory of society appropriately.

By the early 1990's Funtowicz and Ravetz (1990, 1993) had introduced a typology of problem which defied science-based resource management, what here will be called 'post-normal problems'.[15] These problems are described according to three features. Firstly, they exhibit significant uncertainty, which extends beyond an imprecise framing of the issue or from poor quality data, to what Funtowicz and Ravetz (1990) labelled 'epistemological' uncertainty; an ignorance of those things beyond our knowledge or even our imagination, or 'we don't know that we don't know.' Such uncertainty allows for conflicting accounts, and disagreement on what exactly constitutes the issue. Secondly, these issues admit a plurality of legitimate perspectives. Given significant uncertainty it is not possible for any one social group (such as the scientific community) to claim access to objective knowledge, and thereby extends legitimacy to multiple knowledge systems. At the same time, this plurality acknowledges the social choice dilemma, whereby it is not possible to reduce the diversity of incommensurable values to a single social choice. Thirdly, these issues are characterised by high political stakes and urgency; activating deeply entrenched and contested power structures. While resource management appeals to the 'power of rationality,' these issues reveal the 'rationality of power'[16]; "the traditional domination of 'hard facts' over 'soft values' is inverted" (Funtowicz & Ravetz, 1993), hard value commitments may have to be made, based on soft facts.

In recognition of these 'post-normal' issues, models of governance have promoted a departure from a purely scientific or 'Cartesian' means of understanding humans' place in Nature, to embrace more 'dialogic' means; recognising that relevant knowledge for addressing resource and environmental issues is negotiated between social actors, and constructed in the process (discussed as a 'dialogic epistemology - see Chapter 3 and Section 4.2 below). Many governance models start from a strong mode of 'participatory democracy' (Barber, 1984), whereby all stakeholders can participate in the deliberation for collective decision-making; each communicating their own unique and legitimate perspective, and each employing a different form of 'rationality.' Interactive governance, for instance, has at its core the mutually-influencing interactions between stakeholders; recognised by theorists as a multi-faceted and entangled discourse, with stakeholders simultaneously sharing their knowledge, negotiating their values, being creative and exerting their power (Jentoft, 2005; Kooiman, 2003; Kooiman & Bavinck, 2005). Interactive governance thus endorses theories of practical, pragmatic or communicative rationality, which describe rational decision-making in terms

[15] Funtowicz and Ravetz were not alone in the categorisation of these daunting issues, with a number of parallel typologies produced during the same era, notably in planning and the policy sciences, with Rittel and Weber's (Rittel, H. W., & Weber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*(2), 155-169.) 'wicked' problems a well-known example.

[16] In their classification Funtowicz and Ravetz allude to a Foucaultian formulation of the decision-making sphere as framed according to power. This influence has found echoes across multiple disciplines, not least planning, with authors like Flyvbjerg (1998) discussing the 'rationality of power.'

of free and frank dialogue employing the many different forms of reason; placing scientific rationality alongside other ethical, personal or traditional forms of reason (Dryzek, 1987).

It is at this point that this research enters the debate, arguing that conceptualising ICM as interactive governance necessitates a revision of the conventions for mobilising knowledge in support of rational collective decision-making, that gives account to the complexity and plurality of the coastal 'system-to-be-governed.' This thesis is therefore concerned with questions of epistemology; how communities come to 'know' the coastline and its issues, in order to make well-supported decisions. More specifically, this thesis focuses on the *dialogic mobilisation* of knowledge as one element of the multifarious stakeholder interactions that constitute coastal governance. This is not to diminish the importance of the other facets of interaction that are equally central to coastal governance, such as the weighing of competing values and preferences or the coordination of action, but it does recognise that the dialogic mobilisation of knowledge has a particularly important role in arriving at rational decisions, when faced with significant uncertainty, plurality and political stakes.

4. Exploring a dialogic epistemology for ICM framed as 'interactive governance'

This research starts from the assumption that it is desirable to support decisions with knowledge. One way to improve decisions is to ensure that the best quality knowledge concerning the issue and potential solutions is available to fuel deliberation. Better knowledge does not guarantee better choices, but it does provide a sound (or rational – see Appendix B) basis for making better decisions, and for holding decision-makers accountable (Reid, Berkes, Wilbanks, & Capistrano, 2006). Determining the quality of knowledge is contingent in time and space relative to a specific issue; however we can meaningfully discuss quality generically in this thesis in the terms of Cash *et al* (2003) and others (see e.g. US National Research Council (2007)). For these authors, 'high quality' knowledge, which is useful within a deliberative forum, needs to be: (i) credible; (ii) salient to the issues; and (iii) legitimate in terms of the fairness and openness of the process in which it was generated, and the way it is communicated across stakeholders to nurture understanding.

4.1 What is knowledge?

In the post-modern tradition, this thesis defines knowledge as a social construction. Zermoglio *et al* (2005), as part of the Millennium Ecosystem Assessment, defined knowledge as, "a construction of a group's perceived reality, which the group members use to guide behaviour towards each other and the world around them." Starting from this notion, Doody (2003) differentiates between data, information and understanding (knowledge). Data is raw material (usually numbers) without a context[17]. When contextualised it becomes information, and when information is processed through the filter of analysis possessed by a specific group, scientists for example, it becomes knowledge. Polanyi (1967) suggests another classification, in terms of ‘tacit’ or ‘explicit’ knowledge. Explicit knowledge is that which exists in a written or categorical form. Tacit knowledge on the other hand remains held only in people’s minds; implicit and personal; to be used in decision-making it needs to be made ‘explicit.’ Finally, Fabricious, Scholes and Cundill (2006), differentiate between formal and informal knowledge. Formal knowledge has passed through a universally accepted set of rules qualifying it for a particular use, whereas informal knowledge has been subject to local or traditional rules of validity.

Within the literature, three key groups emerge as possessing knowledge (see e.g. (Fabricus, et al., 2006; Reid, et al., 2006)). ‘Science’ is generated, and peer reviewed, within a community of recognised experts within tightly drawn disciplinary boundaries. It is systematised knowledge that can be replicated according to strict rules. Scientific knowledge is usually formal and explicit. ‘Local knowledge’ is place-based experiential knowledge that is largely oral and practice based. It is knowledge that spans all sectors of a community from state actors, to the private sector and wider civil society, and is rarely formal. It can be explicit, in the form of written local histories for example, though is more often tacit; embedded in local customs, traditions and memories. ‘Traditional knowledge’ is a cumulative body of knowledge associated with a culture that has been handed down over generations, and adapted over time (Berkes, 1999). It may or may not be indigenous, but is usually informal and tacit, and always rooted firmly in the past.

4.2 Beginning from a dialogic epistemology

This thesis begins from a ‘dialogic epistemology’ which views knowledge as socially derived, rather than objectively accessed through any strict scientific code[18]. By acknowledging significant uncertainty and plurality, knowledge is considered to be negotiated between conflicting knowledge systems in political arenas. By viewing knowledge as socially derived, rather than an exercise in objectivity, this ceases to give preference to any one group of stakeholders or their knowledge system; all forms of knowledge are extended a degree of credibility, salience and legitimacy. This perspective is increasingly endorsed by governance models (Friedmann, 1987), which attempt to bring together all knowledge perspectives in deliberation; (i) to increase the quantity and quality of

[17] Doody is not beyond criticism. It is erroneous to assume that data can be collected in a vacuum, without any context, with all data collected according to some purpose. This definition does however emphasise the ‘human’ component of knowledge; that it is in effect constructed according to an analytical filter rather than something that is able to be simply collected.

[18] Please see Chapter 3 for a more detailed discussion of a ‘dialogic epistemology’ for governance.

salient knowledge available to inform decisions (Fabricus, et al., 2006; Reid, et al., 2006)[19]; (ii) to increase the legitimacy of decisions [20]; and (iii) to empower previously marginalised social groups (Fabricus, et al., 2006; Pahl-Wostl, 2002; Reid, et al., 2006). This final point is important; advocates of a dialogic epistemology emphasise its role in decentralising the power of 'knowledge provider' from the scientific community and 'political elite' to other social groups.

4.3 The science-policy interface for ICM

By viewing ICM through an interactive governance lens it becomes evident that knowledge for coastal governance is not concentrated within any one group of stakeholders or institution, but diffused throughout the 'governing system' (see e.g. Glavovic (2008a); Stojanovic *et al* (2004)). Moreover, this knowledge is mobilised in a multitude of ways, towards different types of decision and action. However, this thesis will take the 'science-policy interface' institutional setting as its point of departure; given it has traditionally been the central setting for mobilising knowledge in support of public decision-making, particularly within ICM. As such, the science-policy interface represents a sophisticated literature, both within ICM and beyond, and has long been the focus of debates on the role of knowledge for decision-making.[21] Moreover, the interface is the setting most often at the centre of international initiatives to improve the knowledge-basis for decision-making. Indeed, while ICM was formally endorsed in Chapter 17 of Agenda 21, Chapter 35 of the same document urged more attention to the 'science-policy interface.'[22]

From its inception, ICM has sought to mobilise the best available knowledge in support of collective decision-making, and to this end promoted a multi-disciplinary 'science-policy interface.' Latterly, some ICM authors have depicted the science-policy interface as an institutional setting in a governing system, in recognition of the multi-faceted, pluralistic and political nature of collective decision-making, where knowledge is employed as evidence in support of competing values (see e.g. Boesch (1999); deRaynier, Levin and Shoji (2010); Fritz (2010); and Tobey and Volk (2002)). These authors have suggested framing the science-policy interface according to a dialogic

[19] Fabricus et al (2006) showed that local and traditional knowledge is usually more 'fine-grained' and detailed within a locality than the formal science, and is certainly the only source of knowledge on historical use within an area. Indeed Reid et al (2006) argued that while science dominates at larger scales (national or international), informal knowledge systems dominate at the local scale.

[20] Where local knowledge for example is excluded from decision-making, locals will not see a decision as credible because they know they may have better information, or legitimate because their holders of knowledge were excluded.

[21] See Chapter 4 for a detailed exploration of the science-policy interface for ICM

[22] Agenda 21 particularly recommended advances in the science-policy interface relative to: (a) improved scientific capacity; (b) improved communication between science and policy; (c) improved communication between science and society; (c) increased recognition of uncertainty; (d) and an increased integration of society's values into deliberation over knowledge.

epistemological perspective, and put forward a number of approaches for giving effect to such a participatory and deliberative science-policy interface; from Lee's (1993) 'Civic Science,' to Gibbon's (1999; 1994) 'Mode 2 science', to 'Transdisciplinarity' (Klein, 2000; Nicolescu, 2002) to Funtowicz and Ravetz' (1990, 1993, 1994) 'Post-Normal Science.'

After comparing the alternative approaches of giving effect to a dialogic epistemology for governance (see Chapter 3), this research focuses specifically on the 'post-normal science' perspective, and explores how it may contribute to high quality ICM framed according to interactive governance. To what degree does the post-normal science perspective live up to the aspirations of a model of 'interactive coastal governance,' and its associated notions of a dialogic epistemology? To what degree can a 'post-normal' science-policy interface reunite high quality knowledge, which is at once credible, salient and legitimate, with the social choice problem?

4.4 The post-normal science perspective

The post-normal science (PNS) epistemological approach[23] focuses on evaluating the quality of knowledge for informing governance in the face of issues characterised by significant uncertainty, plurality and political stakes (see Section 3 above). In the early 1990's, Funtowicz and Ravetz attempted to find new scientific principles that emphasised "assumptions of unpredictability, incomplete control and a plurality of legitimate perspectives" (Funtowicz & Ravetz, 1993, p. 739). In parallel with the post-modern movement (though in contrast to its unrestrained constructivism) Funtowicz and Ravetz introduced 'post-normal science' as a conscious departure from the 'normal science' described by Thomas Kuhn (1962). Faced with uncertainty, "Quality…becomes the organising principle of post-normal science because the old ideal of scientific truth is no longer attainable or relevant for policy" (Funtowicz & Ravetz, 1994).

Those writing on post-normal science (see e.g. Funtowicz and O'Connor (1999)) emphasise a dialogic epistemology that finds academic foundations in Dewey's pragmatism and Habermas' communicative rationality (Luks, 1999). Thus a post-normal science-policy interface is inclusive of all knowledge perspectives, which it integrates according to reciprocal dialogue. Beyond nurturing a common understanding though, post-normal science accentuates knowledge quality, and to this end proposes the notion of 'extended peer review.' In this way, diverse stakeholders (notably beyond the scientific community) form an extended peer community, which collectively evaluate the quality of knowledge against collectively agreed criteria. Such criteria may therefore extend beyond scientific measures, to social acceptability or ethical standing for example. In this way, though

[23] See Chapters 3 and 5 for a more thorough discussion of post-normal science, and how it sits relative to other models of dialogic epistemology for governance

knowledge mobilisation remains the central objective, this is accepted as intimately linked with stakeholder values and politics.

5. The research questions and objectives

So far this introduction has presented the motivations for the research, the academic context within which it is situated, and the specific debates that it engages. This section now goes on to outline the specific research questions and the corollary objectives.

Recapitulating this introduction, this thesis works within the encompassing framework offered by Integrated Coastal Management, and takes as its point of departure contemporary representations of the coast of as a complex 'system-to-be-governed,' necessitating models of ICM as governance. In particular, this thesis asserts that the model of 'interactive governance' offers an interesting descriptive and normative perspective on coastal management, which has found some expression within ICM.

Within the context set by 'interactive coastal governance,' this thesis engages the specific debate on how to mobilise knowledge in support of collective decision-making. In recognition of the uncertainty and plurality inherent in complex systems-to-be-governed, models of governance like interactive governance argue that knowledge should be mobilised through dialogue between diverse actors in a governing system; a dialogic epistemology. In the field of ICM, ideas of governance have manifested in calls for a more participatory and deliberative science-policy interface setting. Engaging this debate, the thesis looks at framing the science-policy interface for ICM according to the particular approach offered by 'post-normal science.' It explores how a 'post-normal science' perspective may give effect to high quality ICM, as measured relative to criteria salient to 'interactive governance.'

Therefore, this research project can be condensed into the open research question:

How can a 'post-normal' science-policy interface contribute to quality 'Integrated Coastal Management,' framed according to 'interactive governance?'

Importantly, this inquiry starts from an open question, and constitutes an *open exploration* into alternative norms of dialogic knowledge mobilisation for coastal governance. It explores to what degree employing a post-normal science approach for ICM can succeed relative to: (a) its own criteria of mobilising high quality knowledge; and (b) criteria of high quality ICM, as framed by the model of interactive governance. That is, what can we learn by looking at case studies employing a post-normal science approach, looking through the interactive governance lens? This introduces two important distinctions. First, that this thesis limits its exploration to one dialogic means of knowledge production relative to one dialogic (or interactive) model of coastal governance. This is not to deny the existence of the numerous other models that can also provide an interesting perspective on ICM,[24] only that this thesis has chosen these dialogic models as most interesting given the current trajectory of the field of ICM. Second, and related, this thesis does not pretend to offer any universal or neutral insights on ICM in general. It is *not* an exercise in hypothesis testing, according to any universal evaluation scale, or according to any statistically significant number of case studies. Rather it engages the debate from one perspective, and limits any insights to this perspective, through a comprehensive analysis of a few rich case studies.

Also evident from this research question is the centrality of 'quality.' Quality is discussed in this thesis relative to both the quality of ICM, viewed relative to criteria of interactive governance, and the quality of the knowledge mobilised in support of decision-making within this governance framework. Quality is defined, in general terms, as the 'degree or standard or level of excellence.'[25] However, other elements are implicit in this notion also. First, quality is usually discussed relative to some distinguishing features or characteristics. Statements on quality are related to some specific measures, such that food quality may be defined relative to taste, price, safety or health for example. Secondly, quality usually implies some kind of comparison; it is difficult to distinguish the quality of something if there is nothing to compare it to. Thirdly, quality is often discussed in terms of satisfying certain needs, or fulfilling certain purposes. It is via these matters that this thesis engages the notion of quality.

The research question can be broken down into the two parallel projects of this thesis: (i) formulating an evaluation framework for ICM as 'interactive governance'; and (ii) the evaluation of a 'post-normal' science-policy interface setting according to this framework:

[24] It is not useful to expand on all of the other possible lens through which this thesis could have explored ICM, suffice to note that in parallel with 'post-modern' trends toward dialogic approaches (see Chapter 3), have been models recommending the management approach of the private sector to the public sector such as New Public Management, or hybrids of the 'modernist' technocratic approach that account for an increasing recognition of complexity, such as Ecological Modernisation.

[25] www.dictionary.com

5.1 Evaluating ICM as 'interactive governance'

Research question: '*How can the quality of ICM be evaluated relative to criteria of 'interactive governance?'*

Research objective: *Establish an ICM evaluation framework which emphasises the features and criteria of interactive governance.*

The shifting emphasis in the field of ICM, from models of 'management' to models of 'governance,' necessarily has implications for the evaluation of ICM programmes. As noted in this introduction, the two approaches are fundamentally different, from their intellectual foundations to their methodology, and therefore introduce different measures of 'quality.' Evaluating a 'governance' approach against criteria of good 'management' will likely register poor performance, and *vice versa*; like comparing apples with oranges. This distinction is non-trivial because the emergence of 'governance' approaches within ICM, such as post-normal science, will be seen as unsuccessful as long as measures of success are disparate with the ambitions of governance. For example, strengthened stakeholder relationships, as a typically desired outcome of a deliberative initiative, may be overlooked where the *only* indicator is the number of legal appeals avoided by engaging stakeholders. Therefore, any shift toward models of governance must be accompanied by attention to their evaluation.

However, though the field of ICM represents a detailed literature on *ex post* evaluation techniques, these frameworks remain heavily influenced by the predominant 'resource management' paradigm. Such frameworks typically operate according to instrumental rationality, such that an ICM programme is judged to be of high quality where it succeeds relative to its stated goals; whether they are cleaner coastal water, or improved coastal access for instance. In this way, ICM has long sought to demonstrate a linear causality between ICM institutional *means*, and the outcomes within the coastal 'system-to-be-governed' as the *ends* (see Figure 1), through frameworks such as Olsen's (2003a) 'Four Orders of Outcomes,' to the 'Driving Force-Pressure-State-Impact-Response' framework, to the 'Logical Framework'. Moreover, where possible, this causality is demonstrated via quantifiable measures. Nowhere is this more evident than for the institutional setting of the science-policy interface. Many ICM evaluation frameworks continue to promote indicators of a traditional science-centric interface, according to a 'Cartesian' epistemology. More science is assumed to lead to better decisions and therefore better outcomes 'on-the-ground;' such that a high-quality science-policy interface is one that generates a large quantity of scientific reports.[26]

[26] This is a commonly used indicator within the field of ICM and broader resource management, whereby the ability to commission more scientific reports indicates the success of the management regime.

Revealingly, while some ICM evaluation frameworks profess to evaluate 'governance,' their indicators largely resemble those of the management paradigm.

While notions of interactive governance have found increasing expression within ICM, this research could not find any established ICM evaluation frameworks that gave meaningful consideration to interactive governance. As such, this research had to start by formulating its own *ex post* framework, incorporating the features and criteria emphasised by interactive governance. In Chapter 1, interactive governance is described in detail relative to an increasingly complex and uncertain 'system-to-be-governed', before arguing in Chapter 2 that it presents an interesting framework by which to structure ICM. Chapter 2 goes on to propose a novel evaluation framework for ICM that is rooted in interactive governance, which is used to structure the exploration of the literature in Chapter 5, and the empirical case studies in Chapters 6 to 8.

Importantly, this framework departs from the linearity of management models, anchored in outcomes in the 'system-to-be-governed,' to focus on improved quality within the 'governing system' itself. Specifically, this thesis recognises the reciprocal and symbiotic relationship between institutions and stakeholder interactions; to the extent that institutions shape the interactions within them, they are simultaneously re-constructed by these interactions. Therefore, this evaluation framework is best described as cyclic; including *the parallel evaluation of institutional quality and interactional quality*. Institutional quality is measured relative to the extent that institutions give effect to key ICM success or 'meta' principles, which in this thesis are drawn from the exhaustive review of Stojanovic, Ballinger and Lalwani (2004). Interactional quality is measured relative to the stocks of 'capital' that stakeholders can draw on in interacting and deliberating for decision-making, including stocks of financial, social and human capital.

5.2 Exploring the contributions of post-normal science to high quality ICM

Research question:	*To what extent does a post-normal science approach succeed relative to criteria of quality ICM, as interactive governance?*
Research objectives:	*To explore the performance of ICM initiatives that approximate a post-normal science approach, relative to the established evaluation framework.*

Having undertaken to view ICM through the lens offered by interactive governance, and formulated an evaluation framework, this thesis turns to its second project; exploring how a post-normal science approach can contribute to quality ICM according to these measures. Chapter 3 begins by presenting a discussion on how models of governance have opened the doors to multiple perspectives on dialogic epistemology, before Chapter 4 explores the degree to which these perspectives have been affective in shaping the science-policy interface within the field of ICM. After introducing a number of parallel approaches, this thesis goes on to focus on post-normal science, with Chapter 5 distilling the twelve fundamental characteristics of the approach and how 'in the literature' it promises to promote ICM framed as interactive governance.

After introducing post-normal science, this research sought to study instances of ICM that employed a method either explicitly emulating post-normal science, or unintentionally giving effect to the approach. While post-normal science has found some mention in the ICM literature, there are not a wealth of case studies that note it as a motivation, necessitating the study of similar initiatives that give effect to its principles even while not recognising it. The objective was thus to identify examples of ICM that closely approximated the post-normal science approach, analyse the degree to which their science-policy interface could be described as 'post-normal,' before exploring how they influenced the performance of ICM relative to the evaluation framework. This begins in Chapter 5 with a review of the ICM literature, before presenting the results of cross-scale empirical research in Chapters 6, 7 and 8.

6. Research method

This research draws on a method that has long been embodied by the field of ICM, and recognises the reflexive relationship between theory and practice. ICM has evolved in equal measure by the realisation of new intellectual influences and reflection on coastal management practice; embodying inductive learning-by-doing according to an interactive process that moves from theory to practice and *vice versa* (Lowry, 2002; Olsen, et al., 1998; Tobey & Volk, 2002). In this way, ICM can be conceptualised as a field of 'action research;' whereby ICM scholars and practitioners engage in a collective inquiry that transgresses the disciplinary, social and cultural boundaries of knowledge along an iterative and cyclic process of action–reflection. Such research processes aim to respond to practical concerns of coastal communities by implicating the researcher in the problematic, by crossing theory and practice, and thus by admitting the existence of social, historical and cultural influences while searching solutions (McNiff & Whitehead, 2006; Stringer, 2007). Equally, the study of ICM finds parallels with 'grounded theory,' as an inductive approach to theory-building that has been active in the social and human sciences, and encourages the 'grounding' of theory in empirical data. Such inquiries take empiricism as their starting point; building theory according to a process that constantly adjusts as the data does (Glaser, 2004; Strauss & Corbin, 1990). Both these approaches, and ICM alike (Lowry, 2002), promote methodological pluralism; moving from quantitative data to interviews to observation to surveys for instance.

Drawing from the above methodology, this research began from a research problem and question taken significantly from ICM theory (see Section 5 above); identifying the problem of mobilising knowledge for collective decision-making where ICM is viewed through a 'governance' lens, and exploring 'post-normal science' as an interesting epistemological perspective to respond to this problem. At this point, the research departed from pure theory in pursuing its two parallel projects as outlined in Section 5. In formulating the evaluation framework that steered this research, the thesis utilised a framework of ICM that is equally constructed according to the theory of interactive governance, and the 'success principles' of coastal management practice. In this way, the evaluation framework represents an amalgamation of theory and practice, and draws legitimacy from both. At the same time, the 'post-normal science' approach was actualised into readily distinguishable and practical characteristics, for an analysis of the science-policy interface in practice. It was via these two devices, (i) the evaluation framework, and (ii) the analytical framework, that this research moved from theory to practice, according to three iterations.

6.1 Exploring ICM practice in the literature: the first iteration

The first iteration of this research in Chapter 5 analysed the ICM literature to explore the degree to which a 'post-normal' science-policy interface has found expression in ICM practice, and where it has, evaluate its contribution to institutional and interactional quality. This first iteration also served as a means to check the theoretical evaluation and analytical frameworks against 'real world' practice to determine their validity. To these ends, an exhaustive review was undertaken of the published ICM literature to find articles that described practical instances of ICM initiatives, where a science-policy interface was employed that approximated the post-normal approach. The review identified 14 case studies; however, given the non-uniformity of the articles, it was not possible to apply the theoretical frameworks in a uniform manner. Nonetheless, the first iteration was revealing and allowed for a reflexive return to the theory, and the reformulation of the research framework and questions according to the findings.

6.2 Multi-scale empirical studies: the second iteration

The second iteration sought to base the research in empirical study, and to this end followed ICM case studies selected according to a multi-scale imperative, spanning the international, national and local scales. The multi-scale nature of these empirical studies was essential because the demands placed on ICM initiatives differ across scales, requiring different institutional means. Nowhere is this more relevant than for the institutional setting of the science-policy interface, which has been shown within ICM to assume different forms at different scales.[27] At each scale, empirical study began with (i) an *analysis* of the science-policy interface relative to the principles of post-normal science, before (ii) *exploring* the contribution of this interface to quality ICM seen through the lens of interactive governance. At all scales, the research was qualitative and employed a number of research methods that ranged from a desk-top analysis of written material on the initiatives, to interviews, to observation.

a) *International-scale case study: The SPICOSA Project (Chapter 6)*

At the international scale, this research focussed on the European Union's integrated project SPICOSA; Science and Policy Integration for Coastal System Assessment. "The overall objective of SPICOSA is to develop a self-evolving, holistic research approach for integrated assessment of coastal systems, such that the best available scientific knowledge can be mobilised to support deliberative and decision-making processes aimed at improving the sustainability of coastal systems by implementing Integrated Coastal Zone Management (ICZM) policies" (SPICOSA Project, May 2010). SPICOSA sought to develop tools for facilitating a science-policy interface that was strongly 'post-normal' in nature, and implement these tools across 18 European study sites, many of which spanned international boundaries, and extended beyond the EU. SPICOSA was studied via a review of its written material, and through face to face structured interviews with SPICOSA partners from a subset of five study sites, with interview questions structured according to the evaluation and analytical frameworks set out in this thesis.

b) *National-scale case study: New Zealand's coastal management framework (Chapter 7)*

At the national scale, this research sought to map the diverse means of engaging the science-policy interface for Integrated Coastal Management across New Zealand;[28] demonstrating the emergence of new participatory and dialogic norms, and exploring the influence of the science-policy interface on the quality of institutions. This chapter aims to make two contributions to the thesis. First it aims to augment the very focussed studies into post-normal science within this thesis, with a broader perspective that demonstrates the emergence of a suite of approaches for giving effect to 'norms of

[27] By way of illustration, the Intergovernmental Panel on Climate Change is often held up as a shining example of a science-centric interface at the international scale, while the Millennium Ecosystem Assessment project found the interface at the local scale was often more inclusive of local or traditional knowledge (Reid, Berkes, Wilbanks and Capistrano, 2006).

[28] New Zealand has formally endorsed ICM as a signatory of Agenda 21, and has initiated a coastal management regime that follows ICM across many features. Moreover, the New Zealand coastal management regime has been included in audits of ICM progress. It can therefore safely be considered an exercise in ICM, though nowhere is it explicitly labelled as such.

governance' as an alternative to dominant traditions of science-based management. This serves to relativise a post-normal science approach alongside other means of framing the science-policy interface as a 'governance setting,' and nests their emergence within the context of a complex melange of influences and epistemic traditions. Second, it provides a frame of reference within which to couch the discussion of particular instances of post-normal science at the local scale in Chapter 8. The research method was characterised by both (i) a desktop study of government reviews and published evaluations, and (ii) semi-structured interviews with coastal managers at all of New Zealand's 16 regional authorities.

c) *Local-scale case studies: Whangamata, Waikaraka and Gisborne (Chapter 8)*

At the local scale in New Zealand, this research followed three coastal management initiatives[29] in Whangamata, Waikaraka and Gisborne, which employed a science-policy interface approximating the post-normal approach. Besides providing some insight into the contribution of this post-normal interface to the quality of ICM locally, these case studies provided a comparison to the general state of the science-policy interface in New Zealand nationally. For each case study, the researcher visited the locality for one week to (i) study written material on the initiatives; (ii) undertake structured interviews with a diversity of stakeholders from the state, civil society, the scientific community and the private sector; and (iii) observe the local context and institutional settings (resembling methods of ethnography).

6.3 Returning to theory

Having crossed from theory to practice via the second iteration of empirical study, this thesis returns to theory again in the conclusion, where it asks what the post-normal science perspective can contribute to the debate on how to support collective decision-making with quality knowledge, where ICM is framed as interactive governance.

7. Thesis roadmap: the structure of the thesis

This thesis is structured according to five parts as demonstrated in Figure 2. Below, this structure is illuminated with a brief outline of each part, and a very short summary of their constituent chapters.

[29] These initiatives can be considered to be derived from ICM by default, given they exist within the New Zealand coastal management context that is formally derived from ICM. An ICM evaluation framework was therefore considered relevant to these three case studies.

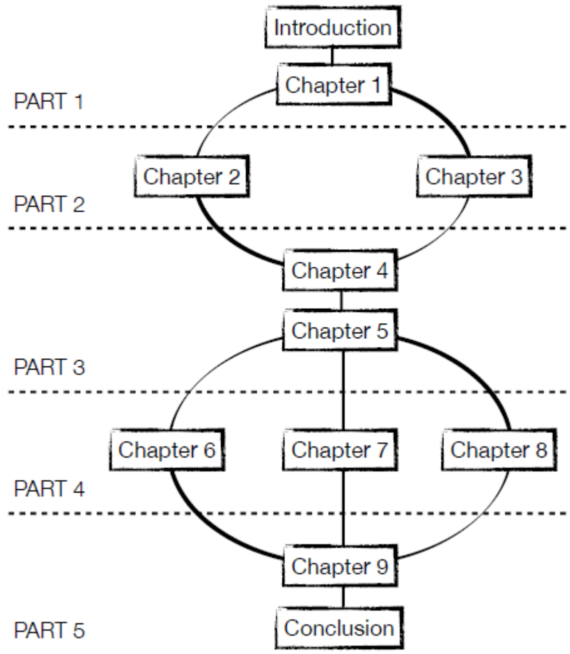

Figure 2: The structure of the thesis

Part I: Introduction and context

This first part contains two chapters, which introduce the research and give some background information to describe the context within which this research is couched. It comprises this introductory chapter and Chapter 1.

Chapter 1: Implications of a complex 'system-to-be-governed:' framing the governing system as 'interactive governance'

This chapter is not specific to the coast or ICM, but rather seeks to expound on the intellectual terrain that has influenced the recent evolution of ICM, and prompted this research. Specifically it presents a short overview of the literature that has conceived the 'system-to-be-governed' as increasingly complex and uncertain, necessitating a departure from models of environmental management toward models of governance. The chapter then presents the 'interactive governance' model in detail, as that lens through which ICM will be discussed in this research.

Part II: Conceptual framework: Evaluation and Epistemology for coastal governance

In Part II the thesis introduces the conceptual frameworks that will guide this research, which has been discussed in Section 5 above as the two parallel projects of the research. This part is constituted of two chapters which exist in parallel, but which will be brought together in Part III.

Chapter 2: Conceptualising an evaluation framework for Integrated Coastal Management as interactive governance

This chapter formulates the evaluation framework for ICM as interactive governance, which will steer this research. It first argues for framing ICM as interactive governance, before reviewing the current state-of-the-art of evaluation for ICM, and revealing the dearth of governance-based evaluation. Beginning from interactive governance, it constructs an evaluation framework with parallel measures of institutional and interactive quality.

Chapter 3: Mobilising high-quality knowledge for governance through dialogue: a comparison of approaches and their institutional settings

This chapter is not specific to ICM. It recognises that models of environmental governance have generally espoused a dialogic epistemology, and through an interactive governance lens, reveals the diversity of different means of dialogic knowledge mobilisation. By focussing on those approaches that are inclusive, integrated and have attention for knowledge quality, it unpacks and compares three specific types of approaches; deliberative democracy, collaborative learning and post-normal science.

Part III: Focussing on the science-policy interface for Integrated Coastal Management: Introducing a post-normal science perspective

In this third part the thesis progresses from the conceptual framework, and focuses on specifically on the way knowledge is mobilised for ICM. Drawing from both Chapter 2 and 3, ICM as governance is discussed in terms of a dialogic epistemology, before focusing on the specific dialogue within the science-policy interface institutional setting. Post-normal science is then introduced as a potential perspective for framing the dialogue within this interface, and its potential interrogated relative to ICM theory and practice.

Chapter 4: Mobilising knowledge for coastal governance: re-framing the science-policy interface for Integrated Coastal Management

In this chapter, ICM is framed as interactive governance; acknowledging the need for a dialogic epistemology, and institutions for integrating the diverse forms of knowledge. Focussing on the institutional setting of the science-policy interface, this chapter reveals a broad dichotomy between science-centric and participatory traditions of interface. It finishes by discussing calls to structure the interface for coastal governance, including according to a post-normal science perspective.

Chapter 5: How can a 'post-normal' science-policy interface contribute to Integrated Coastal Management? A review of the literature

In response to calls to frame the ICM science-policy interface according to a governance model, this chapter unpacks post-normal science as a particularly interesting epistemological perspective. Beginning from the conceptual framework in Part II, it interrogates how the post-normal science approach may, in theory, contribute to high quality ICM. The second half of the chapter presents the results of the first iteration of the research, where the ICM literature was reviewed for initiatives that emulated a post-normal interface.

Part IV: Empirical Studies: Exploring the contributions of post-normal science to Integrated Coastal Management, from the international to the local scale

This part is constituted of three chapters exploring the contributions of a post-normal science-policy interface to quality ICM, through case studies at the international, national and local scale. While Chapter 6 'stands alone' the other two chapters are linked, with Chapter 7 providing the New Zealand national context within which the case studies of Chapter 8 are nested. Chapter 7 does not focus specifically on a post-normal interface, but provides a broader discussion on the influence of the interface on ICM, with a broad focus on the emerging traditions of a participatory and dialogic interface. Chapter 7 also provides a comparison for the case studies in Chapter 8.

Chapter 6: The SPICOSA Project: Applying a post-normal approach to Europe's coastal management

This chapter presents the empirical research attached to the SPICOSA Project.

Chapter 7: The influence of the science-policy interface on Integrated Coastal Management across New Zealand nationally; legitimating new norms of participation and dialogue

This chapter presents the empirical research at the New Zealand national scale.

Chapter 8: 'Post-normal' approaches to coastal governance at the local scale: Lessons from three New Zealand case studies

This chapter presents the empirical research from the New Zealand local scale case studies.

Part V: What has been revealed? Lessons learned and conclusions

This final part reviews the work done in this thesis, the lessons learned, and the meaningfulness of the research results for debates in ICM on governance and epistemology.

Chapter 9: Lessons learned from the empirical research

This chapter reviews the experiences from the three pieces of empirical research presented in Part IV to see what has been revealed about how a post-normal science-policy interface can influence the quality of ICM, framed as interactive governance. It arrives at eight common lessons from across the empirical research, and expounds on what these tell us about the promise of a post-normal science approach for ICM, together with guidelines on how to give effect to this approach.

Conclusion

This thesis is completed with a concluding chapter that discusses the value of this research, for whom, according to the contributions it makes to emerging debates within the field of ICM. Relative to the research question, it reviews what has been accomplished through this thesis, and attempts to make some broad comment on the value of a post-normal science-policy interface for coastal governance. It also presents a brief critique of the research, relative to the research method, and those questions left poorly address by the conceptual framework and discussion in the thesis.

Chapter 1: Implications of a complex system-to-be-governed: framing the governing system as 'interactive governance.'

This thesis is situated within the field of Integrated Coastal Management (ICM) and takes as its point of departure contemporary perspectives within the field that: (a) frame the coast as a complex, humans-in-nature ecosystem; and (ii) frame society's management response according to models of 'governance.' In recognition of this particular starting point, Chapter 1 presents a brief account of the wider intellectual influences which have shaped these perspectives on ICM, and provide the foundation on which this research is constructed.[30]

The field of ICM is not unique in searching for alternatives to modernist representations of the coast and its management. The latter part of the 20th century saw a number of serious challenges to the modernist model of environmental management, and the emergence of governance models as a critical alternative, across many disciplines.[31] Recognition of Nature as complex and uncertain, the plurality of legitimate perspectives that this allows, and a search for a governance response which accommodates this plurality, are themes which have come to traverse many fields. As such, an assortment of governance approaches have come to find constituency across a wide spread of fields including resource and environment management, policy analysis, planning, institutional economics and political ecology for instance. These models present alternative lenses through which to make sense of the complex reality of collective decision-making on resources and the environment. To use the terminology of 'interactive governance' (Jentoft, 2007; Jentoft & Chuenpagdee, 2009; Kooiman, 2003), this has led to alternative conceptualisations of the *'system-to-be-governed'* and the *'governing system.'* Specifically, the system-to-be-governed has become modelled by some as the complex interaction of ecological and social systems fraught with significant uncertainties. In response, society's collective decision-making has been described in terms of an adaptive and self-organising governing system, comprising a complex network of interactions between a plurality of actors, and across multiple institutional settings; from the state, to

[30] See also Appendix A for an account of the evolution of ICM towards models of governance.'

[31] See Appendix B for a comparison of approaches of environmental management with environmental governance.

the market. This chapter thus presents a discussion of these broader themes, before applying them specifically to the field of ICM in the following Chapter 2.

This chapter describes the foundation for the subsequent research by unpacking some of the key underlying ontological and epistemological representations, or assumptions, that it begins from. This discussion is not specific to the field of ICM, but does define the point of entry into the discussion of ICM and the debates engaged within the ensuing chapters. Specifically, Section 1 maps the influences that have seen a re-conceptualisation of the 'system-to-be-governed' as comprising complex and adaptive social-ecological systems, before Section 2 discusses the significant uncertainty that naturally follows this representation. Section 3 goes on to discuss the increasing validity this uncertainty lends to a plurality of perspectives, and the political milieu that is the 'governing system' within which stakeholders negotiate social choices. Section 4 finishes by comprehensively unpacking the particular perspective on the governing system offered by interactive governance, which will be applied to ICM in Chapter 2.

1. Challenging the modernist 'system-to-be-governed': Conceiving of a complex Nature

The 20th Century saw a number of research fields emerge that challenged the reductionist, Cartesian 'modern model' of Nature, operating according to predictable Newtonian processes. For instance, the field of ecology became the source of numerous debates, which set the context for a representation of ecosystems, and by extension our planet, as extremely complex. These debates formed part of a growing appreciation of the complexity of the 'system to be governed' since at least the 1970s.[32]

1.1 Debates within Ecology

Holism vs reductionism

Since the early 20th Century, there has been debate within ecology between those advocating a holistic representation of an ecosystem, and those advocating a more reductionist view. The holistic camp draws heavily on the work of Frederick Clements (1916), who represented an ecosystem as one fundamental unit, or organism, comprising multiple interdependent organisms. Like an individual plant, Clements monistic ecosystem organism follows a linear progression though a number of stages to the mature state, known as the 'climax.' This climax formation is determined

[32] This equally applies to the field of ICM, which from the 1970s onwards began representing the coast as complex dynamic and uncertain - see the Introduction and Appendix A

as the most integrated and complex state of the ecosystem, with the greatest diversity of species. The biotic climax is deemed a closed and stable system that can persist seemingly indefinitely, though it is susceptible to abiotic outside influences from the wider environment. Around the same time, Henry Gleason (1917) put forward an opposing and dualistic view, arguing that an ecosystem is better described as a random selection of individual plants as a result of turbulent changes within an environment continually in flux.

Other influential ecologists later entered into this debate. In 1935, Tansley (1935), wrote an article that moderated Clements holism; describing an ecosystem as a ‘quasi-organism,’ though also extending the concept of an ecosystem from purely biotic to include environmental factors. Ecosystems became considered a basic unit of nature, with Eugene Odum (1993) later building on this concept by proposing the entire planet be deemed a closed system; ‘spaceship earth.’ Together with his brother Henry, Eugene Odum challenged ecologists to integrate reductionism with holism; “…building from parts into larger wholes and patterns…” (Odum, 1971, p. 10). Thus while ecosystems are best studied holistically, there is a significant degree of heterogeneity across different environments and scales (Pritchard & Sanderson, 2002). Perhaps most significantly, in 1953, the Odum brothers (1971) made critical links between human activities and ecosystems and biogeochemical cycles. This heralded humans into the ecosystem; fundamentally challenging the previously held assumptions of the Enlightenment that the natural environment exists separate from, and subservient to, humanity (Pritchard & Sanderson, 2002). This has led to widespread use of terms like ‘social-ecological system’, reflecting society’s place within an ecosystem (Folke, 2006).

Structure vs function

O’Neill *et al* (1986) discuss the division in Ecology between the structuralist approach, focussing on populations and communities, and the functional-dynamic approach. The former approach dominated ecology up until the seminal work of Lindeman in 1942 (Lindeman, 1942) who, influenced by Elton (1927) and Juday (1940), represented a lake ecosystem as a dynamic food chain. Incorporating thermodynamic concepts from physics, Lindeman attempted to show energy and nutrient flows within an ecosystem. Henry Odum later went on to develop the idea of energy flows further, making energy a standard currency within ecology (Odum, 1971).

Equilibrium vs non-equilibrium

The discipline of ecology has long held that ecosystems can exist within a stable equilibrium state, harking back to the ‘Climax’ model of Clements (1916) and carried on by Eugene Odum in 1969 (Odum, 1969). Clements characterised the climax model as a ‘dynamic equilibrium’ to account for the external influences from environmental fluctuations. Odum similarly talked about an ecosystem having a bio-regenerative capacity, with self-maintaining feedback mechanisms automatically correcting any environmental disruptions (such as a storm or a forest fire) and ensuring that the ecosystem remains oscillating within a domain of equilibrium – termed an attractor (Holling, 1973). So conceived, an ecosystem in equilibrium is a closed and integrated 'information network,' with internal feedback loops that connect and regulate the parts of the system. It is energetically efficient, with energy inputs only required for maintenance rather than growth. It is diverse in terms of spatial and species heterogeneity, and complex in terms of the niche specialisation of species. Central to this idea is that the greater the complexity and diversity of species, the more stable the ecosystem.

The 1970's saw the equilibrium theory challenged. In 1972, May (May, 1972) published a mathematical paper demonstrating that the diversity of an ecosystem could in fact be a cause for instability; the more diverse the less stable. Then, in 1974, May (1974) published a second ground-breaking paper demonstrating how, when modelling 'simple' non-linear equations for populations, slight variations in data could give rise to chaotic and intrinsically unpredictable behaviour. This meant that for non-linear systems, general laws of ecology were a non-sense. Moreover, any notions of a single dynamic equilibrium point were precluded by both the intrinsically instable behaviour of biotic populations, and unpredictable effects, such as floods or droughts for example. This position does not argue that ecosystems are incapable of resting in an equilibrium state. Rather it argues that for a given ecosystem, there is no one single optimum equilibrium state where it will remain indefinitely. An ecosystem will move between different states of equilibrium that are more or less stable, according to different sources of perturbation, and within the bounds of upper and lower biophysical limits. For many 'new ecologists' the stability of ecosystems is 'knowable' to the extent that they understanding these 'biophysical floors and ceilings' (Pritchard & Sanderson, 2002).

Ecosystem evolution as linear vs adaptive

Related to the debate over equilibrium is the debate over how an ecosystem evolves. As noted, Clements (1916) and Eugene Odum (1969) advocated a linear unidirectional progression of an ecosystem from the disordered flux of a pioneer community, to a mature and complex equilibrium state. This position remains a popular notion in ecology, and indeed implicitly forms the basis of modern western environmentalism (Russett, 1966). An alternative notion, promoted by Holling (1973), is that of the 'Adaptive Cycle.' More closely related to non-equilibrium traditions of ecology, the adaptive cycle is a cyclic figure-eight, which describes the evolution of an ecosystem iteratively, through four stages. The first stage, 'Exploitation,' sees the uptake of energy by pioneer species as an ecosystem grows and matures. The 'Conservation' stage is the equivalent of Clements climax stage, where the ecosystem remains relatively stable, with energy intake sufficient for maintenance. The 'Release' stage describes the point where an ecosystem's structure collapses due to some kind of perturbation, such as a fire or a storm. The 'Reorganisation' stage may see the ecosystem return to its previous equilibrium state or 'flip' over to a qualitatively different equilibrium, before the cycle repeats itself (Holling, 1995).

Hierarchy

Concepts of hierarchy have had a significant place in Ecology since Tansley (1935), and have influenced contemporary ecologists such as Holling (1973). The implication of hierarchies is that systems, or holons, exist at different scales, with top-down and bottom-up interactions across scales. Higher holons provide the context within which lower holons operate; characterised as constraining factors, or boundary conditions (Holland, 1998). Hierarchies can thus be described as 'nested' or 'non-nested.' Nested hierarchies, like those espoused in Holling's idea of 'Panarchy,' represent systems in a synergistic relationship, with higher holons providing the context for lower holons, while simultaneously representing the sum of the lower holons (Holling, 1995). Holling's panarchy describes fast flowing adaptive cycles nested in progressively slower adaptive cycles. Bottom-up 'Revolt' interactions between cycles represent a disturbance (such as a forest fire) amplified from a small to a large scale. Inversely, top-down 'Remember' interactions represent the 'memory' stored within an ecosystem steering an ecosystems reorganisation following disturbance (Folke, 2006). Non-nested hierarchies relax the requirement that lower holons be nested in higher holons, noting that one ecosystem may exist within another, but that does not mean that they are derived from or reducible to each other (Allen & Starr, 1982). Rather systems are quasi-independent wholes which are part of a hierarchal system of communication.

Finally, key to discussion on hierarchy is the concept of 'emergence' (Holland, 1998). That is, that at different levels in a hierarchy, patterns and properties may emerge that were not apparent at lower levels. O'Neill *et al* (1986) point out that the hierarchal scale of an ecosystem determines whether it is heading towards or away from equilibrium behaviour. For example, at a lower scale ecosystems may appear to be in continual flux, but zooming out spatially or temporally, systems may be progressing towards equilibrium.

1.2 Systems Thinking and Complexity

While these debates unravelled within the Ecology discipline, a parallel and in many ways symbiotic development was occurring within the fields of systems thinking and complexity.

Systems thinking

The systems philosophy is in essence thinking about relationships; the relationships between entities within a defined boundary, and has utility in framing the world for research or intervention (Checkland & Scholes, 1990). Broad systems thinking has been applied across a number of different disciplines or problematiques, and its development stretches back over decades; at least to the 'organismic biologists' of the 1920's (Capra, 1996). The latter part of the 20th century saw systems thinking gain momentum; spurred by von Bertalanffy's proposed general theory of systems (von Bertalanffy, 1975), which ambitiously attempted to summarise rules of system thinking which applied irrespective of context or discipline, and similarly important contributions from Laszlo (1983). While some, like Checkland, saw systems thinking as an effective filter for perceiving the world, and devising solutions to simple system errors (Checkland & Scholes, 1990), others question the utility of abstracting a complex reality to an abstract and simplified model (O'Connor, Faucheux, Froger, Funtowicz, & Munda, 1996). For them, this demands a focus on 'complexity theory' which, while drawing from systems thinking, models the world as irreducibly complex (O'Connor, et al., 1996).

Chaos Theory and the Sciences of Complexity

Chaos theory gained significant popularity in the 1970s and 1980s when computers allowed the modelling of non-linear mathematics. Lorenz (1963), like his ecologist counterparts (May, 1972, 1974), demonstrated that the world was largely composed of non-linear systems, wherein even tiny perturbations can alter the outcomes in a completely unpredictable manner. This became associated with 'the butterfly effect,' whereby the slightest perturbation from the flap of a butterfly's wings, could contribute to a hurricane on the other side of the world (Lorenz, 1963). However, far from dismissing the world as a completely random or incoherent mess of information, chaos theorists found that there were intricate and complex patterns emerging from complex situations; a sort of 'order masquerading as chaos' (Gleick, 1987). Such patterns, described as 'emergent properties' and exemplified by Lorenz in terms of weather patterns, were described as highly unpredictable in any exacting way.

Chaos theory provided a precursor to the broader Sciences of Complexity, or Complexity Theory, that formulated its own field in the latter part of the 20th century. This broad focus on 'complexity' straddled many different disciplines, and was guided by notions on the structure of the universe as dynamic systemic interactions. Specifically, it looked at how these interactions evolved and organised themselves into complex wholes. Converse to chaos theory, which described the world as intricately complex and inherently unpredictable, complexity theorists sought to find the underlying simple roots that gave rise to complex behaviour, or indeed *vice versa*, how complex roots could give rise to simple behaviour (Waldrop, 1992). Therefore, while ecologists were interested in complexity surrounding the structure and physical form of a plant community, complexity theorists were more focussed on ‘big picture’ systematic change towards complexity (Kauffman, 1993). This saw debates between, for example, Darwin’s theory of evolution; which demonstrated life evolving towards more complexity and organisation, and the second law of thermodynamics; which demonstrates ‘entropy’ (as a measure of disorder and disorganisation) always increasing within closed systems (like the earth) to a point where the system is no longer capable of performing ‘useful work’ (von Bertalanffy, 1975).

1.3 Complex Adaptive Systems

Complex Adaptive Systems (CAS) have emerged as a term for describing the adaptive organisation of complex living systems, including social-ecological systems, with influences from both Ecology and Complexity Sciences. This has become a working model of the system to be governed in many research fields, including; Geography (McFadden, 2008), Human and Political Ecology (Adger, 2000; Berkes, Colding, & Folke, 2003), Ecological Economics (Daly, 1996; Gibbs & Cole, 2008), Complexity Science, Computer Simulation, World-Systems Analysis (Berkes, et al., 2003; Diamond, 2005; Francis, 2006) , Environmental Ethics (Berkes, et al., 2003), Post-Normal Science (Funtowicz & Ravetz, 1993), Resilience and Adaptive Capacity (Berkes, et al., 2003; Folke, 2006; Gunderson, 2003; B. Walker & Salt, 2006), and governance (Duit & Galaz, 2008; Mahon, McConney, & Roy, 2008; Olsson et al., 2006). Of course, relevant to this thesis, it has also found expression in ICM.

The characteristics of CAS have been discussed by a number of authors, drawing from the above discussion (see e.g. Francis (2006), Gibbs & Cole (2008) and Kay, Regier, Boyle & Francis (1999)). Firstly, CAS are described in terms of complex ‘open’ systems, receiving a constant supply of energy (termed exergy) from their surrounding environment, to renew themselves, adapt and evolve. Second, by virtue of their open nature, CAS are determined to exhibit non-equilibrium behaviour; with systems dynamically flipping across multiple ‘basins of attraction’ within biophysical limits. Third, CAS exhibit ‘emergent properties;’ that is, those properties or patterns that only emerge from a holistic view, and are not discernable from examining the constituent parts of a system individually. Fourth, CAS are self-organising; with increasingly complex structures of feedback loops emerging without external influence. Fifth, CAS are path dependant; with their evolution strongly influenced by the conditions of their local environment, and the historical behaviour of the system. Sixth, CAS behave according to adaptive cycles of disruption and reorganisations, meaning that they learn, adapt and evolve according to perturbations in the environment. Finally, CAS are structured according to a hierarchy of systems within systems, or a panarchy.

While natural ecosystems alone exhibit a high degree of complexity and unpredictability, by incorporating society within the classification of ecosystems, as for social-ecological systems, one introduces an increasing degree of complexity, termed 'emergent complexity' (Funtowicz & Ravetz, 1994; O'Connor, et al., 1996). Though Complex Adaptive Systems focussed on natural ecosystems may have some limited degree of teleology centred on multiple basins of attraction, by incorporating society as part of an ecosystem; a so-called Complex Adaptive Social-Ecological System, is to incorporate consciousness, and its associated individuality and intentionality. There are no hard and fast rules to human behaviour (contrary to the simplistic utility-maximising behaviour espoused within neo-classical economics), leading to continuous novelty in a system that is inherently unpredictable. As van den Hove (2006, p. 11) notes

Environmental phenomena frequently present physical characteristics of complexity, uncertainty, large temporal and spatial scales, and irreversibility. All these physical characteristics of environmental processes have consequences on what can be called the societal characteristics of environmental issues. These include: societal complexity and conflicts of interests, transversality, diffused responsibilities and impacts, no clear division between micro and macro-levels, and short-term costs associated with potential long-term benefits.

2. Complex systems-to-be-governed as a source of uncertainty

In recognition of the system to be governed as comprising complex and adaptive social-ecological systems, a number of fields including ICM have had to re-examine the degree to which we know the world in order to manage it; to what degree do we have epistemic access to the world. This introduces the philosophical question; 'What about potential surprises?' Funtowicz and Strand (2006, p. 266) very succinctly summarise the two central positions on this question:

Some scientists, decision-makers and citizens have a propensity for complexity, and tend to think that Nature has a large capacity for surprises. Others tend to think that science knows more or less all that is worth knowing about Nature's behaviour, and that surprises are unlikely or manageable…The latter refers to a large series of scientific successes, both in the theoretical and applied realms. The former similarly points to a large series of surprises and failure to control surprises, as well as the development of chaos theory, complexity theory and other fields of research that show the limitations of linear models of Nature. We call this a metaphysical question because neither position is evidence-based today, and *because we believe natural philosophy or worldviews play an important role in individuals' formation of beliefs.*

Central to this metaphysical question of surprise is the concept of uncertainty; how certain can we be that an action will lead to the desired outcome? Uncertainty has been variably defined, though Klauer and Brown (2004) define it as "…lack [of] confidence about the specific outcomes of an event. Reasons for this lack of confidence might include a judgement of the information as incomplete, blurred, inaccurate, unreliable, inconclusive, or potentially false." Depending on one's philosophical standpoint, as outlined by Funtowicz and Strand above, outcomes may be more or less certain, and uncertainties more or less deep-seated. Walker *et al* (2003) broadly distinguish between 'epistemological uncertainty;' due to the need for further scientific study, and a more fundamental 'stochastic (or ontological) uncertainty;' owing to an irreducible complexity and uncertainty in environmental issues.

2.1 Uncertainty within the 'modernist' model

The modernist traditions of resource management work to a simplified model of the world that is able to be reduced to its parts and analysed in terms of simple linear causality (see Appendix B). Such a model is potentially completely knowable; thus science becomes charged with informing policy with objective, valid and reliable knowledge to allow decision-making in light of 'perfect knowledge' (Funtowicz & Strand, 2006). Within this model, a decision-maker is able to determine causality between each action and its resulting outcome. Funtowicz and Strand (2006) assert this modernist model is underlain by two assumptions. Firstly that science, and only science, is able to provide all of the information needed to make decisions for the common good. Secondly, that science is in fact objective, valid and reliable in providing 'certainty.'

However, unlike 'pure' science, the science applied to environmental issues cannot be done in a controlled laboratory; Nature's open laboratory introduces many uncertainties, with 'experiments' irreversible and non-replicable (J. P. Van der Sluijs, 2001). The modern scientific worldview discusses this uncertainty in terms of the probability of regularly occurring events; uncertainties are presented (and managed) according to the statistical probabilities of a defined set of possible outcomes (Funtowicz & Ravetz, 1990). This introduces the concept of 'risk,' for quantifying 'bounded' statistical uncertainty. 'Bounded uncertainty,' as defined by Refsgaard *et al* (2007), implies that science remains certain on the possible outcomes that may result from a particular action, though not adequately confident to predict just one outcome. Risk analysis is therefore concerned with quantifying those possible harmful outcomes and calculating the probability for their occurrence; risk = damages (in monetary terms) x probability (World Commission on the Ethics of

Scientific Knowledge and Technology, 2005). Policy analysts and decision-makers have thus come to expect a 'magic number' on which to base their decisions; however these singular numbers are very often extrapolated from sparse data, from studies indirectly associated with the issue, and comprising compounded uncertainties of data and methodological quality at multiple levels (Funtowicz & Ravetz, 1990). This says nothing for issues characterised by irreducible uncertainty, where, as O'Connor *et al* (1996, p. 233) note, "It is not that the probabilities are unknown or badly estimated; rather they are unknowable for the fundamental reason that they do not exist and will never exist to be known." Paradoxically, risk analysis is derived from uncertainty, but can be considered nullified by significant uncertainty (Rotmans, 1998).

2.2 The Study of Uncertainty

Funtowicz and Ravetz argue that only recently, over the past few decades, have there been opportunities for meaningful review and revision of the traditional views of science as knowledge and power, in light of uncertainty. "Only in the present [20th] century have the challenges for science been changing…so that it is becoming a matter of common sense to see the essential task of science as coping with uncertainties rather than as rolling back the frontiers of ignorance" (Funtowicz & Ravetz, 1990, p. 27). Critiques of the treatment of uncertainty have been raised from multiple perspectives. Beck (1992) has mounted criticisms on the unanticipated, and often disregarded, risks that have accompanied science-fuelled 'progress,' with such risks growing in magnitude as society passes into the post-industrial age. Meanwhile, the 20th century saw a flurry of critical literature on the misleading use of statistics, including in the quantification of uncertainties, from authors like Huff, Feinstein, Jaffe and Spirer (as cited in, Funtowicz & Ravetz, 1990). In parallel with this, a number of authors have argued for revisiting the norms of 'normal' disciplinary science, to create new norms that address uncertainty through perspectives on 'Mode 2' science (Nowotny, Scott, & Gibbons, 2001), or 'post-normal science' for instance (Funtowicz & Ravetz, 1993) (see Chapter 3).

2.3 Sources and types of uncertainty

Multiple authors have written on the sources of uncertainty, which potentially arise when framing an issue, collecting data within the environment, or combining these data within a model of the system. Authors like Vesely and Rasmuson (1984), van der Sluijs *et al* (2005), and Walker *et al* (2003), for instance, have attempted to tabulate these different sources of uncertainty, with some congruence across their categorisation. 'Data uncertainties' are those uncertainties surrounding the quality and appropriateness of the data inputs used to inform policy models. 'Modelling uncertainties' are two-fold. 'Conceptual uncertainties' result from a poor understanding of system studied which translates to a model with little or no relevance to the system it is attempting to mimic. 'Technical uncertainties' are derived from the 'nuts and bolts' of the model itself, whether the equations are correct, its parameters, and any bugs it might have. Finally, 'completeness uncertainties' represent those omissions from the model owing to a lack of knowledge; and often represents ignorance of what needs to be known in order to accurately model the system at hand. Walker *et al* and van der Slujs *et al* introduce another source as the external 'context' (economic, social and environmental) within which the model is formulated, with the context framing the issue.

Funtowicz and Ravetz (1990) zoomed out from these specific categorisations, and identified three broad types of uncertainty which may be present in differing combinations for each issue, in order of increasing conceptual 'severity.' Firstly, 'inexactness' or technical uncertainty corresponds to the statistical spread of data. It is a 'quantitative' uncertainty represented by numerical 'significant digits' or 'error bars,' and reducible by further study. Secondly, 'unreliability' calls into question the confidence in the method for collecting knowledge. It is a more 'qualitative' measure of uncertainty based in ideas of best-practice, and often variable across disciplines. Rather than focussing on the quantity of further science required, it encourages reflexivity on the context of the research and its methodology (World Commission on the Ethics of Scientific Knowledge and Technology, 2005). These first two types of uncertainty are therefore able to be reduced through more research and a review of quality standards.

Thirdly, and perhaps most significantly, 'ignorance' represents that which we do not know we do not know, and encompasses the uncertainties outside of the other two types. This may be ignorance in terms of misplaced confidence in 'mis-facts' (Refsgaard, et al., 2007), an inability to discern significant trends in the data, or more fundamental ignorance of concepts beyond our knowledge (Funtowicz & Ravetz, 1990). Indeed, by conceiving of Nature through the Complex Adaptive System model for example, ignorance becomes less the exception and more the norm (Funtowicz & Ravetz, 1990). As Egler asserted, "…nature is not only more complex than we think. It is more complex than we can think" (Egler, 1970, p. 21). To use the categorisation of stochastic uncertainty of Walker *et al* (2003) ignorance is to a large extent irreducible, for humanity cannot reflect on that which is beyond the bounds of imagination. We can think about the border between knowledge and ignorance as being incrementally pushed outward, with scientific revolutions allowing for greater leaps into the unknown (Funtowicz & Ravetz, 1990; Kuhn, 1962). However, as Pascal (as cited in, Giarini & Stahel, 1993) conceptualised *"Science is like a ball in a universe of ignorance. The more we expand knowledge, the greater the ignorance encountered by the ball's expanding surface."*

Funtowicz and Ravetz (1990) describe 'ignorance' as 'epistemological uncertainty' (not to be confused with the contrary use of the term by Walker *et al* (2003)). This implies that such uncertainty can only be managed through reflection on how we as humanity talk about 'knowing'

Nature; are we able to loosen our Cartesian standards of knowledge to accommodate inherent uncertainty and an attendant plurality of perspectives (World Commission on the Ethics of Scientific Knowledge and Technology, 2005)? 'Epistemological uncertainty' thus brings with it a significant paradox; though a significant source of uncertainty is associated with the plurality of individual perspectives on Nature, it is through a pluralism that we are best able to access the most 'complete' model of Nature. Plurality is thus at once a fundamental cause of, and solution to, ignorance.

2.4 Analysis of Uncertainty

Therefore for many environmental issues, decision-making needs to move beyond calculating the 'risk' associated with actions, to analysing the 'uncertainty' (Patterson & Glavovic, 2008). To this end, any analysis of the uncertainty should take into account all 'types' of uncertainty, including the possibility of irreducible ignorance. There are a number of principles, frameworks and tools that have been put forward to aid analysis of uncertainties, as an alternative to 'risk.' These range from the highly politicised 'precautionary principle' (Weiss, 2007; World Commission on the Ethics of Scientific Knowledge and Technology, 2005); to the 'adaptive management' framework that approaches policy interventions as 'experiments' (Hennessey, 1994; Imperial, Hennessey, & Robadue, 1993; Lee, 1993); to knowledge quality tools such as the NUSAP method (Funtowicz & Ravetz, 1990), or knowledge 'checklists' (Janssen, Petersen, Van der Sluijs, Risbey, & Ravetz, 2005; Risbey et al., 2005). A thorough list of 14 different methods for addressing uncertainty is put forward by Refsgaard *et al* (2007). Common to many of these are two features; a participatory approach that encourages stakeholders to collectively identify the uncertainties; and a greater emphasis on uncertainty identification and management as a 'craft' (Funtowicz & Ravetz, 1990).

3. Society's collective decisions within a 'governing system'

3.1 A plurality of valid perspectives

A system-to-be-governed described in terms of complex and adaptive social-ecological systems can lead to significant uncertainties when we engage in collective decision-making. This has forced society to reflect on how it 'knows' Nature, and turn to an inclusive epistemology that relaxes science's stringent Cartesian standards and admits all forms of knowledge. In designing society's governance response, the 'governing system' is increasingly depicted as drawing on a plurality of perspectives.

The scientific community has come to acknowledge that it is possible to have plural perspectives that are all valid though not necessarily consistent; challenging the 'myth' of objectivity. Within complex systems ecology, the ecologist has become a perceiver rather than an observer;

recognising that there are different ways of perceiving the same complex ecosystems, each bringing its own ‘filters’ and each blinkered by its specialised focus. Checkland (Checkland & Scholes, 1990), through his ‘Soft Systems Methodology,’ emphasised the difference between ‘hard systems’ that actually exist ‘out there’ in an ontologically realist world, and ‘soft systems’ as those social constructs that act as filters on how we perceive reality. Disciplinary science applies their own specialised soft systems filters on reality to make sense of the chaos; at times with little congruence between findings (Sarewitz, 2004). No perspective is ‘wrong’ by its own measures; however they are all of them incomplete without the other perspectives. Moreover, Jorgensen Patten and Straskraba (1992), argue that it is not enough to simply sum the many disciplinary perspectives, as doing so is to ignore that complex systems are more than the sum of their parts, such that reducing a system to its parts is the first step to confounding systems.

Recognising the plurality of valid perspectives is not limited to scientific endeavours. To gain a more complete picture of Nature requires as diverse perspectives as possible, extending to other knowledge systems; reality as a plurality of truths. Post-modernist traditions have had a significant bearing on how we perceive society, and society’s knowledge of the world (Rudel & Gerson, 1999). Ideas of knowledge, including for environmental governance according to authors like Friedmann (1987), Hastie (2007) and Jones (2002), have wavered from the objective Cartesian ‘scientific’ theories of reality, and explored sociological theories of knowledge-building as a social process (Fuller, 2007). Knowledge-building becomes a collective activity, and can be differentiated across different groups, each with their own knowledge system; (i) appropriated for the ends of the group, (ii) judged ‘rational’ according to its own internal standards, and (iii) normatively loaded with the values of the group. Such groups range from indigenous tribes, to local communities, to religious groups, to the scientific community (Fuller, 2007). While science long drew dominance from its instrumental rationality, and its perception of being value-free, this has come under challenge, with instrumental rationality and positivism indeed constituting the values of science (Carolan, 2006; Collingridge & Reeve, 1986). Now all various knowledge systems carry a degree of validity.

Accompanying the pervasive influence of post-modernism, theories of constructivism and other ‘relativist’ approaches have argued that knowledge for collective decision-making is at least in part constructed through negotiations between a diverse array of perspectives about what is accepted as a ‘fact,’ and influenced in equal measure by ‘values’ as by ‘evidence’ (Henrickson & McKelvey, 2002). The picture of reality is not able to be painted by one actor appealing to objectivity, rather it becomes the tapestry woven by a tangle of intersecting stories, as individuals perceive the world around them, make sense of it, and communicate it to others (Blaikie, 1996; O'Connor, 1999a). Indeed, as Collingwood and Reeve (1986) point out, not only is that which is known constructed via negotiation, but also that which is not known. They argue that the representation and perception of uncertainty are important factors, and that uncertainty is partly a construction of negotiation processes between scientists, policy-makers and the public.

Importantly, this 'polyvocality' of different perspectives is context specific and fluid over time (Rudel & Gerson, 1999); we socially construct reality as we move through it. While not writing on constructivism, O'Connor depicts this well in the passage below (1999a, p. 683):

> *Each space, landscape, environment constitutes a place and way of experiencing the world—always incomplete, always biased by the particular physical constraints and by human preoccupations, yet an experience that is in some ways real… Each situation is a moment of being, opening onto other moments, places and their perspectives… So, this view of life in society and of social knowledge 'legitimates' controversy in the sense of admitting it as an inexorable fact of social life.*

In this way, O'Connor, drawing on Latouche (1984, as cited in, O'Connor, 1999a), asserts that the existence of a plurality of perspectives is so inevitable as to map it as a 'scientific law.'

If reality is a plurality of truths, which truth should be used as the basis for rational collective choices? Jones (2002) cautions that the constructivist epistemology can, at its extreme, promote ontological relativism, where the conditions of reality are actually determined by the observer and dialogue; begging the question, 'if a tree falls in the forest, and there is nobody around, did the tree exist in the first place?' According to Soulé (1995, as cited in, Allison & Hobbs, 2006), such 'post-modern deconstructivist' dialogue can be as 'destructive as chainsaws or bulldozers' in efforts to arrive at collective social choices, with each individual asserting their perspective to be 'real to them.' Jones notes though that the majority of constructivism is moderate, opting for ontological realism alongside epistemological relativism; "thus the diverse worldviews are different interpretations of a common reality—they are 'meanings' rather than truths" (Jones, 2002, p. 248).

To return to the question, whose perspective informs decision-making, Pritchard and Sanderson (2002) argue that, given multiple models of Nature and management can be sustained without being falsified, the choice of models is influenced by power; specifically in terms of: (a) numbers – where a perspective gains popular support; (b) the agenda–setting of powerful stakeholders; and (c) the insidious power of a dominant ideology. Flyvbjerg (1998) in his book 'Rationality and Power,' argued that power determines what counts as knowledge and what interpretation of reality remains the dominant interpretation. In any context where there are a plurality of different perspectives, power defines reality by defining rationality, and in turn rationality becomes a significant tool for ensuring those with power achieve their ends. Indeed, the more power held by actors, the less rationality they need employ to rationalise a certain collective choice. In an open confrontation, rationality will always yield to power; as the proverb says, 'truth is the first casualty of war.' This next section turns to the powerful political interactions that constitute a governing system.

3.2 Making collective choices in a high-stakes governing system

Collective decision-making under the modernist model depicts a sterile environment, created by the 'policy sciences,' wherein good choices (see policy) emerge from a rational and rigorous policy process that is informed by science and the aggregated preferences of society. However, for many writing in the fields of planning and policy analysis, this rational policy process has come to represent little more than a tool for excluding meaningful participation and reinforcing the will of political elites, while all the time giving 'collective' decisions a thin veneer of scientific rationality (Colebatch, 2005; Everett, 2003; Schulock, 1999). Policy writers have called the rational process an unattainable benchmark which is rarely practiced and even more rarely valued by decision-makers (Schulock, 1999). This was described by Kirp (1992, as cited in, Schulock, 1999) in the early 1990s, as the death of modernist policy analysis due to "the triumph of the post-modern sensibility in the domain of policy," which favours anecdotes over policy substance, passion over reason, and sound bites over rational political discourse.

Schlager and Blomquist (1996) emphasise that collective decision-making is a deliberate social process, entered into to further the plurality of values within society, and is therefore inherently political. Far from detached and coolly-reasoned, the collective decision-making arena has become the focus of study for political scientists and public choice theorists, who are interested in the strategic behaviour of decision-makers, scientists, technocrats and other stakeholders acting not only to solve society's problems but to advance their own interests. Collective choices are deemed to emerge from the complex and evolving interactions within this intricate network of stakeholders, who enter into negotiation within a 'political marketplace' (Colebatch, 2005; Madison, 2000; Pritchard & Sanderson, 2002; Schlager & Blomquist, 1996). Indeed, Kingdon (1984) argues that collective decision-making isn't a process at all; rather a 'policy soup,' with actors, institutions and principles/ideas mixing around chaotically. Madison recognises that the governing system is increasingly an arena of political conflict due to the growing number of heterogeneous groups, with disagreement on both 'facts' and 'values,' and a disproportionate power base; going as far to say that "increased participation in policy decision-making produces increased political conflict" (Madison, 2000, p. 35). Greenberg *et al* (1977, p. 1542) agree, describing the governing system as complex, "because of temporality, because of a multiplicity of aspects and participants, and because of interaction."

The inevitable multiplicity of stakeholder needs and wants makes the modernist ideal of rational aggregation of values to one preferred action impossible. Rather political scientists and policy analysts have described the way in which power is exerted through the governing system to give preference to some values over others; so-called pluralist governance (Cobb & Elder, 1971; Colebatch, 2005; Everett, 2003; Innes & Booher, 2004). In essence this pluralism describes the dissolving of decision-making power from political representatives and their technocrats, to constituency stakeholders, or lobby groups. These lobby groups lend their support to decision-makers, who in exchange elevate their interests. Madison (2000) describes this pluralistic system as a competitive environment, in which groups compete and negotiate for power. Such political bargaining is complex and dynamic, with lobby groups in a constant state of flux; entering or exiting the political arena, and re-configuring into different 'advocacy coalitions' (Sabatier, 1988, as cited in, Schlager & Blomquist, 1996) around different issues. Collective decision-making therefore progresses in small incremental steps as lobby groups squeeze small concessions out of the others (Lindblom, 1979).[33]

A number of authors have written on the ways in which lobby groups exert power to have their interests set high on the agenda for decision-makers. Mitchell, Agle, and Wood (1997, as cited in, Buanes, Jentoft, Karlsen, Maurstad, & Søreng, 2004) argue that the issues elevated on the agenda are often raised by stakeholders who exhibit (a) the power to influence others and an issue, (b) the perceived legitimacy for a role in governance, and (c) an issue driven by a sense of urgency. Roth and Wittich (1978, as cited in, Jentoft, 2005) offer an alternative list of important sources of legitimacy and power, including; (i) an important and urgent issue, (ii) tradition, (iii) charisma, and (iv) professional or functional knowledge. If power is at the centre of collective decision-making, then what constitutes a 'democratic' distribution of power?

3.3 Participatory democracy for living with uncertainty and pluralism

Democracy takes many forms, with Innes and Booher (2004) describing a constant trade-off between (a) the legitimacy of decision-making, in terms of the 'consent of those governed,' and (b) the effectiveness of decision-making in terms of reaching consensus on a rational order of societal preferences. This echoes Sager (2002) who talked in terms of a trade-off between rationality and democracy, and argued that democracy will always suffer when attempting to arrive at a rational preference that is agreed to by all of society. In this way, democratic principles frame the discourse wherein society makes collective choices (Pritchard & Sanderson, 2002). These discourses may range from the arguably more effective though less legitimate elitist administrative rationality, to more legitimate though less effective pluralist politics (Innes & Booher, 2004; Pritchard &

[33] This inspired Lindblom's planning via 'disjointed incrementalism,' or 'the science of muddling through.'

Sanderson, 2002). Participatory democracy, as ‘strong democracy’ (Barber, 1984), has encouraged collaborative ‘communitarian discourses’ as a means for arriving at more rational decisions in a more democratic way (Pritchard & Sanderson, 2002).

In response to the challenges of uncertainty and plurality, participatory democracy presents a means of sharing power among all different stakeholders who want to participate in collective decision-making, in mutual respect to the plurality of valid perspectives, as per Arnsteins ladder (Arnstein, 1969).[34] Participatory democracy, according to Thomas (1995), is;

> *defined by politics in the participatory mode; literally, it is self-government by citizens rather than representative government in the name of citizens.*

Rather than relinquish their political responsibility to be deliberated by political representatives, citizens under participatory democracy are directly involved in the deliberation themselves. At its extreme this can find expression in full citizen control, though in practice this is normally tempered to partnership. Stakeholders as citizens negotiate their own aspirations within the context of the ‘public good,’ thus elevating combined interests, and sharing responsibility for resolving conflict (Forgie, Cheyne, & McDermott, 1999). This improves the quality of decision-making by making it more responsive, and by accepting stakeholders as having perspectives that can add rationality and legitimacy to collective decisions (Thomas, 1995). Within the participatory model, ‘communitarian citizenship’ is encouraged, with citizenship crediting actors with multiple capacities and expertise for governance which also carry an obligation to participate in political life (Heater, 1990).

4. Framing the ‘governing system’ as interactive governance

Recognition of the above notions of complexity, uncertainty, plurality and ‘messy’ decision-making have seen the growing popularity of the concept of ‘governance,’ in a diversity of forms and across multiple disciplines, over the past 20 years (see Section 4.1 below). Kooiman (1999), in his review, notes a common awareness across this governance literature of the complex and multi-faceted issues facing society, and the need for a complex and multi-faceted response. Kooiman goes on to

[34] Participatory democracy presents an alternative to liberal representative democracy, as the predominant political system associated with modernity. Broadly, liberal democracy has voting as the primary means for citizens to express their political will, and their sole responsibility as a citizen (other than minor roles like jury duty for example), with all citizens equally given one vote. Within ‘liberal citizenship,’ individual liberty is the most important attribute of democracy, with government expected to make collective decisions to protect the rights of the individual.

cite four common realisations across the literature that have contributed to the popularity of governance, including that; (a) the state is not the only crucial actor in addressing major societal issues; (b) there is a need for both traditional and new government-society interactions; (c) governance arrangements differ for levels of society and vary sector by sector; and (d) most issues are complex, leading to interdependency across societal actors.

Theories of governance have thus emerged as challenges to the traditional dominance of a uni-lateral, state-centred 'resource management' response, understanding governance as a multi-lateral tangle of parallel approaches, undertaken at multiple scales. Through governance we can conceive of society's collective response to an issue as the joint responsibility of (i) the state, (ii) the private sector, (iii) civil society, and (iv) the scientific community; operating simultaneously and independently according to their own institutions and guiding principles (Duit & Galaz, 2008; Jentoft, 2005; Kooiman, 2003; Lemos & Agrawal, 2006; Pierre & Peters, 2000). In this way, governance theories present alternative lenses or filters through which to understand the complexity of collective decision-making within the reality of a 'messy' or 'soupy' governing system; introducing four key impetuses for models of governance, listed in Table 1.

First, concepts of governance take as their starting point, and indeed draw legitimacy from, a reconceptualization of social and ecological systems as extremely complex and unpredictable, comprising significant uncertainties. This necessarily admits that most meaningful issues facing society are beyond the control of a state 'manager' operating according to a model of science-based management. Second, it follows that governance theories endorse notions of plurality, whereby no one actor can have full knowledge of a complex issue, no one actor's values should dictate the direction of society collectively, and no one actor has the power to unilaterally 'solve' an issue. Governance theories give effect to plurality through open participation, to yield a broader view of an issue and take multi-lateral action in response. Theories of governance thus challenge ideas of hierarchal 'command-and-control' or 'big' government, citing a perceived weakening of the state's role in contemporary society, and a perceived strengthening of civil society and the market. As Pierre and Peters (2000, p. 52) note, governance theory "links the contemporary state to the contemporary society."

Table 1: Four common impetus for environmental governance theories

(Inspired by a similar list of Kooiman (1999))

1) Appreciating the rules and characteristics of complex systems
2) Recognising and giving effect to pluralism in governance
3) Representing political interaction and cooperation as a more powerful descriptive model of collective decision-making
4) Drawing normative legitimacy from participatory democracy.

Third, governance theories draw legitimacy from being a better descriptive model of the reality of collective decision-making within the 'governing system' (Amin & Hausner, 1997; Kooiman & Bavinck, 2005). They lay bare the illusion of decision-making as a 'policy science,' and how unrealistic it is to discuss the whole of society's response to complex issues in terms of a single unilateral, and state-centred institution. Governance recognises the 'messy' political interactions that constitute social choices. Drawing from 'social network theory,' (see e.g. (Wasserman & Faust, 1994; Wellman, 1991)) many governance theories represent society as interdependent structured relationships rather than an agglomeration of discrete groups. These interactions make up networks of flowing information, resources and power. So viewed, society's governance can be described as emerging from a complex and dynamic network of interactions between diverse stakeholders, across a multiplicity of formal and informal institutional settings, within a 'governing system,' (Amin & Hausner, 1997; Jentoft, 2007; Jentoft & Chuenpagdee, 2009; Kooiman, 2003)[35]. This serves to demonstrate the simultaneous independence and interdependence of stakeholders within a governing system; where a plurality of stakeholders are pursuing different ends, though none alone with sufficient means. As Kooiman (2003, p. 3) notes, "In diverse, dynamic and complex areas of societal activity no single governing agency is able to realise legitimate and effective governance by itself." Fourth, theories of governance draw normative legitimacy according to principles of 'strong' participatory democracy; encouraging the communitarian action of all citizens (Amin & Hausner, 1997; Kooiman & Bavinck, 2005). This noted, some writers consider the network theory to be fundamentally incongruent with participatory democracy (See Section 4.6 below).

4.1 A diversity of governance models

Though governance as a concept may share some common motivations, it can be seen to take different forms; the many ways in which the term 'governance' is used in the literature do not necessarily having the same meaning. Kooiman (1999, p. 68) reviewed how governance has proliferated across social science disciplines in recent years, including the fields of international

[35] This terminology will be expanded on below in Section 4.2.

relations, public administration and management, political science and economics, noting, "Apparently there is a need for such a concept, although a bandwagon effect cannot be denied either." Kooiman describes at least 10 disparate ways in which the concept of governance is employed (see Table 2), and asserts that this precludes any single theoretical approach to governance. This noted, he argues for the co-existence of these many different framings of governance, as particularly applicable to different levels or sectors of society. For example, 'corporate governance' appears to be more relevant at the organisational level, while 'network governance' appears more relevant for sectorial governance, and 'good governance' works best at the national scale. To Kooiman's list must be added at least two further theoretical approaches to governance that have found increasing attention, particularly in natural resource and environmental management fields. The first is the notion of 'adaptive governance' which has emerged principally in the field of political ecology.[36] The second is the 'Governance of the Commons,' developed primarily within the broader field of economics by Elinor Ostrom.[37]

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[36] Adaptive governance takes as its starting point developments in Ecology that recognise the potential for ecosystems to flip between various states of 'equilibrium' (see Section 1.1) and promote the 'resilience' of social-ecological systems in a state mutually beneficial to society and Nature. To this end, these theorists argue for developing an 'adaptive capacity' within society, to adapt to inevitable though unpredictable change, while steering society towards a more sustainable equilibrium with Nature

[37] The governance of the commons starts from a recognition of Hardin's 'Tragedy of the Commons,' but argues for a third way of governing common resources, according to self-governing institutions; citing examples of tribal governance systems for example. In arguing for a new form of institutions – as ways of organising activities – Ostrom argues that they should (i) promote dialogue, (ii) be complex, redundant and layered; (iii) represent a diverse mix of institutions; and (iv) facilitate experimentation, learning and change.

Table 2: Theoretical approaches to governance (taken from Kooiman, 1999)

1) *Governance as the minimal state* – redefining the extent of state intervention in society
2) *Corporate governance* – the way big organisations are directed and controlled
3) *Governance as new public management* – 'less government, more governance'
4) *Good governance* – as advocated by the World Bank and the European Union for eg.
5) *Socio-cybernetic governance* – as embodied by social-political or interactive governance
6) *Governance as self-organising networks* – drawing on social network theory
7) *Governance as 'steuerung'* (German) – the role of government in steering, controlling and guiding social actors.
8) *Governance as international order* – improve global relations through global governance
9) *Governing the economy or economic sectors*
10) *Governance and governmentality* – drawing on power theory, particularly from Foucault
11) *Adaptive governance* – governance as building society's adaptive capacity
12) *Governance of the commons* – governance of 'common' natural resources

This by no means represents an exhaustive list of theoretical approaches to governance, but does present something of the diversity of its usages. In particular, it shows how governance can mean very different things to those discussing governance as the running of a business or an economic sector, to those discussing governance as a model of socio-political interaction in society, to those discussing governance as a means for shaping society's interaction with the environment.

Importantly, while some models of governance may assert a stronger descriptive power than others, none pretend to describe reality 'as it really is.' Rather each model represents a different lens or filter through which to observe the complex reality of the corporation, society or social-ecological interaction for instance, and arrive at some interesting and useful insights for action. Thus each 'lens' focuses on different features of reality, and as such carries its own strengths and weakness in terms of what it can reveal. Likewise, the limitations of each lens' focus have implications for the kinds of principles, institutions and criteria of quality that recommend themselves. Furthermore, the focus of each governance lens is largely determined by its disciplinary 'home.' In this way, one can note how adaptive governance is fundamentally focussed on ecological notions of resilience and adaptability, with governance valued for its fluidity rather than its stability for instance. On the other hand, the governance of the commons begins from ideas of governing common natural resources, therefore shaping its decision-making relative to economic ideas of the distribution of scarce resources.

This thesis chooses interactive or social-political governance as the lens through which to represent and understand and learn about Integrated Coastal Management. The next chapter will argue why interactive governance recommends itself as a particularly compelling way of viewing the complexity of ICM. Here interactive governance is unpacked as explained as the theoretical framework within which this thesis research will unfold.

4.2 Defining interactive governance; interactions, institutions and principles

Interactive governance provides both a descriptive or 'analytical' lens through which to make sense of the governance 'soup,' and a normative correction on how governance 'should' nurture interaction and cooperation in response to complex and pervasive issues. Kooiman and Bavinck (2005) define it as:

> *'… the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them'* (emphasis mine).

This definition identifies what Kooiman (1999, 2003; 2005) terms the three 'orders' of governance, which can structure a discussion on interactive governance.

First order governance

'First order' governance describes the *interactions* between two or more societal actors or groups, 'to solve problems and create opportunities,' relative to a specific issue. It is the through interaction that actors collectively (rather than individually) 'balance problems, opportunities, solutions and strategies' in making decisions and putting these decisions into action.[38] Interactions help bridge the gaps between the 'soft' filters through which individual actors perceive the world, the collective knowledge filter by which society perceives the world, and the ontologically 'real' world 'out there' (Amin & Hausner, 1997). Interaction can therefore be understood as the 'core' of governance, and it is not limited to dialogue.[39] Interaction can take a plethora of meanings: from legal or political

[38] Kooiman defines the 'three elements of governance' which describe intentional interactions for addressing societal issues: (i) collectively define an issue and their common objectives, (ii) design tools for achieving their objectives, and (iii) put these tools into action.

[39] Within this thesis, the term 'dialogue' will be often used to describe the *two-way communication* between stakeholders toward collective decision-making and action, with justification provided at the end of Section 4.2. While other terms could equally be substituted such as 'deliberation,' 'discourse' or 'negotiation,' the

influence, to resourcing, to education, to exchange within the marketplace for instance; to borrow from network theorists (Wellman, 1991), interactions are ‘flows of information, resources and power.’ Interactions can also range in formality; from spontaneous conversation around a kitchen table, to the semi-formal discussion within a public meeting, to the most formal, juridical debates within a court-room, or parliament chamber. However in all cases, interactions are deemed to be ‘mutually-influencing’ between stakeholders; dialogue allows them to negotiate ‘common interests’ in terms of their private values and interests, share their knowledge and intuition, be creative, exert their power, reach decisions and coordinate action (Gibbs, 2008; Jentoft, 2005; Kooiman, 2003; Kooiman & Bavinck, 2005).

Second order governance

‘Second order governance’ refers to the multitude of *institutional* settings which structure interaction ‘to solve problems, and create opportunities;’ decision-making is embedded within its institutional context. Institutions are social constructs that both enable and constrain interaction between actors, by defining a ‘logic of appropriateness’ in terms of rules, rights, roles and responsibilities, and symbolising the system-to-be-governed in particular ways. This enables actors to know what is expected of them, and what form decision-making will take (Jentoft, 2005). Institutions may range from government departments, to laws, to cultures, habits or social norms for instance. To take the example of the ‘market-place,’ it very specifically structures the way actors, particularly from the private sector, interact with the environment and each other. This differs significantly from the interaction and decision-making within the court-room, where state stakeholders may be predominant. Alternatively, a cultural institution or custom may attach spiritual meaning to certain actions or interactions. Importantly, while institutions shape interaction and the interests of those interacting, they are simultaneously shaped by these interactions. Glavovic (2008a) thus argues that institutions must adapt with society in order to be seen as relevant and legitimate by those actors interacting within them. Institutions thus provide for learning and building trust across perceptions of reality (Jentoft, 2005). Nowhere is this more evident than in the market, which is fundamentally shaped by the agglomerated character of individual exchanges. Stakeholders are continuously reconstructing their institutions; therefore institutions are themselves a product of their history.

For Kooiman, second-order governing is concerned with the ‘design, maintenance and renewal’ of institutions that are able to cope with the diversity, dynamics and complexity of the system-to-be-governed, and coordinate the multiple governance responses occurring simultaneously across multiple institutions. This necessitates a diverse mix of institutions, because each type of institution provides ‘strength’ in a particular facet of governance. Governance will comprise a melange of different 'modes,' including: (i) hierarchal state-centred 'management' institutions; (ii) self-governance settings whereby individuals take care of themselves outside of the purview of the state; and (iii) collaborative settings that 'bridge' disparate institutions, encourage interaction across the full spectrum of stakeholders and provide integration to society's governance response. One such conscious expression for linking actors and institutions is through decision-making processes. "Thinking about governance in a process perspective is important because governance is not so much about [institutional] structures, but more about interactions among structures" (Pierre & Peters, 2000, p. 22). Governance writers have emphasised the importance of procedural rationality, with the state as facilitator 'steering' the process through many institutional settings (Amin & Hausner, 1997; Kooiman & Bavinck, 2005; Pierre & Peters, 2000).

Third order governance

The third order of governance is termed 'meta-governance' by Kooiman, and is aimed at the broad '*principles'* which form the normative framework in which institutions and interactions take place. Such principles, or criteria, are "the mortar to keep the construction together" (Kooiman, 1999, p. 87); they provide a common thread linking otherwise distinct institutions. By sharing a common regard for meta-principles collectively agreed to by a community, the multitude of societal decisions can be considered 'collective,' rather than fragmented and isolationist. These principles thus determine the quality of institutions, and ultimately interactions, for coastal governance. Ideally such principles transcend all institutions, and are equally applicable in steering decision-making within a fishing club setting, as in a public debate, as in a formal planning tribunal. For Kooiman (1999), such principles combine the analytical and normative aspects of governance; and may therefore include principles of rationality and efficiency, alongside principles of participation and reciprocity for instance. Of course, like institutions, these principles too evolve over time, and are reconstructed according to interactions.

By extending governance beyond government, society's 'collective' decisions and responses to pervasive issues becomes the totality of <u>all</u> interactions, within and across all institutional settings (Kooiman & Bavinck, 2005). Rather than gathering all stakeholders to a notional decision-making table, 'collective decision-making' is the sum of all decisions made simultaneously, by various configurations of stakeholders, within multiple institutional settings, according to different principles or imperatives. To the extent that such devolved decision-making can be considered 'collective,' governance encourages the collective formulation of 'meta-principles' that permeate all institutions; coordinating and harmonising the otherwise fragmented and independent responses according to a common thread. Governance thus rebuilds institutions to nurture interactions and decision-making *according* to common principles, *toward* common objectives. At the same time, governance promotes the design of new institutions in a collaborative mode, which encourage interaction between all categories of stakeholders across institutional boundaries. Therefore we can consider that within the *'context'* of complex system-to-be-governed, the *'ends'* of the governing system are to arrive at collective decision-making through quality interactions, according to the *'means'* presented by institutions and decision-making process, shaped by meta-principles of quality.

4.3 Visualising interactive governance

Figure 3 (below) depicts the complexity within a governing system as visualised according to the 'three orders' of the interactive governance model. It demonstrates the many diverse interactions and decisions of actors within and across the notional boundaries of multiple 'institutions,' which are nested in a governing system. At the same time, Figure 3 displays the way in which certain 'meta-governance' principles that have become embedded in society, such as 'scientific rationality' or 'democracy,' can permeate a governing system and shape these multiple institutions; acting as a glue to consolidate otherwise fragmented settings. This Figure allows comment on the reciprocal interplay between the three orders of governance. The interactions between actors are largely determined by institutions, but also act to rebuild these institutions bottom-up over time. Furthermore institutions are constructed top-down using the 'cement' of meta-principles, though drawing their boundary as permeable, this Figure shows a two-way flow of influence between the principles of a governing system and institutions, which can themselves foster new norms or principles which shape society's institutions. The model of interactive governance therefore describes at once the diffusion of society's collective decision-making, and its consolidation according to a network of stakeholders and pervasive principles. It also describes the adaptation of the governing system both according to the bottom-up influence of interacting actors, and the top-down influence of influential meta-principles.

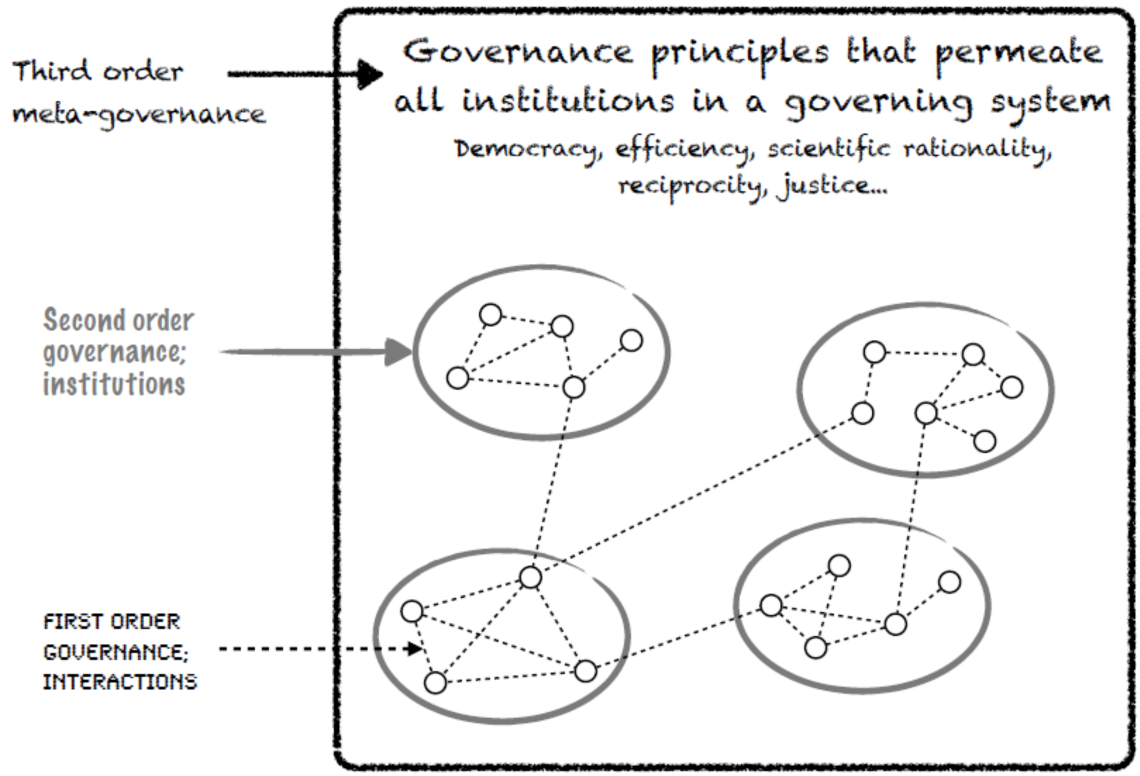

Figure 3: Visualising Interactive Governance; three orders of governance within a governing system

Another way of visualising interactive governance is via symbolism, using the simile of a community as a house. If we are to imagine that the whole of a community lives in one enormous house, then we can consider that each room in that house represents a different institutional setting. As members of the community move throughout this house, the way in which they interact with each other is determined by the room that they are in, and indeed some rooms may only admit some select actors. For instance, if we imagine one room to represent a tribunal setting, then this room will only admit some select experts and will direct their interaction according to the strict rules set by the court; i.e. each actor must direct any interaction through an arbiter figure. By contrast, we can imagine another room to represent a café setting, which equally admits all actors and has much less strict controls on interaction. Nonetheless, there will be some institutional forces that shape interaction, which may primarily be social norms. For instance, in this room actors may feel obliged to queue at the counter, or alternatively, sit at a table and wait to be served. A third room can be represented by a sports club. This room does limit who is admitted to 'members only,' though often anyone is able to join. Within the sports club interaction is dictated by some conventions, usually set by the members themselves and surrounding sporting fixtures, perhaps framed by norms of ‘sportsmanship.’ Not to labour the point, but a fourth room could represent the setting within an actor’s home. While many people may think of their home as free of any ‘controls,’ there are of course different expectations on family life which differ from house to house; while some families kiss on the mouth, others find that abhorrent. By visualising institutional settings as rooms, an institution represents more than just the bricks and mortar that house them; they are a space wherein specific actors are allowed and specific interaction is permitted according to a specific set of controls. In this way, we can extend notions of institutions to almost any socially constructed setting where actors interact.

Finally, to continue the simile, we can imagine that this enormous house is governed by some ‘house rules,’ which pervade all rooms; what can be called meta-principles. If we take the principle of ‘equality’ for example, we can imagine that equality is given some effect in all of our rooms. For instance, within the tribunal all actors will be ‘equal under the law.’ In the café, all actors will have equal right to service and in the sports club all actors will have the equal right to join.

4.4 Interactive governance as multi-scale governance

One significant paradigm-shift across fields of governance, including interactive governance, has been the move from strongly-centralised government according to a vertical hierarchy, to a devolution of power to the local scale as the most ‘appropriate’ level for political organisation, with an increasingly ‘horizontal’ focus on governance networks (Pierre & Peters, 2000). Decentralisation is based on the premise that: (i) where local government is closer to its constituents it is more responsive to the people; (ii) local actors are more motivated to participate in changing their local region, (iii) state actors and politicians are more accountable; and (iv) action at the local scale is better able to internalise costs and benefits within the community (Kingsley, 1996). Equally the local scale often allows for governance that is best in keeping with the ecological scale of an issue, and maximises understanding of complex ecological systems; with some like Wilbanks (2006) asserting that most ecological systems are too complex to be understood at anything above the local scale.

However, the major issues facing society are multi-scale in character, and necessitate a multi-scale response. As with ecosystems (See Section 1), so with the systems of governance; complex systems work at different scales, introducing the need for cross-scale governance. Climate change typifies such issues, presenting a ‘call to arms’ for actors from the local level - preparing for localised changes in climate and their effects - to the Intergovernmental Panel on Climate Change, who try to understand the impacts of climate change globally; and how humanity as a whole can adapt. This has inspired governance authors like Haas (2004, as cited in, Lemos & Agrawal, 2006) to depict governance as multi-level but not non-hierarchal, comprising loose horizontal networks of institutions and actors which are information-rich, nested in progressively higher and slower moving governing systems, like Holling's (1995) idea of holons. Interactive governance models similarly endorse notions of multi-scale governance, with different governing systems existing at each scale, and linked via interactions between actors across scale. These notions have seen governing systems mature at all scales, and for example, seen the increased participation of stakeholders that were previously absent at the global scale, such as NGOs and large corporations (Lemos & Agrawal, 2006; Reid, et al., 2006).

4.5 The interactive governance terms used in this thesis

At this point, it is important to pause and clarify the vocabulary that will appear in this thesis by adopting the particular perspective offered by the lens of Interactive Governance. As such, four key terms are listed below together with their attendant meaning in this thesis.

Stakeholder: In this thesis, all actors active within a governing system network are described as 'stakeholders.' This deliberately denotes their role as interested parties relative to a given issue, who feel sufficiently moved to action as to engage in interactions and decision-making with other actors. This is not to assert that there are no other interested actors who may be more passive or less well connected in terms of the governing system network[40] (see Section 4.6 below), only that the interactive governance perspective privileges those stakeholders who have the motivation and the wherewithal to engage in a governance network.

Interaction: The term interaction is discussed very broadly like in the interactive governance literature, as 'any form of mutually influencing interaction between stakeholders.' This all-encompassing term extends beyond dialogue alone to resourcing or political influence for example. Often interactions will be discussed in terms of their 'quality' for arriving at collective decisions within a governing system; labelled 'interactional quality.'[41]

Dialogue: While notions of interaction for governance encompass a plethora of meanings, in this thesis interaction will often be discussed more specifically in terms of 'dialogue.' This reflects the focus of this research on the 'dialogic' mobilisation of knowledge through interaction, which

[40] This can be represented by the 'common man,' 'the man in the street,' or 'Joe Bloggs' for instance, as that individual who has a strong opinion on an issue, but either does not feel motivated to engage in any formal decision-making, does not the way to become more involved in governance, or does not have the means (*viz.* time or money) to become involved. These individuals do not have a role in any formal agencies connected to an issue, nor belong to any clubs or groups that may be involved, and therefore are often sidelined by notions of network governance like interactive governance.

[41] See Chapter 2

necessarily limits the forms of interaction considered to those which enable the social co-construction of knowledge.[42] The term 'dialogue' is used over terms like 'discourse' and 'deliberation' in keeping with the vocabulary from the wide literature on 'dialogic epistemology' engaged in this research.

Institution: In this thesis the term institution will be discussed as 'the social constructs that both enable and constrain interaction between stakeholders,' as used by those writing on interactive governance. Institutions are therefore much more than simply an organisation or establishment, or the buildings that house it.[43] They are the social constructions of our society; spaces within which we pass each day, and interact with other members of our society. Much more than any formalised rules or regulations, they include the frameworks of un-said social norms that determine how society co-exists. In this thesis, the quality of governance is often discussed in terms of the 'quality' of institutions for fostering collective decision-making, or 'institutional quality.'

Principles: Principles are discussed in this thesis in terms of interactive governance meta-principles. They are the underlying, fundamental guiding doctrines or beliefs of society. Principles are broadly defined, and can therefore be interpreted and given equal effect by multiple means. In this thesis, principles are often discussed in terms of the principles of ICM, which are given various effect across different ICM programmes.

4.6 Limitations of the interactive governance model

The model of interactive governance is not a perfect theory by which to discuss society's governance. Though it does present an interesting means of making sense of the complexities of governance, though it arguably can claim to be a more realistic alternative to modernist models of scientific management, and though it can be useful as a means of designing society's governance response, it is not without its flaws. There are four key faults to this lens:

a) The influence of power on governance

Critiques of governance theories note that the efficacy and legitimacy of participatory approaches are compromised where power interests steer interaction. Many governance theories begin from Habermasian ideals of 'communicative rationality;' reconciling rationality and democracy in

[42] Focussing on the mobilisation of knowledge through interaction between plural perspectives necessarily limits the forms of interaction explored to dialogue. It does not make sense to discuss the social co-construction of knowledge through other forms of interaction like resourcing, or lending political influence for instance. This noted, dialogue is not necessarily limited to speech, and can include other forms of discourse via written correspondence for example.

[43] http://dictionary.reference.com/browse/institution

institutions as spaces for 'real' interaction among actors that is (a) 'true;' (b) sincerely meant; and (c) normatively appropriate (Dryzek, 1994; Outhwaite, 1996) (see Appendix B). Habermas therefore promotes deliberative arenas that illuminate, and therefore neutralise, the corruptive influence of power on 'rational' discourse (Outhwaite, 1996). However, while governance models may enable institutional spaces that give a voice to weak stakeholders, it also allows for powerful actors to consolidate their position, and perhaps even further stifle the voices of the weak (Lemos & Agrawal, 2006). The power advantage will go to those who are best able to manipulate an institutional setting and its tools; often meaning the disempowered remain so (Ford, 2003, as cited in, Lemos & Agrawal, 2006). Lemos and Agrawal (2006) argue, for instance, that international corporations have learnt well to influence the emerging global structures, and have reached a position of power where they set their own environmental restraints. As such, there are a number of commentators who follow the philosopher Michel Foucault in arguing against Habermas' 'naïve' assertions that all dialogue aims to be free and seek rational consensus; asserting instead that within dialogue "power is always present" (Flyvbjerg & Richardson, 2002). Moreover, Foucault rejects any notions that a form of *a priori* morality-based theory can be imposed on all actors through institutions, as itself a possible attack on their freedom; the use of power to dissolve power (Flyvbjerg & Richardson, 2002). However, as a point of cross-over with Habermas, Foucault writes that while all discourse creates and reinforces power, it also exposes it; "renders it fragile and makes it possible to thwart it" (Foucault, 1990, as cited in, Flyvbjerg & Richardson, 2002).

To an extent, some governance literature does explicitly recognise the pervasive influence of power within a governing system, and by exposing it seeks to neutralise its ill effects. Hutchcroft (2001), for example makes the distinction between the *authority* attached to networks of actors, and *power*; 'authority' is the formal roles of individuals within institutional structures, while power is the informal means individuals pursue their values. Via this distinction, the governing system network can be pictured in terms of two intertwined networks; one official and openly discussed, the other unofficial and closely guarded. Moreover, by encouraging partnerships between the state, civil society, the private sector, and the scientific community, the interactive governance model explicitly recognises that the power necessary to solve societal issues extends outside the boundaries traditionally drawn by the 'authority' of the state . In this way, these authors concur with Foucault (Flyvbjerg & Richardson, 2002) by describing power as diffused, with no one stakeholder adequately powerful to steer a governance response alone (Kooiman, 2003; Lemos & Agrawal, 2006).

b) *Governance as un-democratic; a failure to account for the 'common man'*

Sorensen and Torfing (2003) criticise the way in which governance models depict the governing system as a network of interactions between actors. They assert that while governance networks can provide an interesting analytical and normative representation to understand and design governance, that there are some democratic limitations inherent in networks. Networks tend to be neither integrative nor aggregative enough; they do not necessarily include all of the stakeholders affected by an issue. The network organisation is fundamentally based on including those who (a) have a demonstrable stake in an issue, (b) possess the wherewithal (in the broadest sense), and (c) have the necessary connections to other influential stakeholders, as to engage in collective decision-making. Indeed, this network is often drawn even tighter to only include those with knowledge, experience or skills crucial to addressing an issue.

The governing system network is thus limited to the select subset of society that are instrumental in making decisions and taking action that compose society's collective response to an issue; but what about other more passive stakeholders, who are less active, possess less resources, or are poorly connected with other important stakeholders, though nonetheless want to have their perspective represented? This raises the problem of exclusion for the non-powerful, with latent democratic problems. The governing system comes to represent only those dynamic and socially active stakeholders, at the expense of the 'common man.' However a counter-argument to this criticism asserts that no initiative can ever include the participation of ALL stakeholders, and that by attempting to dissolve power to *all* individuals increases the likelihood of 'participatory paralysis;' whereby collective decision-making is suspended by inevitable pluralism (McKenna & Cooper, 2006).

c) Failure to include politicians

There is a second group of stakeholders that are poorly accounted for in governance models; elected politicians. By endorsing a participatory democracy model, governance theories argue that true decision-making power is not in the hands of the elected few, but rather distributed across all constituents. In many cases, models of governance describe and advocate the direct interaction between technocrats from the state sphere with members of civil society, the private sector, and scientific community; effectively 'short-circuiting' a connection that used to pass through elected politicians. In this way, politicians lose their central role in collective decision-making, and indeed may find themselves completely isolated from the governing system network; if civil society is making their own decisions according to models of 'co-management' then what use are elected representatives?

However, this assertion ignores that in most contexts a model of representative democracy remains in place, and that incumbent politicians are reluctant to cede their power. Viewing a model of representative democracy, no matter how weak, through a participatory democracy lens may give a distorted image of what is happening within a context. Exploring 'collective decision-making' within a context through the lens of interactive governance affords a weak perspective on the role of politicians in a governing system. As the empirical research later reveals (see Chapter 8), it is rare that politicians step completely outside of the 'network,' and assuming this to be the case forgets the large amount of power that remains at their disposal.

d) The reality of meta-governance principles

Key to the interactive governance model are the meta-governance principles which, as the mortar, act to cement together otherwise fragmented decisions in fragmented institutions. It is by way of these principles (and the creation of some collaborative institutional settings), that we can meaningfully consider the sum of society's decisions as 'collective.' And it is through instituting these principles that many initiatives seek to influence society's governance response. For instance, a programme may seek to improve the 'integration' of governance, increase 'participation,' or make it more 'adaptable.' But what do these principles mean in practice, and are they consistent with interactive governance doctrines of pluralism?

The notion of meta-principles does have significant explanatory power in describing the way that certain ideas, beliefs or doctrines infiltrate society and determine our interactions with others across almost all institutional settings. The danger is that meta-principles are either defined too broadly or too narrowly. By trying to impose some very narrow principles on a governing system, this does not account for the irreducible plurality of society, which will inevitably see disagreement on what kind of specific principle ought to shape our institutions. For example, asking that all institutions should give effect to principles drawn directly from the Holy Bible will inevitably draw debate from the multitude of stakeholders who are of another denomination, or are not religious, and do not see these principles as legitimate outside the setting of the church. This begs the question, to want extent then can there be some meta-principles that are accepted as credible and legitimate by all, in a pluralistic society? On the other hand, in appeasing the diversity inherent in society, we are forced to adopt principles that are so broad as to be devoid of meaning. One commonly discussed principle in this regard is 'sustainability,' which many argue to have become 'all things to all people.' To what degree then can we meaningfully discuss 'integrating' society's diffused decision-making according some common meta-principles, when these will either map a direction unacceptable to many, or be so vague as to provide no direction at all?

5. Conclusion

In sum, the latter half of the 20th century saw a number of challenges to what can broadly be described as the modernist model of environmental management. Across a number of disciplines, scholars and practitioners began to question the ontological, epistemological and methodological foundations of this model, and suggest alternative ways of framing both the 'system to be governed' and the 'governing system.' Through the influence of disciplines like ecology, systems and complexity sciences, the *system to be governed* has been increasingly represented as composing complex and adaptive social-ecological systems. In parallel, the pervasive influence of post-modernism has seen society reconceptualised in terms of irreducible plurality. These two influences have seen the recognition of the significant uncertainties facing resource managers, which extend beyond calculable risk to complete ignorance. At the same time, some of those working in the policy and management 'sciences,' have come to reject the illusion of a *governing system* modelled on a linear and rational process, which transfers scientific inputs into policy outputs. Rather the governing system has been described as a 'soup' of plural actors engaged in negotiations within a high stakes arena.

This is not to say that the 'management' model has been replaced by new models of 'governance;' far from it! Today, across many fields including Integrated Coastal Management for instance, it is possible to see models of management and governance in mutually influential co-existence. Indeed it could confidently be argued that while the past 30 years has seen the increasing popularity of governance models, management models remain dominant in most spheres; presenting the more alluring promise of full-understanding and centralised control, versus governance models' ignorance and diffused inter-dependence.

This thesis will focus on the field of Integrated Coastal Management (ICM) and take as its point of entry into this field, the ontological, epistemological and methodological foundations broadly grouped under the didactic heading of 'environmental governance,' and briefly introduced in this chapter. Particularly, this chapter introduces the model of interactive governance, and asserts in the next chapter that it presents a revealing perspective on the governing system for coastal management.

Finally, in setting the context for this inquiry, this chapter introduces normative and methodological questions on how doctoral research should be undertaken when confronted with a complex model of the coast and its issues, while working within 'modern' scientific boundaries. It raises challenges of doing scientific research on systems that confound normal scientific enquiry. It demands the researcher recognise the 'post-normal' nature of coastal issues and thus wear the hat of a 'post-normal scientist,' while simultaneously trying to reconcile his research with the rigour necessary of doctoral research within an academy still predominantly shaped by a 'normal science' model. This begs the question, what effect does such an internal conflict have on both the researcher and his research project?

Firstly this research must include an explicit recognition of significant uncertainty, much of which will remain in spite of the research. Secondly, this research must respect the irreducible plurality within society, which dissuades from means of aggregating actors interests and perspectives, and is encouraging of more qualitative approaches. Thirdly, the researcher must recognise the impact that their research will have on the system studied. The researcher rejects the notion that this research is an exercise in objective observation in recognition that his own bias will have direct and less direct implications for the research. Directly, the background of the researcher as a middle-class male, with a professional background in coastal planning and as a former member of the Green Party, will construct a lens through which the system studied will be interpreted. Less directly the researcher's bias and persona will invariably impact on the actors studied, influencing the access to respondents and what they divulge. For example, the researcher's background in coastal planning helped give him legitimacy to access local government processes, though may have at the same time proved a barrier to certain actors cautious of technocrats. Moreover, the researcher must recognise that the systems studied represent high political stakes and that the research unavoidably represents itself a political input to this system.

Part II: Conceptual framework: Evaluation and Epistemology for coastal governance

Having situated this thesis within debates on the most appropriate epistemology for models of coastal governance, facing a particular category of problems characterised by uncertainty, plurality and high political stakes, Part II moves on to introduce the conceptual framework that will guide this research. Part II can be described according to two parallel projects. Chapter 2 applies the model of ‘interactive governance’ to Integrated Coastal Management to construct a novel ICM evaluation framework, and structure the discussion on how to promote ‘high quality’ coastal governance. In parallel, Chapter 3 reviews the wider literature on dialogic epistemology for environmental governance, to interrogate the plethora of approaches for mobilising knowledge for governance, and see which may be promising for promoting high quality coastal governance. These two projects will be brought together in Part III when, armed with an appreciation of the context and an enriching conceptual framework, this thesis shifts the focus back to Integrated Coastal Management and engages the debate.

Chapter 2: Conceptualising an evaluation framework for Integrated Coastal Management as 'interactive governance'

1. Introduction

To this point, this study has established itself within the field of Integrated Coastal Management (ICM), and defined its particular point of entry into this field broadly according to the literature on 'environmental governance,' and more specifically in terms of 'interactive governance.' Following contemporary developments in the field;[44] this thesis describes ICM as the interplay between a coastal 'system-to-be-governed' and the 'governing system,' with Chapter 1 having generally examined this perspective. In this chapter, the thesis adopts the lens offered by the model of interactive governance, which has been increasingly influential within ICM (Jentoft, 2007; Jentoft & Chuenpagdee, 2009), and describes what the complexities of ICM may look like through this lens. It goes on to pose the question; if we accept that interactive governance presents a compelling way of describing ICM, then what implications does this have for our ideas of 'quality' or success in ICM, and how do we evaluate this? This chapter seeks to address one of the parallel research questions of this thesis; '*How can the quality of ICM be evaluated relative to criteria of 'interactive governance?'*

Adopting an interactive governance perspective has important implications for how practitioners and scholars alike evaluate the quality of ICM. The evaluation framework we adopt should be consistent with our theoretical and practical framings of ICM. However, a critical reflection on the ICM evaluation literature shows that there has been a tendency to evaluate ICM according to frameworks based broadly in criteria of good 'management,' rather than good 'governance.' To this extent, the success of ICM has been judged according to progress toward society's collectively pursued goals or 'ends,' and the performance of institutional 'means' for facilitating this progress.[45]

[44] See Appendix A and Chapter 1
[45] See Section 3 below

ICM initiatives have thus often employed linear models of 'means' and 'ends' (see Figure 1 and Section 3 below) and long been vexed by problems of causality: how can we link decisions and action within the 'governing system' with outcomes in the 'system-to-be-governed'? More recently, some ICM evaluation frameworks have emerged that employ the language of 'governance,' but could be argued to retain this same general 'management' framework (see e.g. the IOC (2006)). This chapter asserts that a governance perspective introduces whole new norms of evaluation, and in the absence of any appropriate frameworks in ICM, conceptualises its own evaluation framework.

This chapter proposes a novel *ex post* evaluation framework for ICM as interactive governance. Unfortunately, given the interactive governance literature itself does not represent a very sophisticated discussion of evaluation measures; this chapter describes the construction of an evaluation framework from the ground up. It begins by framing ICM according to the foundations of the interactive governance model, and then looks to other parallel fields which utilise capital-based evaluation mechanisms, to assemble an evaluation framework on these foundations. To this extent it draws on the experience of fields including: ecological economics, planning, policy analysis, development studies, and governance of the commons for instance.[46] In short, the resultant framework seeks to evaluate coastal governance capacity according to the parallel measurement of:

(i) the quality of institutions relative to 'meta-principles' of ICM; and

(ii) the quality of stakeholder interactions, relative to stocks of human, social and financial capital.

Section 2 begins by mapping the influences which increasingly represent the coast as complex and diverse, demanding a departure from management models in favour of models of governance. It argues that the 'interactive governance' model offers a particularly compelling way of viewing the complexity of ICM. Section 3 then discusses the implications of an interactive governance perspective for the evaluation of ICM. It begins by exploring the terrain of ICM evaluation, before outlining the advantages of a novel framework based on interactive governance in comparison to those frameworks already established. Section 4 explores how ICM can be evaluated in terms of interactive governance; unpacking a framework for the evaluation of ICM 'governance capacity' according to measures of institutional and interactional quality. Section 5 condenses the discussion in Section 4 into an evaluation framework framed as a series of questions, before Section 6 concludes.

[46] See Appendix C: Evaluating interaction via a 'capitals framework'

2. Integrated Coastal Management as interactive governance

As noted, the September 2002 World Summit on Sustainable Development in Johannesburg, recognised two significant intellectual developments within ICM; (i) that the coastal context is framed as a complex, humans-in-nature ecosystem; and (ii) that society's management response is framed in terms of 'governance.' To use governance terminology, this has seen the reconceptualization of the coastal *'system-to-be-governed'* and the *'governing system'* (Jentoft, 2007; Jentoft & Chuenpagdee, 2009).

2.1 The complex coastal 'system-to-be-governed'

Vallega (1997) describes how the evolution of ICM since the 1970's has brought increased recognition of the complexity and uncertainty inherent within a coastal system-to-be-governed.[47] Costanza and others (1997; 1995) have done much to bring attention to the unique nature of coastal ecosystems, while Gibbs and Cole (2008) have described coastal ecosystems as exhibiting the characteristics of 'complex adaptive systems.' From this perspective, the coast can be described as a complex 'open' system, which is diverse and dynamic; self-organising and adaptable. This means many of the coast's ecological properties or patterns are discernable only though a holistic ecosystem-based perspective across different scales, rather than examining the constituent parts of the system individually (Chua, 1993; International Oceanographic Commission, 2006). Moreover, as authors like Jentoft (2007; 2009), MacFadden (2007) and Turner (2000) assert, the coastal context needs to be understood as a 'humans-in-nature' or 'social-ecological system;' described in terms of tightly interwoven social and ecological systems interacting in novel and unpredictable ways. ICM must attempt to assemble sophisticated knowledge on the interplay between these two intertwined 'categories' of system in order to make sound decisions. Clark (1998) notes that the multiplicity of perspectives and diverse activities of coastal stakeholders, adds another layer of 'emergent' complexity. As a result, Cicin-Sain and Knecht (1998) argue that most meaningful coastal issues are characterised by significant uncertainty, which makes accurate prediction of future outcomes difficult if not impossible; and hinder efficient 'management.'

Together with emerging notions of a complex social-ecological coastal system, the 1980's saw coastal management subject to the pervasive influence of 'post-modernism,' which permeated many fields of resource management (Vallega, 1997). These influences spurred ICM practitioners and scholars to reflect on how we come to '*know'* the coastal system-to-be-governed, and turn to alternative, inclusive epistemologies that recognise the existence of a plurality of valid perspectives. Traditions have emerged in ICM which challenge the ability of reductionist science to provide an

[47] See Chapter 1 for a fuller account of the literature on complexity

objective and universal version of reality; instead extending legitimacy to a wider spectrum of knowledge, including local and indigenous knowledge systems for example (see e.g. Costanza *et al* (1999), Clark (1998), IOC (2006), Stojanovic, Ballinger and Lalwani (2004), and Tobey and Volk (2002)). By accepting that there may be multiple valid though disparate perspectives on a complex issue, the argument follows that to gain a more complete picture of the coast requires dialogue across as diverse perspectives as possible; what Vallega (1997) termed a shift 'from a disjunctive approach to a conjunctive approach.' Democratising the 'science-policy interface' means knowledge is negotiated between stakeholders, spurring collective 'social learning' toward a greater common understanding of the issues.

Equally, the post-modern influence saw ICM question the idea of a 'common' public interest, and embrace as fundamental the plurality of incommensurable *values* within coastal communities. ICM therefore espouses democracy in the participatory mode; seeking to provide all stakeholders with direct access to the proverbial decision-making table, rather than having their values collected, aggregated, and weighed as per the tenets of representative democracy. It encourages a participatory modality within which a community's values are negotiated and a collective decision arrived at; lending the decision-making process democratic legitimacy (see e.g. Christie (2005), Cicin-Sain and Knecht (1998), Glavovic (2006) and McCreary *et al.* (2001)). Meaningful participation is thus viewed as a significant factor in the long-term success of an ICM initiative. Increased participation has been found to give stakeholders greater ownership of a coastal management initiative, thereby both improving its implementation, and its sustainability after the initial enthusiasm (and funding) subsides (Christie, 2005; Tobey & Volk, 2002). Such participation has been expressed with a long ICM tradition of partnership through co-management and conflict resolution for instance (Clark, 1998; McCreary et al., 2001).

2.2 ICM within a 'governing system'

In recognition of a complex, plural and uncertain coastal 'system-to-be-governed,' ICM authors have increasingly promoted models of a similarly complex and plural 'governance' response (Bille, 2007, 2008; Christie, 2005; Chua, 1993; McFadden, 2007; McKenna & Cooper, 2006; Olsen, 2003b; Stojanovic & Barker, 2008; Tobey & Volk, 2002). In this regard, a number of governance perspectives have been put forward for framing coastal management; including models of 'Adaptive Governance' (Adger, 2000; Gibbs, 2009), 'Governance of the Commons' (Dietz, Ostrom, & Stern, 2003), 'Good Governance' (McKenna, Cooper, & O'Hagan, 2008), and 'Interactive Governance' (Glavovic, 2008a). Despite this diversity of governance perspectives, they do share a number of common themes and motivations, echoing those listed in Chapter 1 (Table 1). Particularly within

ICM, models of governance have been promoted as more participatory and collaborative 'governance-beyond-government' according to four common imperatives in the ICM literature:

(a) *normatively*, it allows for democratically legitimate collective decisions, with the recognition and deliberation of all values within a coastal community (Chua, 1993; Cicin-Sain & Knecht, 1998; Clark, 1998);
(b) *social learning* is enabled across all coastal stakeholders, building competency for deliberation and decision-making (Fletcher, Potts & Ballinger, 2008; Turner et al., 1998);
(c) *substantively*, it allows for negotiation between different knowledge systems to build a more complete vision of complex coastal issues (Costanza, et al., 1999; Stojanovic, et al., 2004); and
(d) *instrumentally*, it improves the ownership of coastal management initiatives, thereby improving implementation and sustainability (Christie, 2005; Tobey & Volk, 2002).

Beyond promoting participation and collaboration, governance perspectives accompany a growing humility among most ICM authors (see e.g. Bille (2007, 2008), McFadden (2007), Olsen, Page and Ochoa (2009), Stojanovic and Barker (2008)); recognising that ICM initiatives represent one small intervention within a complex 'de facto' governing system, shaped by a long history of socio-economic and political influences.[48] The modernist 'myth' of the omnipotent coastal manager (Bille, 2008), has been replaced with an idea of coastal management constituting a complex network of interactions and partnerships between plural stakeholders (Stojanovic & Barker, 2008); many of which are informal and beyond the remit of an ICM initiative.

2.3 ICM through the 'interactive governance' lens

This thesis argues that the governance lens offered by interactive governance presents a particularly compelling way of viewing the complexities of ICM within a coastal 'governing system.' Interactive governance and its vocabulary were interrogated in Chapter 1, suffice to ask here to what degree does this model help to conceptualise the coastal governing system, design ICM initiatives, and evaluate the quality of these initiatives?

Coastal management as interaction between actors

The coastal marine area is well described in terms of social interaction. The coast represents the primary habitat for humanity, and is anticipated to be home to 75% of the world's population by 2025. The coast is therefore characterised as an area of intensive co-habitation, with an inevitably high degree of interaction between coastal actors. In sharing the limited 10% of the world's

[48] See also Chapter 1 for a more full discussion of the common imperatives across the governance literature

habitable space along the coast, few inhabitants can live in isolation; interaction and a degree of cooperation seem to be necessary corollaries of co-habitation. Furthermore, as a result of the natural riches of the coastal marine area and this agglomeration of humanity, the coast is also a zone of intensive economic development and competition. Unique to the coast, much of this competition unfolds in the public sphere, as many coastal resources are owned in 'common.' Resource allocation is thus negotiated as a 'social choice,' rather than according to the individualistic decisions of the market; emphasising interactions for collective decisions.

Those writing on governance as interaction describe interaction as the social action which unlocks the potential within individuals (Amin & Hausner, 1997; Jentoft, 2005; Kooiman, 2003). Interaction makes explicit the knowledge and experience 'tacit' within coastal actors, it allows them to negotiate the community values on the coast in terms of their own values, and it taps into their creativity. Indeed, to borrow from the ideas of 'social constructivism,' interactions within a social setting significantly shape the 'social reality' of the coast; such that the coast is at least as much a construction of its social processes as it is of natural processes.

Coastal management as devolved across many institutions

The governance of the coast is equally well described as devolved decision-making and action across multiple, disparate institutional settings. By accepting the plurality of coastal inhabitants, and the multiplicity of economic activities that co-exist on the coast, we accept the coast as comprising many institutional settings; enabling countless different forms of interaction between coastal stakeholders, and between society and the coast. Rather than centralised collective decision-making in a single state-centred institution, it is more realistic to see the fate of the coast as being continuously shaped, by all coastal stakeholders simultaneously, through interactions, decisions and actions in a multitude of institutional settings.

Significant plurality in coastal communities does call into question the possibility of having some over-arching meta-principles; however if we unpack what these principles (norms and cultures) might be we can appreciate how they may find common recognition across institutions in a coastal context. For example, we can identify some cultures where participatory democracy is deeply seated in their conception of society, while others may have long accepted a system of representative democracy, and be suspicious of citizen participation. Thus in the former case we could assert that participatory democracy pervades their institutions. Other principles that could realistically permeate coastal governance, across all different institutions, could be adaptation to a changing coastline, or precaution in the face of potential sea-level rise.

Interactive governance as influential in the development of ICM

This combined picture of coastal management as fragmentation and interdependence, coupled with the notion of some shared principles of guiding importance, has seen the interactive governance model (or similar) become increasingly influential in framing ICM within the literature (R. Chuenpagdee, et al., 2008; Gibbs, 2008; Glavovic, 2008a; Jentoft, 2007; Jentoft & Chuenpagdee, 2009; Mahon, et al., 2008; McFadden, 2007; Peel & Lloyd, 2008; Stojanovic & Barker, 2008).

Seeing ICM through the interactive governance lens

Employing an interactive governance perspective allows a unique perspective of ICM in a governing system; focusing on certain components of ICM, sympathetic to certain principles and methods, and with certain measures of quality. So how does ICM look through an interactive governance lens, with reference to the ICM literature?[49] For a growing number of authors (Bille (2007, 2008), McFadden (McFadden, 2007), Olsen, Page and Ochoa (2009), Stojanovic and Barker (2008)), ICM initiatives represent one intervention within a multi-faceted *de facto* 'governing system;' accepting that in response to coastal issues there are many responses occurring simultaneously, within a multiplicity of institutional settings, with various configurations of stakeholders. Importantly, society's multiple responses to coastal issues do not, and cannot, occur in isolation; with this a central concern of ICM (Cicin-Sain & Knecht, 1998; Vallega, 1997). ICM scholarship, through authors like Cicin-Sain and Knecht (1998), Stojanovic, Ballinger and Lalwani (2004) and Vallega (1997), has long recognised the need to coordinate and harmonise the fragmented responses of society, and has stimulated integration across institutional settings through ICM initiatives; essentially through stakeholder interaction.

ICM initiatives can, in this way, be seen as the application of some internationally accepted *meta-principles* of ICM best practice, to construct contingent *institutions* within a specific coastal context. These institutions are broadly designed to facilitate *interactions* between coastal stakeholders for collective decision-making, toward some set of community-defined objectives, such as 'sustainable coastal development.' So viewed, an ICM initiative is concerned with the enhancement of existing institutions within a governing system and the construction of new institutions, such that collective decision-making shares a common regard for ICM meta-principles, toward community-defined objectives. New institution settings, whether a participatory decision-making process or a deliberative forum for example, are designed to be inclusive of all stakeholders and build interactive

[49] Here this chapter takes a description of ICM from the literature, and reframes the discussion of ICM according to the headings of interactive governance. Thus the authors cited below may not have espoused an interactive governance perspective on ICM, but their ideas, and descriptions of ICM have been appropriated in the service of seeing ICM as interactive governance.

connectivity between stakeholders to bridge different institutional settings and co-ordinate otherwise fragmented decision-making (see e.g. Bennett *et al* (2005) and Berkes *et al* (2001)). At the same time, these new settings are designed to facilitate 'high quality' interaction, with coastal managers acting as facilitators for interaction (Cicin-Sain & Knecht, 1998; Stojanovic, et al., 2004; Vallega, 1997). The totality of interactions both within and across various institutional settings constitutes the totality of society's 'collective' interaction and decision-making for the coast.

Extending this perspective of ICM as interactive governance, we can see how the field of ICM has reflexively assembled the wealth of experience from evaluating ICM initiatives to encourage practice-based learning of 'success principles,' or 'meta-governance principles.' (see e.g. Cicin-Sain and Knecht (1998), Tobey and Volk (2002), and Lowry (2002)). Such principles represent the foundations of ICM; they are the 'mortar' that bind coastal management institutions, and have demonstrated general applicability across diverse coastal contexts. One robust list of ICM principles has been published by Stojanovic, Ballinger, and Lalwani (2004) (Table 3 below), and used as a starting point in analysing the success of coastal management institutions (see e.g. Glavovic (2006)). This noted, ICM has long emphasised the 'contingent' nature of ICM initiatives, and encouraged initiatives to arrive at their own context-specific 'meta-governance principles.' It is important to think about ICM principles purely as a 'point of departure.'

Table 3: Principles of ICM (Stojanovic, Ballinger and Lalwani, 2004)

1) Contingent: ICM initiatives tailored to local diversity;
2) Comprehensive: at a scale determined by ecosystem boundaries;
3) Long-term: at timescales pertinent to the ecological context;
4) Participatory: epitomised by co-management;
5) Cooperative: inter-sectoral (horizontal) and inter-hierarchal (vertical);
6) Precautionary: proceeding in a risk-adverse manner;
7) Strategic: issues are prioritised for action;
8) Incremental: ICM as an iterative and interactive process;
9) Adaptable: flexible decision-making ready for 'surprise;'

2.4 Matching ICM evaluation to an interactive governance perspective

Adopting an interactive governance perspective has important implications for how practitioners and scholars alike evaluate the quality of ICM; it is important that evaluation frameworks are complimentary to the theoretical and practical framings of ICM. As a reflexive field, ICM has for the past five decades evolved according to the interplay between theory and practice, or 'learning-by-doing,' such that evaluation and adaptation remain central to the entire enterprise.[50] As noted in the introductory chapter, ICM can be described as an exercise in 'action research,' with evaluation inalienable from practice or theory-building. It is therefore important that we continually redefine evaluation frameworks to suit our emerging perspectives on ICM; if we are to discuss ICM as governance, then we need frameworks that measure ICM as governance to allow for the exploration and evolution of this perspective. This is important too because where an evaluation framework is not in-sync with the model of ICM employed, then the success or failure of ICM will inevitably be mis-read. If we evaluate the quality of an apple according to the criteria of an orange, the apple will inevitably perform poorly, even if it is a fantastic specimen of an apple. Likewise, if we employ an ICM evaluation framework derived from criteria of good 'management' to evaluate a project framed as 'interactive governance,' then the project will likely be deemed a failure, despite potentially successful outcomes. If we contend that models of environmental management and governance are fundamentally different, then it must follow that each model should be evaluated according to its own measures of quality. Finally, adopting an evaluation framework that matches an 'interactive governance' perspective on ICM is particularly important for this thesis. Given the main aim of this thesis is to explore how framing the science-policy interface according to the epistemological perspective of 'post-normal science' can contribute to high quality coastal governance, this study must first define concrete and relevant measures of governance 'quality.'[51]

If we accept then that interactive governance presents a compelling way of describing ICM, and that it is important to have an evaluation framework that is in keeping with this perspective, to what extent have governance-based frameworks found expression within the ICM evaluation literature?

3. Evaluating ICM, and the implications of a governance perspective

Having presented interactive governance as a compelling perspective on ICM, this section reviews the ICM evaluation literature to see to what degree evaluation frameworks reflect a shift towards coastal governance in the ICM field, and suggest why this may be desirable.

[50] See Appendix A and the Introduction

[51] As noted in the Introduction, this thesis makes use of the term 'quality' in terms of evaluating the worth of ICM initiatives. This is deliberate because the 'quality' of something - whether it be an ICM initiative, knowledge, or a sewing machine – can be broadly defined according to a set of criteria that are agreed to, with no limit on what form these criteria may take. Thus by using the term quality, this chapter deliberately opens the evaluation of ICM to any and all criteria deemed relevant. In this way, the chapter deliberately avoids terms like 'successful,' 'effective' or 'efficient,' which in many ways presuppose the way in which we evaluate ICM. The term 'success' for instance implies instrumentally rational goal attainment, whereas the terms efficient or effective could be argued themselves, to be two of a set of possible evaluation criteria. Therefore quality is a neutral term that accommodates a plurality of norms of evaluation.

3.1 The current terrain of ICM evaluation

Evaluation has always been a central concern of ICM. As noted by a number of authors (see e.g. Chua (1993) and the International Oceanographic Commission (2006)), monitoring and evaluation are integral components of an ICM initiative, for at least three key reasons:

a) Accountability – to justify the political support and expenditure on coastal management;
b) Adaptive management – so that management can continually adapt to the changing issues;
c) Establish causality – to link ICM initiatives with improved collective-decision-making and environmental outcomes, and in parallel, build on the scholarship of ICM.

The evaluation of ICM initiatives has, yet, been lamented as one of the most neglected aspects of ICM (Tobey & Volk, 2002), not least because of the political nature of evaluation. Cicin-Sain and Knecht (1998) note the reluctance of those initiating ICM initiatives to include evaluation mechanisms for fear that they may be politically destabilising for an initiative in its early stages. This is especially true of evaluating the environmental outcomes 'on the ground,' as these are very often shaped by forces outside of the control of an ICM initiative, and indeed if measured prematurely, may show poor progress (Tobey & Volk, 2002). For these reasons, coastal managers have in the past been pressured into using vague or immeasurable ICM objectives, restricting evaluation to the efficacy of the initiative itself, or indeed skipping formal evaluation altogether to rely on anecdotes (Olsen, Tobey, & Kerr, 1997). Since then, a number of authors have written on *ex post* ICM evaluation methods; providing multiple lists of indicators to guide coastal managers (Bille, 2007; Burbridge, 1997; Ehler, 2003; Henocque, 2003; International Oceanographic Commission, 2006; Olsen, 2003a; Pickaver, Gilbert, & Breton, 2004).

There has been significant debate on exactly which part of an ICM initiative should be evaluated; the 'means' or the 'ends' (Stojanovic, et al., 2004). In terms of 'means,' much ICM literature has focussed on the evaluation of institutions and their necessary human, financial and technical resources; what could be described in terms of '*institutional quality*.' There are numerous frameworks evaluating the existence of ideal-type institutions, which ICM experience has shown are successful in giving effect to ICM principles, and in progressing coastal communities to their goals (see e.g. the IOC (2006), Olsen (2003a), and Pickaver *et al* (2004)). However, evaluating institutional quality alone has the danger of being an insular focus on the initiative rather than the coastal locality that is the subject of the initiative. An ICM initiative may be judged to be 'high quality' according to its own measures, without affecting the desired change within a coastal context (Bille, 2007). As such, some ICM authors have promoted the joint evaluation of 'ends' as those ecological-social-economic outcomes (here jointly termed '*environmental outcomes*') that stakeholders within a certain context have collectively deemed desirable; the attainment of a particular community's goals (see the Logical Framework proposed by Ehler (2003)). Generally, these environmental outcomes are defined contingent to the specific coastal context, but some authors have offered 'generic' lists of indicators for environmental outcomes, for water quality for instance, or ecological resilience (see the indicators offered by the Ehler (2003) and IOC (2006)). Problematically, environmental outcomes within the system-to-be-governed are likely to be continually in a state of flux, and may be influenced by any number of variables; many outside of the control of an ICM initiative.

The crux of the problem is causality; while it is relatively easy to evaluate institutional means, it is far more difficult to measure how institutional mechanisms influence environmental outcomes as ends (Stojanovic, et al., 2004). The linking of environmental outcomes to an ICM initiative can be nearly impossible because: (i) causality is difficult to establish within complex and often poorly understood coastal zones; (ii) environmental outcomes emerge over a long timeframe; (iii) there is often a lack of agreed indicators, with the relevance of indicators changing; (iv) there is often a lack of a scientific baseline; and (v) policy is often divorced from science anyway (Bille, 2007; McFadden, 2007; R. K. Turner, 2000). Consequently, there have been attempts to establish causality between institutional quality, positive changes within the governing system, and environmental outcomes within the system-to-be-governed (Olsen, 2003a).

3.2 Causal models: linking ICM initiatives to environmental outcomes

A number of ICM authors have developed evaluation models to demonstrate the causality between ICM initiatives and desired environmental outcomes, though Olsen's (Olsen, 2002, 2003a; Olsen, et al., 2009; Olsen, et al., 1997) 'Four Orders of Outcome' framework (see Figure 4) provides useful insights. This simple heuristic depicts a sequence of outcomes, from the instigation of an ICM initiative to the realisation of sustainable development, with the achievement of outcomes at one 'order' allowing progression to the next. 'First-order' outcomes are described as the 'enabling conditions' for an initiative, and extend to: (i) institutional capacity, (ii) a core group of supportive and well-informed stakeholders; (iii) formal governmental support; and (iv) a set of unambiguous goals. The evaluation of first-order outcomes has been recently detailed by Olsen, Page and Ochoa (2009), though they could be similarly evaluated by the full cadre of ICM evaluation frameworks (see Section 3.3).

'Second-order' outcomes are evidence of the successful implementation of an ICM initiative relative to 'behavioural change.' That is; change in the behaviour of institutions to become more collaborative, change in the behaviour of coastal resource users to cease destructive practices and collaborate on coastal conservation, and changes in investment patterns to strengthen institutional capacity. The evaluation of second-order outcomes has traditionally been neglected within ICM practice and research, perhaps because of a perceived esotericism of the required indicators? 'Third-order' outcomes include the attainment of those measurable environmental outcomes such as improved environmental quality, and socio-economic wellbeing, set for an ICM initiative. 'Fourth-order' outcomes are the desired end-states of an ICM project; in this heuristic summarised as sustainable development. Evaluation of the success of an ICM initiative can therefore be measured in terms of its ability to achieve outcomes at three discernible steps en-route to sustainable development. The timeline in Figure 4 is best described as logarithmic, meaning an ICM initiative can be evaluated relative to its first-order outcomes almost immediately, but may need to wait decades to realise third-order outcomes. Second-order outcomes may provide an effective way-point to indicate a degree of positive causality between these two.

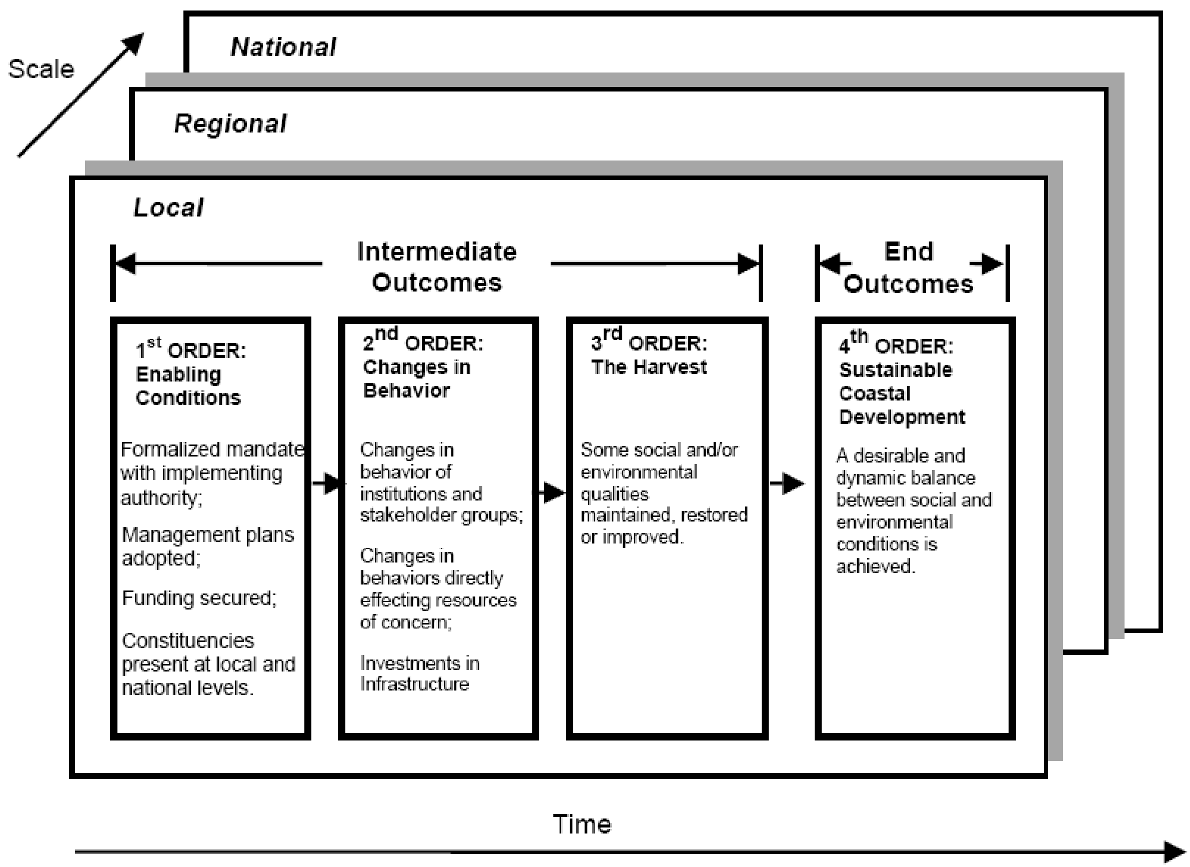

Figure 4: The Four Orders of Coastal Governance Outcomes (Olsen, 2003)

Olsen's heuristic is not beyond criticism. One criticism is of representing 'Sustainable Development' as an end-point in equilibrium, while the reality is that a complex and dynamic coastal system will rarely rest in one equilibrium, nor will a societal goal ever remain fixed at one point. A second criticism relates to its rigid and linear structuration of what in reality is a much more 'organic' process. The hard borders around the different orders of outcomes are in fact far more blurred, with a mingling of first-, second- and third-order outcomes. Moreover, the uni-directional progression from 'means' to 'ends' within the diagram does not allow for any regress, which Glavovic (2006) for example has shown can occur within all politically-charged governing systems. Given an interactive governance perspective, it may be more appropriate to describe means and ends themselves in continuous, and mutually influencing interaction; means, defining ends, defining means, defining ends?

There are a number of different causal models apart from Olsen's though none are faultless. The Driving Forces-Pressure-State-Impact-Response (DPSIR) model maps humanity's 'response' to changing 'states' in the environment, and could thus be described as reactive (International Oceanographic Commission, 2006). Moreover, the DPSIR model does not provide any transparency in terms of unpacking the 'response' of society, including any appreciation for how a response creates institutions, or builds capacity for collective decision-making. The term 'response' is so broad as to be meaningless. Alternatively the 'Logical Framework,' as utilised by Ehler (2003) for example, attempts to demonstrate causality by evaluating four different complementary factors; the inputs into a decision-making process, the process itself, the outputs of the process, and the environmental outcomes. The utility of this framework is again limited by its linear and instrumental construction, whereby inputs are converted into outputs and hence outcomes, even if the process itself is defined as cyclic. A second limitation of this framework is the giant 'leap of faith' whereby policy outputs are deemed to produce environmental outcomes, without any appreciation for the intermediate effect; how these institutions influence coastal stakeholders collectively making decisions that will affect environmental outcomes.

3.3 Evaluating ICM institutions

Having made the distinction between evaluating coastal management institutions [52] within the 'governing system,' and environmental outcomes[53] in the 'system to be governed,' the majority of ICM evaluation has focussed evaluation on the ICM initiative itself; the 'institutional quality.'[54] If for the purposes of this discussion we continue to view ICM through the lens of interactive governance then we can discuss institutions in the broad sense, as the social constructs that both enable and

[52] What could similarly be described in terms of 'means' or 'first order' outcomes
[53] What could be similarly described as the pursued 'ends' or 'third order' outcomes
[54] In large part, this reflects the contingent nature of environmental outcomes, which are set specific to a given coastal community, and therefore preclude any prescription of generic indicators. On the other hand, lessons about institutional principles and mechanisms have been assembled over many decades of practice, such that they have a more general applicability.

constrain interaction between stakeholders. Moreover we can discuss institutional quality as a function of their ability to give effect to certain ICM 'meta-principles' in facilitating collective decision-making and action toward the community goals for the coast. With this classification in mind, the ICM literature is replete with evaluation frameworks measuring the progress of institutions toward achieving the principles of ICM. These frameworks include indicators, based in the reflexive learning of ICM, of institutional factors that have proven enabling in achieving such principles. Echoing the 'logical framework,' most frameworks include indicators of inputs, processes, outputs and outcomes; thereby including an appreciation for both (i) quality institutions and (ii) the institutional capacities necessary to support them (what could be considered indicators of 'enabling conditions') (International Oceanographic Commission, 2006). Importantly, institutional indicators are particular parameters used to simplify in order to qualify changes in the complex governing system, and communicate them. Indicators are therefore not prescriptive steps so much as they are an 'indication' that the institutions of a governing system may espouse the principles of ICM (International Oceanographic Commission, 2006).

Yao (2008) and Ehler (2003), point out that ICM institutional evaluation encompasses both 'performance measures' and 'outcome measures.' Performance indicators evaluate the decision-making process, while outcome indicators evaluate institutional structural outcomes of an ICM initiative. This calls attention to the two symbiotic components of ICM; the institutional *structural* framework, and the dynamic decision-making *processes* between stakeholders, both within and bridging institutional settings structures. The two components of structures and process are like two sides of the same institutional coin; distinguishable yet totally interdependent. Moreover, the mutually influencing nature of processes and structures is well established in the ICM literature (Christie, 2005; Olsen, 2003a; Tobey & Volk, 2002) with it held by Olsen (2003a) for example, that successive decision-making process iterations result in a growth in institutional capacity and quality.

There are a number of evaluation frameworks that are structured primarily around ICM process or 'performance measures.' Olsen suggests a policy cycle framework that maps the ICM process as an iterative cycle split into five steps, based on the enduring GESAMP (1996) model, with priority actions at each stage of the process (Olsen, 2003a). An alternative and more detailed 10-step process is introduced by Henocque and Denis (2001, as cited in International Oceanographic Commission, 2006). On the other hand there a number of evaluation frameworks structured according to institutional structures or 'outcome measures.' Pickaver, Gilbert and Breton (2004) list institutional outcomes as a scorecard to be filled out at the end of each process cycle, with outcomes grouped according to growing 'phases.' The Intergovernmental Oceanographic Commission produced a handbook for evaluating ICM initiatives (International Oceanographic Commission, 2006), which included both lists of institutional outcome indicators and environmental outcome indicators. Since their release, the IOC indicators have been utilised in a number of efforts to evaluate ICM (Glavovic, 2008b; Hoffmann & Löser, 2008; Yao, 2008).

Both the Intergovernmental Oceanographic Commission (2006) and the LOICZ report (Olsen, et al., 2009) recommend that it is better to use a combination of methods for evaluating ICM institutions, rather than one framework in isolation. For instance, if ICM institutional quality is defined by institutional *structures* and decision-making *processes* then this necessitates measures of both; to omit one is to only evaluate half of the institutional 'coin.' Moreover, any comprehensive combination of institutional evaluation frameworks should be considered relative to the ICM principles from which they are derived. Finally, though there are multiple generic evaluation frameworks, it is roundly accepted that these have limited utility compared to indicators developed by stakeholders for objectives in a specific context. The above generic frameworks are just that; frameworks to act as a starting point by which to structure more case specific indicators. This bottom up development of indicators, in concert with top-down ICM frameworks is promoted as the most effective form of evaluation (Fontalvo-Herazo, Glaser, & Lobato-Ribeiro, 2007; Hoffmann & Löser, 2008; International Oceanographic Commission, 2006).

3.4 ICM evaluation within a 'resource management' paradigm

Having traversed the ICM evaluation literature, it can be asserted that the evaluation of ICM initiatives remains deeply rooted in the resource management paradigms from which ICM emerged. For example, many frameworks begin from an idea of some communally-agreed 'ends' as the focus of an ICM initiative; with an implicit assumption that it is possible to arrive at an aggregated vision of the 'public good.' Related to this, there is a consistent theme across evaluation frameworks which maps ICM as a linear, instrumentally rational process defined in terms of 'means' and 'ends.' As seen in Olsen's (2003a) 'Four Orders' framework and the Logical Framework of Ehler (2003), employing ICM institutional 'means' (First Order outcomes) in the 'governing system' are determined to produce collective decisions that lead to environmental outcomes (Third Order outcomes) in the system-to-be-governed. Indeed, even where the decision-making process is depicted as cyclic and iterative, as for Olsen *et al* (1997) for instance, the decision-making cycles and institutions are depicted in terms of ever-increasing sophistication over time (see also Pickaver *et al* (2004)). This embodies linear notions of 'progress,' and ignores the possibility of ICM initiatives stagnating or regressing in sophistication. A third theme evident across the frameworks is the idea of transforming certain human, financial or technical inputs into policy outputs, which has been a guiding assumption of the management paradigm. This is most explicit in Ehler's framework, where inputs are transformed by the decision-making process into policy outputs, though equally comes through Olsen's 'Four Orders' framework where funding and political support is determined to create the conditions whereby behaviour is changed and environmental outcomes achieved. A fourth theme permeating the evaluation literature is an emphasis on 'centralised' decision-making, typically facilitated by coastal managers. All frameworks reviewed included indicators prescribing new state-centred institutions and decision-making processes, such as the creation of a centralised coastal management plan, and stakeholder participation is generally described in terms of consultation programmes.

3.5 Governance perspectives providing new norms of evaluation

Framing ICM according to a 'governance' perspective, and accepting its ontological, epistemological and methodological foundations, demands new norms of evaluation. For instance, by accepting the irreducible plurality within coastal communities, this reduces the likelihood of arriving at any communally agreed 'ends' to guide an evaluation. Thus ideas of linear and instrumental progress towards communally-defined 'ends' lose their meaning under governance frameworks; the ends are multiple and shifting, and indeed there are dissenting views on the 'progress.' Furthermore, governance models take a different perspective on what constitutes a 'rational' decision-making process. It departs from mechanistic ideas of input-process-output, whereby decisions seek instrumental goal-attainment, to accommodate multiple different rationalities, negotiated in a 'soup' of stakeholder interactions across multiple institutional settings. In this way, stakeholders employ other types of rationality; not least the rationality of 'power.' Finally, governance models have abandoned ideas of centralised collective decision-making around one notional table; favouring instead a picture of devolved decision-making across multiple institutions. It therefore makes less sense to prescribe state-centred settings, and rather more sense to discuss commonalities across disparate modes of decision-making.

However, far from a nihilistic vision, governance models open up new horizons for evaluation. They offer a new suite of measures by which we can come to understand the quality and capacity within a governing system, shifting emphasis away from some pursued outcome within the system-to-be-governed, to a more in-depth understanding of outcomes within the governing system itself. Governance models encourage a broader and more nuanced understanding of governance capacity; for instance going beyond a pure calculus of human, financial and technical resources to meaningfully examine changes in the competency of coastal stakeholders participating in governance and the quality of their interactions for unlocking these competencies. Or alternatively, going beyond acknowledging the existence of certain state-centred institutions to appreciate the many-fold institutions on the coast, and the governing principles or norms that underlie the decisions within them.

However, as the review demonstrated, there has been very little attention to governance-based evaluation mechanisms for ICM, and no frameworks that give full effect to a governance model. Indeed it appears that while ICM has embraced a governance perspective, this perspective has struggled to find practical expression, or pervade norms of evaluation. Some frameworks, such as that proposed by the International Oceanographic Commission (2006), have their framework under the heading of 'governance indicators,' but in reality draw on the same indicators used in 'management-focussed' frameworks. Other ICM authors reflect some appreciation for these factors included in a wider understanding of governance capacity, such as the quality of stakeholder interactions. For a number of authors, an ICM initiative should be preceded by research on the 'de facto' state of the coastal governing system, including the state of stakeholder interaction, so as to have a 'baseline' against which to distinguish the impact of ICM (Bille, 2007; Henocque, 2003; Olsen, et al., 2009). Within the 'Four Orders' framework (Figure 4 above) developed by Olsen and the Coastal Research Centre (Olsen, 2003a) the impact of ICM on interactions is described under three broad headings of 'second-order behavioural change;' with the LOICZ Handbook expanding on these three headings with 17 detailed indicators (Olsen, et al., 2009). Similarly, Stojanovic and Barker (2008) argued that the objective of ICM should be to nurture quality partnerships and interaction measured according to; (a) an increased awareness among stakeholders about coastal issues; (b) an altered attitude to their management; and (c) improved communication about roles and responsibilities, leading to coordinated action. They accept that these three things are difficult to quantify, and that measures of 'collective action' may be simpler.

It is clear that there is a need for more sophisticated discussion on the evaluation of how ICM initiatives improve the quality of coastal governance, or coastal governance capacity. The evaluation of governance may offer some advantages over current practice:

(i) Changes in governance capacity are signs that an ICM initiative is affecting a coastal locality beyond the borders of the initiative itself, according to some measure separate to its own internal criteria. It therefore improves on institutional measures alone;

(ii) Governance capacity, particularly measures of the quality of interactions, demonstrate the behavioural change that Olsen (2003a) argues is an essential precursor to desirable environmental outcomes, and signifies causality;

(iii) Governance capacity outcomes are likely to be demonstrated far in advance of environmental outcomes, providing a more responsive means of ICM evaluation; and

(iv) Given the complexity of the 'system-to-be-governed,' and the resultant difficulty in attributing environmental outcomes to an ICM initiative, evaluating change in the governing system may be a more apparent measure of the impact of an ICM initiative.

Therefore, this chapter seeks to make a contribution to the ICM evaluation literature by conceptualising an *ex post* evaluation framework new to ICM, which looks to evaluate coastal governance as interactive governance. The next section looks at how we may craft an evaluation framework based in this governance perspective.

4. Constructing an evaluation framework for ICM as interactive governance

In this section, the chapter sets out to construct an evaluation framework for ICM based in the interactive governance model. However, given the interactive governance literature itself does not have a very sophisticated discussion of evaluation mechanisms; this is not a simple case of transferring a pre-established framework over to the field of ICM. Rather this section constitutes a construction effort, taking the foundations from interactive governance and building on these according to other evaluation mechanisms from across a diversity of literature from ICM and within the wider field of resource management and governance.

4.1 Setting the foundations in interactive governance

While interactive governance presents a helpful normative and descriptive lens by which to understand governance, it has not developed a very pragmatic literature on evaluation; to what degree can we make a determination on the relative quality of governance in a context, and whether or not it is improving? Some authors (see e.g. Chuenpagdee, Kooiman and Pullin (2008) and Jentoft (2007)) have evaluated interactive governance as the 'governability' of the coast. They have tended to make broad statements on governability as a function of the system-to-be-governed and of the governing system, and an interaction between the two. Jentoft argues, for instance, that the diversity, complexity, dynamism and vulnerability of the system-to-be-governed necessitates a governing system that gives effect to meta-principles of being 'context-based, coordinating, learning and safe-guarding.' However, he does not go any deeper, making this broad framework difficult to apply practically in the service of ICM. Chuenpagdee *et al* offer a similarly high-level framework for evaluating governance, dividing evaluation of the governing system broadly according to (i) the 'responsiveness' of the modes of governance,[55] (ii) the 'fit' of the elements of governance,[56] and (iii) the 'quality' of the orders of governance.[57] The framework developed here sets its foundations in

[55] Here, modes of governance are split into self-governance, co-governance, and hierarchal governance.
[56] Here, elements of governance are divided into the images that actors use in steering governance, the instruments they use to give effect to these images, and the action of putting instruments into effect.
[57] The orders of interactive governance have already been defined in Chapter 1 as 'first order' interactions, 'second order' institutions, and 'third order' meta-principles.

this last measure, the quality of governance orders, and seeks to fill it out with measurable criteria that are pragmatic and applicable to ICM.[58]

Kooiman (1999) argues, vis-à-vis 'interactive governance,' that an evaluation of the governance capacity of a particular governing system is to take both first-order interactional and second-order institutional governing into consideration, relative to meta-governance principles. That is, to evaluate both '*institutional quality*,' and '*interactional quality*' relative to *meta-principles* (R. Chuenpagdee, et al., 2008; Jentoft, 2007). Evidently, this co-evaluation of interaction and institutions stems from their mutually reinforcing relationship; whereby quality institutions are likely to shape quality interaction, institutions are themselves in turn shaped by the quality of the interaction.[59] To evaluate only institutions (especially only formal institutions) is to ignore the political history and power relationships that exist within a context's de facto governing system, and the extent to which they shape institutions. On the other hand, to evaluate only the political interactions of governance is equally unsatisfactory, as institutions are a necessary condition to effective interaction, and contribute to the perceived legitimacy of decisions.

This parallel evaluation of institutions and interactions represents a departure from the linear model of 'means' and 'ends' espoused by the management paradigm, and dominant in ICM. Rather than trying to establish causality between institutional means in the governing system, and environmental outcome 'ends' in the system to be governed, evaluation is internalised in terms of changes in quality *within the governing system*. In this way, the 'ends' of ICM become the high quality stakeholder interactions that are the core of governance and essential to collective decision-making, with ICM institutions the 'means' by which we nurture these interactions. If we consider institutions as 'means' toward interactive 'ends' then we realise a *cyclic model of means and ends*. This implies a two-way relationship between interaction for decision-making and their institutions, which blurs their distinction within a general notion of governance capacity. An ICM initiative

[58] As noted in Chapter 1, the interactive governance literature discusses orders, modes and elements of governance. However, this thesis asserts that 'modes' and 'elements' of governance are subsidiary to the over-arching orders of governance, and are thus able to be included in an evaluation of orders. We can consider that institutions, as 'second order' governance, represent a variety of social constructions, and that each social construction will assume a different 'mode' of governance. In a military institutional setting, governance will be very hierarchal, versus a community beach-planting programme, which may represent co-governance between state agencies and the community. Equally we can see that different institutions promote different 'elements' of governance. The tools of governance used in our military setting will be far more 'rules-based' versus the beach-planting programme, which will likely be built on incentives. The point is that modes and elements of governance are incumbent features of an institutional setting and therefore an evaluation of institutional quality will necessarily include an evaluation of modes and elements; as an evaluation of the health of a the human body includes an evaluation of its constituent parts holistically.

[59] See the explanation of interactive governance in Chapter 1 for a fuller explanation of the co-evolution of stakeholder interactions and institutions.

provides the institutional means to shape interactions for decision-making ends, while at the same time having its institutions rebuilt according to this decision-making.

Therefore, this ICM evaluation framework sets its foundations in interactive governance and aims to evaluate the quality of the governing system according to parallel measures of (a) institutional quality and (b) interactional quality. On these foundations it aims to build two complimentary sets of indicators that are specifically relevant to ICM.

4.2 Institutional quality

As noted, ICM represents a long history of indicators on institutional quality. Therefore, in constructing this pillar of the evaluation framework, we can draw on this wealth of theory and practice. Section 3.3 introduced a suite of ICM frameworks, which were categorised according to those that drew on indicators of institutional structures, and those that use indicators of decision-making processes. Section 3.4, went on to show that many of these frameworks favour 'management-type' indicators; measuring institutional quality by those ICM-labelled, state-centred institutions initiated, such as a centralised 'coastal management plan.' However, an interactive governance perspective relativizes such state institutions alongside the multitude of fishing clubs, enterprises, schools and other institutions that comprise coastal governance. Therefore, given these ICM 'management' indicators have limited utility for evaluating the quality of institutions outside of the state sphere; they are not useful for our evaluation framework.

For evaluating institutions, this thesis takes its lead from Kooiman (1999), and measures quality relative to governance meta-principles, which can find various expression across all forms of institution, employing all modes and elements of governance. Meta-principles, where they represent a desirable form of governance, therefore have more wide-spread applicability as a measure of quality than 'management' indicators. Section 2.3 described ICM as concerned with the enhancement of existing institutions and construction of new institutions, such that collective decision-making shares *a common regard for ICM meta-principles*, and went on to list in Table 3, one robust set of ICM meta-principles distilled by Stojanovic, Ballinger and Lalwani (2004). In this evaluation framework, we will evaluate institutional quality according to these ICM meta- principles listed in Table 3.

4.3 Interactional quality

The other pillar of our evaluation framework is the *quality of stakeholder interactions for collective decision-making* within a governing system. But what does the term 'quality' mean relative to interactions? If we assume the definition of interaction as 'any form of mutually influencing interaction between stakeholders' (Kooiman, 1999), and agree that reaching a collective decision implies something different to individual decision-making, then we have a more sophisticated idea of what it may imply. In addition, the discussion on 'first order' interaction in Chapter 1 introduces it as a means for releasing the potential of individual stakeholders; unlocking individual competencies or assets in the service of wider governance. Amin and Hausner (1997) for instance determined interactions as the means for connected personal knowledge and experience to the communal filter through which a community perceives its coastline. Kooiman and Bavinck (2005) saw interaction as the means of connecting stakeholders' own aspirations to the collective negotiation of social choices. However, to advance beyond these broad notions and unpack interaction to assemble some indicators, we need to turn to the literature.

Evaluating interaction in ICM and interactive governance

Questions of how to evaluate the quality of collective decision-making, and the stakeholder interaction instrumental in such decision-making, have long perplexed scholars from across multiple disciplines and opened a non-concordant literature. As seen in Section 3.5, the ICM literature has made only few tentative steps into evaluating high quality stakeholder interaction for governance; focusing on positive changes in stakeholder behaviour relative to coastal issues, improved stakeholder communication, and how interaction may encourage co-ordinated action (Olsen, 2003a; Olsen, et al., 2009; Stojanovic & Barker, 2008). The interactive governance literature itself is relatively ambivalent with respect to any analysis or evaluation of interactions, even while the concept of interaction remains central to governance. While Chuenpagdee, Kooiman and Pullin (2008) do talk about evaluating the quality of interactions, they make clear that there is a need for more research on specific criteria. Therefore in building this pillar of the framework, we need to turn to other fields.

Evaluating interaction in other literature

There have been a number of authors from across political science, planning, policy analysis and public administration for instance that have addressed the elusive and esoteric questions of how to evaluate quality collective decision-making. Indeed such evaluation does not lend itself to objective sets of quantifiable indicators, with any evaluation at least needing to examine (i) the specific context of stakeholder interactions, (ii) the nature of the interactions, (iii) the decision, and (iv) the extent to which the decision gives effect to the important values within that context (Innes, 1999). Innes (1999), writing on the evaluation of consensus-building, noted though that across this broad literature there do emerge two broad approaches. The first approach examines to what degree an agreement or collective choice has been reached, and to what extent stakeholders are content that their values are given effect within this choice (see e.g. Driessen, Glasbergen and Verdaas (2001) and Edelenbos and Klijn (2005)).[60] Innes (1999) notes some weaknesses with this approach nonetheless. Agreement or consensus itself does not necessarily present an accurate measure because agreement can be superficial, or arise from a minority of stakeholders flexing their political muscle for example. Indeed, even a process that does not reach consensus can be considered a success when looking at other measures such as the learning across participants. At the same time, using measures of stakeholder contentment are subject to subjectivity and may be mired in the relative perspectives of a plurality of stakeholders, each using a different, personal measure. Therefore, reaching a collective decision itself is not a good measure of interactional quality.

The second broad approach to evaluating quality collective decision-making is to evaluate the 'social outcomes' that emerge from the process. These are, broadly, the changes in stakeholder interactions or in the stakeholders themselves as a result of participating in a decision-making process, and exclude the decision itself. For Innes (1999), coming from a planning discipline perspective, these social outcomes can be evaluated according to any increase in the capacity of stakeholders to 'communicate, understand, and cooperate' within a self-organising, adaptive governing system. However, a variable regard for social outcomes can be found across other fields. Ansell and Gash (2007), writing on 'collaborative governance' for instance, describe social outcomes of collaborative processes which can be appropriated as indicators; listing increased interaction or dialogue, increased trust, common understanding, recognition of other perspectives, and commitment to collaboration. Alternatively, those writing on 'adaptive governance' (Armitage, Berkes, & Doubleday, 2007; Folke, Colding, Olsson, & Hahn, 2007) describe the social outcomes of governance in terms of stakeholders' increased ability to collectively learn and reach decisions in the face of uncertainty; termed 'adaptive capacity.'

We can therefore define some positive social outcomes, and assert that interactions that give rise to these outcomes are of a high quality, and will contribute to high quality decisions. That is, interactions will be assumed to be *mutually influencing and build strong relationships, which unlock the particular competencies within each stakeholder, to support collective decisions*. Importantly though, these various definitions of social outcomes are only indicators; giving an indication of the likelihood of quality collective decision-making, while not measuring the decision itself.[61] We can

[60] Driessen, Glasbergen and Verdaas (2001) provide a framework that examines both stakeholders perception of the democratic legitimacy of decision-making, and their satisfaction with the final decision. Similarly, Edelenbos and Klijn (2005) measure the quality of collective decision-making according to the contentment of stakeholders with the decision, and the degree to which the final decision can demonstrate elements of all diverse values.

[61] We can draw parallels (perhaps quite abstractly) with the measurement of faecal coliforms as a relatively benign bacterial indicator of more harmful pathogenic bacteria, when analysing water quality. Faecal coliforms

say that indicators of social outcomes do not necessarily guarantee the presence of quality collective decision-making, but provide a more ready measure of its likelihood. Innes (1999) points out three limitations to their measurement: (i) they are largely measured through qualitative indicators; (ii) they may take time to show themselves, though usually much less time than environmental outcomes; and (iii) there always arises the issue of causality in complex systems.[62]

Turning to a capital-based framework to evaluate interactional quality

In constructing a set of indicators of interactional quality, this framework will look to that category of indicators broadly defined by Innes (1999) above as the 'social outcomes' emerging from interactions for collective decision-making. However as noted, there are a diversity of such frameworks from across multiple disciplines and fields, posing the question; 'which indicators are best suited as a measure of interactional quality, when evaluating ICM as interactive governance?'

Here we turn to the economic concept of 'capital,' which has come to be used as a means of evaluation across the full spectrum of social, political and management sciences (see below and Appendix C). By taking a more general definition of capital offered by ecological economics as, "a stock that yields a flow of useful goods and services into the future" (Costanza & Daly, 1992), we can explore what 'stocks,' 'resources' or 'assets' stakeholders can draw on when entering into interaction with each other, and in decision-making. Put another way, if we consider quality interactions for collective decision-making to be the useful service that we desire, then which assets can stakeholders mobilise in giving effect to quality interactions? In this way we can reframe the social outcomes of interactions as stocks; positive social outcomes in terms of relationship-building, social learning or commitment to cooperation for instance, can be considered to build up stocks of assets that stakeholders can draw on for future decision-making. Interaction therefore acts to both building up these 'capital stocks' and simultaneously provides the means of tapping into, or mobilising, this capital. Of course, in accordance with the tenets of 'capital,' these stocks can be 'mined' down to a point where they no longer support interaction; so we can imagine a scenario where poor-quality interaction mines the stocks of trust, knowledge, and deliberation competency built up over a history of good interaction and collective decision-making. Experiences in other fields have shown this capital concept as a powerful tool for evaluating the quality of social

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themselves are not harmful, and their presence does not necessarily guarantee the presence of other harmful pathogens, though their measurement does provide a more readily calculable probability of pathogenic contamination.

[62] Consider questioning whether trust developed between two stakeholders through a collaborative process, or through an unrelated institution, such as their childrens' sports club?

interaction, therefore the next section unpacks the capital concept and how it may contribute measures of interactional quality.[63]

4.4 Unpacking the capital framework as a measure of interactional quality

Capital as an expanding literature

The concept of capital is derived from classical economics, where stocks of 'land, labour and manufactured capital' are discussed as the factors of production for goods and services. Latterly the concept has been extended by the field of ecological economics, which has used 'capital' to describe new 'sustainable' norms of interaction between ecosystems and economic systems. Ecological economics broadened the definition of capital, and gave new character to the stocks of capital; for instance 'land' became 'natural capital,' and came to encompass the full spectrum of ecological goods and services rendered to society (Costanza & Daly, 1992; Daly, 1996; Etkins, Simon, Deutsch, Folke, & De Groot, 2003). Indeed, through ecological economics new forms of capital were theorised. The capital concept was extended to the cultural resource on which society can draw in interacting with the natural environment and termed cultural capital (Berkes & Folke, 1994). Meanwhile, in parallel with these developments in ecological economics, new conceptions of capital began to emerge elsewhere in the social sciences. From sociologists Bourdieu (1986) and Coleman (1988) came the idea of 'social capital,' which was appropriated and popularised by Putnam (2000) as a descriptor for social connectedness and participation in democratic governance. Around the same time Ostrom (1990), writing on the governance of 'the commons,' introduced 'institutional capital' relative to the organisational structures society can draw on. And concurrently, a literature also emerged on the concept of 'political capital,' which emphasises the political dimension in collective decisions, and explores stakeholders' political *nous* and power relations (E. Sorensen & Torfing, 2003). See Appendix C for more detailed discussion.

Capital frameworks as a descriptive and evaluative tool in management and governance

This increasingly rich literature on capital has translated to a growing practice and scholarship on the use of capital as a means of evaluation, across a diversity of fields. For instance, ecological economics has long used capital stocks to distinguish between 'strong' and 'weak' sustainability strategies (Etkins, et al., 2003). However, increasingly we see the use of capital in a descriptive

[63] It is important to note here however that concepts of 'capital,' and in particular certain forms of capital such as social capital, represent an immense literature and field of research in and of themselves. However it is not the subject of this research. Therefore here and in Appendix C the literature is given only a cursory overview, and appropriated for our purposes of building an evaluation framework of ICM as interactive governance.

and evaluative capacity towards problems of governance and democracy, economic development and other general cases of collective action problems (Woolcock, 2001). For instance, Innes (1999), in her discussion on evaluating consensus for planning, described social outcomes in terms of stocks of capital to improve capacity for future decision-making. Likewise, in the field of policy analysis, authors like Leach, Pelkey and Sabatier (2002, p. 654) have evaluated the outcomes of collaborative policy-making according to stocks of human and social capital as indicators of "a partnership having improved its stakeholders' capacity for achieving future tangible accomplishments." Elsewhere, in the literature on development studies and sustainable livelihoods, the capital framework has provided a significant tool in describing and evaluating the livelihood strategies open to the impoverished within developing countries (see e.g. Baumann (2000) and Glavovic (2006)). Similarly, those writing on disaster management have discussed the assets available to communities to adapt and recover after a significant disaster in terms of capital, and to this end have gone beyond the finances available to include the social and human capital drawn on for coordinated action (see e.g. Buckle *et al* (2000) and Mayunga (2007)).

The concept of capital has also found increasing mention across the wide literature on governance; beyond the bounds of interactive governance. Armitage (2008), reviewed the key features of various models of governance, including 'governance of the commons,' 'adaptive governance' and 'multi-level governance,' noting the trust and strong stakeholder networks embodied in 'social capital' to be important across all models. Those writing on the common property theory and the 'governance of the commons' (Dietz, et al., 2003; Ostrom, 1990) use social capital as means of describing the dense social networks, and frequent stakeholder communication necessary to build trust with regard to the use of common resources. In the field of political ecology, those writing on adaptive governance (or co-management) (see e.g. Lebel *et al*. (2006), Plummer and Armitage (2007) and the Resilience Alliance (2007b)) have described stocks of human and social capital, alongside high quality institutions, as central to building society's 'adaptive capacity.' Plummer and Armitage (2007), in their framework for the evaluation of adaptive governance, include an appreciation for stakeholders' 'livelihood assets' framed according to stocks of capital. Likewise, some elucidating articles on multi-level environmental governance (see Brondizio, Ostrom and Young (2009)) have had natural, human and social capital central to their discussion.

The forms of capital drawn on for the evaluation of interactional quality

Having unpacked the 'capital framework' and its utility for evaluating the quality of interactions for collective decision-making and action across multiple fields, we turn to the three forms of capital used here to evaluate interactional quality; human, social and financial. A detailed discussion of these three forms of capital is available in Appendix C; suffice here to define them, and how they may contribute to understanding the quality of stakeholder interactions.

Human capital: 'the stock of education, skills, culture and knowledge stored in human beings themselves' (Costanza & Daly, 1992). High quality interaction can mobilise the unique competencies (skills, knowledge and culture) locked up within individuals, such that it is available to support collective decisions and action. In this way, those writing on human capital for governance (see the Resilience Alliance (2007b) and Muyanga (2007)), stress the need for diverse participation in governance. At the same time, quality interaction can contribute to this human capital stock, by encouraging 'social learning' across stakeholders, on the issues at hand, on other stakeholder perspectives, and the interactions within a politicised institutional setting. Related to this last point, this framework engages a broader notion of human capital that recognises 'political capital' as comprised within individuals, and part of their many competencies, following authors like Throsby (1999).[64] In this way we see quality interactions as a means of simultaneously engaging and building individual stakeholders' competency for deliberating within a political arena, and their *nous* for negotiating the power relations between stakeholders. This political capital can sometimes manifest in stakeholders taking a leadership role, which is important for many collective decision-making initiatives. Finally, at the most fundamental level, human capital represents the health and general 'wherewithal' of stakeholders to participate.[65]

Social capital: 'connections among individuals—social networks, and the norms of reciprocity and trustworthiness that arise from them' (Putnam, 2000). There is a rich literature on how quality interaction contributes to, and is dependent on, a history of dense interactions between stakeholders in terms of trusting and reciprocal relationships; and how this strengthens communities as an important pre-requisite to collaborative management or governance (see e.g. Plummer and FitzGibbon (2007) and Pretty (2003; 2001)). We can thus measure the quality of interactions

[64] See Appendix C; political capital is an important indicator of quality interaction because it gives explicit recognition to the exercise of 'power' in interactions. Following Machiavelli, Nietzsche and Foucault, many writing on collaborative processes describe power as 'always present' in all interactions, therefore a framework evaluating interactions should include an appreciation for this. Unfortunately, the concept of political capital was implicitly included in human capital when undertaking the empirical research for this thesis, and it was not until after that it was found that a more explicit measure of political capital would have been valuable for this framework. Further iterations of this framework would therefore do well to include political capital as a fourth measure of interactional quality.

[65] See Appendix C; The measure of health and socio-economic standing is a relatively intuitive concept; a stakeholder must be healthy and have sufficient resources at their disposal if they are to participate in governance. a community is only as resilient as its most vulnerable members, meaning building governance capacity begins by ensuring a community has the most basic needs. These needs met, individuals should also have access to other forms of capital if they are to participate effectively; social capital in the form of social networks and community support, and financial capital in the form of financial resources for example.

relative to the way they (i) increase the density of interaction or connectivity of stakeholder networks, and (ii) add to the positive norms, such as trust and reciprocity, that structure these interactions; together described as the stock of social capital. To these measures we can add some related measures of social outcomes that have been mentioned elsewhere in this chapter; including any changes in the problematic behaviour of stakeholder relative to a given issue, and stakeholders willingness to participate in collective decision-making and action.[66]

Financial capital: 'financial assets, such as currency, that can be used to store wealth and to purchase goods and services or other forms of capital.' Collective processes of decision-making and action are not cheap; therefore interaction may be evaluated as high quality where it is able to marshal a greater stock of financial capital to facilitate and resource the goods and services needed for building better institutions, human and social capital, and ultimately a greater capacity for collective decision-making. Financial capital is beneficial in that it is fluid and may be used diversely; from funding studies to fill gaps in the knowledge, to supporting stakeholder participation, to hiring appropriate facilitators and administrative staff, to renting venues and equipment. Financial capital also has the advantage of being easily quantified.

However, as a note of caution, financial capital on its own does not necessarily guarantee better quality interaction. Other things being equal, interactional quality is likely to be improved by an appropriate investment of financial resources such that enable stakeholders have a seat at the metaphorical table, and have access to relevant materials. Such access does presume some financial investment. But more financial capital *per se* does not necessarily mean more interactional quality. Just by looking at the ICM literature, we can see a large number of initiatives that have been undertaken in asset-rich settings, but have achieved little more than superficial engagement, while on the other hand, other initiatives in resource-poor contexts have achieved extensive interactional quality, through social and cultural norms for example.

Limitations to the capital-based framework

There are of course a number of limitations to employing this particular capital-based framework to measure interactional quality. Firstly as noted, these stocks of capital only present *indicators* of

[66] See e.g. the literature on ICM. Olsen (2003) in his 'Four Orders' framework describes 'second order' outcomes in terms of stakeholder behavioural change. At the same time, Stojanovic and Barker (2008) describe a willingness to participate in collective action, such as a community beach planting programme, or some other voluntary organisations, as a positive change in stakeholders and their interaction. This finds equivalence in the literature focussed specifically on social capital (see Plummer and Fitzgibbon (2007)), whereby the density of stakeholder networks is measured quantitatively according to voluntary participation or group membership.

quality interaction and decision-making; the presence of these stocks alone do not guarantee quality decisions or governance, which satisfy the community or even achieve desirable outcomes. Conceiving of quality interactions as mobilising, and contributing to, stocks of capital, is only one way of simplifying what is in reality a very complex process. Second, a number of capital stocks are omitted. Natural and manufactured capital are omitted as being of the wrong 'sort' of capital required to nurture effective decision-making; a more healthy natural environment or a more comfortable meeting room with technical supports like computers and projectors MAY be conducive to better quality interactions, but they are considered much less essential. Indeed, manufactured capital falls under financial capital in this framework. Likewise, 'institutional capital' is omitted as being effectively evaluated in the other pillar of this evaluation framework, measuring institutional capacity. However, the most significant omission is that of political capital. In this framework, political capital is incorporated under human capital, but after having used this framework for this research (see Chapters 6-8), it was found that a more explicit attention to power is required. Future iterations of this framework may be well served to incorporate political capital as a fourth measure.

Similarly, there are limitations to using the three capital stocks proposed. Human capital may intuitively be seen as a positive social outcome of interaction, with many of us seeing ideas of 'social learning' as a clear benefit. However, those writing on power may adopt a more Machiavellian approach, and argue that stakeholders are in reality learning how best to wield power in a political space, to manipulate any negotiations of collective decisions in their favour (Flyvbjerg & Richardson, 2002). Social capital too is not without its criticisms as discussed by Plummer and FitzGibbon (2007). It has been accused of being too vague a concept to be considered alongside other more quantifiable forms of capital, with dissention on the indicators to be evaluated. Associated with a lack of clear definitions, and causal links, it has been also said to confound causality, with too many success stories attributed to social capital unjustifiably. Financial capital, as a quantifiable measure, may be seen as a hangover from modernist models and indeed the 'wrong kind of measure' for interaction, as a very 'soft and shifting' study.

5. Introducing an evaluation framework for interactive coastal governance

To recapitulate, this chapter began by describing ICM as interactive governance in Section 2 and argued that such governance perspectives demand a model of sympathetic ICM evaluation framework. However, in Section 3 this chapter reviewed the ICM evaluation literature and found that evaluation within ICM has traditionally followed a 'management-based' framework; focussed on linear progress toward a community's collectively defined goals, and the performance of ICM institutions for facilitating this progress. Against this background, it was argued that ICM may benefit from an evaluative approach centred on the increased quality of governance within a coastal governing system.

Starting from the foundations set in ‘interactive governance’ theory, Section 4 set about constructing an *ex post* ICM evaluation framework according to the parallel measures, or pillars, of institutional and interactional quality. This distinguishes a cyclic relationship between the institutional means of an ICM initiative, and its interactive decision-making ends; whereby means and ends are inseparable, and seen to exist in mutual reinforcement. To this end, the pillar of institutional quality was built according to the existing ICM literature; specifically drawing on the ICM meta-principles which have general applicability as measures of quality across the full diversity of institutional settings. These principles are comprised within the composite framework in Table 4.

Table 4: Evaluation framework for Integrated Coastal Management as interactive governance

Institutional quality	Interactional quality		
	Financial Capital	**Social Capital**	**Human Capital**
Cooperation Contingency Participation Comprehensive Precautionary Adaptability Incremental Strategic Long-term	1) Has there been increased funding of coastal management following an ICM initiative? 2) Has the ICM initiative created a sustainable source of financial capital?	3) Has there been an increase in the connectivity and density of stakeholder interactions associated with an ICM initiative? 4) Have new stakeholders begun participating in coastal management as a result of an ICM initiative? 5) Do interactions constitute 'bonding,' 'bridging' and 'linking?' 6) Do stakeholders perceive increased levels of trust and reciprocity within their interactions associated with an ICM initiative? 7) Do stakeholders perceive a change in 'acceptable behaviour' associated with problematic resource use patterns? 8) Have there been examples of 'collective action' as a result of an ICM initiative?	9) Do stakeholders have the wherewithal to participate in an ICM initiative? 10) Have adequate expertise been accumulated associated with the ICM initiative? 11) Is there an increased diversity of stakeholders participating in an ICM initiative? 12) Have leaders emerged as a result of an ICM initiative? 13) Do stakeholders recognise that, over the course of an ICM initiative, they have learnt more about: a) the issue of concern; b) the values of other stakeholders; c) the network of stakeholders and rules of their interactions?

In building the pillar of interactional quality, this chapter departed from the ICM and interactive governance literature, and drew on the wider debate across the social sciences on evaluating the quality of interactions for collective decision and action. To this end, Section 4 settled on a capital-based framework, which measures the quality of interaction according to the stocks of human, social and financial capital stakeholders can mobilise, and contribute to, through interaction. To give effect to this capital-based framework, this chapter proposes 13 open questions (see Table 4 above[67]), which can be asked of stakeholders in a coastal governing system, to evaluate the quality of their interactions. In this way, Table 4 goes beyond listing measures, to phrase them as questions within a qualitative evaluation effort. Importantly, some questions need to be read with reference to Appendix C, which unpacks the different capital stocks further.[68]

The evaluation of coastal governance capacity for quality collective decision-making is not common-place; particularly an evaluation that measures institutional quality alongside interactional quality. Certainly there are very few examples, if any, of ICM interactional quality being measured relative to stocks of financial, social and human capital. The expectation is that such an evaluation could be undertaken using a combination of quantitative and qualitative methods, as while some questions lend themselves to quantification (financial capital) others can only be evaluated qualitatively. Ideally such governance capacity evaluation would be undertaken using a 'pluralistic' research method couched in the analysis of stakeholder networks, and able to comfortably accommodate both qualitative and quantitative data. To this end, 'stakeholder analysis or mapping' may pose a viable method (see e.g. Burgoyne (1994), Grimble and Wellard (1997), Hjortso *et al* (2005) and Ramirez (1999)), with it already finding some application within coastal management (see e.g. Buanes *et al* (2004), McCreary *et al* (2001) and Rockloff and Lockie (2006)). Finally, any such evaluation needs to be preceded by research into the governing system 'baseline' prior to the ICM initiative, to analyse which changes in governance capacity can be attributed to the initiative.

6. Conclusion

The field of ICM has increasingly reinvented itself as a field of governance, drawing on a number of complimentary models of governance including 'interactive governance.' In this chapter, we have explored what ICM looks like through this lens and asserted that it offers a compelling perspective to help scholars and coastal managers alike to understand the complexities of coastal governance,

[67] Table 4 is reproduced in Appendix D to allow for easy reference to the conceptual framework when reading the thesis.

[68] For instance, Question 5 talks of bonding, bridging and linking, which constitute different forms of interaction, explained further in Appendix C. This question would need to be phrased differently in an evaluation questionnaire given few, if any, interviewees will make a distinction according to this characterisation.

and thus to better design and implement ICM initiatives. However, if ICM is to meaningfully adopt the interactive governance perspective, or indeed other governance perspectives, then the evaluation literature must 'follow suit.' It is very important to have an evaluation framework that corresponds with the theoretical and practical framings and expectations of an ICM programme. An ill-fitting evaluation framework, using the 'wrong measures,' will not do justice to an ICM initiative. This is not least the case for this thesis, which aims to examine how re-framing the specific institution of the science-policy interface can contribute to better quality governance outcomes. Before embarking on this project, it is necessary to have the appropriate measures by which to evaluate any changes.

However, while the field of ICM has been the setting for a debate on what governance theory may mean for the coast, this has not extended to the literature on evaluation; at least not to a meaningful extent. ICM evaluation has typically adopted a 'management' approach to evaluating the performance of ICM institutional 'means' for progressing communities towards their collectively-agreed goals or 'ends.' But the evaluation of a narrow ICM initiative according to its own criteria may serve only to satisfy its own self-perception, rather than check how it affects change within a coastal locality. Conversely, the evaluation of changes within the complex system-to-be-governed, and attributing causality to something as narrow as an ICM institutional change, is both to ignore the significant uncertainty associated with the causal variables of the coast, and to underestimate the power and influence of other socio-economic and political systems at play within a coastal context. Evaluating ICM as governance introduces new norms of evaluation, which may open up new horizons. Creating evaluation frameworks of ICM as governance may represent the next step in a transition toward viewing ICM as coastal governance. We need to go beyond discussing the theory and talk in terms of concrete mechanisms. As a practical field, ICM needs to focus the interactive lens and give effect to it.

Within the context of this thesis, Chapter 2 has established an evaluation framework of ICM as interactive governance, which effectively builds the structure within which the discussion will progress in this thesis. In the next chapter, the thesis turns to the parallel and central project of this thesis; exploring what epistemological perspectives may contribute to better quality governance.

Chapter 3: Mobilising high-quality knowledge for governance through dialogue: a comparison of approaches and their institutional settings

1. Introduction

As Socrates argued that he is wise who first admits ignorance, so post-modernity has seen a growing realisation of our ignorance in governing a complex world. But how do we get beyond nihilism and despair to mobilise knowledge as best we can to make better informed collective decisions as a society? What is the most effective 'epistemology,' or 'way of knowing,' for producing credible, salient and legitimate knowledge in support of decision-making?

To this point, the thesis has established the structure within which its discussion will unfold. Specifically, the research has located itself within the field of ICM, and has defined its perspective on ICM according to the theory of 'interactive governance.' Chapter 1 unpacked this perspective according to the interplay between the coastal 'system-to-be-governed' and the 'governing system;' reframing most meaningful coastal issues as 'post-normal.'[69] Chapter 2 went on to apply the interactive governance perspective to ICM and constructed a framework by which to evaluate 'quality governance.' This structuration of ICM as interactive governance represented one of the parallel projects presented in Part II of this thesis. Having established the structure of the thesis, this chapter turns to the other project of this thesis; *exploring epistemological perspectives which may contribute to high quality coastal governance.*

In this chapter, we zoom out from ICM for an instant, and review the wider literature on epistemological perspectives for environmental governance. More specifically, this chapter reviews approaches to environmental governance that mobilise 'high quality' knowledge through inclusive

[69] See the Introductory chapter and Chapter 1 for a definition of 'post-normal problems.'

and integrated dialogue across diverse perspectives, to fuel deliberation for collective decision-making. The aim of this chapter is to map the diverse terrain that this literature presents, before focussing on a particular epistemological approach that may have something to offer ICM. Using the interactive governance perspective, this chapter presents a conceptual framework for the dialogic mobilisation of knowledge for governance; according to the interaction between (i) civil society; (ii) the state; (iii) the private sector, and (iv) the scientific community. Using this 'map' it identifies some of the more likely approaches. This chapter should be read in conjuncture with Appendix B, which presents a discussion of 'rationality' for governance.

Situating this thesis in the debate

The debate between models of environmental 'management' and 'governance' in the face of post-normal problems is accompanied by an equally vigorous debate on the best means for mobilising the 'high quality' knowledge needed to support society's collective deliberation and decision-making, and how this seemingly innocuous concept of 'quality' is determined. As Reid *et al* (2006) note, high quality knowledge does not guarantee better choices will be made, but it does provide a sound basis for making better decisions, and for holding decision-makers accountable. Cash *et al* (2003) and the US National Research Council (2007) note (as has been variously described elsewhere), to be useful in a deliberative setting, knowledge needs to be (i) credible in terms of trustworthiness; (ii) salient to the issues; and (iii) legitimate in terms of the fairness and openness of the process in which it was generated and communicated. These three criteria form a very general measure of quality in the absence of any contextual and grounded measures, but will suffice for the theoretical review within this chapter.

Funtowicz and Strand (2006) explain how in the modernist 'management' tradition the world is modelled as potentially completely knowable, with scientific research deemed the best means to access credible, salient and legitimate knowledge to allow decision-making in light of 'perfect knowledge.' All other forms of knowledge thus have their quality measured relative to the robust criteria of science. However, facing post-normal problems necessitates reflection on how we as humanity talk about 'knowing' Nature; are we able to loosen our Cartesian standards of knowledge to accommodate inherent uncertainty and relativity? This has implications for who governs and who provides knowledge in support of decision-making, given a complex system cannot be completely 'known' from the reductionist scientific perspective alone, irrespective of how robust the method. Those writing on environmental governance, such as Reid *et al* (2006), and Berkes (1999), therefore recommend a dialogic epistemology; bringing together a plurality of perspectives from across diverse knowledge systems, including local and indigenous knowledge for example, within institutional settings that nurture reciprocal dialogue. In this way stakeholders collectively define the issue and what constitutes credible, salient and legitimate knowledge.

Within the wider auspices of dialogic governance one can conceive of multiple institutional settings that variously frame dialogue for governance, which while complimentary, are derived from different philosophical foundations and place emphasis on different aspects of dialogue. This chapter specifically explores those institutional settings that:

(a) mobilise knowledge through dialogue to support decision-making for post-normal issues;
(b) are inclusive of the plurality of knowledge perspectives;
(c) integrate plural perspectives in co-existence through reciprocal dialogue;
(d) Allow for the collective negotiation of knowledge quality according to credibility, salience and legitimacy.

To this end, it introduces a 'tetrahedral' framework to differentiate across the various forms of dialogue between the four key sectors of governing system actors; whether it be across the 'science-policy interface,' within the 'co-management' arena, or through 'social learning' for instance. Following this conceptual framework, three specific perspectives are unpackaged: (i) Deliberative Democracy, (ii) Collaborative Learning and (iii) Post-Normal Science. The chapter finishes by comparing and contrasting these approaches and their institutional settings in terms of the way they mobilise credible, salient and legitimate knowledge for decision-making.

2. Epistemological traditions in environmental governance

2.1 From technocratic to dialogic governance

When looking at the nature of knowledge for environmental governance, a natural starting point is with the broad dichotomy between what Fuller labels the 'philosophical' and the 'sociological,' or dialogic, paradigms (for a comparison see Fuller (2007)). The Cartesian 'philosophical' paradigm is at the basis of 'normal science,' as observed by Kuhn (1962), with particular influence over the way knowledge is represented in the natural sciences. This paradigm seeks to gain universal knowledge of the world by collecting knowledge according to a logical positivist epistemology, which places emphasis on objective observation, guided by a strict normative code. It operates according to an ontologically realist model of the world as stable and linearly determinant, with actors said to always act in an instrumentally rational manner. According to a number of authors, including Allison and Hobbs (2006), Funtowicz and Strand (2006) and Ravetz (1971), for example, this scientific paradigm has gained prominence throughout the Enlightenment to become perceived as the most valid form of knowledge for modernist resource management. Thus governance since the

Enlightenment has been described, by Friedmann (1987) and Allison and Hobbs (2006) for example, in terms of the interplay between science, a technocratic 'command and control' state structure, and representative democracy, according to two closely related streams of thought; 'social reform' and 'policy analysis.' Both have a positivist epistemology that it is better to arrive at decisions through imperfect science than through fickle unmediated politics (Friedmann, 1987; Sarewitz, 2004). As a consequence, where a problem persists, it can always be overcome through the collection of more science (Sarewitz, 2004).

Counter to the positivist epistemology is the paradigm of knowledge as socially derived, as encapsulated within Hegel's idea of 'dialogic knowledge' and continued through sociology (Fuller, 2007), which has gained credence through the post-modern movement. Rather than prescribing normative standards for how knowledge 'ought' to be collected, it seeks to describe how knowledge 'is' negotiated in political arenas, and explore the diversity of subjective knowledge perspectives. The sociological paradigm argues that all knowledge is normatively loaded; with the validity of knowledge judged according to the quality of the social negotiation, rather than logic or rationality. Its epistemology, and indeed in the extreme its ontology, is relativist; arguing that knowledge is fluid and contextual rather than universal. By viewing knowledge as socially derived, rather than an exercise in objectivity, this ceases to give preference to any one group of stakeholders or their knowledge system; all forms of knowledge are extended a degree of legitimacy. This is particularly the case where an issue can be described as complex, uncertain, or 'post-normal;' given no one perspective can possibly have access to the totality of knowledge. With a plurality of legitimate knowledge systems, rarely in agreement, the knowledge used to inform decision-making must be negotiated as evidence for value-positions within a political arena.

By accepting that there are a plurality of perspectives of reality rather than one universally 'true' version, this introduces another challenge as raised by O'Connor (1999a); how best to integrate, or bring together, diverse perspectives? O'Connor discussed two contrasting notions of reconciliation. The 'Laplacian' perspective attempts to reconcile different perspectives within a single internally consistent framework, in some ways simulating the Cartesian epistemology, with perspectives assembled to build a single, collective, socially sanctioned version of reality. Alternatively, the 'Dialogical' perspective relativises the plurality of perspectives in co-existence and collective understanding. It accepts that the multiple perspectives in society are often irreducible to one single vision, or immeasurable according to one measure of validity, and allows them to exist side by side.

Friedmann (1987) notes that last century saw 'dialogic' governance gain prominence, which sought to incorporate multiple perspectives through inclusive and integrated deliberation for collective decision-making. Based more in the 'sociological' epistemological traditions, with influences from Dewey's pragmatism and Marx's social criticism, Friedmann termed this broad stream of governance 'social learning.' The broad concept of 'governance as dialogue' (or interaction) developed to a large part in reaction to the perceived inadequacy of the technocratic model to cope with complex and uncertain, or 'post-normal' issues, and inspired parallel developments across a number of fields. These developments included within fields focused on facilitating one specific form of dialogue within one specific institutional setting, such as through; planning (see e.g. Innes and Booher (2004), and Lane (2005)), policy analysis (see e.g. Colebatch (2005)), deliberative democracy (see e.g. Dryzek (2002)), post-normal science (see e.g. De Marchi and Ravetz (1999)), corporate social responsibility, and collaborative learning (see e.g. Keen, Brown and Dybal (2005)). It also included more comprehensive governance models, which sought to construct an integrated composite of all different forms of dialogue across multiple institutional settings, including; interactive environmental governance theory (see e.g. Jentoft (2005), Kooiman and Bavinck (2005)), governance of the 'commons' (see e.g. Ostrom (1990)), institutional ecological economics (see e.g. Paavola and Adger (2005)), adaptive governance (see e.g. Armitage (2005), Berkes, Colding and Folke (2003)), and other 'applied' environmental governance fields such as Integrated Coastal Management (see e.g. Glavovic (2008a), Jentoft and Chuenpagdee (2009)).

2.2 The multiple imperatives for dialogic governance

Those writing broadly on 'governance as dialogue' describe it as a multi-faceted approach for addressing 'post-normal problems.' Importantly, dialogue is understood as the totality of governance; with the interactions to mobilise knowledge for governance inseparable from the political interactions over values, which are inseparable from the interactions that put knowledge and values into action. Therefore dialogue is at once an inclusive and integrated epistemological approach, an exercise in democracy, and the basic unit within a formal decision-making process (see e.g. Amin and Hausner (1997), Kooiman and Bavinck (2005)). Advocates of dialogic governance therefore point out that there are multiple imperatives for dialogic governance, (see e.g. Pahl-Wostl (2002, 2005), Reid *et al* (2006)), with these imperatives corresponding loosely to the three facets of 'post-normal problems' discussed in the introduction:

(1) *Substantive imperative to address uncertainty*: given post-normal problems are likely to have some facets that are fundamental unknowable according to scientific standards, in epistemological terms the inclusion of multiple perspectives is likely to yield a broader and more complete knowledge of the issue.

(2) *Normative imperative to address plurality*: by maximising participation according to democratic principles, all values are given consideration, the decision-making process is legitimised and decision-makers are held accountable.

(3) *Instrumental imperative to address high-stakes politics*: the participation of diverse actors within a governance system increases communication and understanding; building trust, reducing conflict, improving chances for consensus, and aiding the implementation of decisions into action.

(4) *Social Learning imperative encouraging participants to learn about the issue, other actors values, and the decision-making process*: many governance writers, particularly those writing on adaptive governance, emphasise that within a complex world where change is inevitable though unpredictable, 'learning-based' adaptation is the only realistic governance option open to society.

2.3 Mobilising high quality knowledge through a dialogic epistemology

While accepting that all dialogue is loaded with values, politics and power, this chapter and indeed this thesis, focuses specifically on how high quality knowledge is mobilised within dialogic governance settings to support collective deliberation and decision-making; *the substantive imperative*. As noted, this chapter discusses quality broadly in terms of *salience, legitimacy* and *credibility*. In general, dialogic models of governance, with their dialogic epistemology, tend to (a) represent an inclusive approach to knowledge collection, which (b) attempts to integrate diverse perspectives through principles of reciprocity and co-existence, and (c) negotiate the quality of knowledge according to the above three criteria. Firstly, by including diverse perspectives, dialogue increases the amount of *salient* knowledge within a context, with Fabricus *et al* (2006) showing that local and indigenous systems of knowledge are often more 'fine-grained' at the local scale than formal science for instance. Secondly, the incorporation of multiple knowledge systems lends *legitimacy* to decisions, such that stakeholders are accepting of decisions and their rationale. If a local governing system is mobilising knowledge for decision-making, then the local problem definition is likely to be defined as more legitimate than a scientifically derived one for example. Thirdly, dialogue improves the *credibility* of the knowledge, with stakeholders able to negotiate the trustworthiness of knowledge, communicate any areas of uncertainty, and where there are conflicting accounts, which perspective should be used to support decisions (Fabricus, et al., 2006). However, it would be a mistake to assume that dialogue for governance is uniform.

3. Classifying the diversity of dialogue in the 'governing system'

This thesis employs the particular perspective on governance offered by 'interactive governance. By viewing governance through an 'interactive' lens, we can consider that different knowledge is held by the full spectrum of stakeholders, and is communicated and revealed through different forms of dialogue, within different institutional settings; from the court-room to the board-room to the back-room. Therefore, it is not enough to simply talk of a dialogic epistemology for environmental governance; one must realise the myriad ways in which knowledge is revealed through dialogue. Each of these different forms of dialogue and institutional settings represents a rich store of theory and practice.

Having established that knowledge is mobilised for governance across diverse forms of dialogue, this section aims to 'map' these dialogic approaches and their institutional settings; that is, tease out the tangled forms of dialogic means of mobilising knowledge, or epistemological approaches. This chapter introduces a conceptual tetrahedral framework (see Figure 5), adapted from O'Connor's (2006) 'Four Spheres' sustainability framework, which maps the totality of interactions within a governing system between the four broad categories of stakeholders and across different institutional settings. Figure 5 reveals all four categories of stakeholders interacting within their own institutional settings, and dialogue between stakeholder categories within separate institutional settings. For instance, private sector actors can be depicted as active within the market setting; civil society actors active within social/cultural settings; state actors active within political/state settings; and scientists active within their disciplinary settings. Dialogue between two different categories of stakeholders can be represented by separate institutional settings, where a unique 'conglomerate' form of dialogue is employed, under-pinned by its own broad academic traditions. This framework requires a caveat; it must be noted that within a complex governing system it is fundamentally meaningless to treat any stakeholders, institutions or dialogue in isolation from the others, and recognised that the pair-wise classification of dialogic approaches is didactic but artificial. This heuristic is a simplification because in reality the divisions between dialogic approaches are not so discrete; in real-world practice there is unlikely to be dialogue that can be described 'purely' in terms of Corporate Social Responsibility for instance. This framework is designed to distinguish between theoretical perspectives, as frameworks of analytical concepts and normative theories, to enable a comparison.

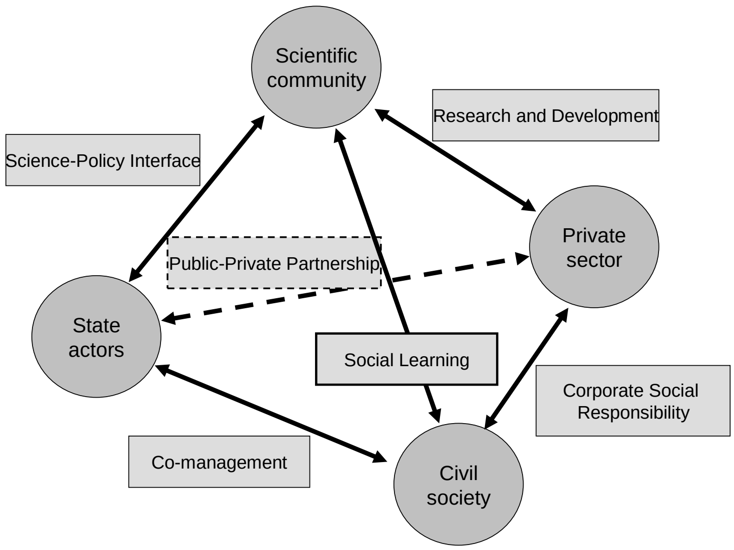

Figure 5: Conceptualising six forms of dialogue between four categories of governing system stakeholders.

Regarding Figure 5, one can note that all four broad categories of stakeholders construct knowledge through dialogue within their own unique institutional settings; effectively representing their own closed knowledge systems. One can also see six broad institutional settings within which a dyad of stakeholder groups engage in dialogue, including though not usually exclusively, for the mobilisation of knowledge. These settings are designed to open stakeholders' closed knowledge systems via dialogue, and mobilise their knowledge in a form accessible to other governing system stakeholders, to support collective deliberation. Each of these 10 settings produces a distinctive opportunity for dialogue, revealing different forms of knowledge used to different ends in governance; however the settings for mobilising knowledge across categories of stakeholders are the focus of this chapter, rather than the closed knowledge systems. Where two groups of stakeholders are engaged in dialogue, new relationships emerge, and the boundaries between these two 'spheres' are renegotiated (Sarewitz, 2004). New principles and institutions emerge, which are accompanied by new academic terrains. This chapter found each of the six different forms of 'bridging' dialogue to possess a rich literature on mobilising knowledge via dialogue - with a varying discussion of inclusiveness, integration and knowledge quality - often spanning multiple fields of inquiry, and ranging from theories to more practical expressions and methodologies. The six forms of dialogue are summarised:

State – Civil Society: This dialogue is best represented within the broad literature on 'co-management' (see e.g. Lemos and Argawal (2006)). It includes dialogue that mobilises the diversity of knowledge contained within civil society alongside their values and preferences, to inform collective decision-making. This dialogue is nurtured through approaches like ‘conflict management’ (Bruckmeier, 2005), ‘collaborative management’ (Armitage, et al., 2007), and ‘deliberative democracy’ (Dryzek, 2002).

State – Private Sector: This dialogue is represented under the umbrella of ‘public-private partnerships,’ often through discussion on the use of market and incentive-based mechanisms in environmental management (Lemos & Agrawal, 2006). One central mechanism, of interest to this chapter, is the transparent sharing of knowledge on the activities of the private sector; ‘information as policy.’

Private Sector – Civil Society: This dialogue is represented significantly within the scholarship of ‘corporate social responsibility’ (Lemos & Agrawal, 2006). It involves a two way dialogue between private sector enterprise and the wider civil society stakeholders it impacts upon, as a deliberate inclusion of the ‘public interest’ in corporate decision-making, and can extend to the inclusive mobilisation of knowledge. Conversely, the perspective of civil society is often communicated through activism and protest.

Private Sector – Science: This more closed dialogue is represented under the heading of ‘research and development,’ but could also be called ‘product development,’ with the objective of arriving at profitable outcomes.

State – Science: This dialogue is represented by the literature on the ‘science-policy interface,’ broadly looking at the ways in which scientific knowledge is mobilised for society’s decision-making. This literature is both a source of analytical description on the socio-political interaction between these two groups of actors; and a source of theory and methodology on ways to better integrate the best knowledge with a decision-making process. This dialogue is nurtured through the practice of approaches including ‘participatory integrated assessment’ (Van Asselt-Marjolein & Rijkens-Klomp, 2002) and ‘post-normal science’ (Funtowicz & Ravetz, 1993) for example.

Civil Society – Science: This dialogue can be described in terms of the ‘social learning’ literature. It describes the collective learning that occurs around an issue when diverse knowledge systems, are communicated within a participatory process of dialogue and reflection (Keen, et al., 2005). Such dialogue may be as part of, or independent of, a decision-making process. It is nurtured through the practices of ‘collaborative learning’ (Daniels & Walker, 2001), and ‘trans-disciplinarity’ (Max-Neef, 2005) for example.

By dividing dialogic governance into its constituent dyads, this chapter found that the broad literatures associated with 'co-management,' 'social learning,' and the 'science-policy interface' contain the most sophisticated discussion on the dialogic mobilisation of knowledge, specifically:

a) They all include a focus on mobilising knowledge through dialogue for post-normal issues;
b) They include discussion on the inclusion of all knowledge systems, espousing a 'participatory democracy' imperative;
c) They include discussion on integrating, or bringing together, disparate knowledge systems for a common understanding through reciprocal dialogue;
d) They include discussion on the collective negotiation of the quality or *credibility, salience and legitimacy* of knowledge.

In this way, all three traditions include epistemological approaches for mobilising knowledge from across *all* stakeholder categories, and integrating it through the principles of reciprocal dialogue and co-existence. In so doing, these approaches have evolved from their previous focus on bridging a stakeholder 'dyad' to take on a far more participatory form inclusive of all four categories of stakeholders. However that noted, the author asserts that each approach has an inherent bias towards one certain type of dialogue (one dyad), reflected in their different philosophical backgrounds, their different theories, and their different institutions for framing dialogue. This bias towards a 'first moment' or 'home' dialogue colours each approach's treatment of dialogue, even when an institutional setting is opened up to more inclusive and integrated dialogue. For instance, while these three traditions share the same four broad imperatives (substantive, normative, instrumental and social learning: see Section 2.2), they differ in terms of the emphasis they put on each of these.

This chapter will therefore finish by unpacking and comparing three approaches emerging from the broad academic terrains of co-management, social learning, and the science-policy interface: respectively the approaches of 'deliberative democracy,' 'collaborative learning,' and 'post-normal science.' It should be noted that this paper stereotypes these three positions in order to draw clear boundaries within what is an indistinct area of study. Within each approach there are a variety of positions held, and therefore rarely are the divisions between these positions so discrete. Again this is a theoretical discussion of analytical concepts. It should also be acknowledged that beyond these three approaches, the broad literature on the philosophy of science, science and technology studies, and the public understanding of science opens out into parallel and fertile fields, which act to cross-fertilise and enrich each other. See for instance the work of Brian Wynne on the interactions between expert and lay knowledge for decision-making (Wynne, 2005, 2006), the work of Shelia Jasanoff on the way in which society engages with scientific knowledge and how the political economy influences society's assessment of knowledge for decision-making (Jasanoff, 1990, 2003), or the work of Roger Pielke Jr. who looks at the role of the scientist in addressing their knowledge to the decision-makers across the science-policy interface, or to society in political arenas (Pielke, 2007). Indeed, beyond this literature devoted to knowledge as political discourse, the literature on environmental governance more broadly includes its own appreciation for this subject, which should also be recognised, though it is not a literature engaged here. See for example the work of Elinor Ostrom and others on community-based means of governing the commons (Dietz, et al., 2003), or the work on creative and flexible combinations of alternative perceptions of reality for public administration by Verweij et al (2006).

4. Introducing three epistemological perspectives on dialogic environmental governance

4.1 Deliberative Democracy

Pierre and Peters (2000) describe deliberative democracy as a conscious expression of participatory democracy, that dictates the creation of institutions better enabling of free deliberation by all of society, as equals in a non-coercive environment, for collective decision-making. It emphasises to Dryzek (2002) that the true nature of democracy is through the deliberation of citizens, rather than simply voting. In this way, Bohman (1998) roots deliberative democracy in a critique of the standard practices of liberal democracy; it rejects the aggregation and strategic behaviour of voting and political bargaining respectively, in favour of the free public reasoning of equal citizens. It appeals to the democracy and rationality of the 'forum,' rather than the 'market' of strategic political pluralism (Bohman, 1998). Pierre and Peters thus describe the 'Athenian City State' as the ideal deliberative democracy forum.

Deliberative democracy theorists take society's unavoidable, and often irreducible, plurality as the point of departure; providing both epistemic and moral challenges. From the epistemic side, pluralism precludes any knowledge of the 'public interest' via aggregation, such as through voting mechanisms. From the moral side, deliberative democrats argue that the strategic behaviour associated with bargaining between personal interests precludes consensus and does not espouse the normative values of democracy (Bohman, 1998). Combining plurality with the liberalism of a free and equal society introduces a tension between individual plurality and popular control, which prevents substantive consensus in many cases. Faced with this dilemma, deliberative democrats turn to a robust process for the moral and epistemic justification of democracy, as embodied within 'constitutional liberalism.'

Deliberative democracy promotes constitutional principles that acknowledge plurality, and set the ‘rules’ of deliberation for the reconciliation and aggregation of predetermined interests, in seeking overlapping consensus (Dryzek, 2002). Rawls (1993), an early advocate of deliberative democracy, thus proposed ‘free public reason’ as a steering principle, or attitude of participation, incorporating both ‘guidelines of inquiry’ and ‘virtues of reasonableness.’ By employing ‘free public reason,’ Rawls argued citizens were able to go beyond their personal interests and consider the wider public interest from their personal point of view, moving him to comment that ‘a good constitutional democracy is a deliberative democracy.’ In terms of a dialogic epistemology, Rawls ‘guidelines of inquiry’ steered the use of evidence and judgement among citizens, recognising the plurality of knowledge systems engaged in deliberation, and providing rules on their reasonable application. In this way, Rawls recognised ‘rationality’ to extend beyond the instrumental form so popular in modernist traditions; echoing Habermas’ communicative rationality. Dryzek (2001), while agreeing with the constitutional liberalism of deliberative democracy, advocates for more social and interactive principles; critiquing Rawls focus on deliberation within the courts and legislature where participation is restricted to those capable of exercising ‘public reason.’ Dryzek argues for a more inclusive democratic setting steered by principles of participation, equity, reciprocity and reflexivity.

Dryzek (2002) discusses deliberative democracy as creating a constitution for the creation of a public deliberation setting; one where all who choose to participate can, without obligation. Within such a setting equity is essential, Dryzek noting that the only power should be “the forceless force of better communication,” while ceding that citizen’s capacity to participate will never be equal (Dryzek, 2002). Accepting that within a pluralistic world ‘consensus’ is unattainable, unnecessary and undesirable, deliberative democracy allows citizens to discuss the public interest in terms of their private interest, before agreeing on a course of action for different reasons. Deliberative democracy provides the opportunity for citizens to hear the perspectives of others, reflect on their own perspective and values, before collectively arriving at a decision as a community. The dialogue within a deliberative democracy setting is therefore steered by procedural principles of reciprocity and reflection, which distinguish it from other co-management theories that see participants as having pre-conceived positions that are non-negotiable, and the basis for strategic power-games and bargaining. Reflexivity through dialogue also encourages social learning of the many perspectives and values surrounding a debated issue. According to such principles, Dryzek asserts that deliberation and decision-making is both procedurally rational (fair, equal, reciprocal, free from coercion, deception, and manipulation) and substantially rational (more rational outcomes).

Dryzek (2002, p. 173) argues “deliberative democracy may be the most effective political means currently available to solve complex social problems, because it provides a means for coherent integration of the variety of different perspectives that are the hallmark of complexity.” To this end, Dryzek bases deliberative democracy in an epistemological perspective linked closely to Habermas' communicative rationality. It legitimises all forms of communication; reducing the status of the scientifically rational argument to a supporting role rather than the lead actor. Rhetoric, narrative and other forms of communication are also allowed providing they are non-coercive, able to be supported by some rational justification, and capable of linking the individual's perspective to a community perspective (Dryzek, 1994).

Finally, Bohman (1998) introduces a debate on whether a deliberative democratic setting is best described as epistemic or moral; is it rather a setting for the production of 'reliable' knowledge and preferences to inform decision-making, or a 'fair' setting for the legitimate inclusion of all perspectives. Bohman (1998, p. 403) notes, "…if (deliberative democracy) establishes its moral credentials of legitimacy via an ideal procedure, it cannot underwrite its epistemic claims; if it establishes its epistemic claims, they can only be underwritten by standards that are not only procedure-independent, but also independent of deliberation." While concepts of Rawls 'public reason' and Habermas' 'communicative rationality' go some way to resolving this tradeoff, deliberative democracy seems to emphasise normative imperatives over substantive imperatives.

4.2 Collaborative Learning

'Collaborative learning' is an approach derived from the wider literature on 'social learning' for environmental governance, which as Pahl-Wostl and Hare (2004) point out, broadly asserts that collective decision-making for complex issues is preceded by learning among stakeholders. Keen, Brown and Dybal (2005) offer up a broad definition of social learning as "a process of iterative reflection that occurs when we share our experiences, ideas and environments with others." For authors such as Daniels and Walker (1996), Friedmann (1987) and Koppenjan and Klijn (2004), this is learning that occurs across three dimensions: (i) the plural framings of reality and more specifically the issue; (ii) the plural values among stakeholders; and (iii) the strategic political behaviour within a governing system. Those writing on the broad social learning tradition, including Keen and Mahanty (2006), Daniels and Walker (1996, 2001), and Plummer and Fitzgibbon (2007) therefore argue that a learning approach requires a shift from our conventional reliance on narrow bodies of knowledge to more collaborative methods that accommodate the wide range of stakeholder perspectives. Daniels and Walker (1996) argue that this necessitates an emphasis on the importance of the *learning* that occurs within collaborative deliberation; however learning has often remained poorly defined and measured in collaborative deliberation (Armitage, Marschke, & Plummer, 2008; Keen & Mahanty, 2006). While many authors define social learning as a side-effect that accompanies problem-solving (Dillenbourg, 1999; Keen & Mahanty, 2006), this chapter argues that social learning can occur separate to a formalised collective decision-making process and is therefore portrayed as a dialogue between civil society and scientific communities.

As an approach in social learning, collaborative learning is not confined to those writing on environmental governance, with a much greater literature within the psychology and education fields. Dillenbourg (1999) provides a widely-cited overview of collaborative learning; describing collaborative learning as the creation of a situation wherein certain forms of interaction are more likely to occur, in order to stimulate additional cognitive mechanisms within a group of stakeholders than would be available to them individually. Dillenbourg goes on to describe collaborative learning as a physical and institutional 'setting', rather than a 'method,' where there is a degree of symmetry in terms of participants power and influence, shared goals, and a low division of labour. Within this context, learning occurs through 'interactive, synchronous negotiation' between participants.

Daniels and Walker (1996) note that collaborative learning is based in a critical, pragmatist epistemological tradition that follows Dewey, Lewin and Piaget, recognising learning as something that is actively engaged in for problem-solving by mobilising concrete experience. This led Armitage *et al* (2008) and Plummer and Fitzgibbon (2007) to frame collaborative learning as an experiential and reflective, 'learning-by-doing' process. Stakeholders 'learn' relative to both their on-going experience with their environment, and through negotiating with other stakeholders; therefore feedback from the environment and from other stakeholders is essential to the learning process. Collaborative learning also has constructivist influences through its recognition that all stakeholders have a 'filter' which shapes the way they experience the world (Daniels & Walker, 1996). Armitage *et al* (2008) differentiate between three different conceptions of the learning mobilised within a collaborative learning situation; experiential learning, transformative learning, and social learning. Experiential learning describes the learning of each individual participant, as they reflect on their concrete experience (and that of others), conceptualise an abstract model to explain phenomena they experienced, and test that model as a hypothesis. Transformative learning (Mezirow, 2000, as cited in, Armitage, et al., 2008) similarly focuses on the individuals learning, where through critical reflection on experience and the experience of others, they are able to transform the filter through which they experience the world. Finally, social learning (Argyris and Schon, 1978, as cited in, Armitage, et al., 2008) places an emphasis on the wider social context, and how iterative reflection is possible through dialogue. As Armitage *et al* (2008, p. 88) note, "both individual and group (social or institutional) learning is necessary. Individuals learn, not organizations, yet a focus only on the individual neglects the social context in which individual learning takes place."

Keen and Mahanty (2006) identify three key learning concepts within collaborative learning; (i) systems thinking, (ii) negotiation and (iii) reflection. Firstly, collaborative learning has a '*systems orientation*' which shapes learning relative to the interaction of social systems with ecological systems. Secondly, dialogue within a collaborative learning setting is framed as *negotiation* across plural and often irreconcilable perspectives. Conflict is accepted as inevitable, and indeed a catalyst for significant learning opportunities according to Dewey, with consensus not sought. Thirdly, collaborative learning emphasises *reflection*; on the part of individuals, and as a group. This is reflection on action, values and beliefs, allowing for different 'loops' of learning as noted by Argyris and Schon (1978, as cited in, Armitage, et al., 2008); ranging from learning from actions (single loop), to rebuilding society's fundamental values and assumptions (double loop), to building competency within a governing system to more effectively deliberate around complex issues (triple loop). Collaborative learning fora are described in terms of a learning 'community,' where competence is built across its members, akin to Haas' (1992) 'epistemic community.'

Finally, as noted by Dillenbourg, within a social learning forum, all knowledge and experiences are accepted on an equal footing; bringing with them their own strengths and weaknesses, which act complimentary to each other for stimulating social learning. Thus authors like Fabricus *et al* (2006) describe local and indigenous experiential knowledge, rooted within deep social memory, sitting alongside more short-term experimental science. However this raises many questions on the role of 'normal science' in governance, especially in terms of how its advice compares to, or interacts with, other more obviously normatively-charged perspectives. For some authors, including Berkes *et al* (2005) and Carolan (2006), science is often seen to 'trump' other forms of knowledge, due to its previously privileged place within science-based management, and its perceived superior 'rigor.'

4.3 Post-normal science

The post-normal science (PNS) epistemological approach[70] focuses on evaluating the quality of knowledge for informing governance in the face of post-normal problems (see e.g. De Marchi and Ravetz (1999), Funtowicz and Ravetz (1993, 1997)) and is thus most active at the science-policy interface. Funtowicz and Ravetz (1993, p. 739), as the initial proponents of PNS, attempted to find new scientific principles that emphasised "assumptions of unpredictability, incomplete control and a plurality of legitimate perspectives". PNS thus begins from a model of the world as complex intertwined social and natural systems, and implicitly endorses a similarly complex network dialogic

[70] For a contemporary discussions of the post-normal science perspective see also two recent special editions A special edition of Science, Technology and Human Values (36(3)) in 2011, edited by John Turnpenny, and a special edition of Futures (43(2)) in 2011, edited by Merryl Wyn Davies. These reviews are not referenced here because they were published after the theoretical and conceptual framework of this thesis were finalised.

model for its comprehensive and holistic governance (Ravetz, 2006). PNS accordingly has a particularly acute respect for complexity through its recognition of a multiplicity of legitimate perspectives, which renders governance inherently uncertain even to the 'epistemological core' (Funtowicz & Ravetz, 1990). That is, we are uncertain of even which epistemology is best placed to begin to understand the issue, necessitating a dialogue across epistemologies (Funtowicz & O'Connor, 1999). Faced with uncertainty, "Quality…becomes the organising principle of post-normal science because the old ideal of scientific truth is no longer attainable or relevant for policy" (Funtowicz & Ravetz, 1994). While 'truth' informs decision-making behind a closed door, Funtowicz and Ravtez asserted (1993, 1994; 1999) that by bringing the uncertainty and quality to the fore, this leaves the door open to new scientific norms of evidence and discourse. Thus dialogue and participation is promoted by Funtowicz and Ravtez (1993) less for normative or instrumental reasons, and more for the substantive furthering of knowledge.

Those writing on PNS, like Funtowicz and O'Connor (Funtowicz & O'Connor, 1999; O'Connor, 1999a), emphasise knowledge as a fundamental component of our shared 'social reality.' Within such a social reality, facts and values are inseparable, and no one perspective can be 'true' as no one has lived the totality of social reality; therefore O'Connor argues controversy between disparate perspectives is so inevitable that it can be mapped as a scientific fact. PNS so conceived necessitates extending legitimacy within a knowledge forum beyond scientific experts, to include other perspectives of complimentary validity (Van de Kerkhof, 2006). This noted, the founders of PNS Funtowicz and Ravetz (1997) are quick to point out that it goes beyond simple constructivism, by grounding science in reflexivity and dialogue to evaluate quality. In this way Luks (1999) defines PNS as influenced by pragmatism, and also ideas of communicative rationality.

How then does one integrate these perspectives? Within PNS, Funtowicz and Ravetz offer up a perspective on integration according to a dialogic process which is committed to methodological pluralism. That is not to say that it attempts to combine the many voices and reduce them to a single consensual view, which would be impossible given the irreducible plurality of epistemologies. Rather, the process 'relativises' contradictory perspectives and encourages their co-existence according to an ethic of reciprocity; if not through reconciliation, then at least through common understanding (O'Connor, 1999a). This draws significant parallels with Habermas' communicative rationality, and is subject to the same criticisms from those who warn of the power underlying all dialogue (Luks, 1999; O'Connor, 1999a); in particular the dominance of normal science.

Though there are multiple epistemological perspectives, they are not all equally good for informing governance. Evaluating knowledge quality has traditionally been evaluated within the context of a single internally consistent framework, which is associated with a particular perspective. Such frameworks are not usually commensurable. However, from the PNS perspective, knowledge is assessed only partly according to its own internal norms, and more in terms of wider community criteria relevant to an issue (Funtowicz & Ravetz, 1993; O'Connor, 1999a; Ravetz, 2006). Therefore quality is judged in terms of the uncertainty associated with the various perspectives, their salience to decision-making for an issue, and their perceived legitimacy (see e.g. Clark and Majone (1985), Frame and Brown (2008), and Funtowicz and Ravetz (1993)). Moreover it is quality not only in terms of the knowledge '*product*,' but also the *process* followed to derive the knowledge, the *people* who generated it, and its *purpose*; Funtowicz and Ravetz' (1993) so-called '4-P' approach. As Clark and Majone (1985) note, knowledge is appraised subject to multiple lists of indicators, drawing on: (a) rational criticism, (b) practical criticism, and (c) ethical criticism; with these meta-lists collectively formulated by an 'extended peer community.' As members of an extended peer community, stakeholders learn competence at the interface between politics, science and decision-making (Van de Kerkhof, 2006), develop reflexivity and learning, and develop trust for the other stakeholders within the extended peer community (De Marchi & Ravetz, 1999; Pahl-Wostl, 2005).

The extended peer community represents a widening of the circle of 'critics' of knowledge for decision-making, to lend legitimacy to those stakeholders previously not recognised in this role (De Marchi & Ravetz, 1999; Frame & Brown, 2008). These critics work together as 'co-investigators' (Frame & Brown, 2008; Funtowicz & Ravetz, 1993) in a pluralistic collaboration; examples of which include 'focus groups,' 'citizens juries,' and 'consensus conferences' (De Marchi & Ravetz, 1999). Importantly, all participants enter on an even footing, with equal rights and responsibilities to engage in critiquing knowledge. Such a peer community is nested in an institutional environment that tolerates the at-times ambiguous responses in such a forum, and is guided by policy-makers as knowledge-brokers, or 'mid-wives of problems' (O'Connor, 1999a; Van den Hove & O'Connor, 1997; Williams & Matheny, 1995). Within this extended peer review process, knowledge is called upon as evidence to support different perspectives, with the burden of proof placed on the participant calling the evidence (Frame & Brown, 2008; Funtowicz & Ravetz, 1994; Ravetz, 2006). Importantly, this process does not attempt to rob any knowledge system of its legitimacy; rather, it is complimentary to each knowledge system which is allowed to co-exist under the close scrutiny of all of its peers.

PNS is science with a long-term strategic focus, rather than a short-term puzzle-solving focus. It begins from a discussion of the common resolve to a committed course of action, and the plurality of values that define this course (Ravetz, 1999; J. P. Van der Sluijs, 2002b). By being issue and long-term oriented, with a focus on sustainability rather than progress, this provides a 'social contract' for science (Funtowicz, Ravetz, & O'Connor, 1998; Moss, 2002). Moreover, according to O'Connor and others (1996), within the context of post-normal science, decision-making is undertaken according to procedural rationality rather than substantive rationality; establishing a legitimate procedure for decision-making that allows social learning via open dialogue between all forms of knowledge, while recognising uncertainty, and the importance of adaptive management to avoid irreversible mistakes (O'Connor, et al., 1996). With the emphasis on procedure, Pahl-Wostl (2002) argue one is less concerned with ensuring 'progress' as they are with 'unending reciprocity.'

5. Comparing dialogic epistemological perspectives

Under the umbrella of dialogic governance, this chapter has identified three distinct epistemological perspectives with a sophisticated literature on the mobilisation of high quality knowledge through inclusive and integrated dialogue; deliberative democracy, collaborative learning and post-normal science. By unpacking these approaches, this chapter is able to compare the ways in which these three different perspectives give treatment to the mobilisation of credible, salient and legitimate knowledge for governance. However, these three theories of dialogue are not rivals; indeed they are, in our view, complimentary if not compatible. By emphasising different dialogic imperatives, they each bring a different and enriching justification for governance as dialogue in the face of complexity. Indeed, the interplay between different perspectives is at the very heart of dialogic governance, and so we can say that the complimentary use of perspectives on dialogue is internally consistent with the philosophy each espouses. To this end, there are a number of comprehensive dialogic approaches to governance that comprise a number of these different dialogic perspectives in concert with each other. This may be through connecting different institutional dialogic settings in an integrated manner, or through facilitating one deliberative forum that gives attention to all forms of dialogue. For example, the scholarship of adaptive governance, or adaptive co-management, has evolved as a comprehensive governance approach with a focus on social learning, while employing dialogic approaches from the science-policy interface and co-management traditions (see Figure 5) (see e.g. Armitage, Berkes and Doubleday (2007), Berkes *et al* (2005), and Plummer and Fitzgibbon (2007)).

This chapter will finish by comparing the three candidate approaches to mobilising knowledge according to the four broad measures noted in the introduction: (a) the degree to which the dialogic setting focuses on knowledge; (b) the inclusiveness of the setting; (c) the integration within the setting; and (d) the means for evaluating knowledge quality; particularly relative to salience, credibility and legitimacy. This section ends with Table 5 which compares the three approaches across various features.

Dialogic imperatives and the treatment of knowledge

While the three theories of deliberative democracy, collaborative learning, and post-normal science all represent attempts at mobilising knowledge through a dialogic epistemology, they are all derived from different 'first moment' dialogic perspectives, with different emphasis on the imperatives of dialogue, and different philosophical influences (see Table 5). This has consequences for each approach's treatment of deliberative fora. Within deliberative democracy, the forum is modelled on the 'Athenian city state,' with the primary purpose of free and equal deliberation between all citizens for collective decisions for the common good. Alternatively, within collaborative learning the deliberative forum is modelled on an 'epistemic community,' with participants sharing their experiences reflexively, and building competence for learning and dialogue. Finally, within post-normal science, deliberation occurs within an 'extended peer community,' wherein knowledge is collectively evaluated for its quality and pertinence to the issue. Therefore this reiterates three different dialogic imperatives within deliberation; respectively, participatory democracy, reflexive learning, and knowledge quality assessment.

Knowledge is valued differently across the three deliberative fora. Deliberative democracy evaluates the usefulness of diverse contributions according to their ability to contribute to a collective vision of the issue and its solutions in 'the public interest,' with the goal of progressing society toward an agreed course of action. Within the post-normal science perspective, knowledge is valued for a number of different qualities which are collectively assembled by those participants providing knowledge, including the knowledge 'product', though also the legitimacy of the process and persons associated with the knowledge, and its level of uncertainty. Knowledge is mobilised according to the degree to which it meets those qualities that stakeholders deem important for the issue at hand. Finally, the collaborative learning approach values knowledge for the learning it brings about, both within individual participants and collectively. Knowledge is valued not only for 'first loop' learning, whereby stakeholders 'learn from doing;' with each governance intervention an opportunity to learn about the reaction of the system-to-be-governed. Knowledge is also valued for the way in which it re-shapes the 'filter' through which stakeholders experience reality, including their values and assumptions (second loop learning), and on to the increased competence of stakeholders to interact and learn within a learning community.

Inclusive of all knowledge systems

All three of the described deliberative fora provide an inclusive setting where all different knowledge systems are able to be communicated as legitimate and salient to support deliberation and decision-making. All three fora begin from an ethic of reciprocity, whereby all participants recognise the legitimacy of each other and enter into non-coercive, open negotiation. Related to this, all three approaches recognise that power will inevitably infiltrate dialogue to some degree, but attempt to minimise the effects of power through the creation of an effective institutional setting, and through an effective process. That noted, deliberative democracy is far more zealous in its attempts to eliminate any forms of coerciveness and create the ideal conditions of communication espoused within communicative rationality. This has led a focus across all three approaches on procedural rationality (rather than substantive rationality), with the process generally described as iterative and reflexive, with a long-term focus.

Bringing together disparate knowledge systems

While all three fora are inclusive of all knowledge systems, the way in which this knowledge is brought together or reconciled varies. In the broadest sense, all three fora share a participatory ethic of reciprocity, which encourages integration across disparate perspectives through dialogue and negotiation (see O'Connors (1999a) Dialogic vs Laplacian discussion). However, on closer inspection deliberative democracy appears to also share a 'Laplacian' influence; reconciling the plurality of citizen perspectives in a search for a degree of overlapping compromise on the 'public interest,' and collectively desired courses of action. Deliberative democracy therefore accepts all knowledge perspectives as contributing to an aggregated community perspective, and judges it rational according to constitutional principles steered by 'public reason' or 'communicative rationality.' In this way, plural experiences are where possible reconciled within one internally consistent collective vision of the issue and the 'public interest' – accepting full consensus as impossible and undesirable. The puzzle analogy of Kuhn (1962) can be extended, with each perspective a jigsaw piece roughly fitting with its adjoining pieces, and the policy-maker as assembling the puzzle. The post-normal science approach sees uncertainty as epistemological, and thus irreconcilable within a single framework. A forum can only seek to relativise the different perspectives and encourage their co-existence through reciprocal dialogue or negotiation. In this way, each participant brings their knowledge as 'evidence' of their individual perspective. Collaborative learning also encourages a co-existence of diverse perspectives through negotiation, as a source of reflection.

However, where conflicting perspectives are simply left to co-exist, and no perspective can claim access to the 'truth,' this does not address the dilemmas of pluralism, and may not render a coherent or agreed upon understanding of an issue to support deliberation. Where there are no means to reconcile inconsistent knowledge systems, there is the danger that knowledge fora will lapse into entrenched pluralist politics, and power will prevail over reciprocity. Similarly, where reconciliation between two conflicting accounts is not possible, there must be means for collective negotiation amongst stakeholders over which perspective has more credibility for supporting deliberation for an issue, or pluralism will again prevail. Unlike collaborative learning, post-normal science seeks a second degree of integration; moving from a focus on 'truth,' to focus instead on 'quality.' Quality, as collectively negotiated, becomes a second means for integrating plural perspectives, while simultaneously allowing for a measure of the credibility of knowledge accounts. With a focus on knowledge quality for decision-making, a 'puzzle-piece' is evaluated for its credibility, salience and legitimacy, while accepting that the resulting picture may be a more abstract melange of multiple perspectives; akin to cubism. The 'quality control' via extended peer review acts as a bridge across multiple epistemological frameworks, by allowing incommensurable knowledge systems to be evaluated via a common framework. Quality becomes a common thread that links knowledge perspectives, and provides an alternative to stakeholders retreating to the safety of their own knowledge system framework.

Evaluating the quality of knowledge

Finally, knowledge is variably judged credible, salient and legitimate for governance, across the three fora. Within the deliberative democracy forum, knowledge is judged salient and legitimate by virtue of the participatory process that is inclusive of all knowledge systems, and credible to the extent that it is deemed rational according to the framework of communicative rationality. Within the collaborative learning forum, knowledge is again judged salient and legitimate according to the participatory process, as well as the degree to which it gives effect to a systems-based framing of the issue. Credibility is less well addressed in the collaborative learning approach, with each form of knowledge deemed credible according to its own incommensurable criteria, and few ways of bridging these criteria. Reflexivity is the primary tool by which other knowledge systems are deemed credible; allowing participants to collective reflect on and compare knowledge systems. Finally, the post-normal science forum determines credibility, salience and legitimacy through an extended peer review process, according to a number of criteria (e.g. product, process, person and purpose) agreed upon by all stakeholders.

Table 5: Comparing the characteristics of post-normal science, collaborative learning and deliberative democracy

Characteristics	Epistemological perspectives for dialogic governance		
	Post-normal Science:	**Collaborative Learning:**	**Deliberative Democracy:**
1) 'First moment' dialogue	'Science-policy interface' Scientific community and state	'Social learning' Civil society and scientific community.	'Co-management' Civil society and state
2) Dialogic emphasis	Substantive	Social learning	Normative and instrumental
3) Epistemology	Dialogic	Dialogic	Dialogic
4) Deliberative forum	'Extended Peer Community'	'Epistemic Community'	'Athenian City State'
5) Primary purpose of the forum	Evaluate the quality of disparate knowledge systems for addressing an issue	Stimulate learning through the sharing of experiences, ideas and environments	Free and equal deliberation between citizens for agreement on a course of action for the public good
6) Ethic of participation	Reciprocity	Reciprocity	Reciprocity
7) Power	Inevitable, but where possible neutralised	A source of learning, but where possible neutralised	Neutralised as primary objective.
8) Knowledge as…	…Evidence in support of a value-based argument.	…Individual and collective reflection on experiences.	…a means for linking an individual's perspective to a community perspective.
9) Inclusive of all knowledge systems	Yes	Yes	Yes
10) Treatment of plural perspectives	Relativise and encourage co-existence	Relativise and encourage co-existence through negotiation	Relativise and where possible reconcile in the public interest

11) Knowledge valued for…	…Its quality, as judged through extended peer review	…Its reflexivity – by challenging participants to alter the filter through which they experience reality, and build competence for learning and dialogue	…Its complimentarity for building a common picture of an issue for collective decision-making.
12) Knowledge judged credible, salient and legitimate	Peer review process, according to agreed criteria.	Participatory process, 'systems-based' knowledge and reflexivity.	Participatory process and communicative rationality, as steered by constitutional principles
13) Reflexive	Yes	Yes	Yes
14) Iterative	Yes	Yes	Yes
15) Procedural or substantive rationality	Procedural rationality	Procedural rationality	Procedural rationality
16) Long-term approach	Yes	Yes	Yes

6. Conclusion

This chapter reviewed the literature on epistemological perspectives for governance and started from the notion that a 'dialogic epistemology' provides an effective means of mobilising knowledge in support of collective deliberation and decision-making for 'post-normal problems;' forming the foundation for many dialogic approaches to environmental governance. Looking through an 'interactive governance' filter, this chapter revealed a diversity of different dialogic epistemological perspectives, each beginning from dialogue between different configurations of stakeholders within different institutional settings built on different schools of thought. This thesis is specifically interested in those perspectives that: (a) focus on the mobilising knowledge through dialogue, in a form able to support deliberation and decision-making; (b) include all knowledge systems; (c) integrate diverse perspectives through dialogue according to principles of reciprocity and co-existence; and (d) allow for collective negotiation on the quality of knowledge; defined here in terms of credibility, salience, and legitimacy. As such, this chapter found the broad traditions of 'co-management,' 'social learning' and the 'science-policy interface,' to contain the most sophisticated literature, and led to a detailed comparison of three epistemological approaches, respectively; 'deliberative democracy,' 'collaborative learning' and 'post-normal science.'

By strictly categorising the three approaches, the chapter is able to discern and compare the novelty within each approach, while accepting that all three approaches are often utilised simultaneously in a complimentary manner within comprehensive governance models, such as 'adaptive governance.' All approaches are found to offer a valuable perspective on the dialogic mobilisation of knowledge to support governance; however the post-normal science approach can be deemed to provide the most robust treatment of the way high quality knowledge is mobilised around a given 'post-normal' issue, through dialogue within a governing system. Originating from the science-policy interface dialogic setting, post-normal science has from the beginning placed the focus on the *knowledge* mobilised through dialogue, while accepting the accompanying values, power and politics as inevitable, and sought to frame this knowledge in a form best able to support deliberation and decision-making. This distinguishes post-normal science from other dialogic institutional settings, which either place a less central focus on knowledge (deliberative democracy), or less explicitly tie this knowledge to deliberation (collaborative learning). Moreover, according to its founding authors Funtowicz and Ravetz (1990, 1993, 1994), post-normal science provides an approach specific to 'post-normal' problems, and takes as a point of departure the systems representation popular in describing an increasingly perceived complex and uncertain Nature.

Finally, by placing the principle of knowledge 'quality' rather than 'truth' at the centre of inquiry, post-normal science demonstrates a more explicit treatment of quality than the other two perspectives

Therefore to this point Part II has defined the landscape of the thesis. Chapter 2 has constructed the structure of this research; formulating a framework of ICM as interactive governance to enable a discussion of what constitutes 'high quality' coastal governance. On the other hand, Chapter 3 has identified 'post-normal science' as an interesting epistemological approach for framing the science-policy interface to mobilise 'high quality' knowledge in support of governance. At this point, we return our focus to ICM, and explore more specifically how a post-normal science perspective may contribute to better quality ICM, defined as interactive governance. Chapter 4 presents a discussion on epistemology specifically related to ICM and zooms in on the institutional setting of the science-policy interface, before Chapter 5 reviews the literature to see how a 'post-normal' science-policy interface may benefit ICM in theory and in practice.

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STATEMENT OF CONTRIBUTION
TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

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Name/Title of Principal Supervisor: Murray Patterson

Name of Published Paper: Mobilising high quality knowledge through dialogic environmental governance: a comparison of approaches and their institutional settings

In which Chapter is the Published Work: Chapter 3

What percentage of the Published Work was contributed by the candidate: 100%

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Part III: Focussing on the science-policy interface for Integrated Coastal Management: Introducing a post-normal science perspective

In Part III, the thesis engages the debates on how knowledge is best mobilised for Integrated Coastal Management, with Parts I and II defining the point of entry into this debate. Chapter 4 reviews the current state of debate, which largely revolves around the 'science-policy interface,' noting calls from ICM scholars to reframe the interface in recognition of models of governance. Taking this as its point of departure, Chapter 5 reintroduces 'post-normal science,' as one promising approach identified in Chapter 3, and interrogates its potential according to the ICM literature using the conceptual framework. Chapter 5 represents the first iteration of the research.

Chapter 4: Mobilising knowledge for coastal governance: re-framing the science-policy interface for Integrated Coastal Management

1. Introduction

Integrated Coastal Management (ICM) has long sought to create political settings within which coastal communities can arrive at collective decisions, and support these decisions with the best quality knowledge available such that they can be called 'rational.'[71] Traditionally this has been through the integration of knowledge from the natural and social sciences with the political processes of coastal decision-making, across the science-policy interface. However, by recognising the uncertainty, plurality and high political stakes that characterise most meaningful coastal issues, and endorsing models of coastal governance, this necessitates new epistemological norms. The debate around epistemological perspectives for ICM is as old as the field itself, and it is to this debate that this chapter turns.

This chapter therefore returns to the guiding framework of this research set by ICM, and effectively brings together the two parallel projects undertaken in Part II. In this way it takes as its point of departure an interactive governance perspective on ICM (echoing Chapter 2), and explores the dialogic epistemology that this implies (following Chapter 3); seeing knowledge as held by the full spectrum of coastal stakeholders, and communicated through many different forms of dialogue, within many different 'institutional settings;' from the court-room to the board-room to the back-room. From this starting point, this chapter questions which kind of ICM institution can bring together this diffused knowledge and present it in a form best able to support decision-making; focussing the discussion on the science-policy interface.

The science-policy interface setting has traditionally been the focal point when discussing the integration and mobilisation of knowledge for decision-making, and has stimulated a sophisticated

[71] See Appendices A and B

literature within the study and practice of ICM. Over the past 40 years, ICM authors have framed dialogue within the science-policy interface setting in many ways; evolving from an exclusive science-based interface, to more participatory interfaces that advocate dialogue between all diverse stakeholders and their multiple knowledge systems. This chapter will describe the evolution of the science-policy interface within the field of ICM, and the resultant impacts on theory and practice. It finishes by asserting, in accordance with ICM authors, that within the context of coastal governance for 'post-normal issues', the science-policy interface needs to be framed as participatory and deliberative. Particularly, it should be a setting that:

a) espouses a new epistemology based in the dialogic mobilisation of knowledge;
b) includes all diverse forms of knowledge;
c) integrates disparate knowledge systems through dialogic reciprocity and co-existence;
d) has explicit regard for the negotiated *quality* of knowledge relative to a specific issue.

2. ICM as 'interactive governance:' implications for the mobilisation of knowledge

2.1 Diffused knowledge mobilised through dialogue within institutions

ICM authors such as Clark (1998), Glavovic (2008a), the IOC (2006), Olsen (2003b), Stojanovic, Ballinger and Lalwani (2004), Stojanovic and Barker (2008), Tobey and Volk (2002), Turner *et al* (1998) and Vallega (1997) recognise that within a complex coastal governing system, knowledge for coastal governance is not concentrated within any one group of stakeholders or institution, but diffused throughout the entire network. In the sociological tradition, all stakeholder groups, from indigenous peoples, to local communities, to the scientific community, are deemed to construct their own unique knowledge of their perceived reality, which guides their behaviour towards each other and the coastal system-to-be-governed (Zermoglio, et al., 2005). Knowledge-building is therefore itself a collective activity, with different knowledge systems differentiated across different groups; (i) appropriated for the ends of the group, (ii) judged 'rational' according to its own internal standards, and (iii) normatively loaded with the values of the group (Fuller, 2007). In this way knowledge relevant to coastal management is not only the 'formal' kind, which has passed universally accepted rules of rigor (viz. 'normal science'), but includes other 'informal' forms of local and indigenous knowledge for instance, which is judged according to its own criteria of credibility (Fabricus, et al., 2006). Moreover, much of the knowledge is not made 'explicit' in terms of being communicated in a written or categorical form useful to coastal governance, but remains 'tacit' to use the terminology of Polanyi (1967), meaning that it remains within the minds of stakeholders; implicit and personal to them. Therefore, in order to be salient and legitimate, knowledge in support of coastal governance must extend to the mobilisation and inclusion of all diverse knowledge systems. This has heralded what Vallega (1997) terms an epistemological shift in ICM, 'from a disjunctive approach to a conjunctive approach;' that is, a shift from the Cartesian paradigm to a dialogic one.[72]

Faced with the uncertainty, plurality and politics of post-normal problems, the theory and practice of ICM has increasingly turned to a 'dialogic epistemology;' it is through dialogue that the myriad different knowledge systems are made 'explicit' and mobilised in a state able to support collective deliberation and decision-making. Vallega (1997) asserts that such a conjunctive approach to knowledge for coastal management is made necessary by the significant uncertainties that cloud many issues, and by extension, in recognition of the possibility for plural perspectives that are all valid though not necessarily consistent; challenging the 'myth' of objectivity. Knowledge for collective decision-making is mobilised through negotiations between the diverse knowledge systems about what is accepted as a 'fact,' and influenced in equal measure by 'values' as by 'evidence' (Fuller, 2007; Henrickson & McKelvey, 2002). The reality of an issue is constructed by a tangle of intersecting stories, as stakeholders perceive the world around them, make sense of it, and communicate it to others (Blaikie, 1996; O'Connor, 1999a). This moved McFadden to describe coastal 'places' in terms of Massey (Massey, 1999, as cited in,McFadden, 2008, p. 274), as where: "distinct stories coexist, meet up, affect each other, come into conflict or cooperation…it is constantly, as space–time, being made." It is through dialogue, for instance, that: (i) diverse perspectives are brought together; (ii) new knowledge is constructed; (iii) coastal stakeholders learn of the issues and each other; (iv) knowledge is evaluated for its quality; and (v) knowledge is transformed into a state able to support collective decision-making (Clark, 1998; Tobey & Volk, 2002; Turner *et al*., 1998; Vallega, 1997). The form that this dialogue takes, and thus the way in which knowledge is mobilised, is determined in large part by the institutional setting.

Recalling Figure 5 from Chapter 3, we can note that within a coastal governing system, knowledge is constructed through diverse dialogue(s), diffused across multiple institutional settings, with certain of these settings more closed or open in their dialogue than others. However, where knowledge is trapped within closed dialogic silos, this is only a slight improvement on Vallega's (1997) disjunctive condition, where knowledge systems exist mutually exclusive of each other. Within these settings knowledge is uniquely revealed, but it is less usefully mobilised for *collective* deliberation and decision-making to tackle post-normal problems. The challenge is to create settings wherein knowledge is mobilised through inclusive dialogue, integrated according to principles of reciprocity, and negotiated to be of high quality.

[72] See Chapter 3 and Appendix B for a broader discussion on the dichotomy between a Cartesian and a dialogic epistemology.

2.2 Creating institutional settings for the integration of knowledge

Viewing coastal governance through an 'interactive governance' lens admits a plurality of legitimate yet inconsistent knowledge systems and diffuses them throughout a complex network of institutional settings. However, this presents a significant dilemma for informing coastal governance; how to integrate knowledge into a collective understanding of an issue to get beyond intractable politics and arrive at a legitimate 'social choice?'[73] This dilemma has two components; firstly how best to bring together all disparate knowledge systems and dialogue within one institutional setting, and the second more profound challenge of reconciling perspectives where they are inconsistent. That is, if the complexity and uncertainty of post-normal problems allows for two (or multiple) legitimate perspectives to exist in apparent contradiction, how can stakeholders collectively agree on a single course of action, and to what extent can this action be said to be based in 'high quality knowledge' or a 'good understanding?' If knowledge is viewed as a product of the social groups which generate it, then different groups possess very different conceptions of what constitutes knowledge, and how to evaluate its quality. Consider the challenge posed by reconciling the at times apparently conflicting perspectives of *experiential* indigenous knowledge, which is judged credible on the basis that it is recounted by a respected and trusted elder, with *experimental* science, which is judged credible on the basis of a robust and reproducible scientific method. Indeed, as Sarewitz (2004) notes, within the scientific community itself, even within the same discipline, there can be conflicting accounts of the same phenomena as a result of the reductionist study of a complex and dynamic system.

Institutional settings are able to provide the means for bringing together and integrating divergent perspectives for collective deliberation and decision-making, by framing the dialogue between stakeholders. As seen in Chapter 3, O'Connor (1999a) defines two notions of reconciling diverse perspectives, with this discussion extended to governance by authors like Berkes *et al* (2003; 2006) and Reid *et al* (2006). O'Connor's 'Laplacian' approach attempts to structure dialogue such that all knowledge systems are reconciled within one framework, drawn from one knowledge system, and evaluated according to its measures of quality. This means 'translating' many different forms of dialogue into a single, common form. Reid *et al* (2006) note how in current practice, many forms of integrated knowledge collection in essence transform informal knowledge into formal scientific knowledge through an implicit peer review method. However, if scientific standards of quality are not accepted by these other social groups, then to what degree will they accept their scientifically transformed knowledge as credible and legitimate? The dilemma remains. In contrast, O'Connor's 'dialogic' perspective *relativizes* the plurality of perspectives in co-existence and collective understanding. Stakeholders accept the co-existence of mutually exclusive perspectives, and

[73] See Chapter 3 and Appendix B

attempt to find bridges between them through dialogue and reflexivity, steered by the principle of reciprocity; with credibility measured according to the criteria of the respective knowledge systems. The key impediment to this approach is the difficulty in achieving real dialogue, given much of coastal governance dialogue is shaped by power.

Chapter 3 showed that there are a number of different dialogic traditions outside of ICM that have attempted to integrate knowledge through reciprocal dialogue, and create institutional settings to this end. Particularly, the broad academic traditions of 'Co-Management,' 'Social Learning,' and the 'Science-Policy Interface' have all proposed institutional settings (see e.g. Deliberative Democracy (Dryzek, 2002), Collaborative Learning (Daniels & Walker, 1996) and Post-Normal Science (Funtowicz & Ravetz, 1993) respectively) where all forms of knowledge and dialogue have been admitted, and attempted to integrate them through reciprocal dialogue. In so doing, these settings evolve from their previous focus on bridging the stakeholder 'dyad' to take on a far more participatory and deliberative form, while retaining many of their original traits (see Figure 5, Chapter 3). As a synthesis of all dialogue, knowledge from inclusive and integrated settings can be readily appropriated within the full diversity of institutional settings. Knowledge mobilised thus can be equally applicable for decision-making within formal state apparatus, such as the court-room, to the private sector's market place, to the multitude of civil society forums such as community volunteer programmes; it is able to support the totality of collective decision-making. Compare this with the knowledge emerging uniquely from an exclusive and closed institutional setting such as within a scientific discipline, which may find limited applicability in supporting decision-making in another institutional setting, such as within the market, or within a local fishing club. Inclusive and integrated settings mobilise knowledge in a form that transcends institutional boundaries.

2.3 A focus on the institution of the science-policy interface

As noted, ICM represents a comprehensive and coordinated governance approach to bringing together the many different forms of dialogue from diverse stakeholders, and integrating knowledge for mobilisation in support of governance. Thus ICM programmes attempt to break down the isolationism that can occur within fragmented governing systems; making the dialogue within these settings transferable, or creating new (often informal/non-statutory) settings into which dialogue from all settings are equally accommodated; through deliberative fora or dynamic decision-making processes that encourage interaction across settings.

While recognising that multiple institutional settings are relevant when discussing the mobilisation of knowledge within a coastal governing system, it is to the 'science-policy interface' setting that this chapter now turns. Since its inception in the 1960's, ICM has placed a central importance on the successful integration of knowledge from the natural and social sciences with the political processes of coastal decision-making, across the science-policy interface. Therefore, within ICM the science-policy interface has traditionally been the setting for the most sophisticated discussion on epistemological questions, and means for mobilising knowledge in support of decision-making. The next section examines the science-policy interface within the ICM tradition. Given ICM is a pragmatic and reflexive field, with tight feed-back loops between the evolution of theory and practice, the section provides (i) a brief overview of the history of ICMs science-policy interface; (ii) an examination of the theories and principles shaping the interface; and (iii) an exploration of the current state of the interface in practice.

3. ICM and the science-policy interface setting

3.1 The evolution of the science-policy interface for ICM

ICM has always placed a central importance on the successful integration of knowledge, particularly from the natural and social sciences, with the political decision-making process across the science-policy interface. At its inception as 'Coastal Zone Management' (CZM) through the Stratton Commission report in 1969, there was an emphasis on the improved management that would result from investments in science and technology (Cicin-Sain & Knecht, 1998). As an emerging discipline of its time, CZM was therefore heavily influenced by the dominant modernist management paradigm, and its science-centric science-policy interface (Stojanovic, et al., 2004). Throughout the 1970's the field of CZM continued to develop, and through the influence of ecology, systems science and other maturing disciplines, the coastal marine area became increasingly viewed as complex and interconnected. With this came a realisation that collecting science for the coast must be similarly complex and interconnected, necessitating a multi-disciplinary approach at the science-policy interface (Cicin-Sain & Knecht, 1998). By the 1980's the field began to 'mature,' and 'Coastal Zone Management' became 'Integrated Coastal Management.' Vallega (1997) noted that this tradition was shaped by three key influences which similarly affected the science-policy interface: (a) an increasing recognition of concepts of 'global change;' (b) a more advanced discussion on the complexity and uncertainty of the coast, leading to a focus on 'interdisciplinarity' to replace multi-disciplinarity; and (c) an increasing emphasis on placing science in the service of 'sustainability' rather than 'progress.'

By 1992 the UNCED Rio Earth Summit and Agenda 21 had established ICM as the central organisational concept for sustainable coastal management around the world. The conference set the goal that all coastal nations would have an ICM programme in place by 2000, but did not specify any strategy by which knowledge, including the best available science, could be mobilised in support of ICM. As such, in 1994 the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (or GESAMP) assembled a task force to better elucidate the role of the science-policy interface in ICM. GESAMP (1996) recommended that 'more science' may not be enough in the face of issues increasingly perceived as complex and uncertain. That noted, GESAMP offered a 5-stage cyclic decision-making process to describe the evolution of an ICM initiative, and demonstrated the specific contributions of science at each stage. It argued that "scientists and managers must work together as a team" to implement ICM initiatives as adaptive management 'experiments.' A decade later, the World Summit on Sustainable Development (WSSD) in Johannesburg revisited the goals of Rio, and reviewed the slow progress in national ICM programmes. Like Rio, the WSSD led to a reformulation of ICM, this time toward models of 'governance,' with profound consequences for the science-policy interface.

3.2 Theories and principles shaping the ICM science-policy interface

An analysis of the evolution of the ICM science-policy interface and its principles can discern two broad traditions evolving in parallel: (a) a science-based interface concerned with how best to mobilise science for governance; and (b) a participatory interface that encourages dialogue across multiple knowledge systems. This dichotomy can be further loosely described in terms of those authors advocating for the collection of new knowledge, belonging to the former tradition, and those authors who argue that there already exists enough knowledge to support wise decisions but that this knowledge is disintegrated, belonging to the latter. Broadly, those advocating science see uncertainty as a lack of science, necessitating settings that effectively create new science and channel it to decision-makers. Alternatively, those advocating participation see uncertainty as inevitable and aggravated by a lack of integration, necessitating interdisciplinary and participatory settings to more effectively bring together the knowledge that already exists. This noted, the dichotomy is not as stark as this, with some overlap between the two approaches; there is research into the forms of science most amenable to deliberation within a participatory setting for instance. Therefore, the science-policy interface within the literature on ICM is characterised by a melange of principles from both traditions.

Ecosystem-based

The perception of the coast has been significantly influenced by ecology, with implications for the way society 'knows' its coast in order to manage it. Forst (2009) describes how the rise in prominence of 'ecosystem-based management' in the mid-1990's, and its endorsement at WSSD, led ICM authors to address the coast as a complex and dynamic humans-in-nature ecosystem, or social-ecological system; to the point where ecosystem-based management has become a fundamental principle of contemporary coastal management (Cicin-Sain & Knecht, 1998;

International Oceanographic Commission, 2006; Stojanovic, et al., 2004; Vallega, 1997), and has been enshrined within the legislation supporting ICM initiatives in Europe for example (De Santo, 2010). Rather than concentrating on the individual elements of the coast, a holistic ecosystem-approach concentrates on the complex, non-linear, and cross-scale interconnections within and among ecosystems, including social systems. Associated with this ecosystems-focus, a number of authors writing on coastal management (see e.g. Cicin-Sain and Knecht (1998) Costanza (1999), Forst (2009), Nicholls and Branson (1998), Olsen (2000) and Vallega (1997)) have drawn parallels with the learning from 'resilience' and 'ecological economics,' by asserting that coastal management should have as its first priority the sustaining of key processes and structures that underlie the health of the whole ecosystem; thereby maintaining the ecosystem services upon which society is dependant. The science-policy interface becomes charged with understanding the connectivity within a system, and the health of key ecosystem variables.

Adaptive and precautionary management

Recognising the complexity associated with a coastal ecosystem-based approach implies recognition of the significant degrees of uncertainty and unpredictability inherent in managing such a system; necessitating an adaptive approach steered by the principle of 'precaution' (Botsford, Castilla, & Peterson, 1997; Forst, 2009). Therefore, adaptive management and precaution have been linked closely to ecosystem-based management, and have become equally fundamental principles of coastal management, (Botsford, et al., 1997; Cicin-Sain & Knecht, 1998; J. R. Clark, 1998; Stojanovic, et al., 2004; Tobey & Volk, 2002). Adaptability explicitly acknowledges the presence of uncertainty, but argues that it does not preclude taking action, thereby freeing society to 'progress with caution,' with particular emphasis on 'learning by doing.' This means creating flexible governance institutions where stakeholders iteratively evaluate the outcomes of management actions, reflect and learn from them, before implementing more-informed actions. In this way, management interventions in a coastal system constitute experiments; furnishing the science-policy interface with an on-going stream of information (Knol, 2010; Torell, 2000).

Science-based

For a number of commentators (e.g. De Santo (2010), Forst (2009), Knol (2010), McFadden (2007) and Turner (2000)) coastal management's focus on complex ecosystems, and the experimental nature of adaptive management, has necessitated a strong scientific presence to inform decision-making. Korfmacher (2002) and Bennett *et al* (2005) for instance, both provide accounts of ICM programmes that have demonstrated the tight relationship between (a) ecosystem-based, (b) adaptable and precautionary, and (c) science-based management.

ICM authors such as Cicin-Sain and Knecht (1998), Clark (1998), Stojanovic, Ballinger and Lalwani (2004), Stojanovic *et al* (2009) and Tobey and Volk (2002), assert scientific evidence is essential for addressing complex and uncertain coastal issues; providing a robust knowledge base and lending legitimacy to the decision-making process. As such, Cicin-Sain and Knecht (1998), and GESAMP (1996) have proposed that there be scientific inputs into every stage of the ICM decision-making process, ranging from scoping the issues, to designing the policy alternatives, to predicting future outcomes, to monitoring implementation. This has led a number of ICM programme evaluation frameworks to include robust scientific input as a key criteria of effective coastal decision-making (see e.g. Ehler (2003) Henocque (2003), International Oceanographic Commission (2006), Olsen (2003a) and Pickaver *et al* (2004)). This all combines to demonstrate the importance that coastal management has placed in science, and the degree to which it has moulded an evolving science-policy interface to incorporate scientific advice. However, despite this, commentators such as Boesch (1999), Cheong (2008), McFadden (2007), and Harremoes and Turner (2001), argue that there has not been enough of an emphasis on science-based management, with too greater prominence placed in institutions for building consensus across values at the expense of institutions for ensuring decisions are well supported by rigorous science. For them, science provides a credible, salient and legitimate source of knowledge for understanding the complex relationships between systems.

Interdisciplinarity

Given coastal management interventions are made within complex and interconnected social-ecological systems, decision-making needs to be informed by science that reflects this reality. In this regard, reductionist disciplined science alone is inadequate. Ecosystem-based ICM demands an interdisciplinary approach to science that demonstrates the complex and co-evolutionary interactions between the social and ecological categories of systems, and how management interventions may alter this relationship (Olsen, et al., 1998; Smith, 2002; Stojanovic, et al., 2009; Tobey & Volk, 2002; R. K. Turner, 2000; Vallega, 1997). This has led ICM authors, such as Cicin-Sain and Knecht (1998), and Tintore *et al* (2009), to assert that well-informed coastal management requires both integration across disciplinary boundaries, and across the science-policy interface; with this often approached as two sides of the same coin.

Interdisciplinarity advocates institutions that nurture a dialogue across various scientists and policy-makers, often to construct and model the various causes of an issue, before predicting any potential outcomes from targeted interventions. One commonly promoted interdisciplinary mechanism for expressing the interaction between coastal social-ecological systems is the Driving Forces-

Pressure-State-Impact-Response, or DPSIR, framework. By demonstrating the relationship between social forces, the degradation of ecosystems, and the resultant interventions into these two categories of system, DPSIR both assembles and structures disparate scientific information, and communicates it in a form relevant to ecosystem-based management. Autunes and Santos (1999), Nicholls and Branson (1998), Turner (2000) and van der Weide and Van Koningsveld (2001), all provide accounts of the DPSIR model for shaping interdisciplinary science to inform decision-making. A second interdisciplinary mechanism is Integrated Assessment (IA) as a "process of combining, interpreting and communicating knowledge from diverse scientific disciplines in such a way that the whole cause–effect chain of a problem can be evaluated from a synoptic perspective, of added-value to decision-making" (Rotmans and Dowlatabadi, 1997, as cited in J. P. Van der Sluijs, 2002a). Often this expresses itself through the creation of interdisciplinary models, as demonstrated by Autunes and Santos (1999), Ruth (2008), Ticehurst (2008), Tintore *et al* (2009), Turner (2000) and Varghese *et al* (2008) or through expert panels, as Knol (2010) described. Thirdly, interdisciplinary science is used as a means to assemble knowledge in one place, so as to make it easily locatable and accessible for coastal decision-makers across multiple different institutional settings. This centralised feature of coastal management science is central to effective management according to those evaluating ICM (Ehler, 2003; Henocque, 2003; Pickaver, et al., 2004).

Participatory science-policy interface

In parallel with science-based ICM programmes, a number of other scholars have advocated a more participatory science-policy interface. In recognition of the complexity and uncertainty of coastal social-ecological systems, the scientific community has acknowledged that it cannot provide complete certainty on the functioning and future of the coast. In so doing, science has given ground to other knowledge systems, with coastal partners beyond the state particularly arguing for a more participatory interface to support decision-making (Runhaar & van Nieuwaal, 2010). This view relativises scientific knowledge along-side other types of knowledge relevant to decision-making; recognising that all knowledge (even science) has some value basis, and can be used in a strategic way (Hommes, Hulscher, Mulder, Otter, & Bressers, 2009; International Oceanographic Commission, 2006; Runhaar & van Nieuwaal, 2010). Integrating all forms of knowledge in a participatory institution of collective research and inquiry recognises not only the political reality of a coastal 'governing system,' but also the epistemological reality that a complex puzzle cannot be completed using only a few scientific pieces; harnessing multiple perspectives builds a more complete vision of the issue (Cicin-Sain & Knecht, 1998; Ehler, 2003; Knol, 2010; Tobey & Volk, 2002). Related to the integration across knowledge systems, is the integration of knowledge with action across the science-policy interface. A number of authors describing a participatory interface note the most important criterion to be ‘communication’ between scientists, civil society, state actors, and the private sector; ensuring that knowledge from all systems is communicated, or at times ‘translated,’ such that a clearer picture of the issue is created to support decision-making (deReynier, et al., 2010; Forst, 2009; Human & Davies, 2010; Stojanovic, et al., 2009).

The participatory opening of the science-policy interface can take many forms. It may be that a network of coastal governance partners are involved in identifying the gaps in their knowledge, and collectively set the scientific research agenda, as described by Human and Davies (2010), and Mahanty *et al* (2007) and Stojanovic *et al* (2009). Alternatively, it may be through the assembling of ‘knowledge banks’ that bring together not only perspectives from across multiple disciplines, but also across other knowledge systems, and make them equally available to all, such as those described by Mabudafhasi (2002), Sarda, Avila, & Mora (2005), or Stojanovic (2007). Other authors write about electronic tools to support the participation of non-scientists in the science-policy interface; providing effective means for channelling local or indigenous knowledge, for example through visualisation techniques (see Jude (2008)), or spatial interfaces (see Wheeler and Peterson (2010)). Still other authors describe research techniques for eliciting the tacit knowledge that remains within stakeholder groups, through ‘stakeholder analysis/mapping’ (McCreary, et al., 2001; Rockloff & Lockie, 2006) or ‘participatory rural appraisal’ (Chua, 1993) for instance, such that it can be appropriated alongside science. What these all have in common is a valorisation of other forms of knowledge alongside science, and the importance of incorporating them within a science-policy interface that allows effective communication between all stakeholders.

3.3 The science-policy interface in ICM practice

Having acknowledged the theory and principles influencing the coastal management science-policy interface, this chapter turns to consider how these principles are in fact put into practice. Again, there emerge the two parallel ICM traditions mentioned in the last section. Following the science-based tradition, a number of authors describe the modernist, or ‘linear’ model, that has been prevalent in coastal management (Forst, 2009) and espouses the traditional view that, “given the increasingly technical and specialised nature of decision-making, scientists and technological experts are needed to clarify and structure the policy options open to decision-makers” (Fritz, 2010, p. 3). According to this model, science is the limiting factor, with more science leading to better informed decisions (Olsen, 2000; Tribbia & Moser, 2008). Indeed, as Hommes *et al* (2009) describe, this linear model continues to find active expression even while it is subjected to significant criticism from some quarters of coastal management; specifically, those promoting a participatory science-policy interface.

For a number of authors, the linear model that turns science into policy options, is not realistic for resolving post-normal problems (Hommes, et al., 2009); particularly owing to the strong politics that are active within a governing system, and the lack of effective communication. Authors like Boesch (1999), Cheong (2008), Fritz (2010) and Runhaar and Nieuwaal (2010) point out that there is a crisis of credibility and legitimacy confronting the closed science-policy interface, with science no longer accepted as a value-free and unbiased speaker of the 'truth.' Increasingly coastal stakeholders are complaining that science itself is appropriated for strategic political behaviour. Runhaar and Nieuwaal relate the political appropriation of science to a failure to communicate, both across knowledge systems and across the science-policy interface. Politicised science and its poor communication have led to an increasing 'disconnect' between science and decision-making (deReynier, et al., 2010; Runhaar & van Nieuwaal, 2010; Tribbia & Moser, 2008); leading Cicin-Sain and Knecht (1998) to comment that the science-policy interface was one of the least well integrated institutions across ICM practice.

Another enduring reason for the 'disconnect' between science and policy stems from the divergent worldviews that each represent. A number of authors on coastal management, including Cicin-Sain and Knecht (1998), De Santo (2010), Stojanovic *et al* (2009) and Tribbia and Moser (2008), have made explicit the barrier to communication associated with the different cultures and paradigms followed by state actors and the scientific community, and moreover, the lack of incentives for overcoming this barrier. The scientific community is broadly characterised by an objective and long-term pursuit of learning the 'truth,' with value placed on rigorous attention to details in the collection of scientific evidence according to an accepted method. Conversely, state actors such as policy-makers are more concerned with making decisions in the short-term, and are well-versed in the pluralistic political realities of the decision-making arena. Within this arena, state actors expect to appropriate clear and definitive scientific evidence to sit alongside other 'softer' forms of evidence employed in decision-making; rhetoric for example. This disjoint between the scientific and the political has led to misunderstanding as to the nature of the science-policy interface, leading to miscommunication between the two groups, misuse of each other's 'products,' and a generally conflictual interface (Cicin-Sain & Knecht, 1998).

Related to this disjointed interface are the oft misunderstood concepts of risk and uncertainty. Given the short-term imperative of a well-informed decision, state actors demand unambiguous answers as to the actual state of the environment, and its future trajectory. Where the future is not completely certain, then it should be quantified according to the calculable level of risk associated with a set of possible trajectories. The scientific community on the other hand often recognise a number of uncertainties in their knowledge, many of which are irreducible in the short-term, and unquantifiable in terms of risk (Stojanovic, et al., 2009). As Botsford *et al* (1997), De Santo (2010), and Knol (2010) write, coastal management led by state actors often ignores these uncertainties as endangering a short-term determination under intense political pressure; preferring instead to quantify uncertainty as risk. De Santo (2010, p. 418) argues that, "…there needs to be a conscious effort on the part of scientists and policy makers to realign the definition of uncertainty to reflect its more positive aspect, i.e. uncertainty as information, as a call to action, as a reason for research—not as a reason to delay a precautionary approach to environmental management."

A growing realisation of the complex mix of science and politics within the coastal and marine science-policy institutional setting has led authors to increasingly describe the interface in terms of interactive governance (Boesch, 1999; Fritz, 2010; Hommes, et al., 2009; Knol, 2010; Stojanovic, et al., 2009). In this way, scientists are brought into the complex and dynamic network of stakeholders, rather than remaining neutral and disinterested advisors. Scientific advice is communicated in terms of the political interactions that characterise coastal governance, constituting the co-construction of knowledge and politics, or values, according to authors like Knol (2010) and Fritz (2010). Fritz emphasises that in order for science to retain an important role in informing coastal management, the scientific community must recognise that it is itself a construct of society, and only one among a number of knowledge systems. From this point of view, the science-policy institutional setting must nurture democracy while preserving the benefits of scientific advice (Fritz, 2010). Thus authors from Cicin-Sain and Knecht (1998) to Runhaar and van Nieuwaal (2010), have advocated institutional settings such as fora that are inclusive of all knowledge and allows all participants to debate knowledge and values simultaneously. As Fritz (2010, p. 3) notes, interaction and institutions are mutually influential:

> *"…science, politics and law are seen to mix to shape institutions, governance processes and indeed concepts of democracy and politics. Concerning scientific advisory processes, it follows that the conceptual and institutional framework defined at the beginning of the process will substantially affect the advice proffered and its acceptance by the policy communities. The search must, therefore, be for a process that offers particular credibility and legitimacy with the best possible standards of scientific knowledge."*

4. Principles for framing the science-policy interface as a governance setting

4.1 Framing the science-policy interface as a governance setting

Recognising the science-policy interface as one institutional setting within a complex governing system (see e.g. Cicin-Sain and Knecht (1998), De Reynier, Levin and Shoji (2010), Fritz (2010), Stojanovic, Ballinger and Lalwani (2004) and Tobey and Volk (2002)) necessitates a new 'integrated, interactive and adaptive' approach (Norgaard, Kallis, & Kiparsky, 2009). Such institutional settings recognise the multi-faceted, pluralistic and political nature of dialogue, where knowledge is employed as evidence in support of diverse and often conflicting values (Boesch, 1999; Fritz, 2010). Knowledge on an issue is therefore deemed to be co-constructed along-side values through dialogue, or indeed negotiation, between stakeholders within the setting (Boesch, 1999; Tobey & Volk, 2002). This provides a constructivist basis to the science-policy interface (Boesch, 1999; Tobey & Volk, 2002; Vallega, 1997), with Norgaard *et al* (2009) arguing that all stakeholders, including scientists, need to understand that they each possess a 'filter' through which they have a unique perspective on the world, which is at least as coloured by values as it is by facts. By understanding the way in which their own knowledge system is socially constructed, they can understand the construction of knowledge across systems within the interface setting. However, admitting a plurality of legitimate knowledge systems also admits a plurality of measures of knowledge quality.

4.2 Addressing knowledge quality

The 'quality' of the dialogue between stakeholders and the associated quality of the knowledge used to support decision-making, is an often neglected aspect of a coastal science-policy interface defined in terms of governance. However, appraisal of the science-policy interface according to agreed-upon principles of quality is deemed essential by some authors like Fritz (2010), and Runfaar and van Nieuwaal (2010). Fritz (2010) discusses principles that could be used to guide interactions within a science-policy interface, and measure the quality of the knowledge mobilised; including procedural measures of diverse participation in an open, transparent and accountable process, and more substantive measures of knowledge in terms of its 'credibility, salience and legitimacy' for supporting deliberation on an issue. Such principles find a basis in a much wider literature on the quality of knowledge needed to support collective deliberation and decision-making, with measures of credibility, salience and legitimacy often reappearing (Cash, et al., 2003; US National Research Council, 2007). Tobey and Volk (2002) similarly emphasise the importance of a participatory and rigorous process by which to structure the ICM interface, but argue that the quality of the diverse knowledge 'products' employed can be evaluated according to peer review within their respective domains. This again raises the issue of 'integration,' (see Section 2.2) because different knowledge systems will not always offer consistent interpretations of an issue, and will rarely have consistent criteria of knowledge quality.

Korfmacher (2002) draws on analysis of a coastal management case study to argue that a strict and fragmented scientific peer review process, while ensuring each disciplines standard of credibility, was inadequate for ensuring knowledge was salient and legitimate to support decision-making within an applied and political context. For those authors supporting a participatory setting, restricting concepts of quality to those of science alone discredits other forms of knowledge which are measured according to different measures of quality. These authors encourage profusion of communication, arguing that where stakeholders fail to understand each other, owing to jargon for instance, then they are more likely to doubt the credibility, salience or legitimacy of another's knowledge (De Santo, 2010; Human & Davies, 2010; Stojanovic, et al., 2009). Costanza (1999) argues therefore that besides a participatory and robust process, the quality of the knowledge mobilised needs to follow a system whereby inconsistencies between knowledge systems are addressed; a breaking down of the mutually exclusive compartments within which knowledge systems are locked.

4.3 Distilling four key principles for framing the science-policy interface

With an increasing number of ICM authors describing the science-policy interface as a governance setting, this chapter attempted to distil a number of key constitutional principles for framing such a setting. A number of authors have written on the characteristics of institutional settings required to nurture quality dialogue for the mobilisation of knowledge in support of collective decision-making (see e.g. Boesch (1999), Cicin-Sain and Knecht (1998), Costanza *et al* (1999; 1999), De Reynier, Levin and Shoji (2010), Fritz (2010), Knol (2010), Norgaard *et al* (2009), Tobey and Volk (2002)). Across this multitude of authors there is some overlap around four broad themes.

Firstly, the settings must be deliberative, facilitating high quality dialogue for the mobilisation of knowledge. This dialogue must (a) have an explicit basis in the complex and uncertain nature of coastal social-ecological systems, and (b) have an explicit goal of contributing toward conflict resolution, and agreement on collective choices. The quality of dialogue can for instance be discussed in terms of the quality of communication, and of listening in particular; as embodied within notions of 'elicitive participation' and 'active listening.' Secondly these settings must be participatory and accommodating of all stakeholders and their perspectives, including their values alongside their knowledge. Achieving this outcome necessitates deliberate identification of stakeholders, and where appropriate, active measures to engage those who would otherwise remain excluded because of their marginalised status within prevailing decision-making processes. Thirdly, settings must be integrated, ensuring that disparate knowledge systems are not left to exist in isolation. This is integration in the form of reciprocal dialogue that brings together the at-times inconsistent perspectives, and encourages their co-existence *relative* to each other. Where possible this dialogue should also aim to *reconcile* conflicting perspectives into a common understanding of an issue, according to principles of reflexivity, adaptability and learning. In this way, stakeholders reflect and adapt their perspective both according to what they learn from other stakeholders, and from their experience though management interventions. Fourthly, a setting needs to have an explicit treatment of notions of 'quality.' This is quality both in terms of the process followed to mobilise knowledge, and the quality of the knowledge 'products' themselves. As for process, the setting should aim to nurture the best quality dialogue possible, and build capacity among participating stakeholders for future dialogue. As for the quality of the knowledge mobilised, this can be achieved through a cross-system evaluation of stakeholder knowledge, whereby stakeholders collectively apply common measures of quality that transcend any one knowledge system.

Finally, there are a number of dialogic epistemological perspectives that have been put forward to guide the evolution of a participatory and deliberative science-policy interface for ICM according to the above four themes. Glavovic (2008a) and Korfmacher (2002) both proposed Lee's (1993) 'Civic Science' as a perspective on the re-marriage of science and politics within democratic dialogue; with models such as Haas' (1992) 'epistemic community' finding mention. Alternatively, Knol (2010) introduces Gibbon's 'Mode 2' science as a contextualised science for policy; inclusive, interdisciplinary, socially accountable and reflexive. Costanza *et al* (1999) and Boesch (1999) have both, in implicating an ecological economics of the oceans and coasts, argued for a 'trans-disciplinary' approach, which goes beyond blurring disciplinary boundaries to the extent that it re-draws new boundaries relative to a conglomerate of different knowledge systems. Finally, Kendra (1997) and to an extent Costanza (1999) have introduced Funtowicz and Ravetz's (1993) 'post-normal science' perspective to structure the science-policy interface, where the knowledge 'quality' becomes the guiding imperative rather than scientific 'truth,' and stakeholders become participants in an 'extended peer community.'

5. Conclusion

As ICM has become increasingly modelled as 'governance,' there has come recognition of the diffused nature of society's knowledge within a complex governing system, and the diverse ways social groups construct knowledge in different institutional settings. In order to address 'post-normal' coastal issues, society faces the challenge of how to bring together this knowledge in a form best able to support collective decision-making. To this end, some ICM authors have proposed democratising the science-policy interface in terms of a governance institution. Within such a participatory setting knowledge is mobilised through dialogue between all stakeholders, and is communicated in terms of the political interactions that shape coastal governance; constituting the co-construction of knowledge and politics or values. This is not, though, to reduce the role of science within the science-policy interface. The question is not whether scientists should be seated at the science-policy interface table – they should – but defining the way in which science contributes constitutes a key part of this challenge.

A number of ICM authors have written on key principles to guide the formulation of a participatory and deliberative science-policy interface setting that can be effective within the context of a governing system. While there are a multitude of authors, and a rich store of literature, four broad principles can be distilled: it must (a) follow a dialogic epistemology; (b) be inclusive; (c) integrate diverse perspectives according to reciprocal dialogue and common understanding; and (d) have an explicit regard for the quality of both the process and the knowledge product.

The above conclusion demonstrates a strong degree of congruence between the ICM epistemological debate, and the wider literature on dialogic governance reviewed in Chapter 3. As ICM has looked to models of governance, some authors have come to discuss the dialogic epistemological perspective that these models imply, and have advocated mobilising knowledge according to the same four broad principles we see often repeated across the wider literature. Within the field of ICM though, the debate on how to link knowledge with decisions has historically focussed on the specific institution of the science-policy interface, at the expense of the other institutions wherein knowledge is mobilised dialogically. As such, the thesis enters this epistemological debate from a perspective on ICM as interactive governance, and looks at how the science-policy interface can be framed in order to give effect to high quality governance.

This chapter unpacked a family of epistemological approaches that have been put forward for framing the ICM science-policy interface consistent with models of governance, including the 'post-normal science' approach, which has been described in Chapter 3. From this point, the thesis seeks to unpack the potential of the post-normal science approach relative to its contributions to high quality coastal governance as defined in Chapter 2. In Chapter 5, the discussion turns to look how a 'post-normal' science-policy interface may contribute to ICM in theory, and to what degree it has found practical expression across the ICM literature.

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STATEMENT OF CONTRIBUTION
TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

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Name of Published Paper: Mobilising knowledge for coastal governance:
re-framing the science-policy interface for Integrated Coastal
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In which Chapter is the Published Work: Chapter 4

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Chapter 5: How can a ‘post-normal’ science-policy interface contribute to Integrated Coastal Management? A review of the literature.

1. Introduction

The last chapter served to characterise the debate within which this thesis situates itself, which was unpacked relative to the evolution of the science-policy interface for ICM in theory and practice. As ICM has become described in terms of coastal governance, some authors have sought to democratise the science-policy interface to give effect to new epistemological norms of dialogue, inclusiveness, integration and quality. This has opened a discussion on how best to give effect to these norms, with ‘post-normal science’ emerging as one potential approach for framing the science-policy interface. In this chapter we turn to explore this particular perspective and interrogate it according to the ICM literature, asking: (i) how may a post-normal science-policy interface contribute to coastal governance *in theory*? And (ii) how has a post-normal science approach found expression *in practice*?

Chapter 5 constitutes the first step in exploring the meaningfulness of the particular perspective proposed by post-normal science for ICM. It draws on the conceptual framework developed in Part II, and applies it to the ICM literature as the first iteration of the research. This first iteration serves to both examine the pertinence of a post-normal science approach relative to criteria of quality coastal governance in theory and practice, and check the conceptual framework against ‘real world’ practice to determine its validity. In this way, the first iteration prepares the way for the second iteration of the research, through empirical studies in Part IV.

This chapter is split into three sections. In the next section we are briefly reintroduced to the post-normal science (PNS) perspective, which is outlined according to 12 characteristics. The third section interrogates the PNS approach according to its potential for giving effect to the measures of quality coastal governance outlined in Chapter 2, *in theory*. The fourth section looks to the published accounts of coastal management practice from the literature, seeking whether a PNS perspective has been put into practice, and if it has, how it has performed relative to measures of quality coastal governance. A fifth section concludes.

2. Focussing on post-normal science

The post-normal science (PNS) approach was described in some detail in Chapter 3; suffice here to recapitulate some of its key points and distil them into a list of key characteristics (see Table 6), in order to sharpen our focus on PNS for the remainder of the thesis. Founders Funtowicz and Ravetz argue that, faced with a new category of complex problems, the reductionist and disciplined 'normal science' described by Thomas Kuhn (1962), which emphasises the principle of 'objective truth' and marginalises uncertainty, is no longer attainable or relevant on its own for supporting decision-making (Funtowicz & Ravetz, 1994). Instead, with assumptions of uncertainty and plural valid perspectives, PNS introduces 'quality' as the organising principle of science. By so doing, this leaves the door open to new scientific norms of evidence and dialogue; thus 'post-normal' science ceases to be a model for formal deduction, and becomes an interactive dialogue among stakeholders espousing multiple knowledge systems (Funtowicz & Ravetz, 1993, 1994; Ravetz & Funtowicz, 1999). Therefore, while PNS prescribes an inclusive and integrated setting for all dialogue its primary focus is on mobilising and evaluating 'high quality' knowledge to support decision-making, and is thus best discussed as an approach for framing the science-policy interface according to a list of characteristics summarised in Table 6.

Stakeholders within a 'post-normal' science-policy interface setting represent an 'extended peer community;' charged with both effectively communicating their own perspective, and providing a critique of the other knowledge provided. Knowledge for decision-making is evaluated relative to collectively defined criteria of 'quality' for a specific issue, which could extend to (i) credibility, (ii) salience and (iii) legitimacy, to use the broad quality measures used in this thesis. Peer review thus requires the clear and jargon-free communication of knowledge so as to open it for critique, and is guided by policy-makers as knowledge-brokers, or 'mid-wives of problems' (O'Connor, 1999a; Van den Hove & O'Connor, 1997; Williams & Matheny, 1995). PNS settings are often subject to the same criticism levelled at all settings that seek dialogic reciprocity, that 'power' is omni-present in dialogue and that this power corrupts that ideal communication desired (Luks, 1999; O'Connor, 1999a). Accepting this criticism represents a call to bolster the decision-making process such that power is exposed and addressed where possible.

Table 6: Characteristics of the post-normal science approach

1) Focussed on the science-policy interface in support of decision-making for issues characterised by uncertainty, plurality and high stakes.
2) Complex social-ecological systems perspective.
3) Epistemological' uncertainty is explicitly recognised as inevitable and irreducible.
4) Dialogic setting wherein knowledge is mobilised and negotiated as 'evidence' in support of normative arguments.
5) Participatory setting admitting a plurality of equally valid perspectives.
6) Relativize, and where possible reconcile, conflicting perspectives according to principles of reciprocity and co-existence
7) Conflicting perspectives are evaluated for their *'quality'* in terms of supporting decision-making for an issue. Quality is the organising principle of science rather than 'truth.'
8) Stakeholders as members of an 'extended peer community,' which collectively evaluate knowledge according to collectively-derived criteria of quality; 'extended peer review.'
9) Reflexive
10) Social learning orientation in pursuit of understanding rather than truth
11) Adaptive cyclic process, with outcomes judged on the quality of the process.
12) Strategic, long-term perspective

The PNS approach as yet remains a fledgling practice; while it represents almost two decades of experimentation and refinement, it is not yet comfortably established in mainstream governance. That noted, there have been a number of methods and institutional settings put forward for giving effect to a PNS perspective. In short, any dialogic setting can be framed to give effect to the PNS ideals, including 'focus groups,' 'citizens juries,' and 'consensus conferences' for example (De Marchi & Ravetz, 1999); however owing to the complexities of transforming knowledge into a form useful for supporting action, PNS settings are often accompanied by other 'Decision Support Systems' or Tools. A number of authors cite PNS as an epistemological impetus behind 'Integrated Assessment' (also known as Integrated Environmental Assessment); particularly the participatory variations that bring together diverse knowledge systems, including 'Scenario Analysis,' 'Policy Exercises' and 'Participatory modelling' (Van Asselt-Marjolein & Rijkens-Klomp, 2002). Alternatively, stakeholders may be aided by 'checklists,' which guide them in their analysis of knowledge quality and address uncertainties, with Funtowicz and Ravetz' (1990) 'NUSAP' tool, and checklists for analysing the quality of models (see e.g. Risbey *et al* (2005) and Walker *et al* (2003)), examples of such checklists. A third example is the Decision Support System created by O'Connor (2007), titled 'The Deliberation Matrix.' This 'Matrix' information technology tool resembles participatory Multi-Criteria Analysis, where stakeholders can express their preferences for different policy options relative to a number of different variables and 'attach' certain indicators as evidence to support their preference.

3. The theoretical potential of a 'post-normal' science-policy interface for ICM

At its most simple, we can say that 'post-normal science' is an approach to the mobilisation of knowledge in support of collective decision-making and action; but how can we analyse the potential contribution of this approach relative to the specific form of collective decision-making presented by ICM? To what extent can the PNS approach claim to produce better 'informed,' or better 'supported,' or just 'better' decisions? To what extent can the PNS approach claim to be a preferable form of knowledge mobilisation than a purely technocratic, science-centric approach, or at the other end of the spectrum, a purely political and pluralistic bargaining exercise? It is to these questions that this section turns, and first attempts to address them through a theoretical discussion of potentialities, using the conceptual framework from Part II.

In both Chapters 3 and 4, the PNS approach was presented as one way of framing the science-policy interface as an institutional setting better suited to models of dialogic governance; endorsing epistemological norms of dialogue, inclusiveness, integration and knowledge quality. This has led authors writing on coastal governance like Kendra (1997) and Costanza (1999) to posit the PNS approach as a useful approach for ICM. Here we examine how, and to what degree, framing a post-normal science-policy interface does in fact contribute to ICM, employing the conceptual framework of ICM as 'interactive governance' presented in Chapter 2. Specifically, the contribution of the PNS approach to ICM is analysed relative to its potential for contributing to the quality of coastal governance institutions and interactions for collective decision-making.[74]

3.1 The potential contribution of PNS to institutional quality

How may the PNS perspective, *in theory*, contribute to high quality ICM institutions? That is, considering the claims put forward by those espousing a PNS approach, to what degree can we argue that it may encourage institutions of a greater 'quality,' relative to a set of criteria or

[74] See Chapter 2 and Appendices C and D for a more in-depth discussion of the evaluation of institutional and interactional quality.

principles? Drawing on the conceptual framework expounded in Chapter 2, the reflexive interaction between ICM practice and research has highlighted a number of practice-based 'meta-principles' that have demonstrated common applicability across diverse coastal contexts, and can be appropriated as measures of institutional quality. Following Chapter 2, here we employ the list of ICM principles provided by Stojanovic, Ballinger and Lalwani (2004), [75] with the potential performance of the PNS approach considered briefly against each principle:

Cooperative (see also; collaborative, coordinated, conciliatory, collective):

A post-normal science-policy interface can be classified as a cooperative setting, insofar as stakeholders are considered co-investigators within an 'extended peer community.' Stakeholders therefore collectively assemble and apply criteria of knowledge quality in reaching a common understanding for decision-making. Moreover, in assembling a comprehensive common understanding of an issue, stakeholders bring together their knowledge according to an ethic of reciprocity, where all knowledge systems are extended respect, and allowed to coexist.

Contingent (see also; contextual, relevant, locally legitimate):

A post-normal science-policy interface is inherently contingent given it does not recognise 'objective' or 'non-contextual' knowledge as valuable for addressing 'post-normal' issues. Recognising knowledge as socially derived and normatively loaded necessarily nests knowledge within a specific social context, and requires the inclusion of local perspectives for a decision to be considered relevant or locally legitimate.

Participatory (see also; equitable, inclusive, ethical, pluralistic, transparent, accountable, legitimate):

A post-normal science-policy interface is inclusive of all stakeholders, who negotiate knowledge for decision-making within a transparent and accountable process; with the success of the science-policy interface largely judged on the quality of the process rather than on the quality of the knowledge 'output.' By including all stakeholders, a PNS approach changes the balance of power within the science-policy interface.

[75] See Appendix D for the list of principles

Comprehensive (see also; holistic, integrated understanding, interdisciplinary, science-based):

In accordance with the wider literature on the participatory mobilisation of knowledge, the PNS perspective argues that a more comprehensive and common understanding of an issue is achieved by bringing together and integrating knowledge from across a diversity of stakeholder perspectives; not solely from across multiple scientific disciplines. As opposed to a purely reductionist science-policy interface, PNS encourages a holistic understanding of issues grounded in a complex social-ecological systems perspective. At the same time, by appraising the quality of knowledge via extended peer review, the PNS perspective conforms to the idea of 'scientific thinking' espoused in the Declaration of Science of the World Conference (ICSU 1999), and can be considered a robust approach.

Precautionary:

A post-normal science-policy interface is necessitated by recognition of a special class of issues that we have discussed as 'post-normal.' It is for this reason that PNS emphasises the mobilisation of the 'best quality' knowledge available, rather than encouraging the discovery of the 'truth.' Faced with irreducible uncertainty on one hand and political urgency on the other, PNS scholars recognise that uncertainty cannot be an excuse for inaction, but that society must act according to a precautionary approach.

Adaptable (see also; flexible, learning-focused):

PNS scholars emphasise that the mobilisation of knowledge within a post-normal science-policy interface demands an iterative and adaptable process of knowledge collection; constantly reconstructing the issue according to an improved quality of knowledge. This recognises that decisions must often be made within the context of significant uncertainty, but that as we interact with the environment in accordance with our decisions, and endeavour to collect more knowledge of the environment, we have an opportunity to (i) reflect on our increased experience; (ii) learn and (iii) adapt our understanding of an issue.

Incremental (see also; pragmatic, practical):

By recognising post-normal problems, a post-normal science-policy interface recognises the practical concerns of mobilising the best quality knowledge available to support decision-making; accepting that society will likely never have a 'complete' picture of an issue to support a 'final' decision. By recognising the ad hoc mobilisation of knowledge, as and when it becomes available, it recognises that decisions and action will be similarly incremental and ad hoc. In this way it is a more pragmatic approach to decision-making in light of the best quality knowledge available.

Strategic (see also; focussed, prioritised, proactive):

PNS scholars emphasise that the science-policy interface should be intimately linked with the decision-making arena, with knowledge mobilised in a strategic and prioritised manner as an issue demands. In this way, stakeholders may collectively decide on certain knowledge priorities, and commission the collection of knowledge in areas where uncertainty particularly hinders effective decision-making or management.

Long-term (see also; sustainable, financially viable, politically committed, state-sanctioned):

A post-normal science-policy interface has a long-term perspective on the mobilisation of knowledge; attempting to understand an issue according to its 'ecological timescale,' while recognising the much more immediate demands of political and market cycles. Therefore, while a PNS perspective may recognise the political urgency of making a decision today, with imperfect knowledge, it also demands the long-term collection of knowledge to enable on-going learning, and to remain flexible and adaptable in response to improved knowledge.

3.2 The potential contribution of PNS to interactional quality

How may a PNS perspective, *in theory*, contribute to the quality of stakeholder interactions for collective decision-making within the framework of ICM? The conceptual framework in Chapter 2 proposed unpacking the concept of 'interactive quality' according to the stocks of financial, social and human capital that stakeholders contributed to over the course of interacting, making decisions and taking action. The contribution of a PNS approach to interactive quality will here be analysed relative to its potential for encouraging stakeholder interaction that increases these capital stocks[76]:

Financial capital:

The PNS literature has not drawn direct links between a post-normal science-policy interface and an increase in funding or financial capital to support deliberation and decision-making.

[76] See Appendix C for a discussion of 'capital' and Appendix D for a distilled list of criteria for measuring stocks of financial, social and human capital as a means of indicating interactional quality.

Social capital:

By providing an inclusive setting, and encouraging the integrated mobilisation of knowledge through dialogue between different knowledge systems, a post-normal science-policy interface is likely to both (a) increase the number of stakeholders participating; and (b) increase the connectivity and density of stakeholder interactions. At the same time, given a PNS approach represents an opportunity for on-going and long-term interaction – guiding dialogue according to notions of reciprocity, and employing stakeholders as co-investigators with an 'extended peer community' – it is conceivable that stakeholders may perceive a change in the norms that frame their interactions. This may extend to increased levels of trust and reciprocity, and an increase in collective action.

Human capital:

As an inclusive and integrated dialogic setting, a post-normal science-policy interface attempts to bring together a diversity of stakeholders; each contributing a unique knowledge perspective, education and set of expertise that can be collectively discussed as human capital. In addition, as stakeholders participate within a post-normal science-policy interface, there is an expectation that they will learn more about the issue, the other stakeholders and their values, and the decision-making process itself. This contributes to a growth in competency for informed and considered interaction for decision-making, and may lead to a growth in the political *nous* of stakeholders, by helping them to understand the way power shapes collective decision-making. The PNS literature is silent though on whether it is encouraging of leadership, or increases the wherewithal of stakeholders to participate.

3.3 Moving from theory to practice

In sum, this section analysed the degree to which a 'post-normal' science-policy interface has the potential, *in theory*, to contribute to ICM; through the construction of better quality institutions, and the nurturing of better quality interaction for collective decision-making. It argued that a post-normal science-policy interface potentially represents a high quality institution, which is likely to perform well relative to ICM meta-principles. It also argued that in exercising a PNS approach, it is conceived that the quality of interactions between stakeholders may likely improve, at least relative to measures of human and social capital. Therefore, the PNS perspective presents a promising approach for mobilising knowledge in support of coastal governance, and is deserving of more thorough attention as to how it performs in practice.

This chapter goes on to review the ICM literature to explore the degree to which PNS has already found practical expression, and the extent to which a PNS approach was instrumental in positive coastal governance outcomes, relative to institutional and interactional quality. In addition, by applying the conceptual framework to ‘real world’ examples of ICM, this serves to test the validity of the framework, and whether criteria of interactional and institutional quality provide a relevant and interesting insight into the quality of coastal governance more generally.

4. Employing a post-normal science approach for ICM: a review of practice from the literature

In this final section, the chapter will explore those instances when an approach resembling PNS has been used to structure the science-policy interface for coastal management, and the influence this has had on the success of an initiative. It seeks to establish whether there may be an empirical basis for claims that a PNS-based interface may influence the success of coastal management; especially given the strong reflexive focus of the ICM scholarship, which places emphasis on ‘learning-by-doing.’ For this section, a thorough search was made within the published literature on coastal management (though coastal management was not always the central focus of the publications), with a focus on case studies published within journals and books. Importantly, the research only allowed a rudimentary search of the enormous grey literature that exists around ICM, so the following discussion could not be described as exhaustive. This section will begin with a discussion of the way in which the PNS approach has found expression across 14 case studies, before looking at the quality of the knowledge that has been generated in this setting. It will go on to look at the way in which such a science-policy interface has influenced the institutional and interactional quality for coastal management.

Given the non-uniformity of the chapters, and in particular the information they revealed about the case studies, it was not possible to apply the specific indicators from the conceptual framework, in a strict and uniform manner as in the previous section. Therefore, this review of practice limited itself to coding common themes. The application of the conceptual framework to ICM practice, as this first iteration of the research did provide an evocative test of the conceptual framework, which led to its refinement; particularly relative to the principles invoked for evaluating institutional quality, and some of the criteria from the capital based framework.[77]

[77] Applying a first version of the conceptual framework to ICM practice from the literature led to the refinement of the conceptual framework, with small changes made throughout the thesis, and a more appropriate interview framework derived for the empirical studies, as the second iteration of the research. For example, in the first version of the conceptual framework, institutional quality was evaluated relative to the ICM principles suggested by Stojanovic, Ballinger and Lalwani (2004), though this list was augmented with the addition of a tenth principle; ‘science-based.’ In applying this framework in the first iteration of the research, the added principle of ‘science-based’ was deemed redundant, and better discussed in terms of the existing principle, ‘comprehensive.’ Some of the criteria relating to capital stocks were also modified slightly. These changes had demonstrable consequences for the interview questions designed for the empirical studies.

4.1 Coastal management initiatives giving effect to post-normal science

A review of the published literature found descriptions of 14 coastal management initiatives that incorporated an institutional setting resembling a post-normal science-policy interface, though none of them made explicit mention of 'post-normal science' as a guiding approach. Generally these projects felt moved to create a participatory and pluralistic science-policy interface to address the perceived complexity of both the system-to-be-governed, and the governing system (Bennett, et al., 2005; Makino, Matsuda, & Sakurai, 2009). A central objective is thus to integrate diverse forms of knowledge to nurture a common understanding and avoid any asymmetry of knowledge across those with a stake in coastal management (Berkes, et al., 2001; Morin Dalton, 2006; Poitras, Bowen, & Wiggin, 2003; Stafford, Carlson, & Hart, 2009). However, despite extending legitimacy to local and indigenous knowledge for instance, for many it was important that 'normal' science remained the basis of any science-policy interface, or that the knowledge generated in this setting was able to exhibit the qualities of robust science (Gerhardinger, Godoy, & Jones, 2009; Poitras, et al., 2003).

By introducing a participatory science-policy interface, many of the studied coastal management projects recognised knowledge as just one component of a broader *dialogue for governance* that also incorporates values, politics and power for example (D'Incao & Reis, 2002; Gerhardinger, et al., 2009; M. Gleason et al., 2010; Morin Dalton, 2006). As such, these projects viewed knowledge collection as a natural extension of dialogue for co-management; emerging as a 'side-effect' from collective decision-making, or consensus-building. In this way, the dialogic mobilisation of knowledge was often discussed within the context of a 'co-management institutional setting,' rather than a purpose-specific setting for mobilising knowledge, such as a science-policy interface. That noted, at least two projects (M. Gleason, et al., 2010; Stafford, et al., 2009) recognised the distinction between participation for consensus building and participation to assemble knowledge for 'decision-support,' and attempted to create a 'hybrid setting.' These projects ensured the forum was comprised of diverse and knowledgeable stakeholders, who were carefully selected via stakeholder analysis/mapping, to allow well-informed knowledge collection in parallel with consensus-building. Finally, many of the projects described the most significant threat to an effective dialogic setting as the power relations between participants; particularly the need for negotiated knowledge collection to pose a realistic alternative to a litigious approach (Berkes, et al., 2001; Poitras, et al., 2003; Stafford, et al., 2009).

A review of the 14 case studies affirmed that there is no single 'best' method or technique for mobilising knowledge through dialogue (Morin Dalton, 2006). Indeed, while in most cases the basis of the science-policy interface was a participatory and deliberative forum (Bennett, et al., 2005;

D'Incao & Reis, 2002; Gerhardinger, et al., 2009; M. Gleason, et al., 2010; Makino, et al., 2009; Norgaard, et al., 2009; Roca, Gamboa, & Tabara, 2008), many of the projects utilised a comprehensive array of different means in concert; for sharing, critiquing, and constructing knowledge (R. Chuenpagdee, Fraga, & Euan-Avila, 2004; M. Gleason, et al., 2010; Makino, et al., 2009; Norgaard, et al., 2009; Roca, et al., 2008). For instance, knowledge collection may encompass (a) a forum structured according to (b) a modelling effort, with (c) joint investigation outside the forum.

The review noted a number of 'deliberation support systems' and 'tools' which were used to augment the discussion within a deliberative forum. Some programmes used interviews and/or focus groups as an alternative to a single forum, to augment the discussion within the forum, or to validate the results from the forum (R. Chuenpagdee, et al., 2004; Stafford, et al., 2009). Other programmes made use of modelling as a means for mobilising and organising knowledge (Bennett, et al., 2005; M. Gleason, et al., 2010), with Norgaard, Kallis and Kiparsky (2009) and Roca, Gamboa and Tabara (2008) describing the application of Participatory Integrated Assessment to coastal management. Such 'modelling' ranged from attempts to represent issues systemically, to the framing of issues with decision-support systems such as participatory 'multi-criteria analysis.' For many coastal management programmes, the co-collection of knowledge was a tool encouraging of inclusive and integrated mobilisation of knowledge (R. Chuenpagdee, et al., 2004; M. Gleason, et al., 2010; Makino, et al., 2009; McCreary, et al., 2001; Norgaard, et al., 2009). Using this tool, stakeholders collectively identify important gaps in the knowledge, before collectively setting out to fill these gaps by a variety of means. For D'Incao and Reis (2002) this took the form of a joint investigation or experiment into the least harmful fishing techniques, while for Stafford, Carlson and Hart (2009), stakeholders acted to dictate which socio-economic research was required, and the ways it should be done, before leaving scientists to undertake the research.

For many projects, the success of the initiative relied heavily on the presence of an effective social scientist or facilitator, to initiate the institutional setting and transform the dialogue, so that stakeholders could effectively construct quality knowledge for decision-support (R. Chuenpagdee, et al., 2004; D'Incao & Reis, 2002; Gerhardinger, et al., 2009; Norgaard, et al., 2009; Stafford, et al., 2009). For at least three authors (M. Gleason, et al., 2010; Norgaard, et al., 2009; Stafford, et al., 2009) concepts of *reflexivity,* and structuring dialogue according to *systems dynamics,* were important to getting the most from these science-policy interface. Some programmes made explicit mention of *adaptive management* as a precautionary and dynamic way of integrating knowledge (Bennett, et al., 2005; D'Incao & Reis, 2002; Makino, et al., 2009).

Finally, central to PNS is the principle of quality, and associated with this, the collective appraisal and scrutiny that accompanies knowledge quality assessment. Of the 14 case studies, a limited number made use of the concept of extended peer review. For many of the cases, collective appraisal of the different knowledge perspectives offered was an implicit or implied component of a deliberative forum (R. Chuenpagdee, et al., 2004; D'Incao & Reis, 2002; Makino, et al., 2009; Norgaard, et al., 2009; Roca, et al., 2008). However, for two authors (M. Gleason, et al., 2010; Morin Dalton, 2006), concepts of knowledge quality assessment were made explicit as a central component of deliberation. For Gleason *et al* (2010), this even extended to the collective writing of a list of agreed knowledge quality criteria against which to appraise different perspectives.

4.2 Mobilising high quality knowledge by 'post-normal' means

The 14 case studies described mobilising knowledge through an inclusive 'bringing together' of diverse forms of knowledge, which where possible and desirable, were integrated into a coherent knowledge base for decision-making (R. Chuenpagdee, et al., 2004; Gerhardinger, et al., 2009; M. Gleason, et al., 2010). In parallel with this assembly of existing perspectives, new knowledge was also constructed according to Gerhardinger, Godoy and Jones (2009). All of the initiatives reported that this knowledge was of a 'high quality;' deemed credible, salient and legitimate by all stakeholders, while accepting that 'power' has the potential to warp the knowledge collected.

The knowledge collected within a 'post-normal science-policy interface was described as very contingent and salient to an issue; with foundations in both the knowledge and the values of coastal stakeholders, rather than in the universality of science alone (Norgaard, et al., 2009; Stafford, et al., 2009). This encouraged collective 'social' learning around specific issues, leading to a shared understanding, including consensus on many aspects of the issues, and the alternative courses of action (R. Chuenpagdee, et al., 2004; Gerhardinger, et al., 2009; Morin Dalton, 2006; Norgaard, et al., 2009). This increased the perceived legitimacy of the knowledge generated, because stakeholders could see their own perspective represented in the shared understanding. At the same time, the initiatives sometimes included a stage of peer review, where participants implicitly or explicitly were able to engage in collective appraisal of the perspectives offered, and thereby judge its quality. These processes ensured that the knowledge mobilised exhibited at least some agreed credibility for addressing the issue at hand, such that the case studies satisfied the general standards or rigors of science, while admitting alternative knowledge systems (M. Gleason, et al., 2010; Norgaard, et al., 2009; Stafford, et al., 2009).

To a large degree, the credibility and legitimacy of knowledge was tied directly to the credibility and legitimacy of the process by which it was generated, emphasising the procedural rationality of a post-normal science-policy interface (Roca, et al., 2008; Stafford, et al., 2009). Authors noted how science in itself was important but insufficient to support decision-making, and noted that to be legitimate, a process of knowledge mobilisation must recognise and allow for the inherent values and power loaded within all dialogue; with power a central consideration. Failure to account for power means that whenever there is a clash or inconsistency between perspectives, power will come to the fore rather than reasoned deliberation (D'Incao & Reis, 2002; Morin Dalton, 2006; Stafford, et al., 2009).

4.3 The influence of a PNS approach on institutional quality in practice

A limited number of the case studies included a discussion on the influence of a PNS approach on the quality of coastal management institutions; making reference to the kinds of principles espoused by Stojanovic, Ballinger and Lalwani (2004). Some authors wrote that a PNS approach led to the creation of a science-policy interface that was itself more in keeping with the principles of ICM, and led to the creation, or strengthening of other ICM institutions and processes (Makino, et al., 2009; McCreary, et al., 2001; Norgaard, et al., 2009). For most, a PNS approach led to the creation of more *participatory* and *cooperative* settings that were *contingent* to their context (Gerhardinger, et al., 2009; M. Gleason, et al., 2010; Stafford, et al., 2009). In addition, Gleason *et al* (2010) noted that a PNS approach led to more *adaptable* and *precautionary* institutional settings, with stakeholders more readily able to influence the re-construction of institutions, and hence society's governance response, as issues change. Finally, a PNS approach was deemed to provide a more *comprehensive* understanding of coastal issues, and promote the more effective integration of knowledge with decision-making. This was both in terms of normal science (Poitras, et al., 2003) and other previously marginalised knowledge systems (Gerhardinger, et al., 2009).

4.4 The influence of a PNS approach on interactional quality in practice

In general, all authors revealed that a PNS-type approach led to the improved quality of interactions between stakeholders. In many cases a post-normal science-policy interface led participants to arrive at a shared understanding, even consensus, on the nature of an issue and its associated values. This shared understanding was often seen to support (even encourage) consensus on the 'best course of action' to take in response to an issue; providing an important factor in the success of these instances of collective decision-making or co-management (R. Chuenpagdee, et al., 2004; D'Incao & Reis, 2002; M. Gleason, et al., 2010; Makino, et al., 2009; Stafford, et al., 2009). Such collective decisions were seen to attract political support given the perceived legitimacy and credibility of the process within the community. Stakeholder participants, and their constituencies, were simultaneously given a sense of ownership of decisions, and a sense of accountability (M. Gleason, et al., 2010; Makino, et al., 2009; McCreary, et al., 2001; Stafford, et al., 2009). However, that noted, in at least two of the cases political power relations pushed their way to the fore and threatened the integrity of a post-normal science-policy interface and its associated decision-making process (M. Gleason, et al., 2010; Norgaard, et al., 2009). Most other authors also urged caution relative to the effects of power when attempting to democratise previously closed institutional settings.

For a number of the case studies, a PNS approach led to increases in the stocks of social, human and financial capital on which stakeholders could draw in deliberating toward collective decisions. Social capital was deemed to benefit from increased, and more diverse, participation among coastal stakeholders at all stages of the decision-making process, together with increased satisfaction with their participation (R. Chuenpagdee, et al., 2004; D'Incao & Reis, 2002; M. Gleason, et al., 2010; Roca, et al., 2008). This led to an increased connectivity of interactions between coastal stakeholders, and a change in the nature of interactions, to become more 'constructive' (R. Chuenpagdee, et al., 2004; Makino, et al., 2009; Norgaard, et al., 2009; Stafford, et al., 2009).

Human capital was also demonstrated to have increased, with both an increased competency amongst stakeholders to effectively participate in deliberation and decision-making, and better informed stakeholders who deliberated via an increased common understanding (R. Chuenpagdee, et al., 2004; D'Incao & Reis, 2002; Ellsworth, Hildebrand, & Glover, 1997; Morin Dalton, 2006; Norgaard, et al., 2009; Roca, et al., 2008; Stafford, et al., 2009). Related to this, a number of authors noted how stakeholders came to reflect on the limitations of their own point of view; prompting a realisation of the value inherent in bringing together diverse perspectives to gain an improved understanding of a complex issue. Stakeholders came to value the relationships that helped them to come to a more global vision of the problem (D'Incao & Reis, 2002; M. Gleason, et al., 2010; Norgaard, et al., 2009; Roca, et al., 2008; Stafford, et al., 2009). Finally, Gleason *et al* (2010) note how financial capital increased, as political and community support for the process transferred into increased funding.

5. Conclusion

This chapter presented the first step in exploring the potential meaningfulness of a post-normal science perspective for ICM, by applying the conceptual framework from Part II to the ICM literature. It began in Section 2 by re-introducing the PNS perspective, and condensing it into a list of 12 characteristics to focus our exploration. PNS was then interrogated relative to how it may contribute to high quality ICM *in theory*, with Section 3 concluding that the PNS approach holds significant promise for both building high quality ICM institutions, and building up stocks of social and human capital to support high quality stakeholder interaction. Having established that a PNS approach presents a significant opportunity for ICM, this chapter urged that further exploration of this approach should be grounded in practice.

A comprehensive review of the peer reviewed literature on coastal management could not reveal any practical initiatives which explicitly sought to emulate a PNS approach, though at least 14 examples of initiatives that sought to give effect to principles characteristics of a PNS approach. Common across these initiatives was a dissatisfaction of science-based management alone to address the complexity of coastal issues; demanding an alternative that was at once participatory, in that it tapped into a range of knowledge systems and nurtured a common understanding, and robust, such that knowledge mobilised exhibited the qualities of robust science. To this end, the case studies attempted to improve the quality of stakeholder interaction within fora, to emphasise the knowledge dimension of 'dialogue for governance.' There was no single best means for improving this interaction, with a diverse range of 'deliberation support systems' employed, though the knowledge quality assessment espoused within the ideals of 'extended peer review' struggled to find expression.

The initiatives all reported mobilising high quality knowledge to support decision-making, while also contributing to institutions that were better in keeping with ICM principles, and contributing to stocks of social, human and even financial capital. By way of caution though, the review also revealed the corrupting influence of power on a post-normal science-policy interface setting, with power looming as one of the greatest obstacles to giving successful effect to a PNS perspective. This noted, in general we can assert that approaches emulating a PNS approach have been shown to exhibit significant success in the field, as well as in theory; further warranting a more detailed exploration of this approach. This then serves to introduce Part IV of this thesis, which looks to explore further the PNS perspective through three empirical studies.

Part IV: Empirical Studies: Exploring the contributions of post-normal science to Integrated Coastal Management, from the international to the local scale

Part IV is constituted of three chapters exploring the contributions of a post-normal science-policy interface to quality ICM, through empirical case studies at the international, national and local scale. These studies started from arguments for the meaningfulness of the 'post-normal science' perspective presented in Part III, and were steered according to the conceptual framework in Part II. While Chapter 6 'stands alone' the other two chapters are linked, with Chapter 7 providing the New Zealand national context within which the case studies of Chapter 8 are nested. Chapter 7 does not focus specifically on a post-normal interface, but provides a broader discussion on the influence of the interface on ICM, with a broad focus on the emerging traditions of a participatory and dialogic interface. Chapter 7 also provides a comparison for the case studies in Chapter 8.

Chapter 6: The SPICOSA Project: Applying a post-normal science approach to Europe’s coastal management

1. Introduction

To this point, the thesis has established itself within debates on how best to mobilise knowledge for Integrated Coastal Management framed as ‘interactive governance,’ and focussed its attention on the most appropriate framing of the science-policy interface. Drawing on the wider literature on epistemology for governance, and the specific literature on the ICM science-policy interface, this thesis put forward ‘post-normal science’ (PNS) as a promising perspective, that gives effect to ‘governance’ norms of ‘dialogue,’ ‘inclusiveness,’ ‘integration’ and ‘knowledge quality assessment.’ In Chapter 5, the first iteration of this research interrogated the PNS approach relative to the theory and practice of ICM in the literature, and concluded that it indeed presents a significant opportunity for ICM framed as governance.

In Part IV of the thesis, the second iteration of the research seeks to give effect to a more in-depth exploration of the PNS approach and its potential for coastal governance, through three empirical studies. These studies are notable for their diversity; divided as they are between the context of Europe and New Zealand, and split between the international, national and local scale. All three studies seek to analyse existing ICM initiatives that embody ‘norms of governance,’ or more specifically a post-normal science perspective, before exploring their contributions to high quality governance in their contexts; relative to measures of institutional and interactional quality.

This Chapter begins in Europe and details research into the EU’s ‘SPICOSA Project,’ which was initiated from 2007-2011 as a concerted attempt at *applying* a new epistemological approach to the science-policy interface for ICM within wider Europe. The SPICOSA Project developed an approach which this chapter approximates in terms of a post-normal science perspective, and sought to give effect to it within 18 European study sites, many of which spanned national boundaries. The SPICOSA Project therefore offered a unique opportunity for exploring the way in which a post-normal science-policy interface setting can contribute to coastal governance, at an international scale. This chapter follows empirical research undertaken part way through the SPICOSA Project, in early 2010, which explored *how did the SPICOSA Project, and its 'post-normal' framing of the science-policy interface, influence ICM, according to the criteria of interactive governance?* To this end, the study sought to (a) analyse the implementation of SPICOSA within a subset of four study sites, through the lens of PNS; before (b) exploring how SPICOSA influenced coastal governance within these study sites using indicators of quality ICM as interactive governance.

Section 2 of the chapter begins by describing the SPICOSA Project according to its founding documents, which detail the Project's objectives for shaping the science-policy interface for ICM, and the means that it proposed for achieving these objectives. The focus is therefore on the anticipated (*ex ante*) methods, tools and outcomes of SPICOSA, which this chapter characterises in terms of post-normal science. Section 3 then sets the context for the *ex post* analysis and exploration of the Project in practice across four study sites, by re-introducing the conceptual framework and describing the research method. Section 4 discusses the results of the research, before Section 5 reveals conclusions on the degree to which SPICOSA did indeed emulate the attributes of 'post-normal science' in practice, and the effect that this approach had on coastal governance within the different contexts.

2. Introducing SPICOSA as a post-normal approach

2.1 Science and Policy Integration for Coastal System Assessment: The SPICOSA Project

The SPICOSA Project is a European Union (EU) 'Integrated Project' which began in 2007, and was commissioned for a duration of four years under the '6th Framework Programme,' call of Priority 1.1.6.3 'Environment and Global Change.' According to the Project's 'Description of Work' document, "The overall objective of SPICOSA is to develop a self-evolving, holistic research approach for *integrated assessment* of coastal systems, such that the *best available scientific knowledge can be mobilised to support deliberative and decision-making processes* aimed at improving the *sustainability* of coastal systems by implementing *Integrated Coastal Zone Management (ICZM*[78]*) policies*" (SPICOSA Project, May 2010, p. 5, emphasis added). In giving

[78] Please note that the SPICOSA Project used the term Integrated Coastal Zone Management, which is the terminology used in the European context, including within EU policy on coastal management. In this chapter,

effect to ‘integrated assessment’ [79] SPICOSA aimed to bring together the knowledge and experience of participants from 54 partner institutes across 26 countries, and a critical mass of researchers, stakeholders and coastal managers, to affect change in the research and practice of ICM throughout Europe. With a focus on the science-policy interface, SPICOSA’s focus was on the setting where, (a) science integration, and (b) science-policy integration, requires the structuring of knowledge according to linked ‘ecological-social-economic systems,’ to effectively support decision-making as formulated under the European ICM principles (IFREMER, 2010).

The Project’s organisation was focussed on its central aim of applying a systems-approach within a coastal context; though the development, testing and refinement of a Systems Approach Framework (SAF) and a portfolio of Deliberation Support Systems and Tools (DST) for use in support of ICM around Europe (SPICOSA Project, May 2010). The intention was that SPICOSA’s tools would (a) mobilise the *best quality* knowledge available for a given issue; and (b) have long-term and general applicability within diverse coastal contexts across Europe, beyond the lifetime of the Project. As such, the SPICOSA tools were tested in eighteen diverse coastal ‘Study Site Applications’ across the European region, ranging from Norway to Portugal to Turkey. The development of the portfolio thus represented a practical combination of experience and theory; applied and evaluated in an iterative manner such that all of SPICOSA’s outputs aimed to be well validated, and ensuring that participants had the opportunity to learn and grow along with the tools and methods. This serves to introduce the six objectives of the SPICOSA Project (SPICOSA Project, May 2010):

1) Create an operational Systems Approach Framework (SAF) for coastal policy assessment;
2) Improve the science-policy interface through the quantification of complex systems;
3) Test the SAF by implementing at various Study Site Applications, to test its generic applicability;
4) Generate a SAF portfolio, consisting of generic Decision Support Systems and Deliberation Support Tools that are user-friendly and updateable.
5) Improve the communication and integration among coastal stakeholders.

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however, we will continue to use the term Integrated Coastal Management (ICM), which has been used throughout the thesis.

[79] *‘Integrated Assessment’* has been variously defined, however below are two useful definitions; the first from Rotmans and Dowlatabadi (1997), and the second from van der Sluijs (Van der Sluijs, J. P. (Ed.) (2002a) Encyclopedia of Global Environmental Change (Vols. 4). Chichester: John Wiley & Sons Ltd.):

(1) ‘Interdisciplinary process of combining, interpreting and communicating knowledge from diverse scientific disciplines in such a way that the whole cause–effect chain of a problem can be evaluated from a synoptic perspective with two characteristics: (i) it should have added value compared to single disciplinary assessment; and (ii) it should provide useful information to decision-makers.’

(2) ‘Integrated assessment is a reflective and iterative participatory process that links knowledge (science) and action (policy) regarding complex global change issues.’

6) Generate new opportunities for academic and professional training in ICM

The Systems Approach Framework (SAF) represented the focus of the SPICOSA project. It aimed to illuminate that knowledge already existing within a coastal context, whether it be science or alternative local and traditional knowledge systems, and structure it for 'integrated and participatory assessment' of policy issues in coastal zones (SPICOSA Project, May 2010). Based on a complex and nonlinear approach to systems, the SAF is a multidisciplinary framework designed to describe the ecological, social and economic systems on the coast, and the interactions between these systems at different scales. Beyond description, the SAF is being developed to explore the dynamics of coastal systems, through the formulation of computer-based simulation models used to explore alternative scenarios in relation to a specific policy issue. Essential to this is the demonstration of the cause-effect feedback loop associated with coastal issues (the 'Coastal Zone Feedback Loop'). Given SPICOSA's policy focus, the iterative process of developing the SAF aims to allow for continuous input from stakeholders within the policy sphere, who are to help in the design, formulation and appraisal of the SAF model. Within SPICOSA, the SAF process is to both begin and end with explicit interaction with the policy sphere (see Figure 6), with Study Sites to employ an external 'Policy-Stakeholder Participant Group' to facilitate on-going participation. The focus of the SAF is not to collect new knowledge, but to better mobilise, structure and communicate existing knowledge.

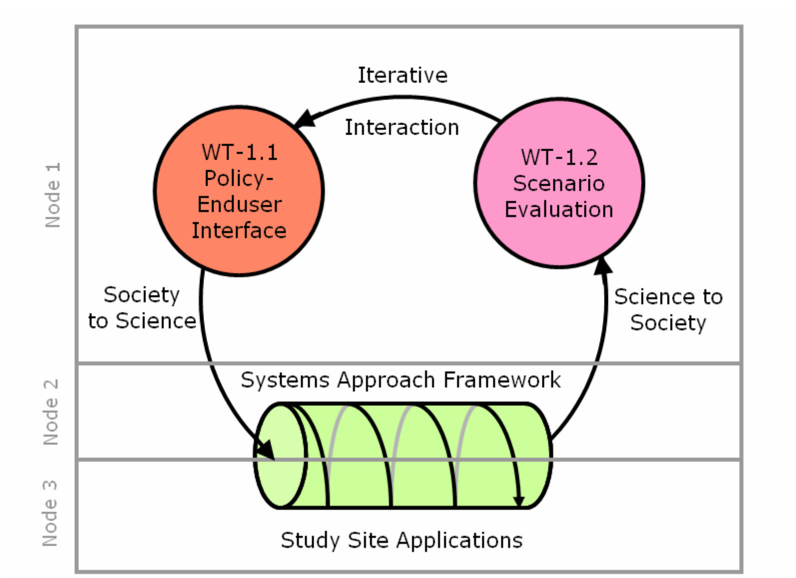

Figure 6: Demonstrating the interaction between the Systems Approach Framework and deliberation within the policy sphere via SPICOSA Deliberation Support Tools (taken from SPICOSA (May 2010))

SPICOSA aimed to contribute to a more participatory and deliberative science-policy interface by developing and testing Deliberation Support Systems and Tools (DST). These DST sought to improve the quality of stakeholder interactions, particularly relative to the way that knowledge is used for identifying policy options, and in support of deliberation. This was envisaged through intertwining stakeholder deliberation within social and policy institutions, with the knowledge assembled through the SAF (IFREMER, 2010). In order to set the context for deliberation, SPICOSA proposed *'Stakeholder-Policy Mapping'* (WT 1.1 – see Figure 6) with two functions. Firstly it was to aid in the identification of stakeholders relevant to an issue, and set the basis for the creation of a participatory and deliberative science-policy interface forum. Secondly, by drawing out the diverse perspectives of stakeholders, it was to enable a multidimensional mapping of coastal issues and human activities within a coastal context, and establish the terms by which policy options may be judged. Specific to SPICOSA, this DST was to provide data on social systems for the SAF, provide for the incorporation of alternative forms of knowledge alongside science, and identify key holes in the knowledge. A second DST was designed to provide a conduit for the SAF results and other knowledge, to be appropriated within deliberations in the policy sphere; via the multi-media-based *'Deliberation Matrix'* (WT 1.2 – see Figure 6). 'The Matrix' is intended to structure dialogue within a science-policy interface forum such that knowledge can (a) be mobilised as 'evidence;' and (b) evaluated for its quality in supporting decision-making for a specific issue.

Finally, we can differentiate between three broad types of objectives within SPICOSA, though they were not explicitly divided as such in the SPICOSA Project, nor were they mutually exclusive. First and foremost, there were the objectives surrounding the development, testing and refinement of the SAF and supporting DST, as the '*outputs'* of the SPICOSA project. These were the tangible products represented in Objectives (1), (3) and (4) above, which were the central focus of the project. Secondly, there were the *coastal governance 'outcomes'* objectives, which were anticipated to result from the exercise of the SPICOSA tools. To use the interactive governance perspective employed in this thesis (Kooiman, 2003), these outcomes could be described according to: (a) the effect on the quality of institutions, such as the science-policy interface (as represented by Objective (2)); and (b) the effect on the quality of interactions among coastal stakeholders within and across these institutions (as represented by Objective (5)). Thirdly, there were the '*learning'* objectives, representing the increased learning and experience gained through the interactive development and implementation of the SPICOSA tools. This learning can be expressed both formally through the preparation of ICM training programmes and resources, or informally through the 'social learning' that occurred where participants changed their ideas and actions as a result of working in groups for SPICOSA (see Objective (6)). *This chapter is concerned with the second group of objectives; how did the SPICOSA project influence coastal governance outcomes, defined in terms of institutional and interactional quality?*

2.2 SPICOSA's 'post-normal' structuring of the science-policy interface

The SPICOSA Project embodied an evolution in the practice and scholarship of ICM, which has seen an increasing tendency to a participatory and deliberative science-policy interface, as viewed through a 'governance' lens. Beyond the scholarship of ICM, SPICOSA was influenced by a wide range of theories and approaches from across a diverse literature, though appeared to find its most explicit theoretical basis in the literature on complex systems theory, and the way it could be utilised to integrate across disciplines and integrate across the science-policy interface (SPICOSA Project, May 2010). This theoretical basis found expression in the more applied literature on 'Integrated Assessment,' which SPICOSA sought to exercise for ICM. That noted, it is the contention of this chapter that the specific science-policy interface setting proposed by SPICOSA could equally well be described in terms of the epistemological perspective of PNS.[80]

Though not explicitly mentioned in any of the foundational documents of SPICOSA, the Project embodied many of the same characteristics as the PNS approach, and can be considered as a practical expression of the PNS epistemological position, as summarised in Table 7. Indeed, SPICOSA appeared to at least implicitly endorse the PNS position through its engagement of partners heavily involved in PNS-type research to develop deliberative DST with a quality-focus (SPICOSA Project, May 2010). Emulating PNS, SPICOSA started from a perspective that fragmented disciplinary science alone is not adequate for understanding the complexity of social-ecological systems, and proposed DST as means for structuring the dialogue within a participatory, yet robust and scientifically sound, science-policy interface. In particular, through the use of stakeholder mapping, all coastal stakeholders' perspectives on an issue were deemed able to be admitted as evidence. This evidence was proposed to be integrated through reciprocal dialogue in the construction of the SAF, and later in deliberation framed by the 'Matrix.' SPICOSA thus aimed to employ a "communicative *mediation* role between scientific knowledge and other sources of knowledge in the policy arena" (SPICOSA Project, May 2010, p. 52).

The tools of SPICOSA were anticipated to encourage an evaluation of knowledge quality via a form of 'extended peer review' amongst coastal stakeholders, at two stages: (i) through the interactive design, formulation and appraisal of the SAF; and (ii) through the use of the multi-media 'Deliberation Matrix,' where stakeholders could appropriate knowledge as 'indicators,' and simultaneously provide an explicit judgement of the indicator's quality. Thus stakeholders' choice of indicators would provide, "…a key input to (their) assessment of scenarios and to the quality of their evaluation in a participatory or deliberative context" (SPICOSA Project, May 2010, p. 52) The

[80] See Chapters 3 and 5 for more detail on the post-normal science epistemological perspective, and Appendix D for a list of key characteristics of this approach.

‘Description of Work’ document anticipated, “…both the ‘face to face’ participatory exercises and the multi-media based deliberation, when inserted into the SAF methodology, will give prime importance to the quality of the information it processes and balance in considering the ecological, social and economic dimensions” (SPICOSA Project, May 2010, p. 53).

Table 7: Characterising the SPICOSA Project as a 'post-normal science' approach

Principles of post-normal science	**SPICOSA performance**
1) Focussed on the science-policy interface in support of decision-making for issues characterised by uncertainty, plurality and high stakes.	SPICOSA had an explicit focus on restructuring knowledge within the science-policy interface, through DST.
2) Complex social-ecological systems perspective.	SPICOSA, through the SAF in particular, proposed structuring knowledge according to complex systems modelling.
3) 'Epistemological' uncertainty is explicitly recognised as inevitable and irreducible, necessitating a precautionary approach.	SPICOSA explicitly recognised uncertainties within the study sites, but espoused a less strong perspective on uncertainty; asserting it is reducible.
4) Dialogic setting wherein knowledge is mobilised and negotiated as 'evidence' in support of normative arguments.	The DST of SPICOSA were to encourage reciprocal dialogue across diverse actors; particularly in developing the SAF and within deliberation structured according to the 'Matrix.' Moreover, the DST were designed so that results from the SAF could be appropriated as evidence within deliberations, particularly through the 'Matrix' where stakeholders appropriate SAF science in the form of weighted 'indicators.'
5) Participatory setting admitting a plurality of equally valid perspectives.	SPICOSA attempted to construct a participatory and deliberative science-policy interface setting. Through 'stakeholder mapping,' the diverse perspectives of all classes of stakeholders were to be admitted access for modelling and deliberation.
6) Relativise, and where possible reconcile, conflicting perspectives according to principles of reciprocity and co-existence	SPICOSA proposed to both reconcile and relativize conflicting perspectives. Through the SAF, conflicting perspectives were to be reconciled into a coherent model of the issue. Equally, the parallel deliberation structured according to the Matrix allowed the coexistence of diverse perspectives.
7) Conflicting perspectives are evaluated for their *'quality'* in terms of supporting decision-making for an issue. Quality is the organising principle of science rather than 'truth.'	SPICOSA placed central importance on mobilising the most high quality knowledge possible via DST. This is quality explicitly judged in terms of supporting the specific policy questions within the study sites. Quality was judged within the context of the SAF, and through the structures of the 'Matrix.'
8) Stakeholders as members of an 'extended peer	Within SPICOSA, two parallel peer communities can be distinguished: (a) the Policy-Stakeholder

community,' which collectively evaluate knowledge according to collectively-derived criteria of quality; 'extended peer review.'	Participant Group developing the SAF, who could arrive at common measures of knowledge quality for its inclusion in the model; and (b) the wider study site stakeholders/end-users, who deliberate with the aid of the DST, and pass evaluation on knowledge quality.
9) Reflexive	SPICOSA was inherently reflexive given its basis in integrated assessment; with an (a) iterative and (b) deliberative focus.
10) Social learning orientation in pursuit of understanding rather than truth	Interactive and iterative learning were central to SPICOSA, as represented in Objective (6), and its strategic vision.
11) Adaptive cyclic process, with outcomes judged on the quality of the process.	Integrated assessment is by definition an iterative process. Within the SAF, modelling of the system was an iterative process via four stages. Interaction between the policy and the science arenas was demonstrated as iterative (see Figure 6).
12) Strategic, long-term perspective	SPICOSA placed importance on the longevity of its DST, and the residual learning/expertise among participants at the conclusion of the Project. This was part of a strategic vision toward sustainability and ICM.

2.3 SPICOSA as a novel initiative for governance

The SPICOSA project sought to question the place of scientific knowledge and scientific actors in the governance of the coast. SPICOSA began from a notion of ICM as governance, and in so doing, implicated a 'governing system' comprising a multitude of institutional settings which frame the interactions of coastal stakeholders with each other and the coastal environment (SPICOSA Project, May 2010). So conceived, ICM initiatives and processes seek integration and coordination across these institutions, such that society's multi-faceted response to coastal issues is not fragmented and contradictory. SPICOSA located itself as a potential initiative for bridging the science and policy institutional settings; in short, the 'science-policy interface.'

By framing the SPICOSA Project as a PNS approach, this distinguishes the Project as a novel way of structuring the science-policy interface for ICM. While the scholarship and practice of ICM has shown a growing tendency to view the science-policy interface as an inclusive, dialogic, and integrated setting within a 'governing system,' the PNS perspective has found scant expression. The review of the published ICM literature in Chapter 5 found relatively few examples of initiatives that emulate the characteristics of PNS, and none that have explicitly endorsed PNS. While SPICOSA did not either explicitly labelled itself as an exercise in PNS, it did espouse a combination of characteristics that collectively comprise a PNS approach. Indeed, SPICOSA provides a unique opportunity for research into the effect of a post-normal science-policy interface setting on coastal governance outcomes. By simultaneously applying a standardised portfolio of tools across 18 diverse study sites, SPICOSA allows for a robust comparison of the tools success within different contexts. Indeed, SPICOSA is a rare initiative in that it focuses on reproducing one sole institutional setting – the science-policy interface – across many case studies to analyse its success within the wider *de facto* coastal governance context, including existing ICM programmes. Therefore, by (a) focussing on the science-policy interface as one particular component of coastal governance, and (b) reproducing this interface across a wide range of contexts, SPICOSA adds some control to the experimental implementation of its tools.

Having outlined the SPICOSA Project, and its anticipated *ex ante* coastal governance outcomes, this chapter now turns to explore the Project *in practice*, via an *ex post* analysis and exploration of the SPICOSA Project. The empirical research described in this chapter aimed to explore the way in which a post-normal science-policy interface, as practiced in the SPICOSA Project, has encouraged high quality coastal governance across a subset of four SPICOSA study sites. In this way, the research focused on the two '*coastal governance outcomes*' objectives of the SPICOSA Project (Section 2.1), which respectively aimed to: (a) improve the science-policy interface institutional setting (Objective 2); and (b) improve the communication and integration among coastal stakeholders (Objective 5). The research did not therefore explore the quality of SPICOSA's scientific outputs, or the learning that has occurred.

3. Studying the SPICOSA Project: conceptual framework and method

3.1 Conceptual framework for analysis and exploration

One key challenge of the SPICOSA Project lay in its evaluation beyond its specific outputs. Though the Project included coastal governance objectives, it did not from the outset establish an explicit framework for the evaluation of the social dynamics within the science-policy interface and the wider coastal governance outcomes at the study sites. It was not until the Project's third year that a suite of programmes were introduced, devoted to the evaluation of social elements/impacts of the SPICOSA Project and its governance outcomes. As such, the empirical study described in this chapter drew on its own conceptual framework, as developed in Part II of the thesis, to guide the analysis of the post-normal science-policy interface, and explore its influence on coastal governance. This conceptual framework later became incorporated within one of the third-year evaluation programmes; the 'Lessons Learned' evaluation initiated in November 2009 (see Section 3.2). This framework is in two steps:

(1) Analysis of the way in which the SPICOSA Project frames the science-policy interface

As a first step, this research began with an analysis of the way in which the SPICOSA Project, and its tools, had an effect on the way coastal stakeholders collectively mobilise knowledge in support of decision-making for a given issue in each study site. This was a critical examination that sought to determine the essential elements of the science-policy interface within the SPICOSA Study Sites. This analysis was undertaken through the lens of PNS, and was thus structured in terms of the principles of PNS listed in Table 7 of this chapter, and the degree to which the study sites emulated these elements. That is, in what way did SPICOSA shape the science-policy interface setting, and to what degree could it be called 'post-normal?'

(2) Exploring the effect of SPICOSA Project on coastal governance outcomes

As a second step, this research sought to explore the effect of the SPICOSA Project on coastal governance outcomes. As noted the SPICOSA Project begins from a governance perspective on ICM, and given this governance focus, SPICOSA suggests that, "a pragmatic evaluation approach would be to frame the problem of ‘social choice’ as a multi-stakeholder deliberation about the merits and demerits of policy alternatives that present themselves to society” (SPICOSA Project, May 2010, p. 51). In accordance with SPICOSA’s governance focus, and in keeping with the conceptual framework set out at the beginning of this thesis, this study measured SICOSA’s governance outcomes through the lens of ‘interactive governance,’ (Kooiman, 2003) with respect to two complimentary components of governance: (a) the quality of institutional settings (including the science-policy interface) relative to the degree they give effect to principles of ICM; and (b) the quality of stakeholder interactions within these institutional settings, according to the stocks of financial, social and human capital contributed to through stakeholder interaction.[81] For the evaluation of SPICOSA, given its status as an EU Integrated Project, this research used the eight principles of good ‘ICZM’ agreed as part of the EU ICZM Recommendation in 2002 as measures of ‘quality’ coastal institutions (see Appendix E).[82]

3.2 Research method within the SPICOSA Project

This research drew on the SPICOSA evaluation programmes as the method of data collection; however as noted, this was complicated by SPICOSA’s emphasis on the evaluation of outputs and the satisfaction of output-type objectives (see Section 2.1 above). This was both output evaluation at the operational or administrative level (setting deadlines by which outputs or ‘deliverables’ are to be produced and monitoring the implementation of these work plans) and evaluation of the deliverables of SPICOSA according to their own internal measures of quality, including the internal coherence and consistency between deliverables for example. This output-focus extended to the implementation of SPICOSA within the study sites, where the primary objective was the implementation and critique of the SAF, by following the SAF method as closely as possible and reporting on the experience. That noted, there have been some evaluation efforts of outcomes ‘beyond’ the SPICOSA deliverables, including the social learning that has occurred, and their influence on coastal governance.[83]

This research drew primarily on data collected through the ‘Lessons Learned’ evaluation programme that emerged in the third year of the SPICOSA Project to “assess the contributions of

[81] See Chapter 2 and Appendices C and D for more detail on this evaluation framework as steering an exploration on the quality of coastal governance.

[82] Elsewhere within this thesis, ‘institutional outcomes’ have been measured according to the principles developed by Stojanovic, Ballinger and Lalwani (2004) , which have been argued to be derived from a more comprehensive study than the EU ‘Demonstration Programme.’ However, given SPICOSA is an EU Project, the EU principles were deemed more appropriate for this particular evaluation.

[83] Though the primary objective within the study sites is to implement and critique the SAF outputs, coastal governance outcomes also find expression within the specific objectives of ‘Work Task 7;’ see Objectives (3), (2) and (5).

the SPICOSA 'Systems Approach Framework' to Integrated Coastal Zone Management," within the study sites. The Lessons Learned programme represented a convergence of a number of evaluation efforts; incorporating a composite of questions to satisfy parallel evaluation initiatives, including the research study presented in this chapter. This research also drew on data collected through a SPICOSA reporting procedure (Deliverable 14.9) placed on study sites to annually report on stakeholder participation, the subsequent form of the science-policy interface, and any future plans for collaboration.

The Lessons Learned survey selected a sub-set of five SPICOSA study sites to investigate, on the basis of both (i) their variable advancement in terms of formal Integrated Coastal Zone Management programmes, and (ii) the diverse issues that they faced. Owing to data availability, this chapter's research has been limited to the analysis and evaluation of four of these sites, though this is deemed an adequate set for a revealing exploration into a diversity of experiences. The Lessons Learnt survey was undertaken using a semi-structured interview framework comprising a standardised set of questions and prompts to aid the comparability of the results. Confidential interviews were carried out by SPICOSA partners at a SPICOSA Conference in February 2010, where face-to-face interviews were undertaken with a single SPICOSA-partner representative from each of the five study sites – invariably represented by scientists and researchers from research institutes.[84] Interviews were recorded, and a transcript sent to respondents for validation, after which responses from all study sites were condensed into a spread-sheet for coding and analysis.

There are four key restrictions attached to the above research method. Firstly, by undertaking interviews with only one representative from each site, this biases the responses in terms of one perspective. Secondly, the respondents were all SPICOSA representatives, and may therefore have been more inclined to report positively on the Project of which they are a part, and which may reflect on their ability to implement the tools. Thirdly, the interviewers were also SPICOSA partners, which may serve to bias the responses by a desire of the interviewee to please the interviewer; themselves part of the SPICOSA community. Finally, the research would have been more robust had it been able to integrate data from other parallel evaluation programmes looking at social learning and the social processes that characterise stakeholder interaction within the SPICOSA science-policy interface.

[84] Here we must acknowledge Jeanette Reis and Tim Stojanovic of Cardiff University who undertook the interviews for the Lessons Learned survey.

4. Exploring the contribution of the SPICOSA Project to coastal governance in four study sites: Results and Discussion

4.1 Four different study sites

The SPICOSA Project Study Sites represented a diverse array of coastal contexts scattered across European nations, and indeed in many cases, focussed on coastal features that span national boundaries. The four study sites chosen for this research are no exception; posing four completely different challenges to coastal governance. To borrow from coastal governance authors (see e.g. Jentoft and Chuenpagdee (2009)), the diversity across these four sites is seen not only in the different types of issues they face in their 'systems-to-be-governed,' but also their unique governance response within the 'governing system.' Indeed, the capacity of governing systems significantly determined the form SPICOSA took in each context. For instance, though SPICOSA is in the service of ICM, the degree to which the study sites have formally, or informally, given effect to the EU's ICZM imperatives ranged from advanced initiatives to virtually nothing whatsoever; with demonstrable consequences for the SPICOSA science-policy interface.

Cork Harbour

Cork Harbour is a large (100km²), sheltered, naturally deep harbour with strong estuarine influences, situated on the south coast of Ireland. While contemporary use of the Harbour is marked by concentrations of urban populations and industry, much of the coast is characterised by agricultural land or protected habitats. Its deep, sheltered channels make the Harbour ideal for shipping and recreational boating. As such this study site is focussed on the policy question of, 'how to optimise the potential for expanding the leisure boat sector in the context of Cork Harbour's multi-use environment?'

The Cork Harbour study site represents the most advanced ICM programme of the four contexts; having been initiated in 2003, respondents now described it as 'well-developed.' Though governance of the Harbour remains divided between various national, regional and local government agencies, according to an array of policy instruments, ICM has introduced mechanisms to encourage integration. The Cork Harbour Forum is a partnership involving stakeholders from civil society, the private sector and the state, as part of on-going efforts to develop and implement the 'Cork Harbour Integrated Management Strategy;' and is supported in this task through the Strategic Advisory Group (SAG) and Focus Group subsets. In initiating the SPICOSA science-policy interface, local SPICOSA partners drew on the Forum as a pool of stakeholders; effectively attaching SPICOSA to the Forum and its goals. A small group of SAG members agreed to support the Project as stakeholder participants - comprising representatives of local councils and the navy;

however the wider members of the SAG and the Forum remain linked to SPICOSA in terms of commenting on its results. An initial meeting was called with the SAG participants, to reach consensus on the policy issue, though subsequent meetings have been informal, taking advantage of already frequent Forum/SAG meetings. These informal meetings do not therefore always include all original participants.

The Rhine-Meuse-Scheldt Delta

The Rhine-Meuse-Scheldt Delta is a 100km-long delta and adjacent coastline spanning the border between the Netherlands, Belgium and France; formed by three major European rivers. This coastline presents a varied environment from sandy beaches to the Scheldt Estuary. It is a heavily populated coastline, including Rotterdam and Antwerp, with recreation, agriculture and aquaculture as dominant economic activities; necessitating at times heavy coastal protection works. This study site is focussed on the issue of ensuring the good ecological quality of phytoplankton in the Scheldt River basin, including the coastal zone (as required under the EU's Water Framework Directive); or more specifically, the feasibility and costs of nitrate reduction.

The Scheldt Delta study site is not governed according to an integrated ICM initiative specific to the delta. Rather, given the delta bridges three nations, the status of ICM differs across the various nations; with the Netherlands for instance instituting ICM in 2005, and advancing to a developing to well-developed stage. Given the selected water quality issue, governance is largely according to those agencies responsible for implementing the EU's Water Directive Framework (WDF); including the International Scheldt Commission (ISC) responsible for the trans-boundary WDF, and central government agencies in France, Flanders (Belgium), and the Netherlands. In initiating the SPICOSA science-policy interface, local SPICOSA partners organised a first meeting to decide on the policy issue; inviting diverse stakeholders from within Flanders and the Netherlands. By selecting an issue implemented principally at the national scale, many stakeholders lost interest, leaving only the ISC and national water agencies. Subsequent to the first meeting, contact was through separate meetings in France, Flanders and the Netherlands, and intensive contact with individual representatives between meetings; with the purpose of providing significant knowledge to the fuel the SPICOSA Project assessment.

The Guadiana Estuary

The Guadiana Estuary is a long, narrow river estuary located in south-east Portugal, and forming the border with Spain. The most important activities within the estuary are aquaculture, fisheries and tourism/recreation, with agricultural activities dominating the surrounding land. This study site is focussed on the issue of decreasing water and sediment quality, owing to: (a) increasing discharges of untreated wastewater; and (b) decreasing freshwater discharges from dams.

The Guadiana study site has had a formal ICM initiative in the form of the Guadiana Forum since 2006, though respondents reported it to be in its infancy. Governance from the Portuguese side remains divided between the central ministries, the regional departments and the local councils, while on the Spanish side governance is divided between the autonomous regional government of Andalusia, and it's local provinces and municipalities. To initiate the SPICOSA science-policy interface local partners met with a diversity of stakeholders - from across civil society (NGO's), the private sector, and the state - to invite their participation; firstly in the completion of a questionnaire, and later through more active participation. The response in Portugal was very positive, with participation of stakeholders largely in the form of one-way knowledge-sharing to allow SPICOSA's modelling of the issue; with the promised 'reward' of a detailed description of the issue. Through this collaboration, ties have been strengthened as expressed through other projects; from 'educational walks' held by NGO's, to radio and television interviews, to organised workshops and talks. In terms of the existing science-policy interface, the local SPICOSA partner organisation had already produced a multi-media tool to frame qualitative information on the estuary which had been very successful in terms of acceptance (schools, governance stakeholders); with SPICOSA forming a quantitative addition to this tool.

The Barcelona waterfront

The Barcelona waterfront represents a 30km-long stretch of beaches and urban construction marking the coastline of the city of Barcelona (population: 4 million) in Catalunya, Spain. Along the coast there are tourism activities, recreational and commercial harbours, some fisheries, waste effluents and two waste water treatment plants. This study site is focussed on the policy issue posed by the effects of changes in water quality on the aesthetic and recreational aspects of the Barcelona beaches.

Respondents reported that the Barcelona study site has no formally-recognised ICM initiative in place. The governance of the coastal environment is shared to a degree between Spain's national government, the autonomous regional government of Catalonia, and the city and province of Barcelona, according to their various statutes of autonomy. In practice though, the majority of governance is vested in Barcelona city council, with jurisdiction over the coastal marine area being transferred from national to local government. To initiate the SPICOSA science-policy interface local partners invited five local representatives, largely from state organisations, to attend a first meeting with SPICOSA scientists. The agenda of this meeting was set by the scientists. At this meeting, stakeholders suggested other state representatives that might be usefully included for the issue but they were not eager to participate. Subsequent interaction was via regular meetings with the original representatives. Though interaction between the particular scientists and policy-makers involved in SPICOSA was not itself new, the integrated, whole-system approach was novel for the science-policy interface.

4.2 Analysis of the SPICOSA science-policy interface

The implementation of SPICOSA in each of the study sites was analysed through the lens of PNS, according to the principles contained in Table 7. The following analysis is therefore structured according to the principles of PNS.

A science-policy interface integrated within the coastal governance context[85]

The SPICOSA Project set out to shape the science-policy interface in the service of ICM, specific to the political situation and practical needs within each study site. For the three study sites with some form of ICM programme in place there was general consensus that the SPICOSA science-policy interface was well nested within the existing programme, and linked closely with an issue of central importance to local coastal governance. Similarly, when asked to what degree they felt SPICOSA was well engaged with the formal policy process within a context, all study sites responded positively; noting that it was either well engaged now, or was anticipated to be well engaged in the near future as SPICOSA built up momentum and visibility. On the contrary, when asked to what degree they felt SPICOSA was integrated with the wider deliberation beyond the formal policy-sphere, the response was divided. Two study sites felt it was well integrated as it was linked directly to an issue of common interest, and was creating indicators of use to deliberation. However two others felt that it was not well integrated, and that the knowledge generated was not fulfilling decision-making needs beyond formal policy-making. Finally, when asked whether SPICOSA was adapting along with the issue and its governance response, there was consensus that SPICOSA was too short-term to allow for demonstrable change over time.

A complex systems perspective for greater learning and understanding/recognition of uncertainty[86]

Central to SPICOSA is its complex social-ecological systems focus, and the desire to express coastal issues holistically. To this end, there was general agreement across respondents that

[85] PNS Principles 1, 11 and 12 from Table 7
[86] PNS Principles 2, 3 and 10 from Table 7

SPICOSA did lead to a more comprehensive understanding of the policy issues, with this understanding extending to interactions between marine and terrestrial systems, the thresholds of these ecological systems, and the effects of human activities on ecosystem health. For two study sites, this more comprehensive vision of the issue, "raising the profile of importance of all components of a system," was one of the most novel and valuable contributions of SPICOSA. Conversely, though no less valuably for two study sites, SPICOSA also provided a useful setting for the identification of uncertainties and knowledge gaps; "it has highlighted a key underlying issue concerning the lack of data." SPICOSA revealed for participants how often important decisions are made without perfect knowledge, or even a good understanding. Finally, SPICOSA was shown to encourage 'social learning' among participating stakeholders. To encourage learning beyond the participants, all study sites initiated arrangements for the sharing of their SPICOSA knowledge; through newsletters or educational programmes for instance.

Reflection on a dialogic science-policy interface [87]

The study sites revealed a reflexive approach to the science-policy interface that saw them place science in a supporting role to stakeholder deliberation, rather than as the central project; "seeking to assess where best that science can offer a means to an end, instead of offering an end in itself." One site considered re-phrasing the interface as a 'policy-science interface' in recognition of "science at the service of policy." This view endorses a governance perspective, "with scientists just one group among a diversity of stakeholders," and extends legitimacy to other stakeholders also. To this end, all four case studies expressed the importance of the 'soft' tools offered by SPICOSA for framing dialogue between stakeholders and scientists: "with good stakeholder analysis, conceptual mapping and Deliberation Support Tools, you don't need modelling." All respondents reported on the utility of stakeholder mapping, as a means for identifying stakeholders, and "encapsulating perceptions of environmental reality." Respondents saw 'conceptual mapping' as a natural progression from stakeholder mapping, to allow a broad scale identification of the "different views on how the system works and…the uncertainties;" while allowing for the 'fuzziness' that accompanies uncertainty, plurality and politics. Furthermore, three of the case studies emphasised the importance of the Matrix tool for structuring deliberation such that knowledge is appropriated as evidence for arguments. Conversely, respondents perceived the 'hard,' quantified computer modelling as difficult to complete given the demands of time and data, and had limited legitimacy among stakeholders. As one site noted, "the focus on 'black box' modelling and complex documents has not been welcomed."

[87] PNS Principles 4 and 9 from Table 7

A participatory setting admitting a plurality of perspectives[88]

To avoid a science-dominated approach, respondents expressed the importance of participation; accepting a diversity of stakeholder perspectives. However, that noted, not all study sites were able to give effect to a participatory setting; in large part owing to the governing system context within which they were set. Only one study site felt that it was able to include the participation of a full diversity of stakeholders, and this is largely due to the existence of previously established ICM participation mechanisms. One of the other study sites which spanned a national boundary reported asymmetrical participation, with strong participation within one nation only. The two other sites commented that their participation was too heavily weighted in terms of state agencies. As such, only one site was able to effectively incorporate local knowledge, with other sites largely restricted to ‘high level’ input from state representatives.

Relativizing conflicting perspectives through reciprocal dialogue[89]

Related to the question of participation, is the question of how case studies addressed plural and sometimes conflicting perspectives. For two case studies, conflicting perspectives did not exist, or where they did there was enough of an understanding of the issue that the ‘correct’ perspective could be determined. Two other case studies acknowledged the presence of conflicting perspectives; both in terms of the perceived elements of the issue, and the different standards on the collection and use of knowledge. In addressing these conflicting perspectives, the case studies attempted to be as transparent as possible, to allow for an open interpretation of the knowledge and communication via reciprocal dialogue.

Addressing knowledge quality through dialogic evaluation[90]

Though no specific questions explored the study sites’ evaluation of knowledge quality, an implicit ‘dialogic evaluation’ became evident. Some respondents noted the strength of SPICOSA to lie in its ability to deliberate multiple stakeholder perspectives on the ‘reality’ of an issue, and their associated uncertainties; encapsulating ideas of reflection, learning and critique. One respondent saw SPICOSA as creating an “interdisciplinary platform for interdisciplinary data,” bringing with it cross-disciplinary evaluation. Another respondent noted that they chose data supported by the politics of the issue rather than solely that data supported by a robust scientific method; demonstrating knowledge ‘quality’ according to what the stakeholders perceive to be important for the issue. None of the study sites verified a dedicated and explicit means for evaluating knowledge

[88] PNS Principle 5 from Table 7
[89] PNS Principle 6 from Table 7
[90] PNS Principles 7 and 8 from Table 7

quality, through 'extended peer review' for instance. The Deliberation Matrix was endorsed as an interesting and important tool, but respondents did not comment on its ability to facilitate knowledge quality assessment.

Critique of SPICOSA

Respondents were asked what they would do differently if they had the opportunity to implement SPICOSA again. One respondent limited their comments to the mechanics of the SAF, with the most common consideration being how the social element could be improved; "The social dimension in my opinion has much more to do with the process of decision making, social networks and governance structures than with a mathematical formulation." This ranged from the means of 'recruiting' stakeholders to participate, to suggestions of omitting hard modelling completely and limiting the process to stakeholder mapping, conceptualisation, and deliberation via the 'Matrix.' One respondent framed SPICOSA's integrated assessment process in the service of a 'social-choice' problem, necessitating social settings within which dialogue is encouraged as a means for eliciting that knowledge. They felt SPICOSA had placed too great importance on the numerical SAF model as a means to support qualitative deliberation, "the complexity of the models has thus been excessive and irrelevant to [stakeholder] deliberation."

4.3 Exploring governance outcomes: institutional quality

Study site respondents were asked to what degree the SPICOSA Project had affected coastal governance institutional settings, including the science-policy interface, that are more in keeping with the principles of good ICZM, as endorsed by the EU's ICZM Recommendation (see Appendix E). Their responses are summarised below according to the 8 different principles.

1 A broad overall perspective of interdependent natural systems and human activities

In general, respondents felt that the SPICOSA science-policy interface had led to a more comprehensive understanding of the policy issue, except with regard to cumulative effects. Where SPICOSA was well integrated with decision-making in other institutional settings (within two sites), a comprehensive perspective and understanding extended to these settings.

2 A long-term perspective taking into account precaution

Most study sites did apply a long-term perspective relative to environmental cycles, often in the vicinity of 40-50 years, but one respondent noted that could not look long-term economically owing to the influence of the discount rate. In addition, all study sites faced difficulty in engaging stakeholders in governance and building relationships with a long term perspective owing in large part to the short-termism of political cycles, and the EU Project funding.

3 *Adaptive management*

In general, respondents felt that SPICOSA's science-policy interface was well integrated with the existing ICM framework and the iterative *policy-making process* within their study sites, though were divided on how effectively integrated SPICOSA was with decision-making *in other institutions*. When asked whether the science-policy interface was adapting with the issue, respondents felt that the Project represented too short a timeframe to discern change.

4 *Local specificity*

For most study sites, SPICOSA led to a greater understanding of the contingent nature of their policy issue, both within and beyond the science-policy interface settings. For all respondents, this understanding led to a greater appreciation for the multiple policy options, instruments or interventions available for their given issue, and for two respondents this led to the formulation of two detailed policy options specific to their site.

5 *Working with natural processes and respecting the carrying capacity of ecosystems*

By employing a comprehensive systems approach to the policy issues, the SPICOSA science-policy interface enabled: (a) the approximation of the carrying capacities or thresholds associated with ecological systems, and (b) the drawing of links between human activities and ecosystem health. For two study sites, this understanding pre-dated SPICOSA, but was nonetheless reinforced through the Project.

6 *Involving all the parties concerned in the management process*

Though SPICOSA respondents were encouraging of a participatory setting, in practice only one of the study sites was able to secure the participation of a representative and diverse collection of stakeholders; owing largely to strong existing ICM participation mechanisms. Within the other sites, participation was either restricted to state agencies, or was asymmetrical in terms of representation.

7 Supporting co-operation between relevant administrative bodies

For the majority of the study sites the existing ‘governing system’ represented an established network of organisations, such that SPICOSA simply served to strengthen the ‘de facto’ integration, though for one study site SPICOSA contributed to building new interactions and cooperation. Moreover, all respondents identified future opportunities for collaboration between administrative agencies, and between scientists and these agencies. Notably though, respondents recognised that SPICOSA did not encourage cross-scale (vertical) integration, or influence future cooperation with coastal stakeholders beyond state agencies.

8 Using a combination of instruments for management

The SPICOSA science-policy interface did allow for a contingent and comprehensive examination of policy issues, with this deliberation extending to discussion of options for policy interventions; including legal, economic, technical, research, educational and voluntary options. However only two study sites advanced to the formulation of detailed policy options, and as of writing, these had not been implemented.

4.4 Exploring governance outcomes: interactional quality

Study site representatives were asked to what degree the SPICOSA Project influenced the quality of coastal stakeholder interactions and dialogue in engaging in collective deliberation and decision-making. The interactional quality was explored relative financial capital, social capital and human capital.

Financial capital

Respondents were asked whether resources, in the form of financial capital or otherwise, had emerged as a result of the SPICOSA Project (separate to the SPICOSA funding). None of the study sites revealed an increase in financial capital to support the science-policy interface or collective decision-making, with resources limited to the provision of data.

Social capital

Respondents were asked questions on the interactions that formed or strengthened between stakeholders as a result of the SPICOSA Project, with variable responses. For one study site, a well-developed ICM mechanism had already nurtured an extensive network of interactions across all categories of coastal stakeholders (‘horizontal’), and across scales (‘vertical’ integration). SPICOSA therefore did not create any new interactions, though did serve to strengthen some of the existing interactions. For two other study sites, interaction had been limited to within the state sphere, where a network of interactions was established between state agencies at the same scale. In these cases, SPICOSA's participation remained largely limited to state agencies, and did not encourage further interaction with stakeholders beyond the state sphere, or at different scales. The fourth study site began with a weakly developed network of interactions between stakeholders, and reported a definite increase in the connectivity of interactions at the local/regional scale. Vertical interaction was not increased though, and indeed deteriorated as a result of a contentious issue. Therefore, in general, the SPICOSA Project was not very successful in nurturing a greater connectivity of stakeholder interactions, particularly in a 'vertical sense,' but did serve to strengthen some of the interactions that did exist.

Respondents were asked questions on how the interactions between stakeholders had developed, with regards to trust, cooperation and collective understanding. There were mixed results on the degree to which SPICOSA had nurtured trust; largely dependent on the capacity of the wider governing system. One case study noted there to be no trust, but anticipated this to change, with local stakeholders deemed likely to develop more trust as knowledge is made available. Another study site perceived a slight increase in trust; noting that before there was none. A third study site described trust as having been already built as a result of an existing ICM initiative. There was, though, more congruence on the increased presence of cooperation and opportunities for future collaboration. In general, the four case studies perceived an increase in cooperation as a result of SPICOSA, as seen through the sharing of knowledge and cooperative projects. Likewise, study sites revealed future opportunities for collaboration that emerged from out of the SPICOSA Project. Finally, a collective understanding of a policy issue across all stakeholders, and the associated stocks of social capital, was variable across the study sites. For one case study, this collective understanding had already been built through previous ICM initiatives, while two other study sites felt that an understanding had been built through the SPICOSA Project. One of these sites preferred to define this in terms of an understanding as contained within individuals (discussed in terms of human capital) rather than a "collective understanding."

Human capital

Respondents were asked whether the SPICOSA Project was characterised by a diverse range of stakeholders, possessing a diverse range of knowledge, skills and experiences. On balance, the study sites did feel that SPICOSA had enabled the inclusion of a wider diversity of perspectives; however in other lines of questioning, only one study site revealed that they had been able to include a fully diverse and representative selection of stakeholders and local knowledge.

Respondents were asked to what degree SPICOSA had led to discernable increases in 'wherewithal,' skills and leadership. In terms of stakeholder's 'wherewithal' or means to participate, both in time/resources, the majority of stakeholders across the study sites were paid state officials, and as such time and resources were not constraints during normal working hours. Moreover, all respondents reported an increasing keenness among stakeholders to participate in what they deemed to be a novel project. In terms of stakeholder's skills and expertise for coastal governance, all sites reported an increase in skills and expertise, though the increase was variable across participants. The majority of participants in all cases were professionals, therefore possessing of a high degree of expertise/skills before SPICOSA. Increased expertise was therefore largely limited to modelling, and some elements of the systems science supplied for the modelling. In terms of leadership, two study sites noted that state agencies had assumed a leadership role in championing SPICOSA.

Finally, respondents were asked to what degree they, and other stakeholders, had learnt more about the issue in terms of: the nature of the issue, the perspectives of other stakeholders, and the decision-making process. There was general consensus across the study sites that individual participants had gained a more comprehensive understanding of the policy issue in terms of the interacting social-ecological systems, the thresholds of ecosystems, and the effects of human activities on ecosystem health. No respondents proffered comment on their learning about other stakeholder perspectives and the decision-making process.

5. Conclusions

5.1 What form did the SPICOSA science-policy interface take?

This chapter started by describing the SPICOSA Project in terms of a 'post-normal science' approach to framing the science-policy interface, as evidenced by its similarity to the principles listed in Table 7; but what form did the interface take in practice? By focussing on one policy issue within each study site, SPICOSA did create a science-policy interface that was well nested in the specific governing system context for that issue and well integrated with the formal policy processes of the study sites. Moreover, by viewing issues as linked social-ecological systems, SPICOSA did provide for a more comprehensive perspective of both what is known about the issue, and equally what is not known; SPICOSA brought a realisation for many participants of the significance of uncertainty. The SPICOSA perspective also led to significant learning opportunities among participants, who professed to a more holistic understanding of the issue to support deliberation and decision-making.

In addition to allowing for a more comprehensive understanding of issues, SPICOSA led to reflection among participants on the most appropriate form of the science-policy interface. This led one study site to conceive of a 'policy-science' interface in recognition of the political dialogue across diverse groups that constitutes governance and science's supporting role as one group supplying evidence in support of this dialogue. For all study sites, this emphasised the importance of 'soft' tools for framing a participatory setting wherein knowledge is mobilised through dialogue between stakeholders and scientists with the goal of reaching a greater understanding of an issue, rather than accumulating 'facts.' Respondents also revealed the value of soft tools for integration; allowing diverse perspectives to co-exist along-side each other within reciprocal dialogue, or a conceptual model. Finally, respondents reflected on the 'knowledge quality assessment' inherent in dialogue, and the co-construction of the soft tools. The SPICOSA experience showed that where stakeholders could see their various perspectives represented, they were more likely to accept the knowledge as having some qualities for decision-making; such as credibility, salience and legitimacy. On the other hand, SPICOSA's 'hard' computer simulation models (the SAF), while assembled according to a credible methodology, were at times deemed less legitimate and salient by stakeholders. Therefore for many participants, SPICOSA brought a realisation of the promise of a post-normal science-policy interface, and criticism of an interface predisposed to modelling alone.

However in practice, both the specific governing system contexts, and SPICOSA's emphasis on modelling outputs, meant study sites were not able to give effect to the ideals of PNS. As noted, few study sites were able to facilitate the participation of a diverse and representative cross-section of stakeholders, with the result that most knowledge was derived from state agencies, and little local knowledge was incorporated. Equally, few sites were able to nurture a truly dialogic setting. In many cases the interaction was one-way, and best described in terms of stakeholders feeding knowledge into the SAF model. Often SPICOSA partners met separately with stakeholders or meetings were fragmented; limiting the opportunity for direct dialogue between stakeholders. Such limited participation and *ad hoc* dialogue had direct implications for the degree to which diverse perspectives were integrated, and the attention to knowledge quality.

5.2 How did SPICOSA contribute to the quality of coastal governance institutions?

For each study sites' policy issue, SPICOSA was able to influence the form of the science-policy interface institutional setting, and where this setting was well integrated with other institutions, it influenced these also. In this way, SPICOSA was shown to improve the quality of coastal governance institutions as measured against four of the EU's Principles of good ICM. In particular, SPICOSA constructed institutions that better gave effect to a broad (EU Principle 1) and long-term

(EU Principle 2) perspective of a specific and contextual issue (EU Principle 4), such that the issue can be understood in terms of the ecosystem's carrying capacity and health (EU Principle 5).

On the other hand, the SPICOSA study sites had variable success in building institutional quality across the other four EU measures, in large part stemming from governing system capacity and a focus on modelling. Specifically, study sites had difficulty in constructing participatory settings that were inclusive of all diverse stakeholder perspectives (EU Principle 6), with repercussions for other EU Principles of institutional quality. Limited participation reduced the ability for SPICOSA to build cooperation between administrative bodies at various scales (EU Principle 7). In addition, with a number of study sites limiting their participation to state agency representatives and the formal policy sphere, their influence on decision-making within wider institutional settings (coastal industries, local fishing clubs, residents associations and so on) was limited; thereby reducing the number of coastal management instruments considered to those within the experience of the state agency participants (EU Principle 8). This more narrow focus has implications for society's wider adaptive management/capacity (EU Principle 3).

5.3 How did SPICOSA contribute to the quality of coastal stakeholder interactions?

This research was not able to see that the SPICOSA Project had a significant effect on the quality of coastal stakeholder interactions within the study site governing systems, as measured across the indicators used within this framework. Specifically, it did not appear to lead to an independent increase in financial capital, nor did it appear to have a significant impact on social and human capital. In terms of social capital, SPICOSA did lead to the construction of new interactions at one site, and strengthen existing interactions at others, but in general SPICOSA did not have a large impact on the connectivity of stakeholders. Likewise, while SPICOSA did conclusively encourage cooperation between participants, it had mixed success in nurturing bonds of trust and mutual understanding. In terms of human capital, SPICOSA had little impact on the diversity of stakeholders implicated in coastal governance, or their wherewithal and skills to participate. It did though lead participants to an increased understanding of the nature of the issue, and increased technical skills in modelling for example.

5.4 In conclusion

In conclusion, SPICOSA can be described in terms of a gap between the post-normal science-policy interface setting anticipated by the Project and its participants, and that setting that emerged in practice. While the Project found significant success in nurturing a comprehensive understanding of the issues, and participants reported the post-normal science approach as holding significant promise, there were barriers to giving effect to this perspective. As such, study site respondents reported variable success in affecting coastal governance outcomes. Within this chapter, a number of reasons have emerged that may provide some explanation of this gap between theory and practice. Firstly, SPICOSA represented a short-term experiment within study sites with ‘de facto’ governing systems that have evolved over a long timeframe, contingent to the cultures of that context. By recognising this long-term perspective on governance, this both means that SPICOSA has to cede influence to other more well-established formal and informal local institutions, and that the governance outcomes of the SPICOSA Project may not manifest themselves for many years to come. Secondly, most study sites struggled to encourage widespread stakeholder participation, with the predictable consequence that SPICOSA was seen as an isolated, and insular exercise among a select group of state officials, with implications for its wider influence. Thirdly, the specific tools offered by SPICOSA ranged from ‘soft’ tools which found wide acceptance from stakeholders, to ‘harder’ modelling tools which may have been perceived as more ‘science-centric’ and less salient or legitimate for the policy issue by some coastal stakeholders. Some respondents felt that SPICOSA had been too focussed on modelling outputs through its membership, its evaluation and its resourcing.

From here, the empirical studies shift their focus to the New Zealand context, and explore the influence of a participatory and dialogic science-policy interface on ICM at both the national and local scale. Chapter 7 begins by reviewing the ways in which the science-policy interface has been engaged across New Zealand nationally, and its influence on the quality of coastal management institutions. It attempts to arrive at some statement on the diverse experiences across New Zealand, and within this, map the growing influence of more participatory traditions of science-policy interface. Chapter 8 zooms in on three particular participatory initiatives at the local scale that imitated a PNS approach, and the extent to which they contributed to institutional and interactional quality within their contexts.

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GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

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Name of Published Paper: SPICOSA Project Deliverable D1.8: Updates review of the Deliberation support tool and its use in coastal contexts

In which Chapter is the Published Work: Chapter 6

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Chapter 7: The influence of the science-policy interface on Integrated Coastal Management across New Zealand nationally: legitimating new norms of participation and dialogue

1. Introduction

The last chapter focussed on the SPICOSA initiative, which implemented a particular approach we described in terms of 'post-normal science,' to framing the science-policy interface for ICM in Europe '*internationally*.' This chapter represents a change in context, scale and scope. It presents an empirical study which attempted to map the diverse means of framing the science-policy interface across New Zealand '*nationally*,' and its contribution to high quality ICM.

This thesis has situated itself within debates surrounding the mobilisation of knowledge for ICM, which Chapter 4 revealed to have largely revolved around the science-policy interface. We noted how the form of the science-policy interface has evolved with ICM over 50 years, according to two parallel yet intertwined traditions of: (a) a science-based interface; and (b) a participatory interface. Under the influence of this latter tradition, and a growing literature discussing ICM as governance, some ICM authors have demanded framing the science-policy interface as a 'governance setting,' according to norms of dialogue, inclusiveness, integration and knowledge quality.[91] Importantly though, Chapter 4 argued that the science-policy interface is rarely described as a 'pure expression' of any one tradition, and is more typically characterised as a complex composite of many different approaches from different traditions. This chapter seeks to unpack this complexity in order to see

[91] Within this chapter, these four epistemological norms, which have emerged from the general literature review in Chapter 3, and the review of the ICM literature in Chapter 4, are labelled in shorthand as 'norms of governance.'

the emergence of these norms of governance relative to other competing influences shaping the science-policy interface, in the New Zealand context.

This empirical research presented here can be distilled into its three components. First it analysed the science-policy interface across New Zealand nationally, to produce a rich map of the diverse and dynamic ways in which it is engaged for coastal management. Second, against this background, it demonstrated the emergence of approaches for giving effect to norms of governance. And third, it explored how the increasing influence of these norms of governance has contributed to quality ICM, relative to the quality of institutions. For this study, the 'New Zealand experience' constitutes the nationally combined coastal management experience, as accessed through multi-scale research; comprising data both at the national scale, and the aggregated experiences from coastal managers in the regions.

This chapter aims to make two contributions to the thesis. First it aims to augment the very focussed studies into post-normal science (PNS) within this thesis, with a broader perspective that demonstrates the emergence of a suite of approaches for giving effect to norms of participation and dialogue as an alternative to dominant traditions of science-based management, and the degree to which they find legitimacy in terms of creating better quality ICM institutions. This serves to relativize a PNS approach alongside other means of framing the science-policy interface as a 'governance setting,' and nests their evolution within the context of a complex melange of influences and epistemic traditions. That is, in reality, rarely is the science-policy interface characterised as a 'pure expression' of any one approach or tradition. Second, it aims to set the context for the discussion within Chapter 8. The next chapter focuses on three local-scale case studies that have engaged an approach resembling a post-normal science perspective, and it is useful to view these relative to their broader national context. Chapters 7 and 8, while focussed on different scales, are mutually enriching; with this chapter providing interesting insights into the local-scale case studies, and *vice versa*.

The chapter begins in Section 2 by describing the New Zealand context in terms of the coastal pressures and the management response. In Section 3, the conceptual framework is re-introduced relative to this particular study, and the research method is expounded. The following two sections present the results and discussion, with Section 4 presenting the analysis of the science-policy interface and Section 5 exploring the influence of the interface on coastal management institutions. Finally Section 6 draws some conclusions on how the science-policy interface has presented both opportunities and barriers to high quality ICM in New Zealand.

2. The pressures facing New Zealand's coast, and its management response

2.1 The pressures on New Zealand's coastal marine area

As an island nation, New Zealand is characterised by 15,000km of coastline and the fourth largest Exclusive Economic Zone in the world (Department of Conservation, 2005). New Zealand's marine jurisdiction spans 30 degrees of latitude, encompassing both subtropical and subantarctic waters, within the path of the 'Roaring Forties' prevailing westerly weather systems. New Zealand is therefore subject to dynamic coastal processes, which combined with a tectonically active coastline, gives rise to a diversity of habitats and species. Indeed, so rich is this biodiversity, some estimate New Zealand's EEZ may contain up to 10% of the world's marine life (Department of Conservation, 2005) – between 23,000 and 75,000 species – many of which are endemic (WWF - New Zealand, 2004). However, with such dynamism and diversity comes a significant degree of complexity and associated uncertainty, with it lamented that more is known about the surface of the moon than the seafloor around New Zealand (Wood, 2006).

Meanwhile, New Zealanders are a maritime people; all four million living within 130km of the coast (Oceans Policy Secretariat, 2001), sharing 250,000 recreational vessels, and one in five of them going fishing each year, mainly along the coast (Peart, 2006). This attachment to the coast has most recently been illustrated with a 'human tide' of migration to coastal townships, where house prices sky-rocketed 200% from 2000-2005 (University of Otago, 2005). As a result, New Zealand's coastal commons is subject to fierce competition amongst a diversity of values, debated within a political arena fraught with high stakes and conflict, as evidenced by studies of the Parliamentary Commissioner (1999) and Oceans Policy Secretariat (2001) for instance. These values are as multitudinous as there are New Zealanders; however the Oceans Policy Secretariat was able to distil six key values at the core of coastal conflict, including: (i) market values; (ii) ecosystem services values; (iii) public access values; (iv) recreational values; (v) spiritual values, or a sense of self/identity; and (vi) cultural value for Maori, as the indigenous people of New Zealand.

New Zealand's coastline is therefore increasingly subject to issues (see Table 8) that are notable for their complexity and intractability, and can be distinguished by three broad properties: (i) significant uncertainty; (ii) a lack of consensus on the definition of the issue and its most appropriate 'solution,' owing to a plurality of legitimate perspectives; and (iii) decision-making made within the context of urgency and high political stakes. It is important to understand though that pressure on the New Zealand coastline varies across the regions. In a recent review (Bremer, 2009), coastal managers were questioned on the pressures facing their coast. Interestingly, of the

16 regional authorities interviewed, nine respondents felt that their region's coastline was not under significant pressure and of the seven other regions, most noted that pressure was not uniform but condensed into pockets of development.

Table 8: Key coastal issues as perceived by New Zealanders

(i)	competition for use of the coastal marine area;
(ii)	development pressure along the coast;
(iii)	declining water quality;
(iv)	coastal hazards as a result of climate change;
(v)	the threatened integrity of coastal ecosystems;
(vi)	the threat of pests; and
(vii)	a declining fishery resource.

A number of surveys have identified these key issues - see e.g. (Arnold, 2004; Bremer, 2009; Oceans Policy Secretariat, 2001; Warren, 2005; Willis, 2003; WWF - New Zealand, 2005)

Please note that the relative ranking of issues varies across the surveys.

2.2 New Zealand's coastal management regime

Since 1991, New Zealand has been steered by a coastal management regime that gives effect to the ICM approach. In 1991, a new regime was established centred on the Resource Management Act which, while never formally described as an exercise in ICM, nonetheless gave particular regard to the principles, institutions, methods and tools espoused by ICM. Moreover, by 1992 New Zealand had ratified Chapter 17 of Agenda 21, which endorses the ICM approach, and submitted its new coastal management regime as proof of this commitment. Subsequently, New Zealand has been subject to at least two international reviews by the Scottish Executive (2001), and the OECD (1997), evaluating New Zealand's progress toward ICM. Therefore, within the context of this chapter, it is considered appropriate to discuss New Zealand's coastal management within the framework of ICM.

New Zealand's coastal and oceans management is spread over more than 25 different statutes, and administered by at least 14 different agencies across seven different spatial jurisdictions. That noted, local government is the lead agency in coastal management, with devolved governance powers and responsibilities under the Resource Management Act 1991 (RMA) and Local Government Act 2002 (LGA). The RMA is an 'effects-based' statute that allows for the integrated allocation and management of all natural resources along the coast (with the exception of fisheries and minerals) by broadly stipulating the form of local government policy documents and processes. Both the RMA and the LGA recognise 'sustainability' as the steering purpose of local government, though the RMA is more environment-centred and regulatory, and the LGA more socioeconomiccentred and strategic in focus. With significant devolved power comes significant accountability, with local government required to be transparent in its operations and follow a comprehensive ‘special consultative process’ for most of its decision-making processes. This process dictates the statutory minimum public consultation to precede decision-making by local government representatives (councillors), and allows for these decisions to be appealed by public stakeholders to the ‘Environment Court.’ In this way, the allocation of the coastal commons, whether through a broad policy process or through the consideration of one proposed coastal project, is at least presumed to be an exercise in collective decision-making within a community. At its inception New Zealand’s coastal management regime was thus described as a ‘partnership’ between the state and the community, given effect to through local government bodies (Department of Conservation, 1994).

At the local government scale, coastal management under the RMA is divided between ‘regional authorities’ and ‘territorial authorities.’ Territorial authorities (as typified by city councils) have jurisdiction of the management of land-use to the high tide mark, as defined within their ‘District Plan.’ They are also charged with the more common operational duties related to roads and utilities for example. Regional authorities have a much broader spatial jurisdiction based broadly on catchment boundaries, and extending to the edge of the territorial sea (12nm). Regional authorities have jurisdiction over the use of all other resources, including allocation of space below the high tide mark, meaning they are usually the lead agency for coastal management. These resources are managed within the Regional Coastal Plan, which must give effect to the guiding principles of the RMA and the objectives and policies of the Coastal Policy Statement (see below). Coastal Plans primarily fulfil a regulatory role, indicating where people are able to take or use a resource by right, or whether they need to apply for ‘resource consent.’ Any application for resource consent must be accompanied by an Assessment of Environmental Effects (an Environmental Impact Assessment), outlining any actual or potential effects of their proposal on the environment, and how they propose to remedy, avoid, or mitigate these effects. The regulation of the Coastal Plan is balanced by the non-regulatory measures embodied within a region’s Long Term Council Community Plan (as required under the LGA) which details a community’s long-term goals and the required Council spending priorities; including the support of coastal education, or beach-care groups for instance.

With New Zealand’s coastal management high devolved to the local level, the RMA has introduced the national-scale New Zealand Coastal Policy Statement (NZCPS) to ensure harmonised and coordinated coastal management across the regions, and as a means of ensuring a consistently high quality of coastal management. The NZCPS was prepared by the Minister of Conservation with DOC and released in 1994, after a long process of intensive consultation with stakeholders and the general public. The NZCPS sits high within the RMA policy hierarchy, and is supposed to ensure that the multitude of contingent decisions made at the local level share a common regard for a set of collectively agreed principles of good process and guiding values. It provides a nationally agreed list of (constitutional) principles, to both: (i) ensure decision-making follows 'good process,' and (ii) provides for those diverse and important values considered as national priorities (roughly corresponding to those values listed in Section 2.1 above) in giving effect to the overall goal of sustainable development. These principles are closely aligned with those of ICM, particularly procedural principles of participation and precaution for instance. The NZCPS must be reviewed every 10 years, with a second generation NZCPS due to be released in late 2010.

The Conservation Act 1987 and the Fisheries Act 1996 are the other two key statutes governing the New Zealand coastline. The Conservation Act provides for the creation of the Department of Conservation (DOC) to both manage public conservation estate (including the foreshore and seabed), and act as an advocate for conservation of natural and cultural heritage. DOC itself is a central government department, though it has a local presence through 19 local conservancy offices. The Fisheries Act allocates and manages the marine fishery and is guided by a resource use imperative through the implementation of a quota management system. It is highly centralised in its implementation within the Ministry of Fisheries (MFish), with few local officers.

This serves to demonstrate the most fundamental source of disintegration within New Zealand's coastal management regime; the three key statutes of the RMA, Conservation Act and Fisheries Act are steered by three different agencies, with different imperatives, different governance structures, different sources of funding, and different decision-making processes. In an attempt to provide some integrative influence, the Environment Act 1986 provided for the creation of the Ministry for the Environment (MfE). MfE does not have any management role in a regulatory or operational sense; rather its mandate is restricted to tools of inquiry, monitoring and advice across all state agencies (including local government) on the best means of resource and environmental management.

3. Exploring the influence of the science-policy interface on coastal management institutions: Conceptual framework and research method

Within the New Zealand context, this empirical study set out to unpack and analyse the various forms of the science-policy interface, and explore how they influence high quality ICM, relative to the quality of coastal management institutions.

The research was undertaken relative to the nationally combined coastal management experience within New Zealand, comprising both coastal management at the national-scale, and the aggregated experiences from the 16 regional authorities. This broad perspective was deliberate. It was an attempt to present the multifarious experiences across New Zealand to enable an appreciation for the coastal management regime at large; including both some sense of the 'widespread' practices,' or 'prevailing cultures' dominant at the science-policy interface, while at the same time allowing an appreciation of regional diversity. This discussion of diversity together with common themes was important for mapping the emergence of norms of governance in terms of a suite of different approaches for shaping the science-policy interface. At the same time, this broad exploration of the New Zealand national context is essential to precede an exploration of more fine-scaled case studies, which are nested in this context, in Chapter 8. A nationally aggregated study reveals the wider social, historical and cultural environment within which specific instances of coastal management operate, and allows for framing local-scale experiences in terms of the way such a widespread coastal management regime is given expression within a more specific context.

This section presents the conceptual framework used to steer this research study, as comprising two separate steps: (i) an analysis of the science-policy interface; and (ii) an exploration of its contribution to high quality coastal management institutions. The section finishes by detailing the method of data collection according to this framework.

3.1 Analysis of the science-policy interface institutional setting

As a first step, this research began with an analysis of the diverse forms of science-policy interface engaged for coastal management across New Zealand; as a function of both the formal coastal management regime, and common practice. Drawing on the discussion from Chapter 4, the analysis was structured as a 'dialogue' between the two parallel traditions that shape the science-policy interface within the ICM literature, and their corollary elements. That is, to what extent is the science-policy interface framed by elements of the science-based tradition and/or elements of the participatory tradition; accepting that the two traditions are not mutually exclusive? For this analysis, the two traditions were each unpacked into four separate elements, with the participatory tradition depicted relative to the four norms of governance (see Table 9 below). The elements were grouped as complimentary or 'like-concepts' often grouped in the literature, with the distinction didactic but somewhat artificial. For instance, ICM authors like Bennett *et al* (2005) and Korfmacher (2002) have both provided accounts of ICM programmes that have demonstrated the tight relationship between (a) ecosystem-based, (b) adaptable and precautionary, and (c) science-based management. Therefore, the analysis of the science-policy interface was steered according to these eight elements.

Table 9: Framework for analysis of the New Zealand science-policy interface

Science-based tradition		Participatory tradition	
a)	science-based management	e)	inclusive of multiple forms of knowledge
b)	ecosystem-based	f)	dialogic epistemology
c)	precautionary adaptive management	g)	knowledge integrated through reciprocity
d)	interdisciplinarity	h)	attention to negotiated knowledge quality

Key to this analysis was establishing the 'dialogue' between these two broad traditions, to allow insights into how norms of governance have emerged to shape the science-policy interface across New Zealand, relative to other dominant traditions. This dialogue can thus be embodied in a number of questions which set the character of this analysis, asking: If the science-policy interface contains elements of both traditions, how do they relate to each other? Do they co-exist, or are they in competition? Is one tradition dominant, and if so, why? And how do they influence decision-making relative to each other?

3.2 Exploring the influence on coastal management institutions

As a second step, this research explored how the emergence of new norms of governance within the science-policy interface has contributed to high quality ICM across New Zealand. To this end, the research study drew on the evaluation framework of ICM as 'interactive governance,' introduced in Chapter 2 and engaged in Chapters 5 and 6.[92] We recall that this framework introduced parallel measures of institutional and interactional quality as two mutually reinforcing features within a 'governing system.'

To measure institutional quality, this study first examined whether there were any guiding 'meta-principles' of coastal management that are specifically meaningful for shaping coastal management institutions within the New Zealand context. In this regard, the principles of the New Zealand Coastal Policy Statement (NZCPS) were considered as a good starting point, with an independent evaluation of the 'first generation' NZCPS undertaken by Rosier in 2004 (Rosier, 2004). However, this measure was discarded for two reasons. First, Rosier found the quality of the evaluation was compromised due to difficulties in determining to what degree the NZCPS found 'true' expression in institutions. That is, to what degree was a value given effect in action, rather than given mere 'lip-service' in a policy document. Rosier criticised the lack of monitoring and outlined the difficulties in linking the principles of the NZCPS, to coastal management institutions, to collective decision-making. Second, the principles of the NZCPS are very specific to guiding the formal institutions set

[92] See Appendix D for a summary of the conceptual framework steering analysis of the science-policy interface and exploration of contributions to coastal governance in this research.

by the RMA, and this regard, does not provide a suitable set of measures for other ‘informal’ institutions, like that of the science-policy interface.

Consequently, for measuring institutional quality this study drew on the principles of successful ICM that were proposed within the generic evaluation framework posited in Chapter 2; arguing that the nine principles presented by Stojanovic, Ballinger and Lalwani (2004) provide a robust list. Indeed, if we consider New Zealand to espouse an ICM philosophy, we can argue that these generic principles provide a relevant and meaningful measure of institutional quality.

This study did not embark on an exploration of how the diverse forms of the science-policy interface contributed to interactional quality. This was because of the complications posed by arriving at an aggregate picture of the stocks of human, social and financial capital across New Zealand nationally; these measures are far more contingent to specific contexts and did not lend themselves to the broad-level perspective sought by this study.

3.3 Research method

Data collection for this research began in late 2007 and concluded in mid-2009, after progressing in two stages. As a first stage this research began with a ‘desktop study,’ for a more general exploration of New Zealand’s coastal management regime, and the place of the science-policy interface within this regime. It utilised resources from a number of resources including:

(A) The ‘stocktaking’ and ‘issues and options’ documents undertaken as part of the Oceans Policy consultation process;
(B) The legislation and Brookers Online;
(C) Raewyn Peart’s (EMS) books, ‘Looking out to Sea’ (Peart, 2005) and ‘Beyond the Tide’ (Peart, 2007);
(D) New Zealand Office of the Parliamentary Commissioner for the Environment (1999) ‘Setting Course for a Sustainable Future’;
(E) A range of Department of Conservation reports;
(F) Chapters at the Seachange05 Conference, and at the Royal Society Conference 2006;
(G) D.J Rosier’s review of the NZCPS (Rosier, 2004).

During this first stage, it quickly became apparent that owing to the highly devolved nature of New Zealand’s coastal management, and the diversity across regions, a sufficiently rich appreciation of New Zealand’s coastal management required an exploration of practice across the regions. The exploration needed to be extended to local government. Meanwhile in conjunction with this first stage, a review of the ICM literature allowed for a finalisation of the conceptual framework detailed above, which guided the formulation of a semi-structured interview framework to be applied at the local scale.

As a second stage, the research endeavoured to undertake face-to-face interviews with coastal managers at all of the 16 regional authorities within New Zealand. Regional authorities were chosen instead of territorial authorities, given their greater statutory responsibility for coastal management, as embodied within their Coastal Plans and spatial jurisdiction. The research targeted those staff most knowledgeable of coastal management in their region, and ranged from planning/policy staff, to scientists to land-management staff, depending on the region. In all but two regions, interviews were conducted by a single interviewer with a single interviewee; the two exceptions including a group of 4-5 interviewees within the same room. The semi-structured interview framework comprised broad questions drawn from the theoretical framework, along with a list of prompts, and was sent to interviewees in advance of the interview. Interviews lasted between one and two hours and were recorded, with notes taken from these recordings and sent to the interviewees for confirmation. These notes were then coded and analysed according to the theoretical framework. Apart from this chapter, the results of the evaluation were condensed into a published monograph (Bremer, 2009) and presented at the Ports and Coasts conference in Wellington 2009 (Bremer & Glavovic, 2009).

There are four key restrictions attached to the above research method. Firstly, by undertaking interviews with only one representative from each region, this biases the responses in terms of one perspective. This can be significant given a regional council can extend to hundreds of staff, with a coastal management response that is multi-faceted, and rarely does any one individual have a comprehensive knowledge of all facets. Secondly, the majority of respondents were from a planning background, and as such the research was apt to bias according to this perspective. Thirdly, given the length of interviews and the dialogic manner in which they were undertaken, notes were taken from recordings rather than a full transcript. This can prejudice the research according to the perspective of the note-taker; who inevitably imposes their perspective on the recorded data. Finally, the research would have been enriched by a more detailed ‘discourse analysis,’ to analyse the interaction between the interviewer and interviewee, and the degree to which respondents gave answers to please the interviewer.

4. Analysing the science-policy interface: results and discussion

The lack of knowledge on New Zealand's coastal and marine environment is one of the most significant barriers to management of these areas. National reviews of the coastal management framework since the 1990s have outlined huge gaps in New Zealand's coastal knowledge and encouraged the accumulation of 'knowledge capital' to enable sustainable development (Hooper & Chong, 2006); with this same message echoed by regional coastal managers through this research. Faced with the prospect of decision-making in the absence of knowledge, much of New Zealand's discussion of its coastal management is broadly centred on the science-policy interface. The analysis of this science-policy interface is divided according to the two broad traditions listed in Table 9, and is usefully read in conjunction with Appendix F.

4.1 Elements of a science-based tradition

a) Coastal management as science-based management

The research found New Zealand's coastal management, consistent with its broader environmental management, is dominated by a bias towards science-based management; giving science the principle role within the science-policy interface (see e.g. Parliamentary Commissioner for the Environment (2001, 2003, 2004) and the Ministry of Research, Science and Technology (MoRST) (2001, 2007)).[93] Coastal managers at all 16 regional authorities reported science to be the dominant form of knowledge, such that attempts to mobilise knowledge for coastal management usually begin with a discussion on how best to mobilise 'more science.'

Broadly, the three key coastal management agencies – regional authorities, DOC and MFish – are responsible for collecting the science necessary to undertake their roles, with MfE undertaking research that spans all three jurisdictions. For instance, while not one of their formal roles, MfE has taken on the responsibility of producing a national State of the Environment report every 10 years. However, this coastal management framework has been criticised as hampering the effective collection, mobilisation and dissemination of science; summarised in six points:

1) There is a lack of in-house scientific capacity and resources to spend on commissioned science, across all three agencies. This is worsened by the prohibitive costs of science below

[93] The Parliamentary Commissioner and MoRST have both undertaken broader studies into the state of the science-policy interface more generally; that is, not specific to coastal management. See Appendix F for a brief review of these studies, which sets this discussion of the science-policy interface for coastal management in the wider context of how knowledge is mobilised for policy and management in New Zealand.

the high tide mark. To address capacity shortfalls, the 'Envirolink' fund was created, and some organisations have entered into cooperative research projects.

2) Owing to the disparate governance imperatives of the three agencies, and their poorly defined and coordinated roles and responsibilities, science collection is often silo-ed, resulting in large gaps in the science. As the state Services Commission noted back in 1999 (as cited in, Parliamentary Commissioner for the Environment, 2007), "Information is typically generated in departmental silos as there are few incentives to share information and resources."
3) There is an inadequate national State of the Environment monitoring framework – with only three indicators of coastal health. This has resulted in a disintegrated and patchy knowledge-base for the coast (Parliamentary Commissioner for the Environment, 2007).
4) The Ministry of Fisheries devolves almost all science collection to private fishery quota holders; however experience has shown that quota holders are not sufficiently motivated by their property rights to invest in research (McKay, 2006).
5) The science that does exist is poorly disseminated. It is often in an unusable form, has been lost through poor information management, or is held guardedly by private organisations and research institutes (Ministry for the Environment, 2005; Willis, 2003)
6) There is not any strategic policy for coastal management, which could steer and fund the collection of science for coastal management nationally. As one of its priorities, the NZ Biodiversity Strategy sought improved knowledge of coastal and marine biodiversity through cross-agency, interdisciplinary initiatives, including the Oceans 20/20 project.

Since the restructuring of New Zealand's state agencies according to principles of New Public Management in the mid-1980's, regional coastal managers reveal that science-based coastal management is a luxury not all regional authorities can afford. Many respondents described a lack of in-house scientific expertise and a small science budget as two important holes in their coastal management capacity. This confirmed a MoRST (2004) report which found that only three regional authorities had significant in-house science capacity (scientists) and a good engagement with the science, with variable capacity across the other 13 Councils; owing mainly to variable rating and asset bases across the regions. As such, this research has found most regional authorities purchase 40-50% of their science requirements (Ministry of Research Science and Technology, 2004); usually in the form of specific issue-based scientific reports. Moreover, the lack of in-house science capacity represents a weakening in the ability of policy- and decision-makers to engage with science to support decision-making (State Services Commission 1999, as cited in, Parliamentary Commissioner for the Environment, 2007), as evidenced by a large number of 'first generation' coastal plans that were founded in a minimum of science. By 2007, the Parliamentary Commissioner noted that the relationship between policy-makers and science providers had improved but noted, "capacity and resourcing issues, continue to restrict this." This introduces the interesting paradox of coastal managers who place a priority on science-based decision-making, within a coastal management regime that limits their access to science.

The science used to support coastal management at the regional-scale can be broadly divided into three streams, which found variable utility across the 16 regional authorities. The first is the on-going 'State of the Environment' (SOE) monitoring, which only six regions felt made a significant contribution to their decision-making. For most regional authorities there is insufficient scientific capacity in-house to allow them to monitor a large number of indicators over a long time series; leading to significant regional variance in the type and number of indicators measured. As such, respondents felt that SOE monitoring was poorly linked to policy preparation because of the small number of indicators measured, the fragmented collection of science, and a feeling that the truly important indicators, such as coastal amenity, are immeasurable. The second stream of science is 'resource consent-based research,' associated with the preparation of an Assessment of Environmental Effects (AEE) for a particular proposal, and with monitoring afterwards. Six regions felt that resource consent-based research constituted a significant contribution to their decision-making. In general, these regions did not have significant in-house scientific capacity, or a significant budget to commission science, and therefore relied on resource consent applications to incrementally build up a picture of their coastline. To this end, three regions reported the assembly of a database within which the individual AEE form a piece of a growing puzzle.

The third stream of science is 'issue-based' research, which a majority of respondents (9) felt contributed significantly to coastal management. Issue-based research is usually conducted in response to political pressure from the community who perceive an issue threatening their coast, though sometimes it is collected to fill knowledge gaps that become evident through a policy/decision-making process. Due to their focussed and specialised nature, issue-based reports are most often commissioned from consultants. Respondents favoured issue-based science for a number of reasons, including; (a) the limited scope of their SOE programme; (b) issue-based reports have a specific policy-purpose, and are therefore more efficient than maintaining expensive in-house capacity; (c) issue-based research, when done in partnership with other agencies, means the council budget can be more effectively used; and (d) scientific resources are allocated on the basis of political pressure.

b) Ecosystem-based

While New Zealand's coastal management regime under the RMA is labelled ecosystem-focussed, both the national- and regional- scale research found that the mobilisation of science is not sympathetic to this approach.[94] Perhaps most fundamentally, the artificial division between the three key agencies of coastal management has led to fragmented and silo-ed science collection that does not serve an ecosystem-based perspective. Specifically, the gap between the collection of science for fisheries management under the Fisheries Act, and coastal ecosystem management under the RMA, leaves any scientific understanding partial at best. Furthermore, regional coastal managers reported that SOE monitoring was often limited to three or four indicators, which were historically derived rather than based on ecosystem health, or on the key stocks or flows within an ecosystem. Moreover, only seven respondents reported undertaking any socio-economic monitoring, demonstrating a bias towards natural science, and disinclination toward linking socio-economic and natural systems. Similarly, resource consent and issue-based research was often described as ad hoc; undertaken in a fragmented way according to an urgent issue, or for a specific project. This, respondents noted, does not allow for an integrated understanding of an ecosystem, or an appreciation of the cumulative effects of coastal activities.

In recognition of this shortfall, there have been a number of central-government funded research projects under the Biodiversity Strategy, which have led to a more ecosystem-based understanding of the oceans and coasts, including: the National Aquatic Biodiversity Information System (NABIS); the Marine Environment Classification System (MEC); and most notably the Oceans 20/20 initiative, which aims to map New Zealand's marine territory, with a focus on regions that experience high use. These projects are interagency and interdisciplinary in nature; demonstrating the links between social-ecological systems.

c) Precautionary adaptive management

Increasingly the science-policy interface is characterised by the need to proceed in the face of significant uncertainty. To this end, the precautionary principle and associated concept of probabilistic risk have become a basis for coastal management in New Zealand (Ministry of Research Science and Technology, 2001).[95] It is explicit in a number of pieces of legislation and implicit in others, such the Fisheries Act or the RMA, where environmental effects are assessed on the probability of their occurring and their scale. Peart (2007), in her analysis of three coastal plans, found that all were influenced by a precautionary approach that restricted the use of the marine area on the basis of poor knowledge. This reflects the political urgency associated with producing a policy document that provides for procedural and development certainty, while not providing time for the research required to reduce uncertainty (MoRST, 1998, as cited in, Parliamentary

[94] See also Appendix F for a broader appreciation of the way science is mobilised for environmental management more broadly.
[95] See also Appendix F

Commissioner for the Environment, 2004). Associated with this, five regional coastal managers described exercising the precautionary principle through the resource consent process, by requiring applicants to supply a comprehensive AEE, and granting short-term consents with stringent monitoring conditions.

However, while having good regard for principles of precaution, New Zealand's coastal management regime is poorly able to adapt in response to new information; to implement 'adaptive management.' The first reason for this is the lack of emphasis placed on monitoring. As noted above, most regions do not have the capacity to monitor a large number of SOE indicators, and no regions reported mobilising resource consent monitoring results in a form able to support decision-making. The second reason for this lack of adaptability is the inflexible policy documents stemming from the political inertia within a decision-making process that regularly spends years in the Environment Court.

d) Interdisciplinary

At the national-scale, interdisciplinary science is rarely given effect, mainly due to a framework which encourages fragmented and ad hoc science collection.[96] However, as noted, a number of interdisciplinary projects have been developed at a national, inter-agency scale, including NABIS and Oceans 2020 for example. Regional coastal managers were asked whether the science they used to inform coastal management was interdisciplinary. For the majority of authorities, science remains very much silo-ed, with two restrictions to interdisciplinarity being: (a) a coastal management framework that collects science incrementally, 'as required'; and (b) the prohibitive cost. Only six authorities reported undertaking any science that was interdisciplinary. Three of these six authorities were very well resourced councils that were able to collect science from multiple disciplines to build complex models of the issues. The other three ran a less resource-hungry dialogic process that allowed for interaction between scientists, which they recognised as interdisciplinary. Four respondents felt that 'planners' acted in an interdisciplinary role, by bringing multiple disciplines together within the context of an RMA policy or resource consent process. Two other respondents described their in-house scientists as adequately knowledgeable to facilitate the bringing together of multiple disciplines. Three regions made special mention of the Oceans 2020 interdisciplinary project, and how valuable this science has been.

[96] See also Appendix F

4.2 Elements of a participatory tradition

The research discovered that within many regional authorities the science-policy interface is being re-defined to encourage a wider dialogue between different knowledge systems; espousing what we have discussed here as 'norms of governance.'[97] This follows recognition that all stakeholder groups – whether from the state, the private sector, civil society or the scientific community – are possessing of valuable knowledge perspectives, which can be mobilised in support of decision-making through dialogue. At least seven respondents felt that science alone was not sufficient for resource management. While not phasing out the traditional interaction between scientists/consultants and policy-makers, many regions were found to compliment this interface with methods for mobilising other forms of knowledge, and facilitating dialogue across the different forms of knowledge. This normally signalled a departure from the statutory process, and was influenced by a growing philosophy of co-management or 'governance' across the regions.

e) Inclusive of multiple forms of knowledge

The ICM review found five ways in which regional authorities complimented their science-dominated science-policy interface with methods for mobilising other knowledge perspectives, listed below in order of least-to-most 'participatory' (according to Arnstein's (1969) ladder):

(i) *Education programmes*: All respondents reported education programmes as forming part of their coastal management regime, and many had staff devoted solely to education. Where these education programmes found expression through forums or travelling 'road-shows,' there were often opportunities for stakeholders to contribute their perspective.

(ii) *Consultation with the broad public*: At least 12 respondents reported undertaking some form of non-statutory consultation as a means of accessing the broader community's knowledge. Most regions released a draft document for public comment prior to entering into the statutory 'special consultative process,' with this document accompanied by a combination of public meetings, travelling road-shows, newspaper surveys, postal surveys, and the use of other media such as radio or internet.

(iii) *Cross-agency coordination around an issue*: All respondents reported being able to pick up the phone and initiate as-required coordination with stakeholders from other state agencies on an issue; including sharing knowledge. Eight regions reported some kind of formal inter-agency knowledge mobilisation for key issues.

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[97] See also Appendix F.

(iv) Preparing non-statutory strategic policy: At least nine regions created strategic, non-statutory policy documents for the coast; with the preparation of these involving the creative mobilisation of knowledge. While the majority of these non-statutory processes were initiated by the community, a division can be made between those that were then led by local government, and those led by the community. Most projects are led by local government, and start from the science-based management paradigm. Community stakeholders are invited to contribute their perspective at well-defined entry points in a highly structured and formal process. There is a clear boundary between the knowledge provided by scientists and other stakeholders. Conversely, community-led projects start from community knowledge, with council and scientific knowledge invited to fulfil a supporting role. The process is more inclusive and less structured, with less of a boundary between state, scientific and community actors.

(v) Knowledge partnerships with stakeholder groups: All respondents reported entering into partnerships with stakeholders that transcend the state agencies, though for many of them, the mobilisation of knowledge was only one facet of a multi-faceted relationship. There were four broad forms of partnership, in order of most-to-least common:

- 'Planning partnership:' a small group of stakeholders are presented with all available knowledge, including science, and they are asked to deliberate on its credibility, salience and legitimacy for supporting policy-making.
- 'Research partnership:' two or more partners (from the private sector or civil society for instance) undertake research on a particular issue of interest. There is no defined policy outcome; rather it is a knowledge gathering exercise.
- 'Operational partnership:' a partnership that may be built around a concrete project or piece of infrastructure, such as a rehabilitation project, coastcare programme, or the operation of a port for instance. This partnership meets regularly to discuss any emerging issues, and to aid in the evolution of knowledge on this resource.
- 'On-going forum:' This is a forum comprising <u>all</u> categories of stakeholders, which meets regularly to discuss emerging issues across a defined area. It is different to the operational partnership in that it has a broader, strategic focus.

f) Opportunities for dialogue across different sources of knowledge

As noted above, an increasing number of regional authorities are creating opportunities for dialogue between knowledge perspectives, which transcend science, and incorporate the knowledge systems from across the full spectrum of stakeholders.[98] Particularly through community-led 'non-statutory policy processes' and 'knowledge partnerships,' regional authorities have 'democratised' the science-policy interface to allow for the mobilisation of previously inaccessible knowledge perspectives, and the co-construction of new knowledge relative to an issue. Such settings allow for the negotiation of what constitutes the 'facts' within the context of strongly-held value positions; making clear the politics and power present in coastal management.

Setting aside unique dialogic settings, coastal managers were asked to characterise more generally the interaction between science and other knowledge perspectives, with three broad views put forward. Three respondents viewed the resource planners, and the RMA process, as the principle means of encouraging interaction between knowledge systems. For four respondents, the community was invaluable in their role as the 'eyes and ears' of the council; observing changes in the environment which were then further investigated by the council, and where necessary, scientific analysis. Finally, for two respondents the community was useful in helping science to establish the cause of different scientifically observed changes.

g) Integrated through principles of reciprocity and co-existence

Regional coastal managers were asked to what degree disparate knowledge systems were able to be 'integrated,' or brought together, according to principles of reciprocity and co-existence. A number of respondents felt that science and other knowledge systems were not able to co-exist, or that they may be equally accepted as knowledge for coastal management until they conflict with each other, and then the dialogue becomes adversarial. For two respondents, there was a fundamental and irreducible rift between the science-based perspective and the 'cultural-ethical' perspective characterised by other knowledge systems within the community. This rift was seen to stem largely from the transparency of the value-loadings inherent in both forms of knowledge; with science professing to 'objective knowledge,' while other knowledge systems have a more explicit link between their values and their knowledge perspective. Indeed it is this perceived 'objectivity' that has elevated science as the most legally defensible form of knowledge. It is perhaps for this reason that one respondent noted that where these sources of knowledge clash, regional authority staff (policy-makers) often turn directly to science, while for politicians (councillors) the choice is not so evident. Five respondents noted how the choice of which knowledge to give precedence is a political decision; for politicians the most credible source of knowledge is that which strengthens their cause. Therefore if the science fails to support the cause, it will be construed as 'narrow, 'short-term' or even just 'bad' science; while other forms of knowledge will be dismissed as 'anecdotal' if it is counter to a politician's line. In this way, one respondent emphasised that while

[98] See also Appendix F

the RMA is often defined as science-based, that in fact almost all decisions are political, which greatly dilutes the potency of the science.

Finally, for two respondents, the dialogue between science and other knowledge systems had been beneficial in bridging the rift between the two; resulting in 'social learning' across both fact and value dimensions, and eroding mis-conceptions on both sides. For example, one group of respondents described how dialogue between local coastal inhabitants and ecologists had eroded the polarised positions on the worth of mangroves. The ecologists came to realise the barrier mangroves pose to the effective use of the coast, while the locals came to realise their ecological value; resulting in an amicable agreement somewhere near the middle of the spectrum.

h) Attention to negotiated knowledge quality

Coastal managers across all of the regions described the dominance of science as the dominant form of knowledge used to inform coastal management, predominantly given its legal defensibility within a litigious RMA decision-making process. Many made the point those other forms of 'experiential' knowledge, local or traditional for example, held less credibility under legal scrutiny, due in large part to the difficulties in validating their truthfulness, and a perception that they were more fallible in terms of false memory, value-bias, and broad unqualified statements. Given the importance of legal defensibility in a decision-making process that is regularly decided in the Environment Court, scientific criteria have become the universal measure of knowledge quality. Given the dominance of scientific measures, a number of respondents felt it was impossible for science to sit alongside other knowledge systems in a cross-validation role. However, this is not to forget the measure of quality decided according to political power; what some planning authors have described 'the rationality of power' (Flyvbjerg, 1998). As long as decision-making is political, knowledge will be appropriated to the degree it supports specific value positions.

5. Exploring the influence on the quality of institutions: results and discussion

To this point the study exposed a rich diversity of experiences for engaging the science-policy interface for coastal management across New Zealand. It revealed the dominance of science-based management traditions, but also revealed the fundamental barriers to the effective engagement of science. In answer, it has seen the increasing engagement of a number of participatory approaches that we analysed as norms of governance. In terms of a 'dialogue' between these two traditions, we can discern the emergence of new norms of governance within the science-policy interface as a response to the perceived shortfalls of science-based management alone. At this point the study turned to see how this translated into influences on coastal management institutions; to what degree has the emergence of the science-policy interface as a 'governance setting' contributed to better quality institutions?

For this second step in the study, the research explored the ways in which the form of the science-policy interface has encouraged or discouraged giving effect to the nine principles of ICM across coastal management institutions; that is both within and beyond the interface itself. Below the discussion unpacks the way in which the dominant science-centric tradition has performed relative to these principles, and what promise is offered by alternative norms of governance; with each principle addressed in turn.

Comprehensive:

The current form of the science-policy interface does not give a comprehensive, holistic and integrated understanding of the coast and its issues. With the exception of some large scale interdisciplinary and ecosystem-based projects (Oceans 2020), coastal management is supported largely by narrow disciplinary science, commissioned from consultants in an ad hoc and fragmented manner as issues arise. Moreover, poor information management often hinders the incremental assembly of a more integrated understanding. This has equally influenced other institutions, with coastal managers citing 'uncertainty' as a key barrier to managing the coast, as evidenced through poorly supported first generation Coastal Plans. However, the second generation of Coastal Plans, and a new raft of non-statutory policy instruments, are demonstrating willingness for a more participatory and dialogic science-policy interface to encourage a more comprehensive understanding, and to support this process with a greater amount of targeted science.

Participatory:

The dominant science-based tradition shaping the science-policy interface discourages participation and dialogue. Science is generally communicated directly to policy-makers via written reports (often from consultants), which does not allow for transparency or accountability within the wider community. Equally, this science is often communicated as evidence within a litigious, court-based decision-making process. The Parliamentary Commissioner, and this research, found this form of science-policy interface to have discernable effects on participation within other institutions. Specifically participation was discouraged by feelings of cynicism of poorly informed stakeholders, whose main avenue for involvement was via the litigious statutory process, where they felt their perspectives were automatically over-ruled by scientific advice. Conversely, the research found a fast emerging tradition of more participatory and dialogic science-policy interface mechanisms, which were supported by more transparent and accountable science, communicated to all stakeholders. These new institutional settings had an immediately discernable impact on other institutions because they are directly integrating the science-policy interface with collective decision-making.

Co-operative:

The dominant science-based interface is not encouraging of co-ordinated or collaborative collection of knowledge in support of decision-making. Rather science is collected in departmental silos, and used to inform narrow departmental decisions. This demonstrates a basic lack of coordination across state agencies on how science can be collaboratively collected in a strategic manner and shared such that all departmental decisions are better supported. It also demonstrates a lack of wider coordination with other coastal management stakeholders/partners, in the cooperative collection and sharing of knowledge. That noted, a number of coastal managers reported both formal and informal mechanisms for the sharing of knowledge, and some agencies have engaged in partnerships for the collective mobilisation of science and other knowledge. More broadly, engaging the full spectrum of stakeholders in a participatory setting has allowed for the sharing and collaborative collection of knowledge. Specifically, eight regions reported the collaborative monitoring of the coast with the community – including the monitoring of dunes, shellfish or mangroves for instance – with five feeling this empowered the community to drive the collection of knowledge.

Contingent:

The dominant science-based tradition framing the science-policy interface encourages the collection of science contingent to a specific issue encountered. Often though, this science is collected in isolation of the broader context; both socio-economic and environmental. Large interdisciplinary projects, such as Oceans 2020, have gone some way toward addressing this shortfall, with comprehensive surveys of all systems within a locality. Similarly, more participatory interface settings have allowed for a wider and more comprehensive account of the coast and its issues, thereby contextualising coastal management and its science. This was noted by six respondents, who noted the community as invaluable as the ‘eyes and ears’ of the council, and helping to establish the causality of scientifically observed changes. This increased contingency within the science-policy interface has had flow-on effects to decision-making, as especially demonstrated in the non-statutory documents.

Precautionary:

The science-policy interface is inherently precautionary in its approach. Where sciences, or indeed other forms of knowledge, are not able to provide sufficient certainty on the future state of the coast, then decisions are framed in a precautionary way. For example, the first generation Coastal Plans were found to be poorly supported by science and other forms of knowledge, and as such resorted to a highly regulatory framework, whereby very few activities are permitted as of right, requiring most activities to apply for a resource consent. At the activity level, resource consent decisions are also described as precautionary. Where the effect of an activity is uncertain, applicants are required to provide a detailed AEE, and the council may issue consent for a short duration with stringent monitoring clauses.

Long-term:

In general, the dominant science-based interface can be described as short-term in its focus. This is because, with the exception of coastal erosion, long-term state of the environment monitoring is scarce and fragmented, and commissioned consultant reports are variable in their treatment of long-term change over time; most restricting their scope to the anticipated short-term effects of an activity. This short-termism is reinforced by a public-good science funding system that is competitive and based on business cycles, and a lack of any long-term capacity building for coastal management expertise, including any 'institutional memory.' Decision-making for Coastal Plans, resource consents and the LTCCP, is often long-term; however there is usually a poor consideration for any long-term dynamism or cumulative effects over the lifetime of the 'decision.' There is also a lack of knowledge building with other key stakeholders in the community, with implications for their long-term commitment to coastal management. That noted, some participatory mechanisms, such as 'knowledge partnerships,' have built some long-termism into the science-policy interface with wider effects on stakeholder participation and long-term commitment. Similarly, central government has begun some long-term scientific projects, and made available more long-term strategic funding for coastal management.

Strategic/Focussed:

Within the dominant science-based tradition, there are rarely any strategies for the collection of science, including focussed research priorities for instance. Rather, science is collected in an *ad hoc* manner as coastal issues are recognised as important. Alternatively, where such a strategic plan does exist it is rarely attached to any meaningful financial commitment. Significantly, the administrative division between a Coastal Plan, and the more strategic LTCCP, means non-regulatory means within the Coastal Plan, including research, often fail to be allocated funds.

Moreover, the compartmentalised nature of science-based management within departmental silos serves only to deepen these divisions. Conversely, the collection of knowledge within a participatory setting, such as through a non-statutory plan or knowledge partnership, is often centred on strategic and focussed knowledge collection. As such, stakeholders will collectively identify key gaps in their understanding, and prioritise research to fill these gaps. Non-statutory plans often appear to be shaped by their participatory and strategic knowledge collection, by themselves taking a more strategic, focussed and multi-faceted approach.

Incremental:

The collection of science to support coastal management can be considered incremental, in that it is added to or assembled in small increments; often though AEE or commissioned reports. However, as a result of poor information management, and a thinning institutional experience, regional authorities (and indeed other coastal agencies) often fail to integrate these pieces of science into an increasingly clear picture of the coast. Similarly, there are deficiencies in the on-going monitoring and evaluation of coastal management efficacy, which precludes better informed action/implementation to be taken as incremental steps. Taken collectively this represents a lack of incremental learning, and/or adaptation. That noted, a number of regions have taken steps to rectify this, specifically through the creation of large updateable databases, and through participatory mechanisms that disseminate knowledge to all coastal stakeholders, and thus invest in a wider 'institutional memory.' Equally in the wider coastal management regime, incremental action is central to the framework but poorly implemented in practice. This can largely be traced to a failure to monitor, evaluate and review, and therefore derives influence from the science-policy interface.

Adaptable:

The science-policy interface, in general, does not encourage 'learning' from previous coastal management interventions to support future decisions. While resource consents may involve stringent monitoring conditions, and a requirement to alter their practice in accordance with this monitoring, the same does not apply equally to Coastal Plans and other strategic non-statutory documents. Within the science-policy interface, monitoring is neglected; both broad SOE monitoring, but perhaps more importantly, monitoring of policy effectiveness in terms of environmental outcomes. Rosier (2004) noted this as a serious barrier to evaluating coastal management. At the same time, the research found a thinning institutional memory in councils, both within scientists and other staff, meaning councils were continuously 'reinventing the wheel' as previously encountered issues re-appeared. This poorly adaptable science-policy interface was reported to have influenced other institutions. Combining this science-policy interface with long-term Coastal Plans and resource consents, existing use rights, and the inertia in the litigious decision-making process, respondents criticised coastal management as inflexible.

6. Conclusions

ICM has long debated the ideal form of the 'science-policy interface' for coastal management, with the debate summarised according to a loose dichotomy between science-based and participatory traditions, and latterly in terms of a 'governance setting.' This chapter set out to contribute to this debate through revealing the many forms of the science-policy interface within the broader New Zealand's context, and exploring how it has influenced or shaped coastal management institutions, using measures of ICM. In particular it sought to explore the degree to which 'governance' norms of dialogue, inclusive participation, integration and knowledge quality assessment have found expression, and how they have contributed to ICM institutional quality.

The research found that within New Zealand the science-policy interface is comprised of elements from both science-centric and participatory broad traditions, with a rich diversity of experiences across the regions. This makes it very difficult to make observations that are universally true across the coastal management regime, and in all practice. Similarly, the influences that have shaped New Zealand's coastal management institutions are multiple, complex and dynamic; easily confounding any attempt to follow one source of influence from the science-policy interface. However, this noted, the chapter has endeavoured to make clear some broad observations on common themes, in terms of a 'widespread' or 'prevailing' experience.

The research found the science-based tradition to be dominant in shaping the science-policy interface in New Zealand. Indeed, science has proven a powerful source of knowledge to support coastal management in the past, with many coastal managers emphasising the improved predictability offered by science, and better informed decisions. In this regard, they pointed to the benefits derived from large interdisciplinary projects like Oceans 2020, and the significant scientific research surrounding aquaculture. However, there are also a number of significant barriers to the effective mobilisation of science. These barriers are many and diverse, but echoing the findings of the Parliamentary Commissioner, stem primarily from a lack of resources to invest in science, resulting in reduced in-house scientific capacity and poor engagement between policy and science. This has adverse spin-off effects in terms of silo-ed science collection, a poor emphasis on long-term monitoring, poor information management, and a short-term focus on ad hoc consultant reports. Therefore we can, in a very real way, discuss a paradox within the science-policy interface.

On one hand, there is a reliance on science as the most robust and powerful forms of knowledge, to push back the bounds of uncertainty and render a clear picture of coastal issues. On the other hand, there is a coastal management regime that seriously hinders the mobilisation of science, such that there is significant uncertainty. Moreover, there are elements of the coast important to New Zealanders that are immeasurable by science such as amenity and cultural value, which frustrates a decision-making process reliant on 'hard' and unequivocal scientific measures. As a result of this paradox, policy- and decision-makers struggle to use science properly; often misappropriating scientific findings as hard limits or rules. Therefore, if considering the 'quality' of a science-based interface in New Zealand against principles of ICM, one can conclude that it performs adequately well in terms of being contingent, precautionary and incremental, but performs poorly against all other measures of quality.

The research found that a science-based interface had a number of direct implications for the form and quality of other coastal management institutions in New Zealand, with four specific implications outstanding. Firstly, the narrow focus on communication between scientists and policy-makers via written reports has contributed to poorly informed stakeholders across all categories, with direct effects on stakeholder participation, and also coordination between coastal agencies. This influences institutional quality in terms of the comprehensive treatment of issues, participation, cooperation and long-term or strategic qualities. Secondly, a precautionary approach to science has led to a fundamentally regulatory approach founded in misappropriated scientific 'limits,' with adverse influences on the implementation and conflict resolution of coastal management. This has demonstrable effects on institution's comprehensiveness, contingency, adaptability and precautionary approach. Thirdly, a science-based interface has been a formative influence on the litigious decision-making process, where science is employed as evidence for a value-position. Reciprocally, this court-centred process has shaped the science-policy interface; pushing science further toward short-term, one-off, activity-specific consultant report. Such a decision-making process performs poorly against ICM measures of comprehensiveness, participation, cooperation, precaution, long-termism, and adaptability. Fourthly, a lack of long-term monitoring or strategic science collection, when combined with 'hard' rules and a litigious process has left New Zealand's coastal management inflexible. This has most significant effects on the quality of institutions according to measures of long-termism, incrementalism, adaptability and strategic focus.

In contrast to the dominant science-based tradition, coastal management in New Zealand is increasingly supported by a participatory and dialogic science-policy interface which this chapter described in terms of new governance norms. The research found this at least represents the influence of:

a) an increasing experience and maturity relative to the coastal management regime, leading to more creativity beyond core functions;
b) an increasing emphasis on co-management in some regions;
c) an increasing recognition of the impediments to mobilising science; and
d) an increasing tendency to base decisions in a fuller understanding.

The introduction of a more participatory and dialogic science-policy interface mechanism signalled a willingness in many regions to invest in both greater participation, and more science, to better support decision-making. This is evidenced by the processes preceding the emerging 'second generation' coastal plans, and the raft of non-statutory plans which have attempted to incorporate strong participation with a strong science-basis. Importantly, participation and the inclusion of a wider array of knowledge perspectives is not seen as an alternative to science. On the contrary, science retains an essential role given its powerful ability to elucidate the coast. However science becomes raised more within the context of a participatory process; one which integrates the science-policy interface and decision-making arenas. Science becomes more targeted to gaps identified in the participatory process; and in that way can incorporate more long-term monitoring efforts – often comprising other non-scientific monitoring – within a more strategic knowledge forum. These participatory and dialogic interfaces have taken many forms, ranging from inter-agency knowledge sharing fora, to community-led non-statutory policy processes, to knowledge partnerships and on-going community fora.

Where regions have undertaken to employ these participatory and dialogic science-policy interface mechanisms, the research found that institutional quality increased across most principles of ICM, with perhaps the exception of long-termism, incrementalism and precaution, where quality remained equal. This led many coastal managers to support participatory measures as an important innovation; however they were also quick to point out the limits to participation, which have already been written on extensively by the Parliamentary Commissioner. Notably, (i) the existing degrees of cynicism and distrust among coastal communities; (ii) poorly informed coastal communities; (iii) lack of stakeholder capacity – time and resources – to participate; (iv) lack of regional authority capacity to facilitate long-term participation; and (v) community interest in participation. These barriers are non-negligible, and when combined with a coastal management regime that remains hard-wired toward regulation and litigious decision-making, mean that the dominant science-based interface will likely persist, even as participatory processes gain influence.

In the next chapter we move from the national to the local scale in New Zealand. In doing so, we move from a broader discussion on the emergence of new norms of governance within the science-policy interface across New Zealand, back to a focussed exploration of the particular approach presented by the post-normal science perspective, as given effect within three local-scale initiatives. In this way, this chapter has provided a broader context within which three local-scale case studies are nested in Chapter 8.

Chapter 8: ‘Post-normal’ approaches to coastal governance at the local scale:
Lessons from three New Zealand case studies

1. Introduction

Part IV of this thesis explores the empirical basis for introducing a ‘post-normal’ science-policy interface to Integrated Coastal Management, viewed as ‘interactive governance.’ As the final chapter in Part IV, this chapter presents an empirical study that followed three local-scale coastal management initiatives in New Zealand, which gave effect to an approach that could be meaningfully described in terms of a post-normal science (PNS) perspective. It goes on to explore how these three initiatives contributed to coastal governance within their local context, and draw some comparisons with the national experience.

Important to a reading of this chapter is an understanding of the wider New Zealand context as presented in Chapter 7 and Appendix F. That chapter noted a diversity of means for engaging the science-policy interface for coastal management, drawing on elements of both a science-based and participatory approach. It went on to show though that New Zealand has a distinct bias toward science-based management; introducing the paradox of a governing system that is dependent on science to make decisions, but does not have the human, technical, financial or institutional capacity to accumulate this science for a comprehensive understanding. This paradox has had significant implications for the quality of coastal management institutions and decision-making in New Zealand, leading local government to turn to more participatory science-policy interface initiatives. Among these initiatives are approaches that approximate a PNS approach, as the focus of this thesis.

This chapter is distinguishable from the other empirical chapters in Part IV by its focus on coastal management *at the local scale*, which is anticipated to deliver unique insights on the experience of a 'post-normal' science-policy interface, from those garnered at an international scale (Chapter 6: The SPICOSA Project),[99] or at the national scale (Chapter 7)[100]. Authors writing on ICM (see e.g. Cicin-Sain and Knecht (1998) and Costanza *et al* (1999)), and environmental governance in general (see e.g. Lemos and Agrawal (2006), Pierre and Peters (2000), and Wilbanks (2006)), have long acknowledged its multi-scale nature; necessitating a unique suite of institutions and tools at each scale, integrated according to mechanisms of vertical integration. It is therefore conceivable that the form of the science-policy interface may be fundamentally different dependant on the scale addressed. Indeed, Reid *et al* (2006) have argued that while formal scientific knowledge dominates at larger scales, as represented by the Intergovernmental Panel on Climate Change, informal knowledge systems are more likely to be considered alongside science at the local scale.[101] This demonstrates a greater potential for a participatory and dialogic science-policy interface at the local level, and echoes arguments made by Costanza (1999). This chapter also allows a more comprehensive and rich contextual analysis than the other empirical chapters insofar as it collects a greater diversity of stakeholder perspectives within each case study site, and more detail on the specific local conditions.

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[99] Note that the SPICOSA Project was implemented across a number of 'local scale' study sites across Europe, Scandinavia and Turkey, with this implementation providing the basis for the evaluation in Chapter 6. However, it should be recognised that the approach itself was instigated and largely administered at the international scale.

[100] Note that Chapter 7 attempts to broadly analyse the 'common' national state of the science-policy interface for coastal management in New Zealand, and the general influence of this interface on coastal institutions. It does not, therefore, focus specifically on national experiences with a 'post-normal' science-policy interface, rather providing insights into the general state and potential of participatory traditions of science-policy interface in New Zealand.

[101] Authors writing on political ecology, ecosystem management and adaptive co-management (see e.g. Berkes, Berkes and Fast (Berkes, F., Berkes, M. K., & Fast, H. (2007). Collaborative Integrated Management in Canada's North: The Role of Local and Traditional Knowledge and Community-Based Monitoring. *Coastal Management, 35*(1), 143-162.), Folke, Colding, Olssen and Hahn (Folke, C., Colding, J., Olsson, P., & Hahn, T. (2007). Interdependent Social-Ecological Systems and Adaptive Governance for Ecosystem Services. In J. Pretty, A. S. Ball, T. Benton, J. S. Guivant, D. R. Lee, D. Orr, M. J. Pfeffer & H. Ward (Eds.), *The SAGE Handbook of Environment and Society*. London: SAGE Publications Ltd.) and Wilbanks (Wilbanks, T. J. (2006). How Scale Matters: Some Concepts and Findings. In W. V. Reid, F. Berkes, T. J. Wilbanks & D. Capistrano (Eds.), *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington: Island Press.), have argued that most social-ecological systems and their issues are far too complex to be understood at anything above the most local scale, necessitating the integration of science with local knowledge perspectives. Similarly, Fabricus, Scholes and Cundill (Fabricus, C., Scholes, R., & Cundill, G. (2006). Mobilizing Knowledge for Integrated Ecosystem Assessments. In W. V. Reid, F. Berkes, T. J. Wilbanks & D. Capistrano (Eds.), *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington: Island Publishing.) and Kingsley (Kingsley, G. T. (1996). Perspectives on devolution. *Journal of the American Planning Association, 62*(4), 419.) have argued that informal local and traditional knowledge is often more 'fine-grained' at the local level than formal science, and extends an appreciation to historical context.

The analysis of the local coastal management initiatives within this chapter necessarily follows from the analysis of the common New Zealand national experience in Chapter 7, which scrutinised the diverse conditions of the science-policy interface and its influence on coastal management institutions. In this way, Chapter 7 forms a 'frame of reference,' or background, to understand the local scale initiatives. Specifically, Chapter 7 provides both the broader context within which the local initiatives are nested, thus providing some understanding of the influential forces beyond the case study site itself, and a standard or referral by which to compare the success of the three case studies relative to the national experience. This allows an investigation of whether a post-normal science-policy interface contributes to 'better' coastal management; understood in terms of (a) better quality institutions and interactions, (b) satisfaction of stakeholders within the local context, and (c) in terms of an improvement on the norms[102] of coastal management prevalent across New Zealand nationally.

Therefore, the three specific objectives of this chapter are to:

(i) *Analyse* the specific science-policy interface utilised across the three case studies to examine the degree to which they give effect to the post-normal science perspective;
(ii) *Explore* the degree to which the science-policy interface within the three case studies have contributed to the success of Integrated Coastal Management within their local context, relative to measures of institutional quality and interactional quality.[103]
(iii) *Compare* the experiences across the three case studies, and identify common features including facilitators and barriers to implementing a post-normal science-policy interface, and the use of the knowledge garnered to support more successful coastal management. Compare also the experiences of the three case studies with the national experience outlined in Chapter 7.

In the next section, this chapter presents the conceptual framework and research method used to explore the three case studies according to the objectives presented above, before presenting each case study in turn within three separate sections: Section 3 presents the Whangamata case study; Section 4 presents the Waikaraka case study; and Section 5 presents the Gisborne case study. Unfortunately, the space required to present the comprehensive analysis and contextual exploration demanded by this study would have made this chapter far too long, with a reader potentially lost in the details and unable to harvest those interesting findings. Therefore, this chapter stops short at briefly introducing each case study, with the exhaustive analysis relative to the conceptual framework shifted to Appendix G. In this way, Appendix G should be considered an important

[102] See also: 'general state;' 'common practice;' 'prevailing culture;'
[103] This Chapter utilises the evaluation framework outlined in Chapter 2, validated in Chapter 5, and used in Chapters 6 and 7 – see Section 2 below.

support to a reading of this chapter. After addressing each of the case studies separately, Section 6 brings together the three diverse experiences to compare and contrast them; identifying any commonalities and differences. Section 6 also allows for a comparison of these case studies against the national frame of reference in Chapter 7. Section 7 concludes.

2. Research framework and method

2.1 Selection of the case studies

The three case studies were selected following the nationwide review of the science-policy interface for coastal management in New Zealand, described in Chapter 7. As part of the national review, the researcher undertook semi-directed interviews with senior coastal managers at each of the 16 regional authorities in New Zealand. Interviewees were asked, among other things, whether there were any coastal management initiatives that employed a participatory science-policy interface in their region, and on the basis of their responses, a short-list of potential case studies were assembled. After further discussion and clarification with local government staff, the short-list was narrowed to three case studies (see Figure 7). The three case studies each represent their own rich context, and present unique insights into coastal management and the science-policy interface; however in selecting them it was important also to ensure that they share some similarities, such that cross-comparison is not irrelevant. These similarities will be presented in detail in Section 6; suffice to note here that all three case studies employed a similar form of participatory science-policy interface in response to a similarly ‘post-normal’ coastal water quality issue. In all cases this interface sought to bring together diverse knowledge perspectives through open and reciprocal dialogue, with some attention given to knowledge quality.

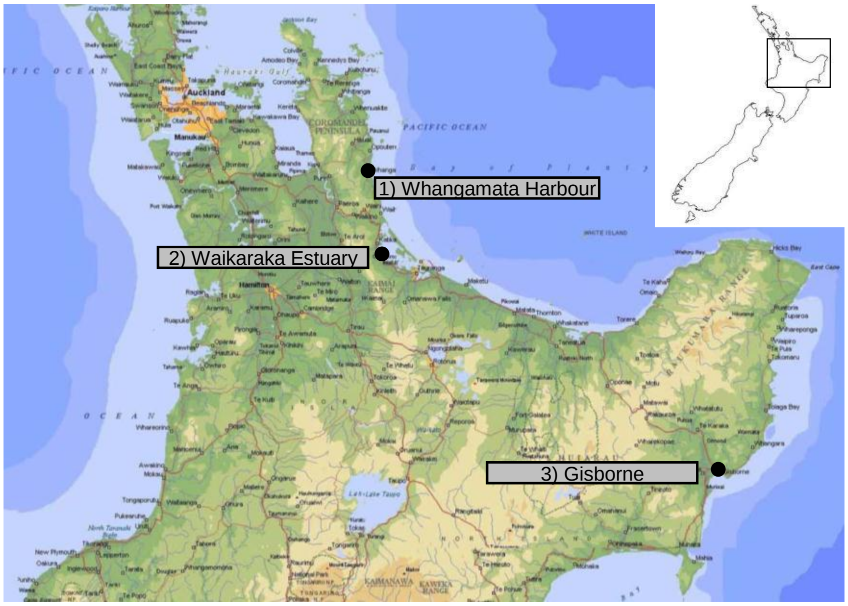

Figure 7: Location of the three New Zealand local-scale case studies

2.2 Interview framework

The three case studies were studied through the use of semi-structured interviews of key stakeholders. The conceptual framework that guided the exploration of the case studies is essentially two-tiered.[104] The first tier *analyses* the science-policy interface through the lens of the post-normal science perspective, while the second tier *explores* the contribution or influence of the science-policy interface for promoting successful coastal management:

- The first tier analyses the science-policy interface relative to 12 broad principles, or characteristics, of post-normal science derived from the literature (see Chapters 3 and 5), to determine whether each case study represents a strong or weak instance of a PNS approach, and thus allow some comment on the applicability of PNS to coastal management.
- The second tier is derived from the evaluation framework presented for ICM in Chapter 2, and validated relative to the published literature in Chapter 5. Drawing on 'interactive governance' theory, this framework proposes evaluating ICM relative to both the quality of coastal management institutions and the quality of stakeholder interactions for collective decision-making. Chapter 2 provides lists of indicators for measuring the quality of both institutions and interactions.

[104] See Appendix D for the detailed table of the conceptual framework. See also Chapters 2, 3 and 5.

Using this conceptual framework, a semi-directed interview framework was created, comprising 15 broad questions (and prompts) spread evenly across three sections corresponding to: (i) the analysis of the science-policy interface; (ii) the evaluation of institutional quality; and (iii) the evaluation of interactional quality. An identical interview framework was used across all three case study sites, and indeed was also the basis for the interviews of the SPICOSA Project.[105]

2.3 Research method

The research at each case study began with the identification of stakeholders (individuals and groups), and contacting them to request their participation. The relevant stakeholders at each case study were identified according to a basic 'snow-balling' technique of stakeholder analysis, whereby known stakeholders (from local government) were asked to identify who they considered to be other relevant stakeholders, who were then in turn contacted and also asked to identify other relevant stakeholders, and so on. The process finishes upon saturation; when no new stakeholders are identified. For these case studies, saturation occurred after talking with only three or four stakeholders, given there were never more than 8-12 stakeholders for each initiative. Upon compiling a list of all relevant stakeholders for a case study, the potential interviewees were selected according to the following three criteria, in decreasing order of importance:

(i) Did they represent a diverse range of perspectives? The selection of stakeholders was guided by a governance typology, which identifies four broad categories of stakeholders: civil society, the state, the private sector, and the scientific community. Importantly, stakeholders from local Maori iwi[106] were also included in every case.
(ii) Did they represent the stakeholders most knowledgeable of the initiative?
(iii) Did they represent the stakeholders with an important stake in the issue/initiative?

After identifying six appropriate stakeholders at each case study, the researcher contacted them all by telephone to request their participation, with the majority of stakeholders responding enthusiastically. Where stakeholders agreed to participate, they were sent a letter informing them of the research and their rights relative to it, together with the interview framework of questions and prompts. All stakeholders had these questions at least three weeks prior to the interviews.

The researcher spent approximately one week at each case study, during which time he visited sites of interest, collected material on the initiative, and undertook the six semi-directed interviews with stakeholders. In most cases the interviews were with one interviewee, though on some occasions two or three interviewees were present. All interviewees were asked to sign a participant consent form before beginning the interview, which confirmed that they understood their rights

[105] See Chapter 6
[106] Iwi is a term used to describe an extended kinship group, or extended tribe, descended from common ancestry

relative to the research, understood their response was confidential, and consented to the interview being recorded. Interviews were run in a semi-directed manner and generally lasted between 40-60 minutes. The recorded interviews were transcribed, and the transcriptions were emailed to respondents within 10 days of the interview, to give them an opportunity to make any changes.

The transcribed interviews were analysed according to a systematic process of discourse analysis, which resulted from planning and discussion between the researcher and his supervisors and colleagues. Each transcript was read through and material coded according to its relevance to the criteria of the conceptual framework. That is, coded according to what the material reveals in relation to (i) how ‘post-normal’ an initiative is relative to its principles; and (ii) the contribution of an initiative on governance relative to measures of institutional and interactional quality. For each case study, a ‘master sheet’ compiled extracts from all six interviews relative to each given criteria. Where a particular comment was relevant to multiple criteria it was replicated appropriately throughout the master sheet. This condensing of interviewees responses relative to each criterion enabled a balanced and comprehensive analysis. Two final points require noting. First, the analysis did not follow a ‘hard’ quantitative means of text analysis employing programmes like nVivo or Atlas.ti, in favour of a ‘softer’ approach with more regard for the contingency of the discourse. Second, the process did not follow the kind of ‘deep’ discourse analysis associated with anthropology for example, where the underlying meanings and strategies for employing discourse are analysed. This study did not have time for the researcher to immerse himself in the different contexts. Rather, actors’ statements were taken on face value.

3. Whangamata Harbour and Catchment Plan and the Iwi and Care Stakeholder Forum

The small township of Whangamata exists at the base of the Coromandel peninsula, at the mouth of the Whangamata Harbour (see Figure 8). The catchment is relatively steep, isolating Whangamata from other larger townships nearby, and characterised by a mixture of farmland and forestry. Whangamata has traditionally been a popular summer holiday destination with its two wide sandy beaches, consistent surf-breaks, and boating in the harbour at the north end and a small estuary to the south. This can see the normal resident population of 3555[107] swell to more than 25,000 over the Christmas and New Year’s period; putting immense stress on the limited infrastructure. Indeed, this development pressure has caused deep divisions within the community, which have surfaced through heated political and legal battles over a new marina, the upgrading of the local wastewater system, and the removal of mangroves.

[107] 2006 census; comprising a significant proportion of retirees

Since the 1940's the sedimentation of Whangamata Harbour and the associated expansion of mangroves has been increasingly widespread, with perceived implications for the coastal amenity, recreational and property values of Whangamata residents; "We could see that if it was left to continue, we were going to have no harbour, and that's really what Whangamata is about; the harbour and the beach…That's really part of the structure of the community." Fourteen years ago the local community began organising public meetings and forums on mangroves, and lobbied local government for help, through groups such as 'Harbourcare,' the 'Ratepayers Association' and the 'Community Board.' 'Whangamata locals' groups demanded the removal of the mangroves from the harbour back to their extent in the early 1940's. To this end, and in conjunction with their lobbying, the Whangamata locals went through the process of applying for three resource consents[108] to remove mangroves. It was at this stage that other stakeholders mobilised in opposition.

Figure 8: Aerial photograph of Whangamata Township and Harbour (Google Earth)

[108] See Chapter 7. A resource consent is a permit issued by local government to undertake any use or development of natural resources that is not permitted as of right, according to local government policy documents. Depending on the scale of the proposed activity, it will involve an assessment of environmental and social effects, and public consultation. The public have the right to appeal a decision made by local government to the Environment Court.

In opposition to the Whangamata locals were a collection of groups who argued for the retention of mangroves on the grounds of ecological values and services, and the intrinsic value of the natural environment. For these groups, the spread of mangroves is a symptom of more endemic and pervasive problems that have infiltrated society's relationship with the natural environment, and that require fundamental change to this relationship, rather than the stop-gap measure of removing the mangroves. At the same time, they argued that the mangroves provide a unique and diminishing habitat for native species of birds and fish. These groups were led by tangata whenua[109] (Ngati Hako and Ngati Whanaunga) and the Hauraki Maori Trust Board conglomerate, though they are supported closely by environmental non-governmental organisations, such as Forest and Bird, and more locally, the Whangamata Salt Marsh Society.

However in addition to these two clusters of groups, there were a number of other stakeholders that had varying stakes in the mangrove issue. Unavoidably, local government (led by Environment Waikato regional council, but also including the Thames Coromandel District Council) had a role in formalising the local community's collective decision-making, together with the local branch of the Department of Conservation. Alongside state agencies, the Rayonier private forestry company also had a stake insofar as they are the largest landowner in the catchment, and potentially contribute much of the sediment that has filled the harbour. Finally, there were also a number of stakeholders from the scientific community, ranging from consultants employed by 'the locals,' to scientists from Massey and Waikato universities.

By 2008, two events had occurred which raised the political urgency and stakes for the issue. Firstly, frustrated by the slow pace of the resource consent processes and the apparent lack of success at lobbying the regional council, Whangamata locals took illegal action to clear mangroves from the harbour. At this stage, Environment Waikato (EW) had to make a decision; to prosecute or work with Whangamata locals, with the decision made to work with them. Secondly, in February 2008 a Whangamata local was voted in as a regional councillor using the mangrove issue as their platform, and immediately set about promoting resource consent for the removal of 70ha of mangroves. In response to these two events, tangata whenua signalled their objection and requested the deferral of a decision on the removal of mangroves until after a deliberative process; "(Maori) didn't want mangroves defined as a priority without going through a robust process." In response EW introduced the idea of a strategic and holistic Whangamata Harbour and Catchment Plan (the Plan), which would be informed largely through an Iwi and Care Stakeholder Forum (the Forum), in parallel with other widespread and comprehensive community consultation. The Forum was to be comprised of a diversity of knowledgeable stakeholders and had the role of both

[109] Tangata whenua describes the local people of an defined geographical area; people born of the land

deliberating knowledge on the issue, alongside finding some consensus for the future of the harbour. However, while the Plan and the Forum were able to reach resolution on most of the issues, ultimately discussion reverted back to mangroves, and after 18 months stakeholders remained entrenched in a stalemate. At the time of writing, this necessitated a decision from regional councillors, to break the stalemate relative to the final form of the Plan, and relative to the deferred resource consent to remove 70ha of mangroves.

This research follows the Iwi and Care Stakeholder Forum, as a participatory 'science-policy interface setting' for bringing together knowledge for decision-making. The Forum was convened by EW, who restricted membership to those stakeholders who were knowledgeable of the Harbour and its issues. In this way, the Forum attempted to move beyond consensus alone, to enable a meaningful dialogue about the knowledge that underlay these value-positions. The Forum held regular meetings, chaired by an independent facilitator, wherein EW presented itself as an equal stakeholder at the table. These meetings were structured according to a number of deliberation support tools, including a series of formal presentations of stakeholders' perspectives (including scientific presentations) followed by debate, and collective mapping exercises. In parallel with the Forum, knowledge has been collectively compiled into the Plan through monitoring the effect of removing mangroves within small 'trial plots,' as well as quantifying observations of locals and tangata whenua.

In exploring this case study, six interviews were undertaken with stakeholders who had been active within the Forum, comprising:

1) A stakeholder from EW;
2) A stakeholder from DOC;
3) A stakeholder who had represented the tangata whenua perspective at the Forum;
4) A stakeholder who had represented the Whangamata locals' perspective at the Forum;
5) A stakeholder from the Rayonier forestry company; and
6) Two stakeholders that were members of Forest and Bird environmental NGO.

Please consult Appendix G for the comprehensive analysis of the Forum relative to the conceptual framework.

4. Waikaraka Estuary Managers Inc

The Waikaraka Estuary is a relatively small estuary (approximately 0.55km^2) located in the southern basin of the large Tauranga Harbour, in the Western Bay of Plenty (see Figure 9). The estuary is described as a low energy estuary, shielded from wave action by a sand spit at the mouth. The Oturu Creek and an unnamed tributary enter the estuary at the southern end, draining a catchment that has a history of intensive development. In the late 1960's, land-use within the catchment changed from dairy to orchards, and nowadays is characterised by low-density urban development, small 'lifestyle' farms, and some orchards. The development of the area has had adverse effects on the health of the estuary and water quality, predominantly through sedimentation and the associated spread of mangroves. Mangrove populations in the wider Tauranga Harbour have increased in area from an estimated 240 ha in 1943 to 521 ha in 1991.[110]

Figure 9: Aerial photograph of Waikaraka Estuary (Google Earth)

The Waikaraka estuary itself has a number of values that have been compromised by its deteriorating health. These values range from aesthetic, amenity and recreational values, to being considered a significant marsh bird habitat, an area of significant cultural value, and an outstanding natural feature and landscape in the local Coastal Plan. These values have attracted small pockets of residential development around the edges of the estuary; particularly as improved roads have made the area more accessible from nearby Tauranga city. These residents can be characterised as a significant number of active and retired professionals; representing a fairly unique demographic. At the same time, the Waikaraka estuary also has significance for the tangata

[110] Bay of Plenty Maritime Wetlands Database, August 2000

whenua; more specifically, the Hapu Piriraku,[111] who descend from the Iwi Ranginui and the Waka Takatimu.[112] The sand spit at the mouth of the estuary has spiritual significance as the ancient pa site Rarupua[113], and there is a nearby marae and kohanga reo[114]. Since the 1980's, the deterioration in estuary health has been a concern for Waikaraka locals; Maori and pakeha[115] alike.

It was the Piriraku people that initiated action toward addressing the issues of sedimentation and mangroves in Waikaraka estuary, noting that the children at the kohanga reo now had to wade through mud and mangroves to get to a favourite swimming hole. In 1988, and by the instigation of Piriraku, Wairaraka locals organised a series of community meetings to call for action, and were joined by representatives from the regional council Environment Bay of Plenty (EBOP) and the Western Bay of Plenty District Council (WBDC). These meetings revealed division within the community over whether to remove mangroves or not, with environmental NGO's such as Forest and Bird particularly vehement to retain the mangroves as important habitat. However, with the encouragement of EBOP and WBDC, together with the Department of Conservation (DOC), subsequent meetings of the Waikaraka community showed a "maturing of thinking," as they began to think more critically about the estuary in a holistic fashion. Rather than a simplistic focus on mangroves, state agencies encouraged Waikaraka locals to organise themselves, and create a management plan. Importantly, at these initial stages, the 'default position' of these state agencies was to retain mangroves in accordance with policies within the legislation, and research commissioned by the New Zealand government in the 1970s from an international expert.

By the early 1990's, the people of Waikaraka estuary had begun to cooperate with state agencies in the preparation of an estuary management plan (the Plan). As noted by one Waikaraka respondent, "on this we realised that we had to get research and credibility." To this end, they embarked on two parallel campaigns. On one hand they engaged the local community through regular meetings which included state agencies and environmental NGOs, both to gather different perspectives and to communicate community desires for the estuary. On the other hand, the Waikaraka people sought professional expertise. In this they engaged 'New Zealand Landcare Trust' (Landcare) as a national organisation with expertise to help private landowners in the preparation of land management or restoration plans. Landcare worked alongside the Waikaraka

[111] Hapu describes the immediate kinship group or tribe, and is a sub-tribe of the Iwi
[112] Waka means canoe, and refers to the allied kinship groups descended from the crew of a canoe that migrated to New Zealand
[113] A pa is a fortified village or stockade
[114] A marae refers to the common meeting place of a hapu or iwi, where formal discussions and greetings take place; normally comprised of an open courtyard, a Whare nui (meeting house) and whare kai (dining room). A kohanga reo may also be part of a marae complex, and is a Maori-language preschool.
[115] Pakeha is a term used to refer to a New Zealander of foreign (especially European) descent.

community and the land-management officers of EBOP to facilitate the preparation of a holistic Plan, wherein mangroves were only one component. At the same time, the Waikaraka community approached the National Institute of Water and Atmospheric Research (NIWA) to request their help in collecting science on the state of the estuary, and in developing tools for clearing mangroves and monitoring the effects. NIWA saw this as an opportunity to develop a suite of tools that had applicability to other estuarine environments, and bridge the 'science-uptake gap' between their science and community action.

In this way, by 1997, the Waikaraka community had formed an incorporated society, the Waikaraka Estuary Managers Inc (WEM), which all residents could join simply by putting their names on a list. A smaller group volunteered to be on a steering committee. Soon after, by 2003, WEM had prepared a Plan for the restoration of the estuary, with the support of the local community. This Plan established the community values and priorities for the estuary, via community meetings and 'Weka Parades'[116]. These values were in turn used, alongside scientific advice of EBOP, WBDC, and NIWA, to set a number of objectives, which were distilled into a mission statement and five strategic goals. This Plan was presented to a public meeting and approved.

As the Plan was implemented, there was an increased momentum, with impressive 'results;' removing 128 car bodies, $90m^3$ of dumped toxic material, and planting 2500 new native plantings for example. Waikaraka became a focus of scientific observation to measure the results of removing mangroves, with a Waikato University PhD student and masters student studying mangrove removal; both physically and ecologically. In 2003, WEM had also engaged the services of a consultant to investigate and prepare an ecological restoration plan for the Waikaraka Estuary. By 2004 though it was revealed that to undertake any more of the mangrove removal within their Plan, WEM would need resource consent. To this end, Landcare and EBOP land-management officers helped WEM through the resource consent decision-making process to remove approximately 8 ha of mangroves back to their extent in 1986, as defined by historical aerial photographs, at a rate of 1.5 ha per year. In the absence of hard knowledge of the effects of mangrove removal, WEM prepared a rigorous monitoring strategy in partnership with state agencies, and formed a consultative group comprising WEM, Maori, DOC, EBOP and the Ornithological Society, to discuss the effectiveness of monitoring in an ongoing manner. With this assurance, EBOP issued resource consent to WEM.

[116] Weka parades consisted of groups of stakeholders taking a walking tour of the estuary in a group, and discussing the issues. They take their name from a well-known indigenous wading bird.

This chapter will focus on WEM, and the means by which it mobilised knowledge, and is continuing to mobilise knowledge, in support of actions within the Waikaraka Estuary. Specifically, the WEM was seen to bring knowledge together through (a) its regular meetings; (b) its pamphlets and booklets; (c) its working days; and (d) its social events, which often followed working days, and allowed informal dialogue. Within the meetings, stakeholders described the debate as, “good and a healthy; it wasn’t necessarily a confrontational debate. It was a scientific debate, well chaired, where people sat down and every now and then did listen to each other.” In this way, WEM created settings for the collective mobilisation of knowledge and decision-making incorporating both formal science and informal local or traditional knowledge into the dialogue; through seminars, reports, and through adaptive management and monitoring strategies.

In exploring the Waikareka Estuary Managers Inc, six interviews were undertaken with a diversity of stakeholders, who had been active within WEM, or in cooperation with WEM, comprising:

1) A leading member of WEM, who represented the local non-Maori residents’ perspective;
2) A leading member of WEM, who represented the tangata whenua perspective;
3) A land-management officer at EBOP;
4) A scientist at EBOP;
5) A DOC stakeholder;
6) A member of another nearby estuary care group.

Please consult Appendix G for the comprehensive analysis of WEM relative to the conceptual framework.

5. The Gisborne Wastewater Adjournment Review Group

Gisborne city is located at the north end of Poverty Bay on the sparsely populated and rugged East Cape (see Figure 10). The city centre straddles the convergence of three rivers, which drain the surrounding steep, clay hill-country. With a population of just 34,000, Gisborne retains a rural character that is accentuated by its relative geographic isolation; however with close proximity to three sandy surf beaches, and a dry sunny climate, it is also a popular holiday location. Gisborne’s high sunshine hours mean it is particularly well suited to horticulture and viticulture, and made it home to industries processing wine, fruit and vegetables. Even so, it is not a wealthy city, with census figures demonstrating a lower than average income compared to the national average. Gisborne also represents a uniquely bi-cultural community, with more than 42% of the population of

Maori ethnicity, compared to 14.5% nationwide, and almost half of Maori bi-lingual.[117] Finally, given its remoteness, the Gisborne District Council (GDC) is one of only four 'unitary authorities' in New Zealand; charged with both the duties of a territorial city council, and the duties of a regional council.

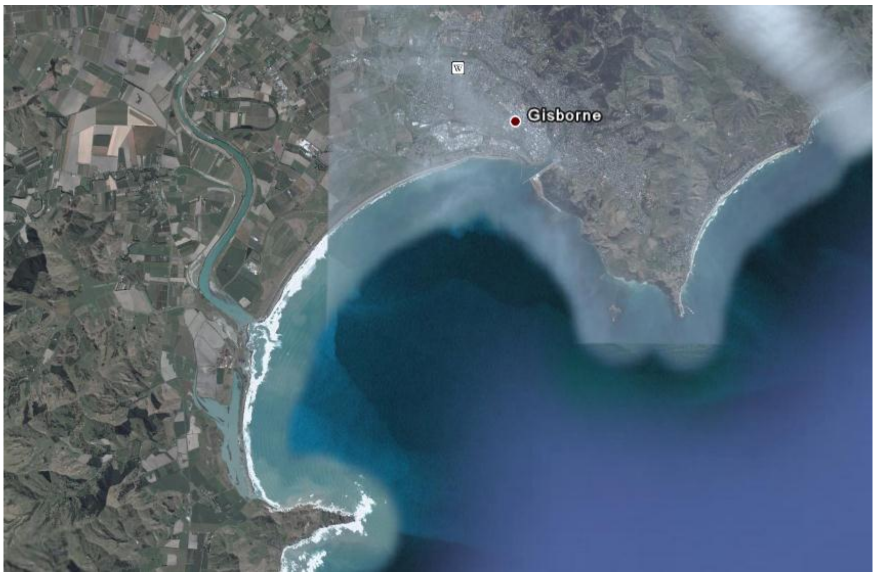

Figure 10: Aerial photograph of Poverty Bay, with Gisborne city identified (Google Earth)

This case study follows the decision-making process surrounding the discharge of Gisborne's wastewater (including raw human sewage) into Poverty Bay, which has long been a controversial issue. In 1964 the existing Gisborne wastewater outfall was commissioned and began discharging raw wastewater into the Bay. Apart from the installation of milliscreens in 1991 to remove some of the larger suspended material, no further treatment steps were implemented for more than 40 years of operation, providing an on-going source of discontent within the local community. The discharge of human waste into the Bay is culturally offensive to Maori, and repugnant to a significant portion of the wider Gisborne community. This discontent came to a head in 1993, and again in 1999, when GDC was required to apply for resource consent to continue discharging raw wastewater via the existing outfall. Given GDC is a unitary authority, these consent processes created the uncomfortable situation whereby GDC was applying for resource consent from itself. As both the applicant and the regulator, the city Engineering and Works department were making an application

[117] 1996 New Zealand census figures

to the Environment and Planning department across the hall. These publicly notified resource consent applications provided the setting for fierce public debate between the Council and groups within the community; including local Maori, environmentalists, and recreational clubs who used the Bay. Simply put, the community demanded the immediate upgrade of the discharge into the Bay, while GDC claimed that such measures were too expensive for a poor city like Gisborne. More strongly, tangata whenua demanded the complete cessation of the discharge into the bay – a practice they considered culturally abhorrent – and for wastewater to be discharged to land; "What is created on land should be treated by the land." To avoid charges of bias, these resource consent 'hearing' processes were run by independent commissioners, including one appointed by the Minister of Conservation. These commissioners roundly criticised the GDC for their disregard for the concerns of the community, and while resource consent was extended until the end of 2005, significant pressure was put on the Council to upgrade the system before any subsequent application to renew consent. At the same time, community groups appealed these decisions to the Environment Court and battled with GDC within that court setting over the ensuing years.

In 2002, the GDC outlined a new Wastewater Strategy that proposed certain upgrades to the wastewater treatment system to be begun in 2005 and completed by 2016, but these were loudly criticised as inadequate by key community stakeholders. Stakeholders were strengthened in their position by the ruling of the Environment Court, which stated in 2003; "We feel compelled to send a message to the Council that time is running out….The Council's wastewater strategy…causes us to ask the question – is the Council only giving lip-service to the (Resource Management Act) precepts?" And so it was that in September 2005, when GDC applied for a renewal of their resource consent complete with the upgrades proposed in their Wastewater Strategy, they again faced strong opposition and a stalemate was reached. The regulatory arm of GDC saw they needed to try a fresh, deliberative approach.

From early 2006, GDC initiated informal meetings with the community stakeholders – particularly those that had made submissions against the GDC resource consent application – to explore the possibility of some commonly agreed means of discharging Gisborne's wastewater. As these meetings became less entrenched, and the 'Biological Trickling Filter'[118] emerged as a realistic and mutually acceptable option, the resource consent commissioners agreed to an 'adjournment' of 6 months in their Interim Decision of April 2006. This adjournment required the forming of a

[118] A Biological Trickling Filter is a means of biologically and aerobically treating wastewater. Basically, wastewater is sprinkled over a deep bed of stones and allowed to permeate down, coming into contact with the surfaces of the stones, which develop a thin film of biota that feed of the pollutants within the wastewater. Water taken from the base of the bed is then clarified within a deep tank to allow any loose biota (slime) to sink to the bottom, and clean water is siphoned off the top to be discharged.

Wastewater Adjournment Review Group (WARG) to co-investigate the option of the Biological Trickling Filter (BTF), with the WARG meeting once per week up until December 2006, under the independent facilitation of a local lawyer. The WARG, from the beginning, set clear objectives, defined collaborations, membership and protocol. Detailed minutes were kept and regular updates were made by the WARG to submitters, GDC, the commissioners, and to the community via the media. The WARG incorporated stakeholders from GDC, the local Department of Conservation office (DOC), the District Health Board, tangata whenua as represented by Te Runanga o Turanganui a Kiwa (TROTAK), and Oho Ake a local environmental NGO. To support deliberation, the WARG also brought in scientific expertise and a resource planning consultant to advise on process. The timeframe was subsequently extended at the request of all participants and by early 2007 the WARG made a recommendation to the commissioners to build a BTF plant, commencing late 2010, before piping wastewater to the existing outfall. Further treatment, via ultra-violet disinfection, was proposed to be added by 2012. Resource consent was proposed to be granted for 35 years with on-going monitoring conditions, and the creation of a Wastewater Management Committee, to research alternatives to using the existing outfall.

Subsequent to the WARG process, the group continued to meet, though with less regularity. GDC later felt that the agreed BTF needed to be modified, both in terms of its location and size, and the WARG was reconvened as the Wastewater Options Review Group (WORG), though it largely retained the same membership and objectives; to collectively explore and agree on amendments to the original design. By mid-2009, an amended resource consent was issued, and as part of this consent, the WORG continued to meet, though now as a Wastewater Technical Advisory Group (WTAG), charged with overseeing the initiation of the BTF Plant Monitoring and Investigation Study, and continuing the search for alternatives to discharging into Poverty Bay. The WTAG has increasingly included the participation of local agricultural industries who are deemed stakeholders by virtue of the high volume of wastewater that they put into the system.

This case study will specifically follow the WARG/WORG/WTAG group, which presented a means of collectively mobilising knowledge on wastewater discharge options, making decisions, and monitoring the on-going effects. While the group has evolved over time and changed its name under changing circumstances, here it will here be discussed simply as the 'WARG.' In analysing the WARG experience, six interviews were undertaken with a diversity of stakeholders that have been present in the WARG from its inception to today:

1) Three GDC stakeholders representing both the Engineering and Works department, and the Environment and Planning department;
2) A stakeholder representing the tangata whenua perspective;

3) A stakeholder from the District Health Board;
4) A stakeholder from the Oho Ake environmental NGO;
5) The resource planning consultant brought in to provide expertise to the WARG; and
6) The independent facilitator.

Please consult Appendix G for the comprehensive analysis of the WARG relative to the conceptual framework.

6. Discussion: comparing and contrasting the three case studies

The three previous sections have provided a rich description of three separate case studies, including an analysis of their 'science-policy interface' relative to the post-normal science (PNS) approach, and an exploration of their success relative to measures of institutional and interactional quality. Section 6 seeks to summarise these results and tease out any lessons that are able to be drawn from across the case studies. It begins in Sub-section 6.1 by examining why the three case studies chose to depart from more widespread coastal management practice in New Zealand and employ a 'post-normal science-policy interface.' This discussion goes on in Sub-section 6.2 to look at the degree to which these initiatives could be labelled post-normal, and any barriers and facilitators that emerged to following this path. In Sub-section 6.3, it is examined to what degree a post-normal science approach led to 'high quality' coastal management institutions; in terms of ICM principles, stakeholder perceptions, and a comparison with the national-scale evaluation from Chapter 7. Finally, in Sub-section 6.4, the post-normal science approach is examined for the way it affected the quality of interactions between stakeholders for collectively arriving at a social choice.

6.1 Community responses to post-normal issues

All three case studies were seen to face issues that could variously be described as 'unstructured,' 'messy' or 'post-normal;' exhibiting the three characteristics highlighted by Funtowicz and Ravetz (1993) as necessitating a shift from strictly 'normal' science: (i) significant uncertainty; (ii) a plurality of legitimate perspectives; and (ii) high stakes political urgency.

There was an appreciation that the spread of mangroves in Whangamata and Waikaraka and the wastewater discharge in Gisborne represent complex and pervasive issues; best described in terms of interacting social and ecological systems, rather than a simple, linear chain of cause and effect. The complexity of these issues gave rise to significant uncertainty on what may constitute the causes or best solutions, allowing for conflicting understandings of the issue, even among scientists from within the same discipline. Uncertainty was therefore ‘epistemological’ in that it stemmed in large part from conflicting knowledge perspectives.

Beyond uncertainty, decision-making within the three case studies was complicated by a plurality of conflicting worldviews within the communities; based on a different ontological representation of the world, understood via different epistemological frameworks, toward different values and priorities, communicated via a different vocabulary and set of socio-cultural norms. This posed a dilemma of social choice; given no apparent ‘solution’ performed equally well against the plurality of values and priorities. By way of illustration, all three case studies demonstrated some dichotomy between stakeholders espousing ecocentric values versus those espousing anthropocentric values. At the same time, this value-based dilemma was overlain by a debate over which evidence qualifies as legitimate, salient and credible to inform decision-making, with the greatest division over whether formal[119] science or informal local and traditional knowledge takes precedence. Using Figure 11 as a rough heuristic device, we can say that tangata whenua often employed traditional knowledge toward customary and ecocentric values; local community groups often employed their own local knowledge toward their own ends; and local government usually adopted a similarly anthropocentric position, though favoured formal science as the most legitimate evidence. Figure 11 attempts to account for all stakeholder groups that emerged across the case studies, though in its simplification it loses the idiosyncrasies of each perspective. For example, the environmentalist group Oho Ake in Gisborne equally drew on formal science, traditional knowledge and local knowledge in presenting their position.

[119] Formal knowledge has passed through a strict and universally accepted set of rules qualifying it for a particular use, whereas informal knowledge has been subject to local or traditional rules of validity (Fabricus, C., Scholes, R., & Cundill, G. (2006). Mobilizing Knowledge for Integrated Ecosystem Assessments. In W. V. Reid, F. Berkes, T. J. Wilbanks & D. Capistrano (Eds.), *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington: Island Publishing.)

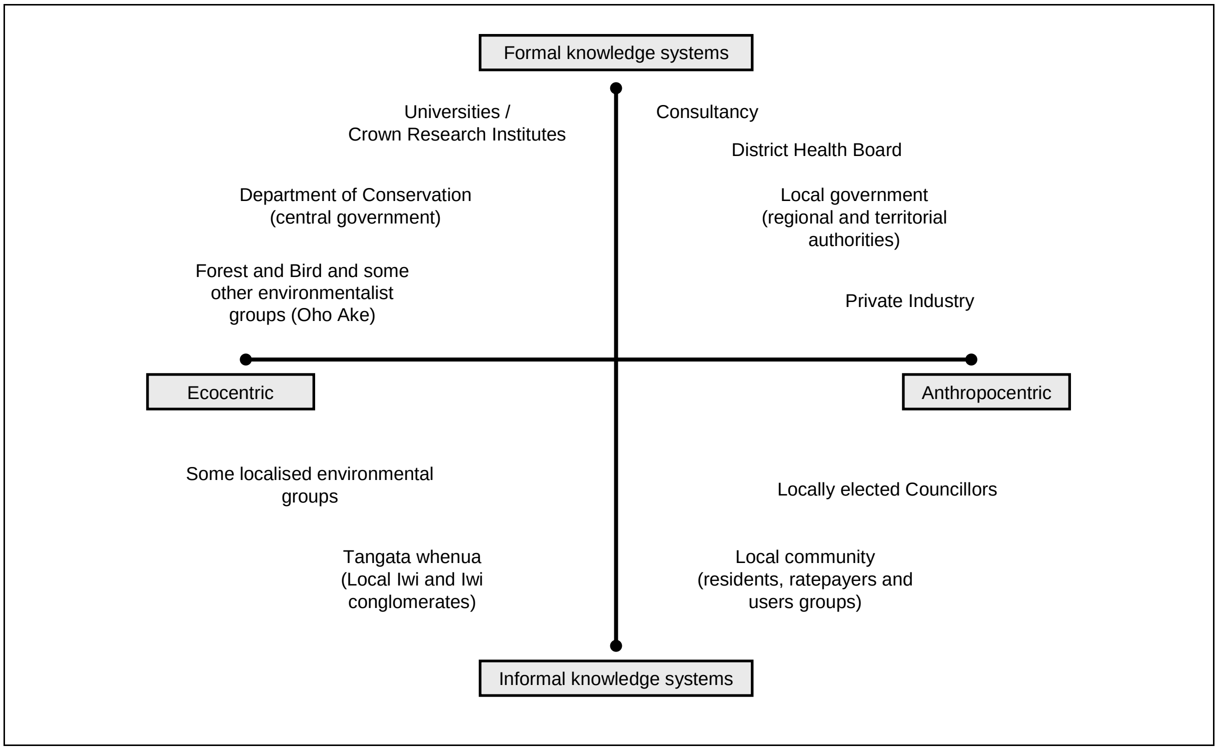

Figure 11: Demonstrating the plurality of perspectives relative to water quality issues along an: (a) epistemological spectrum; and (b) value spectrum

Given the plurality of stakeholder perspectives within each of the three case study communities, the decision-making processes in all three cases were characterised by high stakes, urgent and politically heated debate. Whangamata and Gisborne, in particular had a long history of animosity between stakeholder groups, who had repeatedly met in the Environment Court. In both cases, frustration over the perceived failure of the statutory and legal system had spilled over to activism and illegal activity outside of the court-room. Furthermore, in all three case studies stakeholders made references to power imbalances that endangered the decision-making process. For example, in Gisborne and Whangamata some stakeholders represented this power imbalance as "Pakeha insensitivity, colonisation, arrogance, domination, exploitation;" the way wealthy, non-Maori groups were able to influence local politicians toward their own ends.

There was one area of consensus that emerged across all three case studies though; dissatisfaction with the statutory and litigious decision-making process, and the science-centric science-policy interface that supported it (see Chapter 7 and Appendix F for greater detail). The statutory decision-making process was not deemed to encourage meaningful participation of stakeholders and the wider community, or interaction between stakeholders. Rather 'collective decision-making' operated according to a model of 'representative democracy' or indeed ‘technocracy,’ with power limited to local politicians, or local government experts/technocrats with delegated authority. Within this model, community participation was best described as ‘consultative,’ rather than nurturing any kind of community ‘partnership’ [120], or ‘participatory democracy.’ On one hand, the case studies revealed general discontent with the ‘formal’ setting of the local government hearing or the Environment Court, which were described as ‘litigious’ and ‘adversarial.’ Such settings had strict and restrictive protocols on the ways stakeholders could present their perspective and deliberately excluded stakeholder interaction, with all communication through an arbiter figure in the form of local politicians, independent commissioners or judges. On the other hand, stakeholders expressed equal discontent with the ‘informal’ process of influencing decisions through the lobbying of local politicians. At the same time, there was criticism across all three case studies of the science-dominated science-policy interface endorsed by local government. This was embodied within the distrust of local communities and tangata whenua toward science that claimed value-neutrality, while actually being underlain by a strong value basis, and an uncompromising reluctance (‘professional arrogance’) to share legitimacy and credibility with other knowledge systems. Associated with this distrust, many stakeholders questioned the quality of the science to support decision-making, criticising it as:

- Highly theoretical and poorly grounded in the local context;
- Poorly recognising of significant uncertainty;
- Fragmented and ‘patchy,’ assembled according to a few isolated consultant reports;
- Poorly supported by relatively few indicators, measured over a short time-series;
- Permissive;
- Poorly reconciled with other forms of local or traditional knowledge.

As to the last point, this saw knowledge relevant to coastal management fragmented into societal silos, with stakeholders loath to admit the legitimacy, credibility and salience of other knowledge systems. For instance, Maori traditional knowledge was closely guarded by kaumatua[121] for distrust of it being mis-used. As a result of a ‘closed’ decision-making process and silo-ed science-policy interface, the three case studies had become divided by deeply entrenched political positions, argued according to deeply personal knowledge systems, and shaped largely by power imbalance. Stakeholders had a poor understanding of rival perspectives, or indeed the wider issue, with understanding very much limited to their own knowledge. There was an acceptance that the uncertainty, plurality and politics of these issues warranted a new approach, to augment if not replace the statutory process.

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[120] To make reference to Arnstein’s (Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners, 35*(4), 216-224.) ladder of participation

[121] Elders of a Hapu or Iwi entrusted with the knowledge of those people

All three case studies formed a non-statutory dialogic setting, which operated in parallel with, and fed into, the statutory process. In Whangamata and Gisborne, these settings were convened by local government to augment a resource consent process and/or policy document. In Waikaraka, the setting was convened by the local community, who sought to apply for resource consent. In all cases, the setting was steered by a desire for community stakeholders to arrive at collective decisions (if not consensus), but there was an equally heavy emphasis placed on the collective mobilisation of knowledge to form some common understanding of the issue. The intention was that such a setting would balance any power asymmetry associated with knowledge of the issue, with a resultant effect on consensus-building. In this way, fora acted simultaneously as a dialogic science-policy interface, and an exercise in participatory democracy.

6.2 To what extent did initiatives create a 'post-normal' science-policy interface?

It is important to note that these three initiatives were NOT self-proclaimed attempts at giving effect to 'post-normal science.' As anticipated, none of the stakeholders interviewed were aware of Funtowicz and Ravetz or the PNS perspective; indeed none of the interviewees made reference to any specific theoretical models that had steered their efforts. This noted, it is possible to make some comment on the 'family resemblance' of these three case studies with the PNS-approach and indeed each other, as a point of departure for exploring its potential for coastal management. After all, less is revealed from how an initiative is labelled, compared to what characteristics it embodies; it's nature. By breaking post-normal science into its constituent elements, this chapter has analysed the initiatives' resemblance; see Table 10 below.

Table 10: Comparing New Zealand local-scale case study performance against the characteristics of post-normal science

Characteristics of post-normal science	Three New Zealand local-scale case studies		
	Whangamata Harbour case study	**Waikaraka Estuary case study**	**Gisborne wastewater case study**
1) Dialogic setting wherein knowledge is called as evidence	The Forum enabled dialogue, wherein knowledge was called in an evidential function.	The WEM was characterised by parallel dialogues: (i) community-based dialogue calling all forms of evidence; (ii) council-based dialogue between experts.	The WARG enabled dialogue such that stakeholders negotiated and sought consensus on tabled evidence. Science dominated the evidence.
2) Participatory setting admitting a plurality of stakeholder perspectives.	The Forum was inclusive of scientific, local and traditional knowledge, however participants critiqued the dominance of a scientific epistemology.	WEM settings were equally inclusive of all knowledge: local, traditional, land-management and scientific. Statutory settings valued science exclusively.	WARG was an 'all-inclusive' setting for science, traditional and local knowledge, though science dominated
3) Relativise and reconcile conflicting perspectives according to notions of reciprocity and co-existence	Forum participants increasingly listened to other perspectives, but reciprocity was compromised by political division. Evidence was scientised.	WEM settings nurtured knowledge 'partnerships;' but statutory settings did not extend reciprocity and scientised other forms of knowledge.	The WARG demonstrated a significant reciprocity; accepting the co-existence of diverse perspectives. Science did dominate though.
4) Perspectives are evaluated for their 'quality' relative to the issue.	EW had previously been the judge of knowledge quality. The Forum was to make knowledge quality assessment a collective activity.	WEM stakeholders emphasised knowledge quality for action. Local government stakeholders emphasised quality as robust evidence in court.	The WARG placed an emphasis on high-quality knowledge; all perspectives were respected, but there was no 'right to rubbish.'
5) Stakeholders participate in a process of 'extended peer review'	The Forum evaluated quality dialogically. EW retained a position of power, science dominated, and politics saw some evidence judged *a priori*	The WEM community reviewed knowledge quality with dialogue and ground-testing. Statutory settings review quality relative to scientific norms.	WARG stakeholders formed an 'extended peer community' of diverse expertise; to critique evidence by diverse measures / reach consensus.
6) Reflexive	The Forum encouraged reflection, though was hindered by deeply held	The WEM enabled stakeholders to be reflexive relative to their knowledge of	The WARG enabled stakeholders to be reflexive relative to their knowledge

	political convictions.	the issue and the social context.	of the issue and the social context.
7) Social learning orientation	All Forum participants learned more about the issue, other perspectives and the process. However, entrenched political positions undermined learning.	All WEM participants had learned more about the issue, other perspectives and the process.	All WARG participants learned more about the issue, perspectives and process; particularly as trust grew, and focussed on biotransformation.
8) Adaptive process	The Forum did not place significant emphasis on adaptive management.	The WEM was an opportunity for adaptive management; learning by doing	The WARG process designed flexible, adaptive ends and review conditions.
9) Strategic and long-term focussed	The Forum identified gaps in the knowledge and set a long-term strategy for collecting new knowledge.	The WEM drew on historic traditional knowledge, and is collecting data for future decision-making.	The WARG processes was described as a long-term and strategic 'journey.'

Please note: The first three characteristics of post-normal science, as shown on Table 6, are not listed here, but are addressed in the discussion in Section 6.1 of this chapter.

A comparison of the case studies relative to the characteristics of PNS is revealing across a number of features. Firstly the initiatives attempted to nurture dialogue between stakeholders, wherein participants called knowledge as evidence in support of their value-positions, though the underlying litigious decision-making system did influence which evidence was allowed. Secondly, the initiatives were largely inclusive of stakeholders and their knowledge systems, however, science was sometimes found to dominate. Thirdly, owing to the dominance of science, dialogue across knowledge systems was not always truly in accordance with notions of reciprocity and co-existence; traditional and local knowledge were at times 'scientised.' This is to say, knowledge was reconciled within a scientific framework, rather than being allowed to exist relative to each other according to their own framework. This lopsided power relationship endangered attempts at 'extended peer review' because it automatically favoured scientific measures of quality over others. Therefore, fourthly it must be noted that the initiatives did not give good effect to 'extended peer review' as advocated by PNS. While all initiatives formally and explicitly acknowledged the importance of high quality knowledge for decision-making, and were all successful in assembling an 'extended peer community,' the act of peer review itself was normally implicit and buried within the dialogue. There was not any formal, demarcated discussion on indicators that stakeholders felt might be relevant to deliberation over knowledge quality, or attempts to arrive at a collectively defined list of quality indicators. Stakeholders' use of knowledge quality indicators was not often distinguishable from their use of narrative, rhetoric, metaphor and other dialogic tools; with one exception. Indicators of knowledge quality were at times made explicit by local government, according to criteria of 'good science' and 'legal defensibility.' Fifthly, the general experience was that the initiatives allowed a more long-term and strategic vision of the issue, and an incremental, adaptive means for addressing it. Finally, in all cases the initiative had encouraged reflection from stakeholders on the issue and it's social context, such that there was individual and social learning across three parameters: (i) the issue; (ii) stakeholder perspectives, and (iii) the process.

One can conclude that the three case studies unintentionally constructed a science-policy interface closely resembling that espoused by PNS, though did not give 'perfect' expression to its ideals. While all cases did represent genuine attempts at mobilising knowledge according to the organising principle of 'quality' for decision-making rather than 'truth,' there was little formal attention given to the notion of 'extended peer review,' and a number of barriers prevented the realisation of such peer review.

Beyond this conclusion, one can explore the reasons why these initiatives took the form they did. Where the initiatives have succeeded or faltered in the ideals of PNS, one can identify a number of barriers and facilitators to PNS, as identified in Table 11 below. Five common barriers were identified to creating a post-normal science-policy interface setting, summarised here:

(i) Litigious decision-making process:

All three case studies revealed the 'corrupting' influence of the litigious statutory decision-making process, which ultimately underlay all three dialogic initiatives. In all three cases it saw preference given to scientific evidence, and often demanded the scientific quantification of other traditional or local knowledge in order to lend it legitimacy within the statutory arena. Thus litigious measures of knowledge quality undermined any meaningful efforts to collectively assess knowledge quality according to communal criteria of quality.

(ii) Dominance of science:

All three case studies demonstrated the perceived supremacy of scientific knowledge that pervaded stakeholder perspectives; particularly stakeholders from the scientific community or state agencies. In Waikaraka for instance, this saw a division between the inclusive WEM forum, and the exclusive expert dialogue within the local government setting. The dominance of science saw civil society stakeholders in all case studies employ strategies to reconcile their perspectives with the science as a means of strengthening their 'case.'

(iii) Power imbalance:

All three case studies saw stakeholders complain of an underlying power imbalance, whereby local government had the final decision-making authority. While all three case studies had independent facilitation, and attempted to include local government as an equal participant, there was a perception that collective decisions were steered significantly by local government. The WARG case study presented an exception in that the ultimate decision-making authority rested with independent commissioners, to the extent that GDC councillors felt disempowered.

(iv) Political division:

All three case studies addressed issues characterised by deep political division and animosity. However, while the WEM and WARG were able to overcome this division, reach some collective understanding of the issue, and eventually arrive at a collective decision, the Whangamata Forum remained characterised by entrenched political division. This weakened any attempts to reconcile perspectives according to reciprocity, and arrive at a common understanding.

(v) Resourcing:

All three case studies revealed difficulties with enabling the continued participation of civil society stakeholders in a process that demands a significant commitment of time and effort. EW and GDC both supported participation by paying unpaid participants.

Table 11: Barriers and facilitators to running a post-normal science-policy interface

Barriers	Facilitators
(i) A litigious statutory decision-making process that valorises scientific evidence	(i) Knowledge quality assessment and shared understanding provided a less politicised arena to deliberate intertwined value/knowledge perspectives
(ii) Dominance of science and a tendency to reconcile other knowledge within a scientific framework	(ii) Strong leadership and commitment to the process
(iii) Power imbalance; particularly in favour of local government as the 'final decision-maker.'	(iii) Independent and effective facilitation
(iv) Entrenched political division among stakeholders	(iv) Increased norms of trust and reciprocity emerging from prolonged stakeholder interaction
(v) Resources; particularly to enable participation from civil society stakeholders	(v) Mechanisms for reconciling knowledge perspectives and deliberating knowledge quality: • Formal presentations and guest speakers • Collective mapping • Ground-testing knowledge • Working bees and social events • Agreed (cross-cultural) protocol • Knowledge partnerships (science/local) • A central idea or metaphor (biotransformation)

At the same time, the case studies revealed a number of facilitators that encourage the creation of a post-normal science-policy interface, summarised here:

(i) Non-politicised knowledge quality assessment:

All three initiatives doubled as a forum for (a) collectively mobilising knowledge toward a common understanding, and (b) arriving at collective decisions. Stakeholders asserted that the knowledge mobilisation function of the fora helped to depoliticise the debate, and promote an atmosphere of meaningful deliberation of intertwined 'facts' and 'values.' Stakeholders were more ready to compromise in reaching a shared understanding of an issue, than in a direct debate over values and preferences. With the exception of the Whangamata Forum, this compromise over knowledge perspectives extended to value compromises also, and finally, a collective decision.

(ii) Leadership:

The two most successful case studies at Waikaraka and Gisborne both emphasised the importance of strong leadership for championing the process. In Waikaraka this was represented by the partnership between a kaumatua from the tangata whenua and a well-respected non-Maori resident in steering the WEM. In Gisborne, stakeholders were quick to note how a change in staff at GDC had broken the cycle of litigation, and encouraged dialogue.

(iii) Facilitation:

All three case studies emphasised the importance of independent facilitation, such that stakeholders felt they were equal participants in a truly collective process. All case studies noted how high quality facilitation nurtured high quality dialogue.

(iv) Increased trust from prolonged interaction:

All three studies demonstrated a commitment from participants to a long-term decision-making process, characterised by multiple meetings and interaction away from the 'meeting table,' over a number of months. In this way, all case studies revealed a general increase in norms of trust and reciprocity in shaping their interaction/meetings, which influenced the successfulness of the initiative. In Waikaraka and Gisborne, tangata whenua stakeholders described the development of their relationship with others according to a growth in trust. Within the Whangamata Forum, less trust was displayed, and it was found to be less successful.

(v) Knowledge quality assessment mechanisms:

Across the three case studies, there emerged a number of mechanisms that facilitated effective knowledge quality assessment. These ranged from stakeholders having the opportunity to formally present their knowledge and be questioned on it, to collective mapping exercises where stakeholders create a common map to reconcile their knowledge. In WEM, it was important to incorporate Maori protocol and informal social gatherings to nurture the necessary bicultural relationship, while WARG fell upon biotransformation as a metaphor for bridging traditional and scientific knowledge systems. All three case studies called on 'ground testing' of knowledge to avoid the external imposition of knowledge generated elsewhere, and poorly calibrated with the local conditions.

6.3 Have the initiatives created better quality institutions for coastal management?

It is not enough to have analysed the initiatives in terms of their resemblance to a PNS perspective, this chapter seeks to explore their contribution to more or less successful coastal management within the case studies. To this end, the first measure is relative to the quality of the institutions created in support of coastal management. 'Institutional quality' will be discussed relative to (a) measures of Integrated Coastal Management, (b) stakeholder perceptions, and (c) a comparison with the national experience revealed in Chapter 7.

a) ICM measures of institutional quality

As has been noted, the scholarship and practice of ICM has long sought to create the best quality institutions possible to enable well-supported collective decision-making. This research borrowed from ICM to assemble nine guiding principles of successful coastal management institutions and used them as a generic measure of institutional quality, to explore the degree to which giving effect to a PNS approach led case study institutions toward actualising ICM principles. Figure 12 summarises the results of this evaluation.

ICM Principles	Whangamata Harbour	Waikaraka Estuary	Gisborne Wastewater
Cooperation	+ / -	+ / -	+ / -
Contingency	+ / -	+	+
Participatory	+ / -	+	+ / -
Comprehensive	+	+	+
Precautionary	-	+	+
Incremental	-	+	+
Adaptive	-	+	+
Long-term	+	+	+
Strategic	+ / -	+	+

Key / Legend	
+	Gives effect to this principle
+ / -	Gives partial effect to this principle
-	Does not give effect to this principle

Figure 12: Evaluating the contribution of the case studies to institutional quality relative to ICM Principles

Figure 12 allows a number of general comments across the three case studies on their influence on institutional quality. Most broadly, Figure 12 demonstrates that all three initiatives led to institutions that gave effect or partial effect to *most* ICM principles. More specifically, in all cases the initiatives led to institutions that gave more comprehensive and long-term treatment to the issue, indicating that they led to better informed decision-making. Conversely, while all three case studies allowed for partial expression of a cooperative institution – encouraging of close collaboration between state agencies in particular – none fully gave effect to this principle. In all three cases this stemmed from an inability to facilitate meaningful 'vertical' cooperation with central government departments; with the central office of the Department of Conservation often depicted as disconnected with the regions. At the same time, two case studies noted that while the initiative led to *more* participatory institutions, they were not fully participatory. In Gisborne and Whangamata they included stakeholders who could 'engage at a higher level,' but in both cases excluded key stakeholders. This came from a desire to resolve conflict that had begun in the courtroom, and therefore limited participation to formal appellants within the legal process. Finally, one can note that the Whangamata case study was the least successful against measures of ICM institutional quality. This can be traced to two context-specific influences; firstly the entrenched political positions and power asymmetry that characterised this initiative, and secondly an overly cautious approach by EW, which attempted to dispel all uncertainty before initiating any form of action. To summarise, the case studies revealed that by employing a PNS approach to frame coastal management institutions, and the science-policy interface particularly, they were able to realise principles of high quality institutions according to ICM.

b) Stakeholder perceptions on the quality of institutions

As part of the exploration into the contributions of these three quasi-PNS initiatives, stakeholders were asked to consider their previous experience with coastal management decision-making processes and policy, and compare this with their experience within the initiatives. This comparison allowed for an exploration of institutional quality based on a perceived increase or decrease in stakeholder satisfaction with the initiative. A significant majority of the stakeholders interviewed revealed a long experience with resource management decision-making and policy.

Stakeholders were first asked to what degree they felt the knowledge mobilised in the science-policy interface was well integrated with decision-making. All three case studies reported via a majority that the quasi-PNS initiatives allowed for a *much greater integration* of quality knowledge with decision-making, for the issue at hand. All three initiatives were designed as participatory and deliberative fora that doubled as a means for mobilising knowledge for a better understanding of the issue, and as a means for reaching collective decisions. In this way, deliberation between knowledge perspectives was seen as intrinsically intertwined with deliberation over values and preferences. As one WEM stakeholder summarised well: “The knowledge collection occurred to address matters of concern raised during the decision-making process, and effectively they both depended on one another;” with this echoed within the WARG; “Clearly our decisions were based on those shared knowledges.”

Stakeholders were then asked whether their respective initiatives had led to a more or less effective decision-making process and policy outcome, with a unanimous response across all three case studies that they were *more effective*. Firstly, all initiatives led to a process and a decision that was more specific to the context, and relevant to the stakeholders and the wider community; “It’s much more localised; it’s much more relevant to the people.” For example, the WEM process was able to incorporate Maori tikanga (protocol), which contributed to building a bi-cultural partnership between tangata whenua and local non-Maori residents. Secondly, these initiatives were deemed to lead to a more effective mobilisation of knowledge for decision-making, including an increased quantity and quality of formal science; “…that kind of approach is critical in any knowledge collection process…” Thirdly, stakeholders valued these initiatives for constructing a common understanding of the issue while allowing stakeholders to retain their own unique perspective, as a significant step to resolving conflict and building social capital among participants; “it has created a social capital that wasn’t here before.” For these three reasons, the WEM initiative in Waikaraka and the WARG initiative in Gisborne have been described as ‘model’ approaches, which would be used to frame decision-making for ‘tricky’ approaches in the future.

c) A comparison with the national experience revealed in Chapter 7

In Chapter 7, this research attempted to make some comment on the diverse states of the science-policy interface within New Zealand’s coastal management framework, and the influence of this interface on the form and quality of institutions. The evaluation of institutional quality was undertaken relative to the same nine ICM principles discussed above.

Chapter 7 revealed that within New Zealand the science-policy interface is comprised of elements from both the science-based and participatory traditions expounded within the ICM literature, but that the science-based tradition is dominant. It went on to reveal the paradox of a system that relies on science as the most robust and powerful knowledge to support decision-making, while simultaneously hindering its effective mobilisation; such that irreducible uncertainty remains a leading barrier to coastal management in New Zealand. As such, the widespread engagement of the science-policy interface was judged to perform adequately against measures of contingency, incrementalism and precaution, but to perform poorly against all other measures of quality. This reveals an interface that is unable to provide a comprehensive or long-term understanding of the issues to support decision-making; that is ‘closed’ and discourages participation or cooperation; and that fails to provide any strategic or adaptive direction for the future management and understanding of an issue.

Against the background of this dominant science-based interface, these three quasi-PNS initiatives represent examples of a growing trend in New Zealand toward a more participatory and dialogic form of interface. Chapter 7 tentatively asserte that where these more participatory approaches had been applied, institutional quality was demonstrated to have improved, with the three initiatives presented in this chapter appearing to support this assertion. Even admitting the weaknesses of comparing the specific with the general, it appears that these three initiatives have been able to construct better quality coastal management institutions than have been constructed under the prevailing regime. While Chapter 7 revealed a prevailing science-policy interface that performed adequately relative to three of ICM’s guiding principles, Chapter 8 has demonstrated initiatives that have performed well relative to all or most of these same principles.

6.4 Have the initiatives created better quality stakeholder interactions for collective decision-making?

This research begins from an 'interactive governance' perspective on Integrated Coastal Management, which recognises the reciprocal relationship between stakeholder interactions and institutions. While institutions provide the setting within which collective decision-making occurs, it is through interaction that stakeholders give effect to the 'collective' nature of decisions, and indeed continuously reconfigure the institutions themselves. Finding ways to evaluate interactive quality presents a quandary though, with this research evaluating quality relative to the three broad stocks of financial, social and human capital which stakeholders contribute to through interaction, and can draw on in making decisions. To what degree did the three case studies improve the quality of stakeholder interaction, relative to these three stocks of capital?

Financial capital can provide a ready indication of stakeholder 'buy-in,' whereby stakeholders committed to a process may be expected to contribute resources to support the process. Accordingly, the two most successful case studies in Waikaraka and Gisborne revealed the widespread contribution of financial capital from across almost all stakeholder groups, with resources becoming available as trust in the process increased (see social capital). The WEM was initiated by the community rather than local government, and therefore relied upon stakeholder buy-in to be realised. Alternatively, the WARG was convened by the GDC but later saw financial contributions from tangata whenua and local industry, as a signal of their belief in the WARG. Whangamata provided a contrary case though, with the Forum convened by EW and almost all financial capital provided by that same agency. This may reflect the persistent distrust that divided the initiative, both of other stakeholders and the process itself.

Social capital refers to both the 'quantity' and 'density' of stakeholder interactions, and the norms that shape these interactions; typically described in terms of trust and reciprocity. All three case studies noted increased stakeholder interaction, both as a result of increased participation, and an increased density of interactions amongst participants. Measures of density were based on a stakeholder mapping exercise whereby participants depicted new interactions arising from the initiative, with connectivity typically increasing by 50 to 100 percent. At the same time, the initiatives all served to increase the prevalence of trust and reciprocity in shaping stakeholder interactions. The majority of respondents from the Forum initiative, and all respondents from the WEM and WARG, identified an increase in their trust for other stakeholders, while all case studies unanimously reported increased reciprocity. Beyond these norms, stakeholders were asked whether the initiatives had given rise to any positive behavioural changes. Common to all three case studies was an increasing maturity of perspectives on the issue; an increasing tendency to listen to other perspectives, and a greater likelihood to compromise. Furthermore, the WEM and WARG identified increased norms of collaboration and partnership, manifest in notions of co-management at both locales. It bears noting, however, that the Whangamata case study was the least successful in generating social capital, with this posing a key barrier to the success of the initiative in general. Social capital was likely inhibited by the latent distrust held by stakeholders following 14 years of political debate, and indeed one stakeholder reported less trust following the initiative, given a perception that it was highly politicised.

Human capital refers to the stock of education, skills, culture and knowledge stored in human beings themselves, which can be mobilised in support of decisions and action. All three initiatives saw an increase in the quantity and diversity of education, skills and knowledge that stakeholders could draw on in making a decision. Firstly, this stemmed from encouraging the increased participation of a diversity of stakeholders. Secondly, initiatives made an effort to bring in any expertise that was found to be lacking 'around the table;' through the engagement of technical experts, or experts in resource management processes. Thirdly, stocks of human capital were increased according to the individual and social learning that occurred within these fora, on the issue, on the plurality of stakeholder perspectives, and on the decision-making process itself. Beyond these measures of human capital, respondents were question on the 'wherewithal' of stakeholders to effectively participate in the initiatives, with all three case studies recognising that unpaid participants were at times limited in the time and other resources that they could volunteer, with tangata whenua in particular 'stretched thin.' Finally, respondents were asked whether any stakeholders had taken a leadership role, to champion the initiative. The responses indicated that the conveners of the initiatives typically assumed a leadership role; local government in Whangamata and Gisborne, and the WEM in Waikaraka. Beyond this, tangata whenua was seen to take a leadership role in all three of the initiatives.

In summary, the three case studies were shown to increase the quality of stakeholder interaction for collective decision-making, relative to all three stocks of financial, social and human capital.

7. Conclusion

This chapter explored three case studies where coastal communities faced 'post-normal' issues that exhibited; (a) significant uncertainty; (b) a plurality of legitimate perspectives; and (c) urgency and high stakes. Faced with such issues, these communities chose to discard the prevailing model of decision-making, and its supporting science-based management, in favour of a more participatory and deliberative alternative. While not explicitly steered by any theoretical framework, all three initiatives gave effect to a science-policy interface setting closely resembling that espoused by the 'post-normal science' (PNS) approach. The initiatives were all shown to emulate PNS across a number of features, though struggled to actualise the notion of extended peer review. These quasi-PNS initiatives were found to lead to 'high quality' coastal management institutions, measured relative to both the guiding principles of ICM and stakeholder satisfaction. Indeed, a comparison with the findings in Chapter 7 led to assertions that these initiatives allowed for 'better' quality institutions when compared to the more widespread experience nation-wide. At the same time, the initiatives were shown to increase the quality of stakeholder interaction for collective decision-making, measured according to stocks of financial, social and human capital. Drawing on this empirical study, this chapter implies that a PNS approach *can* contribute to more 'high quality' ICM within a given context, when measured relative to institutional and interactional quality.

Having finished presenting the empirical research in Part IV this thesis goes on to the final Part V, which aims to distil any interesting lessons that can be drawn on the meaningfulness of a 'post-normal science' perspective for ICM from across the diverse empirical studies, and any conclusions that can be drawn.

Part V: What has been revealed? Lessons learned and conclusions

This final part reviews the work done in this thesis, With Chapter 9 condensing the lessons learned from the empirical studies on how a post-normal science-policy interface may contribute to high quality ICM, as interactive governance. The Conclusion reviews the meaningfulness of the research results for debates in ICM on governance and epistemology.

Chapter 9: Lessons learned from the empirical research

1. Introduction; what has been revealed?

The previous three chapters have detailed the three separate pieces of empirical research undertaken as part of this research, exploring the influence of the science-policy interface on ICM at the international, national and local scale respectively. This chapter aims to review the lessons drawn from across these studies, asking *what have these specific empirical explorations revealed about how a post-normal science-policy interface can influence the quality of ICM, framed as interactive governance?* To this end, the chapter unpacks eight key lessons learned from the empirical studies, and finishes by looking at what these lessons reveal for the promise of the post-normal science approach for ICM.

Key to this research was its attempt to assemble a rich portfolio of different experiences from which to explore the influence of a post-normal science-policy interface. In this way, the studies are split between New Zealand and Europe, as two very different coastal management contexts; exhibiting very different coastal 'systems-to-be-governed' and 'governing systems.' At the same time, the research is cross-scale in nature, which is important given the science-policy interface has been shown to take a very different shape, according to very different influences, dependent on scale. While not a statistically significant sample, the diversity of contexts and scales represented by the studies did allow for unique insights on how a PNS approach can find expression under different conditions; allowing for some interesting contrasts and comparisons. In fact, across this diversity of experiences there were nonetheless some common themes, which can be expressed as lessons.

This last chapter intends to be a concise recapitulation of the key points within the previous three chapters, and the interesting themes that emerge across the three studies. As such, each of the eight lessons is afforded only a brief discussion here, which does not do justice to the more nuanced discussion in the previous three chapters. Section 2 looks at the motivations for coastal stakeholders to democratise the science-policy interface and their means for doing this. Section 3 goes on to look at the value of a PNS approach for contributing to high quality ICM, before Section 4 looks at the significant obstacles to its successful implementation. Section 5 unpacks the unique perspective allowed by empirical studies at three different scales and contexts, before Section 6 finishes by asking what promise a post-normal science approach holds for ICM?

2. What are the motivations and means for democratising the science-policy interface?

Lesson 1: Coastal stakeholders sought to democratise the science-policy interface out of dissatisfaction with science-based management

One common theme across all three studies was a dissatisfactory experience with science-based coastal management alone, with this a key motivation to try democratising the science-policy interface, including through a PNS approach. There was demonstrated within these specific contexts a failure of science alone to effectively support coastal decision-making, legitimating a search for alternative means of mobilising knowledge. Firstly, this dissatisfaction manifested itself through a lack of stakeholder trust in the science. At the New Zealand local scale, this distrust often emerged from a belief that the science was disconnected from the specific context, with local stakeholders arguing that their observations were more salient than the science. At the same time, many stakeholders perceived scientists to present a false image of neutrality while in fact pursuing their own agenda, or that of their employer. For some Maori stakeholders, science was perceived as a powerful tool of Pakeha domination. In the SPICOSA Project, this distrust came from the use of 'black box' scientific modelling, which hid the inner workings of the model or how it arrived at the sometimes shocking predictions.

Secondly, this dissatisfaction with science-based management stemmed from a poor connection between the science and stakeholders, including coastal managers. At the New Zealand national scale, this was seen by an eroded in-house scientific capacity in state agencies and a poor history of interaction across the science-policy interface. In Europe, this was seen by a disconnection between those building scientific models and those prescribing the problem.

Thirdly, at the New Zealand national scale, there was dissatisfaction with science-based management according to a 'science-policy paradox.' On one hand, there is a reliance on science as the most robust, powerful and 'legally defensible' form of knowledge to render a clear picture of the coast. On the other hand, there is a coastal management regime that seriously hinders the mobilisation of science, such that there is significant uncertainty. This reliance on a form of knowledge poorly accessible to coastal managers, while ignoring other more accessible forms of knowledge, paints a picture of paralysis and uncertainty.

Lesson 2: The post-normal science approach has not found explicit practical application in ICM, though there are many ways to give effect to its principles

This research could not find a single example of ICM initiatives that have explicitly labelled themselves as an exercise in 'post-normal science;' indicating that the approach has not found widespread practical expression. However, it was not uncommon to find in the ICM literature and practice, initiatives that effectively give effect to the principles of PNS, even while not being 'labelled' as such. The three empirical studies presented in the previous three chapters are testament to the increasing prevalence of a participatory and dialogic science-policy interface for ICM, and in particular initiatives that have a 'family resemblance' with PNS.

There is no *one* way to give effect to a PNS approach, as this research revealed, though most initiatives begin with a dialogic forum. To improve the quality of this dialogue within these fora, initiatives often drew on deliberation support systems. In Europe, the SPICOSA Project sought to engage a diverse group of stakeholders in dialogue, according to three deliberation support tools; from stakeholder and conceptual mapping, to scientific modelling, to the 'Deliberation Matrix.' At the New Zealand national scale, at least five different forms of participatory interface were revealed across the different regions; from preparing non-statutory policy documents to knowledge partnerships. While at the New Zealand local scale, all three case studies were centred on a forum for the mobilisation of knowledge, but used different mechanisms to improve the quality of the dialogue; from site visits to wastewater treatment plants, to working days in the local harbour, to mapping exercises.

The empirical research did reveal, however, that it was difficult in practice to give effect to three of the central tenets of a PNS approach. Firstly, there was common recognition that it is not easy to encourage the participation of the full diversity of knowledgeable stakeholders within a science-policy interface setting. Indeed, these exercises in mobilising knowledge studied tended to draw on pre-established networks of stakeholder interaction, rather than encourage new participation. Moreover, among those stakeholders who did participate, it was recognised that it is difficult to give effect to the ideals of reciprocal dialogue. Often in practice, one knowledge system dominates, and other perspectives are subsumed within its framework (see Lesson 5). Similarly it was found that in practice there is rarely explicit attention to knowledge quality assessment, with the empirical research demonstrating almost no examples of a commonly agreed set of quality criteria to steer an extended peer review.

3. What was learned about the value of a post-normal science approach for contributing to ICM, framed as interactive governance?

Lesson 3: A post-normal science approach can contribute to better quality ICM institutions

The previous three chapters have explored the way in which framing the science-policy interface contributes to the quality of ICM institutions, across a defined list of ICM meta-principles. Though Chapters 6 and 8 focussed on specifically post-normal initiatives, while Chapter 7 presented a broader commentary on the influence of participatory traditions of science-policy interface, nonetheless, this research was able to elucidate some interesting themes across all three studies. The general experience taken from these particular contexts is that a participatory or post-normal science-policy interface can pose a better 'quality' ICM institution compared to a purely science-centric institution, across a number of parameters.

The research found a common increase across all three studies in the quality of ICM institutions relative to (i) the *comprehensiveness* of their perspective on coastal issues, with an understanding more deeply based in ecosystems; (ii) their *contingency* to the context and issues; and (iii) their *strategic* treatment of coastal issues, particularly to the strategic collection of knowledge. This translates to institutions that are better able to arrive at a comprehensive and contingent understanding of an issue, and tightly integrate this understanding with decision-making, in a strategic manner. However, relative to other measures of quality, there were mixed results.

The degree to which a PNS approach led to institutions encouraging of greater stakeholder *participation* and *cooperation* was largely dependent on the context (see Lesson 7). It was demonstrated that successfully implementing post-normal initiatives was largely dependent on pre-established stakeholder networks and institutions, where the quality of existing dialogue was improved relative to epistemological parameters. Likewise, the degree to which a post-normal approach led to a more *long-term* focussed institution was context dependent (see Lesson 8). The three case studies at the New Zealand local scale emerged from a process that had been on-going for ten years or more, and therefore they were very long-term focussed. On the other hand, the SPICOSA Project constituted a short-term intervention with a short-term focus. Finally, a post-normal science-policy interface was rarely found to be more *precautionary* or *adaptive*. Indeed in the New Zealand context, both nationally and at the local scale, such an approach signalled a departure from a highly precautionary approach, to mobilise what knowledge that does exist and take bold steps forward.

Lesson 4: A post-normal science approach can contribute to better quality stakeholder interactions for collective decision-making.

Chapters 6 and 8 explored the degree to which PNS initiatives have contributed to the quality of stakeholder interactions, relative to the stocks of human, social and financial capital built by stakeholders. In sum, both the SPICOSA Project and the New Zealand local scale case studies demonstrated an increase in the quality of stakeholder interaction relative to most capital measures, with the degree of improvement contingent on the context.

The PNS initiatives studied consistently gave rise to an increase in the stocks of human capital across coastal stakeholders. They were demonstrated to bring together a greater diversity of skills, expertise and knowledge for building a comprehensive picture of an issue. Similarly, all initiatives resulted in significant 'social learning' across participating stakeholders; relative to the issue itself, the diversity of stakeholder perspectives, and the process of collective decision-making. Finally at the New Zealand local scale, where the initiatives represented a long-term commitment, leadership and political *nous* was a positive outcome, though this did not occur in the SPICOSA Project which represented a short-term endeavour.

A PNS approach was demonstrated to contribute to stocks of social capital among stakeholders; however this was significantly dependent on the political and institutional history within a context. The extent to which a greater connectivity of stakeholder interactions was nurtured depended on the degree of pre-existing connectivity. On the other hand, all initiatives had a demonstrable impact on building norms of trust and reciprocity between stakeholders, together with an increased 'maturity' within a political setting; described as a keenness to participate and a willingness to listen and compromise. To this degree, this research found that a PNS approach improved the quality of existing stakeholder interactions more than it created new interactions.

Finally, the degree to which a PNS approach increased stocks of financial capital was dependent on the degree of social capital accrued in a context, and relatedly, how long-term the initiative was. At the New Zealand local scale, the full spectrum of stakeholders was seen to contribute financial capital, in recognition of their growing trust in a long-term initiative. Conversely, the SPICOSA Project was implemented as a short-term project, and unsurprisingly, stakeholders did not feel moved to contribute financial capital.

4. What are the most significant obstacles to the successful implementation of a post-normal science approach?

Lesson 5: Science is powerful and there is a danger that all knowledge perspectives become subsumed within a scientific framework.

Across all three studies emerged one common obstacle to the successful implementation of a post-normal science-policy interface; the power and dominance of 'normal' science. In this way, though a science-policy interface may admit stakeholders drawing on a rich diversity of knowledge systems, these diverse perspectives often become co-opted into the service of building a scientific picture of the coast; other forms of knowledge are rarely allowed to co-exist according to their own standards. To this extent, other knowledge systems find themselves needing to conform to the standards and norms of science in order to have credibility, salience and legitimacy within the interface.

The SPICOSA Project began by collecting coastal stakeholders' knowledge on their perceived issues by way of conceptual maps; however these 'soft' maps (often incorporating qualitative or value-based concepts) were then quantified and digitised in the form of 'hard' scientific models. To some stakeholders this was a disenfranchising process of transforming their knowledge into science. At the New Zealand national scale this obstacle was again raised. Though many coastal managers recognised the value of a more participatory science-policy interface, they questioned the utility of the knowledge mobilised in this setting, given it is less legally defensible in the Environment Court.

The three New Zealand local scale case studies also described this recurring obstacle. All three revealed stakeholders who felt that they had to frame their knowledge in scientific terms, and according to scientific measures of robustness, in order to be allowed admission to the forum. Furthermore, the Gisborne case study demonstrated the long battle that Maori and local stakeholders faced to have policy-makers and scientists put aside their scientific standards of ecosystem health, and admit cultural standards of ecosystem health.

Lesson 6: Power is ever-present within any dialogic institutional setting, and influences the way knowledge is mobilised.

Beyond the powerful influence of science, the successful implementation of a post-normal science-policy interface is largely dependent on the way power shapes the interactions between stakeholders. As for many processes drawing on a Habermasian ideal of 'real' reciprocal dialogue, this is only successful insofar as stakeholders do not seek to exert their power, either consciously or unconsciously, over others or over the process. Following the likes of Foucault, this research found that 'power was always present,' with the more detailed analysis of the three New Zealand local scale case studies illuminating this.

All three case studies revealed the positive and negative influences of power. In Gisborne, the initiative was described as being just one expression of a far more insidious power struggle between Maoridom, and the dominant European culture in Gisborne. As testament to the Gisborne initiative, it was able to resolve these tensions, at least among those participating stakeholders. In Whangamata, this power was far more visible, and came to a head when one of the stakeholders was elected as a local councillor, upsetting what had before been a delicate balance of power between those pro- and anti-mangroves. Indeed, it was these deep-seated tensions, and struggles for control of the initiative that in large part prevented the Whangamata initiative from realising its potential. Finally, the Waikaraka initiative demonstrated the positive side of power, whereby the tangata whenua and non-Maori community came together in a partnership secured through strong and trusted joint-leadership.

5. What are the consequences of applying a post-normal science approach in different contexts and at different scales?

Lesson 7: Context matters; a post-normal science approach is best used to improve the quality of pre-established dialogue and collective decision-making.

The empirical research demonstrated how the specific contexts offered by the case studies had a significant influence on the degree to which a post-normal science-policy interface contributed to better quality institutions and interactions. Notably, a PNS approach was less a means of encouraging new stakeholder participation and interaction as it was a means for improving the quality of those pre-established interactions, particularly relative to the way stakeholders mobilised knowledge.

Where a context already had a long history of participation, a strong network of stakeholder interactions, and existing dialogic institutions, a PNS approach found success; serving to improve further the quality of interactions and institutions. Importantly also, where stronger stakeholder networks existed, this meant that the knowledge mobilised in a post-normal science-policy interface was better able to be disseminated to other stakeholders who did not participate directly in the dialogue. This embedded a post-normal approach within decision-making in the context, rather than having it as an isolated event. For example, at one of the SPICOSA study sites that did have a well-established ICM programme in place, complete with stakeholder forum, the Project was found to secure wide participation and improve the quality of interactions between participants. Moreover, the knowledge mobilised was more easily diffused among other stakeholders not directly participating. Similarly, the New Zealand local scale initiatives had all developed out of a long-standing issue, such that stakeholders had a long history of interaction. As such, the post-normal initiatives in these contexts did have a discernable impact on the level of participation and connectivity of interactions; building as they did on the existing stocks of social capital.

On the other hand, where a PNS approach was exercised as a short-term intervention into a very fragmented context, with a poor history of stakeholder participation and interaction, it posed a very insular exercise with more limited success. This was best seen in those SPICOSA study sites that had a poor history of ICM, or where they tried to nurture international cooperation that had not existed before. In these sites the Project was found to include only a select group of coastal managers, interaction was difficult to initiate, and those benefits that were accrued in terms of improved interaction, and a more comprehensive perspective of coastal issues, remained within the closed science-policy interface setting. There was little opportunity for the knowledge to be diffused across other institutions and stakeholders.

Lesson 8: Scale matters; a post-normal science approach works best at a scale close and salient to the issue.

By undertaking three separate pieces of research at the international, national and local scale, this research was able to offer some insights into the influence of scale on the shape of a post-normal science-policy interface. Scale was found to be important insofar as dialogue within a 'post-normal' setting was better enabled at a scale closely corresponding with a given issue. In this way, it was important to start from a well-defined issue, and match the science-policy interface dialogue to the appropriate scale of the issue; defined spatially, temporally, and in terms of the tier of decision-making and administration.

In terms of spatial scale, PNS or other participatory initiatives at the science-policy interface worked better where they addressed an issue at a scale that reflected the natural boundaries of ecosystems. In this way the local scale case studies at Whangamata and Waikaraka both benefitted from a discussion of their issues relative to the catchment scale, while Gisborne looked holistically at Poverty Bay. The limit to this may be where the scale becomes too large for stakeholders to conceptualise the issues, as for some SPICOSA study sites which took into account catchments that spanned international boundaries. At this scale, the number of stakeholders who can meaningfully and knowledgeably discuss coastal issues is dramatically reduced, and the issue becomes ill-defined. Indeed, some SPICOSA sites found themselves addressing coastal issues that were stark at the large scale, yet had little meaning for stakeholders. As such, the appropriate spatial scale appears to be determinant on both scientifically-defined ecosystem boundaries, as well as the boundaries within which stakeholders feel they have a clear vision of an issue important to them.

The PNS initiatives studied were perceived to be more legitimate where they engaged stakeholders that an affected community deemed to have credibility and a salient perspective on the issue. This emphasised the need for a PNS initiative to bring together stakeholders congruent with the correct 'tier' of decision-making; particularly the need to include locally-recognised stakeholders for local decision-making. All three New Zealand local scale case studies illustrated the importance of having knowledge that is 'grounded' in a specific context for the process to be perceived as legitimate, with external expertise extended less credibility. At the international scale, those SPICOSA sites that drew the boundary of an issue so large as to traverse national boundaries implicated such a large and diverse 'governing system' that it was difficult to (a) bring together a diversity of stakeholders in dialogue and (b) be recognised as legitimate by the myriad of communities in an affected area. Participation was either asymmetrical (more participation from one country than another) or limited to an insular exercise among high level state representatives.

Finally, the temporal scale over which a post-normal science-policy interface ran determined its success. The New Zealand local scale case studies all emerged from a long history of stakeholder interaction and decision-making going back in excess of 10 years, and all took a long-term perspective on the future, particularly with regard to the collection of knowledge on an issue and its management. On the other hand, the SPICOSA Project constituted a short-term intervention, and as such the dialogue was short-term in focus and effect. A long-term focus is both more realistic in addressing complex issues, and better embeds a PNS initiative in the *de facto* governing system. A short term initiative is more likely to be considered an isolated event.

6. What promise does a post normal science approach hold for Integrated Coastal Management

To conclude this chapter, here we ask what promise a PNS approach offers for framing the science-policy interface for coastal governance. What guidelines can the scholarship and practice of ICM take from a PNS approach to mobilising knowledge?

The three previous chapters have demonstrated the significant promise offered by participatory and dialogic forms of science-policy interface, and particularly a PNS perspective. The cases studied all saw the creation of institutional settings that (to differing degrees) improved the quality of stakeholder interaction toward collective decision-making, with particular regard for the way knowledge is mobilised and linked with decisions. In this way, the initiatives were able to realise a substantive increase in the availability and quality of knowledge in which to base decisions; offering a more comprehensive contingent and long-term picture of issues meaningful to coastal communities, and integrating it closely with the political decision-making process. At the same time these initiatives saw a more concrete expression of participatory democracy, by empowering previously marginalised stakeholders and encouraging new norms of inclusive knowledge production. As a result, these institutions were seen to give rise to significant 'social learning' amongst stakeholders toward a common understanding of an issue, and indeed provided a precursor to stakeholders compromising or even finding consensus.

Within the New Zealand local scale case studies, stakeholders associated with post-normal initiatives were satisfied with both the process and the decisions that emerged from this process. Stakeholders were asked to consider their previous experiences with coastal management, and compare these with their experience as part of a PNS approach. Across all three case studies, there was general agreement that the initiative had allowed for much greater integration of knowledge with decisions, by recognising that knowledge perspectives were intrinsically intertwined with debates over values and preferences; "Clearly our decisions were based on those shared knowledges." Moreover, the initiatives were perceived to provide better decisions that were: (i) more contingent to the issues; (ii) based in a greater quantity and quality of knowledge, including more science; and (iii) less divided by conflict owing to a common understanding of the issues.

However, this rather glossy conclusion needs to be accompanied by two qualifications. First, it is important to reiterate that this research has begun from a model of coastal governance, with this having a significant effect on the conclusions drawn. By adopting an interactive governance perspective, this has implications for the particular aspects of governance focussed on, and accordingly, those aspects that are overlooked. Another study, adopting different criteria, may have drawn different insights from the case studies and arrived at different conclusions. Second, it is important to recognise that a post-normal science approach by no means presents a 'silver bullet' solution. Giving effect to this perspective needs to be accompanied by a number of guidelines, set out below:

6.1 Not a blanket solution

A PNS approach is not a blanket solution. For many coastal issues, which are simpler and less contentious, a purely science-based management approach may be sufficient. What the three previous chapters have shown though is that there is a certain category of coastal issues for which 'normal' science alone fails to provide the knowledge needed to support collective decisions. Funtowicz and Ravetz categorised these issues as exhibiting significant uncertainty, a plurality of perspectives and high political stakes, but more broadly we can discuss instances where communities have expressed dissatisfaction with science to solve their problems. This may be because scientific products are not available or not communicated in a form useful to support decision-making. It may be because communities feel the science is not salient to their issue, or because they are distrustful of it. In any case, where 'normal' science loses its credibility and legitimacy, then 'post-normal' science may provide a useful alternative.

6.2 Contingent on context

The success of a PNS approach is highly contingent on context. Importantly, the empirical studies have shown that it is not an effective approach for bringing together stakeholders, but rather an approach for improving the quality of pre-established interactions between stakeholders. Where a post-normal science-policy interface has been instituted in a context characterised by a long history of participation, and been able to augment existing stakeholder deliberation, then it has been seen to greatly improve the quality of institutions and interactions. Similarly, a post-normal approach has been seen to work best as part of a long-term community commitment to address an issue, and has found less success as a short-term 'appendage' to the normal decision-making process.

6.3 Depending on leadership

In departing from the prevalence of 'normal' science-based management, and turning to an alternative 'post-normal' approach, strong leadership is important. The motivating influence of leaders was revealed across all three pieces of empirical research, as an essential part of setting a favourable context for a post-normal science-policy interface.

6.4 Nurturing of reciprocal dialogue through deliberation support tools

Giving effect to the ideals of PNS begins by shaping the science-policy interface as a setting of inclusive and reciprocal dialogue between knowledge perspectives. However, the three empirical studies revealed that achieving this in practice is non-trivial. Key to this is the quality of stakeholder interaction, necessitating different forms of deliberation support systems and tools. The empirical studies noted multiple means for nurturing a 'better quality' of dialogue at the science-policy interface. In the SPICOSA Project, the soft tools of stakeholder and conceptual mapping were particularly well received, as was the deliberation matrix to a lesser degree. Reviewing the New Zealand national experience exposed five different forms of participatory science-policy interface, with knowledge partnerships, and non-statutory policy working groups posing the most ambitious of these. Finally, at the New Zealand local scale, a number of mechanisms from stakeholder presentations, to maps, and 'ground-testing' exercises helped to maintain participation, and nurture reciprocity. Important also is the need for independent and experienced facilitation from an individual recognised as legitimate.

6.5 Explicitly recognising the influence of power

Power poses a significant obstacle to giving effect to a post-normal science-policy interface. It presents an important formative influence on the shape of any institution, and the way in which stakeholders interact, and as such should be recognised at the beginning of any initiative. The science-policy interface needs to be acknowledged as a political setting, wherein dialogue is underlain by deep-seated value-conflicts and high political stakes. Illuminating the influence of power then presents the first step toward neutralising its ill-effects. Where the clear advantages afforded to some stakeholders are made explicit, and open to discussion, then a group can take steps to address these. Of particular note, across all three pieces of empirical research, was the pervasive power of science. The danger is that in bringing together diverse knowledge systems in a setting traditionally dominated by scientists, that other forms of knowledge become subsumed into a scientific framework. This danger needs to be recognised from the outset.

6.6 Explicitly focussing on knowledge quality

PNS approaches struggle to give effect to the ideal of a collectively agreed set of criteria of knowledge quality, according to which stakeholders evaluate knowledge perspectives as an extended peer community. This particular attention to 'quality' is essential to neutralising the dominance of science, and encouraging reciprocal dialogue, but has struggled to find strong expression in practice. Notions of negotiated knowledge quality were usually implicit in stakeholder dialogue, and rarely channelled through any formal mechanism. Most SPICOSA study sites failed to effectively use the 'deliberation matrix' tool, and measures of scientific quality were dominant in the study of the New Zealand context; both nationally and locally. Therefore, tools that allow a more explicit focus on knowledge quality assessment, as a means of deliberation support, are worthy of more attention.

6.7 Disseminating the knowledge

A post-normal science-policy interface needs to be accompanied by means to disseminate the knowledge mobilised for decision-making. An important concern of stakeholders in SPICOSA, and at the New Zealand local scale, was that the knowledge mobilised and learning realised within a forum was not limited to those participating stakeholders. For an initiative to have a meaningful influence on collective decision-making, the knowledge produced needs to be diffused throughout other institutions and stakeholders. At the New Zealand local scale there were a number of mechanisms used to do this, from information booklets to media releases, as well as the informal dissemination associated with strong stakeholder networks. In SPICOSA, dissemination was often not achieved, such that the Project represented an insular exercise among a few stakeholders, with little effect on wider decision-making in a context.

7. Coming to a conclusion

As this thesis comes to its conclusion, the experience across the empirical studies can be summarised by noting that; *a post-normal science approach has significant promise for contributing to high quality coastal governance, if employed in the service of appropriate issues, in an appropriate context, and according to the above guidelines*.

Conclusion

1. The value of this research, for whom

This thesis situated itself in the field of Integrated Coastal Management (ICM) and took as its point of departure contemporary debates over whether to frame ICM according to models of 'management' or 'governance.' This thesis followed authors like Glavovic (2008a) and Olsen (2003b) and explored perspectives on ICM as coastal governance. To guide this exploration, the research adopted the particular model of governance proposed by 'interactive governance' (Jentoft, 2005; Kooiman, 1999; Kooiman & Bavinck, 2005), which has found increasing influence in the field of ICM (Glavovic, 2008a; Jentoft, 2007).

The discussion on framing ICM as governance is multi-faceted. Adopting a governance perspective necessitates reflection on the complete ICM project, from its ontological foundations, all the way through its epistemology to its institutions and methods, and to its measures of quality. This thesis engaged the specific debate on the epistemological implications of a governance perspective; how can we best mobilise knowledge in support of collective decision-making? It started from a wider literature on 'dialogic' epistemological approaches for governance, before following ICM authors like Boesch (1999), De Reynier, Levin and Shoji (2010), Fritz (2010), Knol (2010), and Norgaard *et al* (2009), who see governance perspectives as demanding of a more participatory and deliberative 'science-policy interface.' This thesis employed the particular epistemological approach offered by 'post-normal science' (PNS) (Funtowicz & Ravetz, 1993) and explored how a science-policy interface framed according to post-normal science may give effect to high quality ICM, measured relative to criteria salient to an 'interactive governance' model. This was manifest in the open research question:

How can a 'post-normal' science-policy interface contribute to quality 'Integrated Coastal Management,' framed according to 'interactive governance?'

This thesis was written for scholars and practitioners alike in the field of ICM. It aimed to make some new and valuable contributions to the contemporary discussion on framing ICM as governance, with special attention to epistemological questions at the science-policy interface.

In this way, it will be most interesting to those interested in models of ICM as governance, and/or those interested in how knowledge is mobilised across the ICM science-policy interface.

1.1 Unpacking a governance perspective on ICM

ICM has been increasingly described in terms of 'governance,' but it is important to unpack what exactly this means for ICM. If we adopt a governance perspective, and employ the terminology used by Jentoft and others (Jentoft, 2007; Jentoft & Chuenpagdee, 2009), how does this affect the way we see the coastal 'system-to-be-governed?' How does it affect the way we see ICM initiatives within a 'governing system?' If the field of ICM is seriously considering a governance perspective, and the 2002 'World Summit on Sustainable Development' suggests that it is, then scholars and practitioners need to explore the full implications of this perspective. We need to follow to their conclusions all of the many lines of reasoning associated with governance; even if these lines of reasoning lead us to some uncomfortable conclusions. Though the field of ICM has been witness to an increasingly rich literature on coastal governance, it was the assertion in this thesis that there is a need for a deeper discussion on many aspects. It has thus been the aim of this research to contribute to this literature on 'ICM as governance.'

The literature on governance is a disordered terrain, comprising numerous models originating from many different disciplinary homes (Kooiman, 1999); to discuss a 'governance perspective' for ICM is to open a Pandora's box of literature. Therefore, to guide an exploration of the governance perspective for ICM, this thesis adopted the particular perspective offered by the 'interactive governance' model, which Chapter 2 argued to be increasingly used in the ICM field. Adopting the interactive governance perspective helped to bring order, in a synthetic way, to the complex reality of ICM within a governing system. It offered insights that focussed the attention of this research to certain features of governance, while still remaining open enough to allow for surprise and learning.

This thesis thus began from the assertion that interactive governance presents a compelling and interesting perspective on ICM as governance. The story of ICM as interactive governance provides an enriching contribution to the growing literature in this area. By unpacking interactive governance, this thesis was able to undertake an in-depth exploration of the full implications of this perspective, along its ontological (Chapter 1), epistemological (Chapter 3) and methodological (Chapter 2) axis. Finally, by adopting a perspective on ICM as interactive governance, this allowed the research to focus on one certain aspect of governance, specifically epistemological approaches, and frame the discussion, according to a framework of 'quality' governance. In this way, the thesis attempted to provide some well-needed depth to the contemporary discussion on ICM as governance.

1.2 The importance of appropriate evaluation

The field of ICM is continually evolving, and in latter years has come to reinvent itself from traditions of 'environmental management,' towards models of 'environmental governance.'[122] As discussed, these two paradigms offer their own unique insights on how communities can arrive at collective decisions and realise their aspirations for the coast. Each paradigm presents its own advantages and disadvantages, and it was not the point here to build a case as to whether one is better than the other.[123] What is vitally important is that, whichever way we chose to pursue ICM, we make the clear distinction when evaluating ICM. The 'management' and 'governance' perspectives have very different frameworks of quality or success, and it is important not to confound the two. In looking at an ICM initiative, it is important to be clear which approach a community is attempting to give effect to, and 'call each initiative by its right name.'[124] Where an ICM initiative seeks to give effect to science-centric coastal *management*, according to a centralised state-sanctioned 'coastal plan' for example, then this implies certain measures of quality. Conversely, by attempting to give effect to devolved coastal *governance* according to a multi-faceted approach, then this necessarily implies fundamentally different measures of quality. Thus it is important to 'evaluate each initiative by its right measure,' as demonstrated in Figure 13.

	Coastal management approach	Coastal governance approach
Coastal management criteria of quality	Succeed	Fail
Coastal governance criteria of quality	Fail	Succeed

Figure 13: Matrix demonstrating the importance of 'evaluating each approach by its right measure'

This discussion on evaluation can be represented in a simplistic matrix (see Figure 13), which makes the distinction between 'management' and 'governance' approaches on the x-axis, and criteria of quality management and governance approaches on the y-axis. With the aid of this matrix we can didactically demonstrate how a coastal management approach will typically

[122] See the Introductory Chapter, Appendix A, and Chapter 2.

[123] Indeed, this thesis has asserted, following Kooiman and Bavinck (2005) that the two approaches are complimentary, with formal 'environmental management' processes an essential component within a wider model of governance.

[124] To borrow a well-known quote from Pasternak's (1957) 'Doctor Zhivago,' where Lara desires to explore Nature and 'to call each thing by its right name.'

succeed (depending on its quality of course) against its own measures of quality, but will typically fail (though not always) relative to measures of quality coastal governance, and *vice versa*. This diagram communicates two simple messages. First, that there are no universal measures of quality ICM that are true across all contexts and approaches; and second, approaches must necessarily be evaluated relative to the ambitions they set for themselves. Though this second point can be argued to introduce a degree of circularity, akin to a student writing their own exam questions, in this thesis it is argued that this circularity is less harmful than evaluating an approach relative to irrelevant measures. Well-crafted measures of quality created for a particular approach nonetheless provide for some surprise and learning on the potential utility of the approach. While not pretending to any objective statement on the quality of an approach, an evaluation process can still serve as a point of reflection on an approach and what it has to offer.

The discussion here may seem elementary; however what we saw in Chapter 2 was that the scholarship and practice surrounding evaluation for ICM remains strongly attached to criteria of quality derived from the management paradigm. This means that as long as 'high quality' ICM remains evaluated according to one broad framework of criteria, then any alternative approaches, under the broad heading of governance for instance, will struggle to succeed. The management paradigm will continually reinforce its place at the centre of ICM to the possible exclusion of other approaches. Therefore, this discussion has special relevance within the field of ICM, relative to debates on governance models.

By adopting an interactive governance perspective on ICM, an important first step in structuring the exploration of this perspective was to arrive at relevant measures of quality. If we aim to look at epistemological approaches suited to governance models like PNS, then it would be a mistake to evaluate the success of such approaches according to criteria of management. In this way, the first work of this thesis was to create a novel evaluation framework of ICM as interactive governance, to structure a discussion on *how* the particular approach offered by PNS may contribute to quality coastal governance.

1.3 Enriching the discussion on the ICM science-policy interface

By adopting a perspective on ICM as interactive governance, and taking on its dialogic epistemology, knowledge was depicted as diffused amongst diverse stakeholders throughout a coastal 'governing system,' and mobilised through interactions within and across multiple 'institutions.'[125] This noted, the particular institution offered by the 'science-policy interface' has been the focus of the debate on how to mobilise knowledge in support of coastal governance. A number of ICM authors have begun to promote the science-policy interface as a 'governance setting,' and to this end have recommended framing it according to new epistemic norms of: (i)

[125] See Chapter 4

dialogue; (ii) inclusiveness; (iii) integration (according to a reciprocal ethic of co-existence) and (iv) knowledge quality (see e.g. Boesch (1999) and Fritz (2010)). In this way, the debate within ICM echoes the wider debate on epistemological approaches for governance reviewed in Chapter 3. Out of this debate has opened a discussion on how to give effect to these norms, with post-normal science emerging as one potential approach for framing the science-policy interface.

It was at this point that this thesis entered the debate, and sought to explore further the potential posed by framing a post-normal science-policy interface for ICM.[126] In this way, the discussion within this thesis aimed to enrich the emerging discussion within ICM on the science-policy interface as a governance setting, and indeed on wider debates within the ICM literature around dialogic epistemological perspectives.

2. Reflecting on the research method

Having outlined the research method in the Introduction, and then again in the relevant chapters, suffice here to briefly reflect on its strengths and weaknesses.

This thesis situated itself in the field of ICM, and adopted a research methodology closely associated with this field, recognising the reflexive relationship, between theory and practice. If we reflect critically on this method though, we must cede that this thesis has been weighted more heavily in terms of framing the theoretical debate in Parts I and II, at the expense of attention to building theory from practice, or ‘closing the loop,’ in Parts IV and V. If this research were undertaken again, it would benefit from a more sophisticated discussion on what can be learned from empirical research.

Part II set the conceptual framework for the research through the parallel projects of (i) building a framework of ICM as interactive governance (Chapter 2), and (ii) defining PNS as the epistemological approach that would be explored within this framework (Chapter 3). This served to set the bounds of this research, such that it focussed on a particular form of science-policy interface, and explored its contributions to governance according to a defined set of features, which were deemed interesting from an interactive governance perspective. This is of course necessary to make sense of a reality that is infinitely complex, such that learning can occur. However, setting the bounds of research can also be limiting, insofar as focussing on particular aspects of governance accordingly means other aspects are overlooked. Another study, adopting different criteria, may have drawn different insights from the case studies and

[126] This focus on the science-policy interface influences the character of the thesis. If this thesis chose to explore the pertinence of post-normal science within a market institutional setting, or for Corporate Social Responsibility towards ICM, then this would likely have resulted in a very different research project.

arrived at different conclusions. Nonetheless, research must begin from some perspective and this thesis has argued that the interactive governance perspective presents a compelling framework.

In Chapter 5 this research moved from theory to practice; interrogating the particular theoretical approach offered by post-normal science relative to the published accounts of coastal management in the ICM literature. In this way, Chapter 5 represented the first iteration of this reflexive cycle between theory and practice attempted through this thesis. It did serve to both reveal some broad insights on how a PNS approach has contributed to coastal governance according to the specific measures set by the conceptual framework, and validate this framework before using it in the empirical studies. However, while the review aimed for comprehensiveness it was not exhaustive, and was limited to those initiatives described in peer reviewed publications. This review would have benefitted from widening the review to include the myriad of grey literature; from governmental to non-governmental organisation reports, and websites.

The second iteration of the research in Part IV sought to base the research in empirical study. Key to this research was its attempt to assemble a rich portfolio of different experiences from which to explore the influence of a post-normal science-policy interface on coastal governance. Rather than seeking a statistically significant sample, this research sought to explore diversity of contexts and scales to allow for unique insights on how a PNS approach can find expression under different conditions. This proved a strength of the research, which was able to draw on empirical research in New Zealand and Europe, and look across scales; spanning international, national and local scales. This allowed for some meaningful contrast and comparison.

However, a weakness of this approach was that the research was not able to apply the theoretical framework in a uniform manner across the case studies, with this limiting the degree of comparison permitted. The research at the New Zealand local scale was by far the most comprehensive and robust; allowing for a richer understanding of context, and how a PNS initiative has contributed to the governing system in that context. On the other hand, the research on the SPICOSA Project was forced to draw on Project publications and second-hand data from a set of interviews with only one SPICOSA representative from each of five study sites. Necessarily, these data were much less revealing. At the New Zealand national scale, this research did not follow any particular ‘post-normal’ initiative or project and instead broadened its focus to look at how the diverse forms of science-policy interface have influenced coastal management institutions more generally. This did allow some valuable insights on the emergence of ‘norms of governance,’ and set the context for the studies at the local-scale, but did not allow for a direct comparison or exploration of interactional quality for instance.

Therefore, the thesis highlighted both the benefits that can be accrued from a diversity of empirical case studies, and the pitfalls that can befall research if the method is not able to be standardised across them. If this research were to be repeated, it would benefit from a more uniform exploration of case studies according to a standardised theoretical framework. Ideally, this would mirror the comprehensive treatment afforded to the New Zealand local-scale case studies.

As a final reflection on the research method, the influence of the researcher on the research discussed in Chapter 1 must be reiterated. By ontologically and epistemologically endorsing a model of the coast and coastal governance in terms of 'post-normal' issues, the researcher introduces an internal conflict to the doctoral research; how to conduct a 'post-normal scientific enquiry' within an academy that retains a bias toward 'normal science?' Indeed the researcher has needed to continually alternate between wearing the hat of 'normal scientist' and a 'post-normal scientist.' Paramount to such a trade-off is an explicit recognition of the uncertainty, plurality and high political stakes within the systems studied, and the effect of the research itself on this system. This requires that the researcher himself reflexively recognise his position relative to the research, and the direct and indirect effect this may have had on the research. Such recognition necessarily implies that, while the research followed a robust and replicable method, a different researcher may have arrived at slightly different insights.

3. What has been accomplished?

Having laid bare the 'quantum of meaningfulness' of this thesis, and critiqued the research method, it remains to review what has been accomplished. Having come to the end, what interesting and useful insights does this research bring to the debate? What lessons have been learned that can contribute to the evolving scholarship and practice of ICM? Here, some key themes from the thesis are reiterated, drawing on the lessons learned from the two iterations of the research.[127]

3.1 Lessons from the literature: the theoretical potential of post-normal science

This thesis, in Chapters 3 and 4, followed arguments put forward by Kendra (1997) and Costanza (1999) establishing that, at least in theory, PNS has the potential to deliver a science-policy interface espousing the characteristics of a 'governance setting' promoted by a growing number of ICM authors. Moreover, following a systematic discussion of the PNS perspective relative to measures of institutional quality and interactional quality in Chapter 5, this thesis concluded that PNS presents significant potential for contributing to high quality ICM framed as

[127] See Chapter 5 and Chapter 9

interactive governance. It is a perspective on mobilising knowledge that warrants more attention in the ICM field.

3.2 Lessons from the literature: post-normal science in ICM practice

As a first step to exploring the PNS perspective Chapter 5 interrogated it according to the ICM literature, asking; how has a post-normal science approach found expression in ICM practice and to what degree has it contributed to coastal governance? This research discovered a diversity of PNS-type approaches, and the numerous ways that these approaches interacted with and influenced a governing system. According to measures of institutional and interactional quality, a PNS approach was generally demonstrated to positively shape collective decision-making and the institutions that enable it, with a number of key themes emerging. Interestingly, these themes anticipated many of the same insights that were later drawn from across the empirical case studies in Part IV, and discussed in Chapter 9. In this way, the two iterations of the research served as a positive check on the validity of each other.

An absence of 'post-normal' initiatives, but a wealth of experience

Despite its significant potential, the PNS approach has not at all been explicitly pursued in published ICM practice. This noted, the ICM literature is replete with descriptions of participatory science-policy interface settings as part of ICM initiatives, and this research found 14 such initiatives which effectively gave effect to a PNS approach even without being labelled as such. All initiatives recognised that the complexity of the issues they faced meant science alone was insufficient to support decision-making, and demanded a pluralistic approach.

Improving deliberation to epistemological ends

Common across all 14 initiatives was recognition that knowledge was one component of a broader *dialogue for governance* that also incorporates values, politics and power for example. In this way, the mobilisation of knowledge was seen as inseparable from the interaction for arriving at collective decisions; and was often debated within the same forum. However, this noted, all initiatives gave special recognition to the importance of knowledge for guiding 'rational' decisions, and attempted to improve the quality of stakeholder interaction relative to epistemological ends. Therefore while most initiatives were centred on a forum, the deliberation within this forum was often structured according to deliberation support systems such as models, or a parallel programme of knowledge co-collection. Largely absent, with the exception of two cases, were explicit means of evaluating knowledge quality such as 'extended peer review,' with the negotiated quality of knowledge generally deemed implicit in the interactions within a forum.

High quality institutions that mobilise high quality knowledge

The initiatives reviewed did not include a widespread discussion on their contributions to governance quality. Some initiatives did report that by giving effect to their approach, this had resulted in a science-policy interface that was more in keeping with ICM meta-principles, and indeed supported the creation of other institutions similarly espousing these principles. Particularly, authors discussed the creation of institutions that were more comprehensive, contingent, participatory, cooperative, adaptable and precautionary. Authors described these initiatives as mobilising knowledge that was of a high quality for decision-making; satisfying the general standards or rigors of science, while admitting knowledge systems beyond the normal realms of science.

Improving the quality of stakeholder interaction

Most initiatives discussed positive changes to the quality of stakeholder interaction, though these were rarely discussed in terms of 'capitals.' The initiatives revealed that in most cases stakeholders arrived at a shared understanding, which supported consensus for collective decision-making. Stakeholders similarly built up stocks of social capital as a result of increased and more diverse participation, together with increased connectivity of interactions, and more 'constructive' relationships. Human capital was seen to emerge from stakeholders learning more about the issue, other perspectives and the process of mobilising knowledge itself. Finally, financial capital stocks increased as these initiatives gained political and community support.

Beware power

One consistent cautionary note emerged across the 14 initiatives reviewed though, relative to the effects of power when attempting to democratise previously closed institutional settings, such as the science-policy interface. Many of the projects described the most significant threat to an effective dialogic setting as the power relations between stakeholders, and noted that a legitimate process of knowledge mobilisation must recognise and allow for the inherent values, politics and power loaded within all dialogue. Indeed, in at least two of the cases, political power relations pushed their way to the fore and threatened the integrity of the initiative.

3.3 Lessons from the empirical research

In Chapter 9, this thesis reviewed the wealth of experience gained from the three pieces of empirical research presented in Chapters 6-8. These three pieces of research were characterised by their diversity, allowing insights on how a post-normal science-policy interface can find expression under different conditions, and the way this defines how it contributes to coastal governance within a given context. A comparison of the three chapters at once allowed for an appreciation of their commonalities and their difference. These were able to be distilled into eight key lessons, which were unpacked in Chapter 9; suffice to list them below in Table 12. Many of the lessons in Table 12 echo those broad themes that emerged from the literature review in Chapter 5, allowing a degree of internal validation.

Table 12: Eight lessons learned from across the three empirical studies

Lesson 1:	Coastal stakeholders sought to democratise the science-policy interface out of dissatisfaction with science-based management
Lesson 2:	The post-normal science approach has not found explicit practical application in ICM, though there are many ways to give effect to its principles
Lesson 3:	A post-normal science approach can contribute to better quality ICM institutions
Lesson 4:	A post-normal science approach can contribute to better quality stakeholder interactions for collective decision-making.
Lesson 5:	Science is powerful and there is a danger that all knowledge perspectives become subsumed within a scientific framework.
Lesson 6:	Power is ever-present within any dialogic institutional setting, and influences the way knowledge is mobilised.
Lesson 7:	Context matters; a post-normal science approach is best used to improve the quality of pre-established dialogue and collective decision-making.
Lesson 8:	Scale matters; a post-normal science approach works best at a scale close and salient to the issue.

These eight lessons can be distilled further into three interesting insights relative to the meaningfulness of a post-normal science-policy interface for ICM.

First, by comparing the empirical research done across scales and contexts, this led to a significant finding; that while a post-normal science-policy interface has significant promise, the degree to which this promise is translated into success is largely contingent on the ‘governing system’ within which it is implemented. A PNS approach is not a blanket solution. It is better described as a targeted approach, which is suitable for mobilising knowledge around a certain category of coastal issue for which ‘normal science’ alone is inadequate. Moreover, its success is to a large degree dependent on the socio-political and institutional context, including its history of participation and stakeholder interaction, and the presence of strong leadership. Indeed, a PNS approach appears to work best at the local scale, where stakeholders are more closely acquainted with their coastal context and its issues, empowering them to participate in governance as part of an extended peer community.[128]

[128] This accords with other research done as part of the Millennium Ecosystem Assessment for example, which showed that decisions at the local scale are often supported by knowledge from a diversity of stakeholders, including local and traditional knowledge, while at the international scale decisions remains largely science-based.

Second, a post-normal science-policy interface setting presents significant promise for promoting high quality ICM, framed as interactive governance. All three empirical studies showed that such an approach can contribute to high quality institutions, which better give effect to principles of ICM. At the same time, the experience from SPICOSA and the local-scale case studies in New Zealand showed that a PNS approach can contribute to high quality stakeholder interaction. Principally this was seen through social learning around an issue, leading to a common understanding and increased human capital. It was also shown to strengthen interactions between stakeholders according to norms of trust and reciprocity, and an increased tendency towards compromise and collective action.

Thirdly, the most significant threat to a successful expression of a PNS perspective is 'power.' Where there is a power imbalance it is difficult to give effect to the reciprocal dialogue demanded by post-normal science. Most significantly, the power of science in such settings often acts to subsume other knowledge systems.

3.4 'Post-normal' as a viable alternative to 'normal' science

Through Figure 13 this conclusion made the point that models of ICM should be evaluated according to their 'right' measures in determining their success. Comparing models of 'management' with models of 'governance,' it noted that typically (though not always) models of management will succeed relative to their own criteria of quality, but fail relative to those of governance, and vice versa. This on its own is relatively trivial, and should not surprise us. It has seen the parallel development of models of management and governance, and many other models besides,[129] over the past 50 years of ICM. It has also seen models of management, as noted above in Section 1.2, retain a position of dominance. However, what is non-trivial, and in fact a crisis, is when we see models of management fail to achieve the aspirations they set for themselves. This legitimates, indeed necessitates, a deliberate change in approach. Where a management approach has failed to live up to its own expectations, we need to seriously look for alternatives.

This thesis began from developments within the scholarship of ICM, which assert that 'normal' science-based models of 'management' are ill-equipped to respond to post-normal issues (Costanza, et al., 1999; McFadden, 2007; Vallega, 1997).[130] Faced with such coastal issues, management models are unable to achieve their own aspirations of scientific certainty and centralised control, and it is difficult to attribute the linear causality of instrumental 'goal-achievement' that they demand (Stojanovic, et al., 2004). This failure of management models

[129] Figure 13 compares broad models of 'management' and 'governance,' though this matrix could be easily enlarged to include all other competing approaches to for arriving at decisions on how to allocate coastal resources and develop coastal communities, such as through market mechanisms, 'New Public Management', or dictatorship for instance.

[130] See Chapters 1 and 2

to succeed relative to their own criteria of quality has seen a deliberate decision to explore alternatives, with this theme emerging through the literature review and empirical research in this thesis (see e.g. Lesson 1 in Table 12). To this extent, ICM scholars and practitioners have explored models of coastal governance as a meaningful alternative to coastal management; implying new approaches, new criteria of quality and new aspirations of success. Within this thesis we focussed on the appropriate epistemology for models of coastal governance; exploring approaches for framing the science-policy interface that are congruent with an interactive governance perspective, and able to succeed relative to its measures of quality.

This thesis introduced post-normal science as one particular approach for framing the science-policy interface as a 'governance setting,' and interrogated how this approach contributed to ICM as interactive governance. This thesis revealed that where a PNS approach has been employed, it has made demonstrable contributions to quality coastal governance across measures of both institutional and interactional quality. In this way, we can assert with some confidence, that a post-normal science-policy interface presents an approach that well-fulfils the aspirations and expectations of ICM as interactive governance, with probable applicability to other models of coastal governance.

As such, where models of 'normal' science-based management have failed to perform relative to their expectations, we can viably offer up a PNS approach as a meaningful alternative, with demonstrated success relative to criteria of interactive governance.

4. What has not been accomplished? Questions left unanswered

The particular perspective on ICM as interactive governance that steered this research, and the dialogic epistemological norms that accompany this perspective, set a framework within which the thesis discussion took place. It defined the research questions, the research method, the way in which 'reality' was perceived, and resultantly the kinds of conclusions that this thesis has arrived at. For the most part we can argue that this particular perspective on coastal governance offered an enriching contribution to the unfolding debate in the field of ICM. However, by drawing the boundary of the conceptual framework, this research also acted to omit certain features of coastal governance 'reality,' which for the purposes of this particular project, were deemed to be less interesting. As noted in Section 2, this is a normal consequence of scientific research; however, as this research has progressed, at least four groups of questions have emerged that are very relevant to the debate within which this thesis engages, though for which the research framework was ill-equipped to explore.

4.1 Questions of power

This thesis began from a perspective of governance as interaction, and explored the potential contributions of a dialogic epistemology. In this way it followed a long tradition of scholarship, from Hegel to Habermas, that has focused on the way dialogue can unlock the resources contained within individual actors, in the construction of 'the collective'; from collective understanding to collective decisions. The research framework thus grounded itself in the normative foundations embodied in notions of participatory democracy, and epistemological foundations of communicative rationality. Alternatively, there is an academic tradition, following the likes of Machiavelli, Nietzsche and Foucault, which focuses on the way dialogue allows individual actors to exert power over each other (Flyvbjerg, 1998). The dichotomy presented between these two traditions of Habersian 'real' dialogue and Foucaultian 'dialogue as power' can be argued to represent two sides of the same coin of stakeholder interaction and dialogue, and a balanced enquiry should include both (Flyvbjerg & Richardson, 2002).

However, the research framework in this thesis gave a weak account of matters of power. This meant that in exploring the contributions of a PNS approach to coastal governance, there was little attention to its influence on power relations within a governing system. In conceptualising ICM as interactive governance, Chapter 2 constructed an evaluation framework that drew on the parallel pillars of institutional and interactional quality, though neither enabled a sufficient discussion of power. Most notably, the framework unpacked 'interactional quality' according to stocks of human, social and financial capital, but omitted 'political capital,' which would have posed an interesting measure of the degree to which stakeholders understand and utilise power in decision-making.

Despite the limited attention to power, the outcomes of both the literature review and the empirical research allowed for a rich discussion on the way in which a PNS approach can influence, and be influenced by, the power that exists within a governing system. In particular, the research served to reveal the significant power of 'normal' science within the science-policy interface, and the dominance scientists exert over stakeholders espousing other forms of knowledge in a dialogic space. To this extent, while power was poorly considered in framing the research, it emerged as a very important feature over the course of the research, and future iterations of this research would benefit from a framework that enabled a more sophisticated discussion of this.

4.2 What about politicians?

This thesis explored the contributions of a PNS approach to coastal governance according to a framework set by interactive governance, raising questions on the role of elected politicians within this framework. As expounded in Chapter 1, the perspective of interactive governance generally begins from notions of participatory democracy, whereby all citizens have an active role in governance. This devolves society's collective decision-making from a notional decision-making table of elected politicians, to citizens themselves within multiple different institutions, with the effect that politicians find themselves outside of these decision-making processes. For this reason, the conceptual framework did not consider elected politicians within governance.

However, the empirical research demonstrated that politicians remain an important influence on a governing system, even in instances where there has been a decision to move to participatory initiatives of co-management for example. It was found that a governing system is inevitably comprised of multiple different modes of decision-making, and thus represents a combination of centralised decisions according to modes of representative democracy, alongside more decentralised modes of participatory democracy. Conceiving of governance in this way re-admits politicians into governance, and acknowledges their powerful role. Politicians appear to have a pervading influence on a community's decision-making, even where it is not their direct prerogative. In this way, future iterations of this research would benefit from including an appreciation for the way politicians interact with, and influence, initiatives in PNS for instance.

4.3 Which other stakeholders were excluded?

This thesis utilised a conceptual framework that visualised governance according to a network of interactions between four broad categories of stakeholders: (i) civil society; (ii) state agencies; (iii) the private sector; and (iv) the scientific community. However, conceiving of governance in this way acted to exclude some important stakeholders.

Firstly, stakeholders broadly categorised as 'the media' were ignored. This is despite a growing recognition amongst scholars of governance of the significant role the media plays in influencing society's collective response to issues, and its potential role in coordinating the fragmented responses characterising governance. Indeed, it can be argued that the media has a particularly important role when we turn to questions of epistemology for governance, with a growing literature surrounding the role of the media in communicating climate change for instance (Carvalho, 2007). The research would have benefitted from a research framework that recognised the role of the media in coastal governance.

Secondly, the 'common man' is also excluded in models that map governance according to stakeholder networks, with this detailed in Chapter1. As argued by Sorensen and Torfing (2003), conceptualising a governing system according to tightly-knit networks of actors with a defined stake in an issue, and the means to participate in a community's decision-making, represents an undemocratic model that ignores the masses of coastal inhabitants that sit outside these networks though nonetheless have a significant interest in their coastline. Including an appreciation for wider civil society therefore represents a challenge to models of network governance, and likewise to this thesis.

4.4 Looking beyond the science-policy interface

In this thesis, the science-policy interface institution has been the focus of study on how we can introduce new epistemological norms of dialogue in support of decision-making. In this way, the definition of the interface has been cast very wide, to include any institutional setting where knowledge has been assembled as a means to support formal decisions; with institutions represented as a social construction shaping stakeholder interactions. The reason for this focus stems from the literature on ICM, which has traditionally confined its epistemological discussion to the science-policy interface, and meant that the discussion in this thesis too revolved around this setting. This poses three concerns. First, the science-policy interface discussed in this thesis was a very vague and ephemeral setting, at once representing many different institutions and none. Secondly, by discussing a 'post-normal' science-policy interface, this does not account for the fact that by encouraging participatory dialogue, and including values alongside knowledge, this could be argued to create a categorically different institution. This research showed that many 'post-normal' initiatives began from a broadly deliberative forum which doubled as the setting within which knowledge was mobilised, and where collective-decisions were made. We could argue that such settings are much more than a science-policy interface institution. Thirdly, a focus on the science-policy interface meant that other interesting institutions went unexplored. A governing system introduces many different opportunities to mobilise knowledge, in different institutions.

5. Returning to the research question

In concluding we return to the research question, and demand to what extent we addressed it. Firstly we can argue that, in Part II, this thesis formulated an interesting and enlightening research framework within which to structure a discussion on this research question. Notably, Chapter 2 constructed a novel evaluation framework for ICM as interactive governance, which allowed a unique insight into the workings of a governing system according to features of institutional and interactional quality. This framework was targeted on well-defined criteria, though still allowed for surprise and learning. Accepting the weaknesses of this framework (see Chapter 2 and Section 4), it did allow for an interesting commentary on the way a PNS approach may contribute to governance.

Secondly, we can argue that the two iterations of this research, via literature review and empirical research, did give rise to some interesting results, which allow us to begin answering this question. Though none of those initiatives studied labelled themselves as an exercise in PNS, they revealed a diversity of means of giving expression to a PNS perspective, which were contingent on their context. In their diverse ways, these initiatives made demonstrable contributions to the quality of coastal governance institutions, relative to the features espoused by meta-principles of ICM. They also led to demonstrable changes in the quality of stakeholder interactions, by contributing to stocks of human and social capital within a governing system; notably through social learning, and nurturing norms of trust and reciprocity. Evidently, more research on this topic, across different contexts will further enrich these results.

Finally we can assert that in answering this research question, this thesis has made valuable contributions to debates within ICM on models of governance, and their implications for the way communities mobilise knowledge for decision-making, particularly across the science-policy interface. These contributions come through (a) a rich discussion of governance perspectives, (b) a novel evaluation framework, and (c) unpacking the promising epistemological perspective presented by post-normal science as a means of framing the science-policy interface.

6. Afterword

Models of science-based management remain powerful. They offer alluring promises of control and predictability; utilitarian efficiency and effectiveness. In comparison, models of governance promise much less; accepting as they do a future we cannot 'know,' and reinvesting responsibility in the hands of a community to cope as best as they can via their own diverse means. The value of a governance perspective lies in recognising the co-existence of these diverse activities in society, and seeking their reciprocal integration as the collective response '*to solve societal problems and create societal opportunities*.' Indeed, in this regard, we should not abandon models of management, which have proven themselves valuable for many of society's problems. What we must do is couch models of management within notions of a community as a 'governing system,' and thus usher in a new era wherein management exists *within* governance. Within the field of Integrated Coastal Management this seems a not unlikely next 'stage,' such that in ten years we may discuss Integrated Coastal Governance.

Appendices

Appendix A: The evolution of Integrated Coastal Management in theory and in practice

This appendix details a brief history of the scholarship and practice of coastal management, and its evolution toward Integrated Coastal Management. The purpose here is less to provide a detailed account of what it is to employ an Integrated Coastal Management approach - its principles and methods are discussed within the body of the thesis - and more to provide some background information so as to set the context for this discussion.

The coastal marine area has been the special focus of concentrated efforts at resource management since the 1960's. This reveals an on-going and evolving reciprocal relationship between coastal management practice, and the attendant study into its 'success principles,' first under the heading of 'Coastal Zone Management,' (CZM) and later under the heading of 'Integrated Coastal Management' (ICM). As Tobey and Volk (2002, p. 288) argue, in their discussion of ICM:

> *"Common understanding of concepts and methods is important to allow us to build on what we already know and advance the practice and discipline of ICM. It also allows greater cross-fertilization with other conservation practitioners and related disciplines. A common understanding of ICM makes it possible for observers to ask comparable questions and explore similar hypotheses."*

In this way, Vallega (1997) has mapped the evolution toward the concept of Integrated Coastal Management in terms of increasing 'stages' of sophistication on the decadal scale. Vallega described this evolution in terms of three key influences: (a) a focus on global environmental change, and particularly the urgency posed by potential sea-level rise; (b) the increasing emphasis put on sustainable development as a guiding principle of resource management; and (c) an epistemological change from scientific positivism and reductionism, to more global visions rooted in the pooled knowledge of a variety of knowledge systems. Vallega's stages are used to structure the discussion below.

1. The ‘rise’ stage: coastal zone management in the 1960’s

The 1960’s saw the first explicit recognition of the unique values of the coast, and the beginnings of efforts to manage a few key uses of the coastline; often associated with coastal hazards and desires to effectively plan for coastal development (Cicin-Sain & Knecht, 1998).

In 1969, the USA’s Stratton Commission published their report ‘Our Nation and the Sea,’ which recognised the unique importance of the coastal marine area of the United States, and advocated a ‘fresh approach’ to coastal planning and decision-making; incorporating both a more coordinated approach between government departments across spatial scales, and more investment in science to inform decisions. Following the Commission’s recommendations, the federal Coastal Zone Management Act was adopted in 1972 with the purpose of creating systems of coastal planning and decision-making at the municipal and state scale, which would meet federal standards and address a set of priority issues. To qualify for federal funding and support, a state programme had to demonstrate that it met rigorous standards for stakeholder participation, and that it had the mechanisms in place to implement its Coastal Management Plan. As a result of this first formal effort at coastal zone management, almost all states responded to the incentive-based programme, and over the following 30 years produced federally approved coastal plans (Cicin-Sain & Knecht, 1998). Around the same time, coastal zone management programmes began to emerge in other developed countries around the globe (Tobey & Volk, 2002).

1.1 Intellectual origins

The intellectual origins of coastal zone management are complex, and there is no one single discipline that could be called its ‘home.’ During its formative stages, CZM initiatives borrowed heavily from a number of other disciplines, professions or broad areas of scholarship of the time that were also concerned with the allocation of resources within a political economy. In this way, CZM drew on the theory and experiences of at least (i) planning; (ii) resource/environmental management; (iii) resource economics; (iv) the management sciences (including public administration); (v) policy analysis/science; (vi) geography; and (vii) institutional economics (see e.g., Cicin-Sain and Knecht (1998), and Stojanovic, Ballinger, and Lalwani (2004)). Moreover, to add to the complexity, each of these areas of scholarship are themselves often a conglomerate of a number of other more narrowly defined ‘disciplines,’ and are seen to overlap with each other. To take planning as an example (which was particularly influential on CZM), Campbell and Fainstein (2003, p. 1) assert that planning is an elusive subject of study, drawing on a variety of disciplines and with no widely accepted canon. “Studies in planning refer to works in political science, law, decision theory and public policy…urban history, urban sociology, geography and economics” (Campbell & Fainstein, 2003, p. 5). While many fields, such as economics, are defined by a set of methods, planning draws methods from a wide range of fields. Coastal management has therefore, from its beginnings, been a relatively indistinct area of study; employing theory, methods and tools from a number of different fields, which are themselves vague in definition (Stojanovic, et al., 2004).

Though the intellectual origins of CZM's may be vague, there are three characteristics that emerged very early in its development, and which are important to its study. Firstly, coastal management has always considered itself a multi-disciplinary exercise - indeed 'defining' itself as multi-disciplinary – and emphasising the importance of this to the effective management of the coast. This multi-disciplinarity extended beyond those professionals and social scientists interested in the management of resources, to include a diversity of natural scientists also, who were proposed to be involved in a coastal management initiative from the beginning. From the beginning, coastal management has nurtured a strongly science-centric science-policy interface (Cicin-Sain & Knecht, 1998). Secondly, following from the same traditions of social learning and ideas of scientific management and organisational development that influenced planning (Friedmann, 1987), coastal management has typically been an empirical exercise in 'learning by doing.' It is an empirical or applied field of study to accompany other fields which may be more theoretical in focus. For instance, theories of planning, resource management or economics may be applied as appropriate within different coastal contexts, which are in turn monitored for effectiveness, and distilled into principles of success (Stojanovic, et al., 2004). Thirdly, and related to the second point, coastal management is seen to evolve alongside the disciplines which influence it. The evolution of coastal management from CZM to ICM and beyond can be described in terms of the evolution of its constituent disciplines, and by the introduction of new intellectual influences. In this way, CZM in the 1960's and into the 1970's mirrored the dominant paradigm within planning and other fields, which was broadly characterised by the 'rational comprehensive,' or 'modernist' model. This model assumed a coastal manager was able to make the most rational decisions because they had access to (i) perfect knowledge of the issues, and (ii) insight into a common public interest.

2. The 'implementation' stage: the 1970's

Though the 1970's brought an increased focus on coastal management, the discipline of coastal zone management (CZM) remained limited to recognising some of the more obvious development mistakes and social conflicts along the shorefront, and responding with various forms of regulation. There were though two key developments in the discipline: (i) an increasing view of the coast as complex, and (ii) a desire to balance resource use with maintaining the integrity of the natural environment. The coastal marine area increasingly became viewed as complex and interconnected, such that the coastal zone became more broadly defined in recognition of the interconnectedness between terrestrial and marine areas. With this came a realisation that collecting science for the coast must be similarly complex and interconnected, necessitating a multi-disciplinary approach (Cicin-Sain & Knecht, 1998). Importantly also, the

1970's saw coastal 'use management' balanced with concepts of 'environmental protection' associated with some uses. While before the emphasis had been on the most efficient use of resources, there was now a growing conception that some areas of the coast should be protected from exploitation; both from a conservationist and a preservationist perspective. This illuminated a key trade-off between 'environmental management,' which minimised the social impact on natural ecosystems, and 'development,' which maximised resource use (Cicin-Sain & Knecht, 1998). This trade-off became increasingly stark in light of the newly forming principle of 'sustainable development,' through publications like the Club of Rome's 'Limits to Growth,' published in 1972.

2.1 Intellectual influence

The 1970's saw an increasing sophistication of CZM academically. Importantly, thinking within the fields of ecology and systems science began to infiltrate CZM (Olsen, 2000), leading to the questioning of linear cause-and-effect models, in favour of more complex and interconnected alternatives. The influence of these two academic fields had a profound effect on the disciplines surrounding planning and resource management. They questioned the ability of a technocrat to have access to perfect information to inform political decisions, and in so doing questioned the viability of the modernist model. In planning, this led Lindblom (1979) to promote 'incrementalism,' within ecological fields it led Holling (1995) to develop theories of 'adaptive management,' and within coastal management it further enforced ideas of iterative management cycles, with coastal management initiatives and the scholarship in general learning from its mistakes and its successes. Two other developments also accompanied the influence of ecological thinking. Firstly, the influence of ecology brought with it the first elements of 'ecosystem-based management' which would later become more prevalent (e.g., see Forst (2009)). Secondly, research within the field of nature conservation also saw an increasing influence within CZM, with a growing focus on Marine Protected Areas in particular (J. R. Clark, 1998).

3. The 'maturity' stage: the 1980's

As the name suggests, the 1980's saw a maturing of CZM. Rather than focus on a few important uses of the coast, management was extended to the full range of uses across an increasingly broadly defined coastal zone, now extending to territorial sea boundary in many cases. Associated with this, there came an increasing effort toward nurturing inter-organisational integration, to coordinate actions and create effective linkages across all the coastal stakeholders (Tobey & Volk, 2002). Similarly, in recognition of the trade-off between environmental protection and resource use, coastal management attempted to marry together economic and ecological principles where possible; to exploit resources within the carrying capacity of ecosystems, without destabilising its structure, and thereby maintaining their resilience in the face of disturbances. This saw an increasing focus on 'resilience' as a guiding principle. This maturing of CZM thus signalled a transition to the new discipline of Integrated Coastal Management (ICM), particularly in anticipation of the UN Conference on the Environment and Development (UNCED) in Rio de Janeiro in 1992 (Cicin-Sain & Knecht, 1998). Importantly, it must be noted though that though there were an increasing number of ICM programmes being initiated around the world, they were largely restricted to developed states, with very few (if any) efforts in the developing world (Tobey & Volk, 2002).

As noted by Vallega (1997), the 1980's saw three key influences at work in shaping ICM. Firstly, in 1988 the World Meteorological Organisation and the United Nations Environment Programme established the Intergovernmental Panel on Climate Change, with a Coastal Zone Management subgroup. This saw the development of ICM tied closely to notions of global climate change; with ICM noted as the preferable approach as an adaptive governance response. Secondly, the 1980's saw a more advanced discussion on the theory of a 'complex coast;' changing the focus from a traditional epistemological background rooted in positivism and structuralism, to one that sought the construction of new knowledge across perspectives, including the introduction of 'interdisciplinarity' to replace multi-disciplinarity. Thirdly, the Brundtland Report in 1987, and other influences, advanced the cause of 'sustainable development' as a system of goals for (i) the protection of ecological integrity, (ii) economic efficiency; and (iii) social equity (including future generations). The World Commission on Environment and Development shifted this to a political paradigm endorsed by UN General Assembly in 1989. As Vallega described:

> "The sustainable development principle designed the final goal to which the specific goals, pursued in the single coastal areas, should be correlated. The theory of complexity made it possible to build methodological frameworks tailored to the concept of integrated management" (Vallega, 1997, p. 12).

3.1 Intellectual influence

During the 1980's, coastal management became influenced by the pervasive post-modern revolution that infiltrated many fields of research. The most significant effect of this was a rejection of the idea of a 'common' public interest in favour of theories of a diverse society, comprising a plurality of unique perspectives and value-systems. This again posed a significant blow to the practice of the modernist model, because it challenged the state's ability to aggregate or sum the values of a community, in isolation from the community. Instead, the state was required to take on a facilitation role in allowing society to negotiate and reach consensus on its own values (Vallega, 1997). Within planning for instance, this saw the increasing popularity of theories of 'advocacy planning' and 'equity planning,' (Campbell & Fainstein, 2003) while within other fields of resource management it saw the arrival of 'collaborative management' or 'co-management' (Armitage, et al., 2007). This signalled an important transition for coastal management, for while the state remained central to the decision-making process, the interface with the community became increasingly bi-directional and participatory (see e.g., the discussion of McCreary *et al* (2001)).

Related to the participatory collection of society's values came calls for a more participatory collection of knowledge to inform resource management, in other words, a democratisation of the science-policy interface. With fields of ecology, systems science, complexity and chaos theory revealing an increasingly complex and uncertain image of ecosystems, it became evident to social scientists that science alone did not have access to the totality of knowledge for decision-making. Calls were made for a science-policy interface that allowed for dialogue between science and other forms of knowledge, such as local or traditional knowledge. For Foucault, this was to deconstruct the modernist power structures that gave preference to science as only one form of knowledge (Flyvbjerg & Richardson, 2002). For Habermas, such a dialogue was essential for the achievement of 'communicatively rational' decisions; that is decision-making that endorses all forms of rationality (Outhwaite, 1996). The influence of these philosophies was immediately evident within planning and resource management, through models of 'communicative planning' (Campbell & Fainstein, 2003) and 'deliberative democracy' (Dryzek, 2002) for example. Within coastal management it saw the valorisation of other forms of knowledge within a participatory science-policy interface, and though science remained strongly at the core of management, a dialogue was encouraged through ideas of interdisciplinarity (Runhaar & van Nieuwaal, 2010).

4. The 'ICM' stage: the 1990's

By the early 1990's, Sorensen identified 57 nations who were engaged in coastal management initiatives at the national and/or sub-national scale, which resembled the emergent practice and concepts of ICM (Sorensen, 1993). However it was the UNCED Rio Earth Summit and Agenda 21 in 1992 that established ICM as the central organisational concept for sustainable coastal management around the world. Chapter 17 of Agenda 21 emphasises the coupling of sustainable development with ICM, and that the management of oceans and coasts must be, "integrated in content and precautionary and anticipatory in ambit" (Agenda 21, as cited in, Cicin-Sain & Knecht, 1998). The conference set the goal that by 2000 all coastal nations would have an ICM programme in place. ICM therefore became "internationally accepted practice" in the decade after the 1992 Rio Earth Summit, and began to feature prominently in various regional and international agreements and conventions. As an example, the United Nations Convention on the Law of the Sea (UNCLOS) in 1994, created a basic constitution for oceans – establishing the rights and duties of nations within ocean zones and high seas, which 'dove-tailed' with the emphasis on ICM contained in Agenda 21.

Following UNCED, the concept of ICM began to take further definition through international events such as the 1993 World Coast Conference in Noordwijk, Netherlands, where the Noordwijk Guidelines for Integrated Coastal Zone Management were developed. In 1994, the Joint Group of Experts on the Scientific Aspects of Maine Environmental Protection (GESAMP) met, with the intention of more clearly defining ICM, and the method or process by which it could be implemented. Of particular concern was the way in which science would be incorporated into ICM programmes and practices. GESAMP (1996) offered an enduring five step cycle as a means of showing the different phases of an ICM initiative, and to describe how the contributions of science change in each phase. For CZM and ICM practitioners and scholars alike, this diagram proved to be a powerful mental system representation for mapping the different facets of coastal management.

Billions of dollars have been invested in ICM efforts by bilateral and multilateral agencies since UNCED. Externally funded projects are the primary means through which governments in many developing countries translated their coastal management aspirations and policies into programs of action over the 1990's and beyond 2000. In Latin America for instance, the investments by international donors in coastal management for the period 1992–2001 totalled approximately $USD1.3 billion. By one estimate, the World Bank invested nearly $USD500 million in ICM initiatives internationally for the period 1996–2004. And by 2002, the Asian Development Bank had invested $1.2 billion for marine resources projects in the Asia- Pacific region (Tobey & Volk, 2002). However, with few exceptions, these investments were short-term projects designed to help nations progress through the initial planning stages of an ICM programme, with the expectation that subsequent phases would be funded by the individual countries government. As a result, not all projects were 'sustainable' in terms of their continuation after the money is gone (Christie, 2005). Nonetheless, Sorensen, in 2002, identified hundreds of purpose-design ICM programmes over 140 nations, with developing countries largely accounting for the increased number of ICM activities (Sorensen, 2002).

Cicin-Sain and Knecht (1998) noted near the end of the 1990's that ICM had emerged as the framework of choice for realising the goals of Agenda 21, and implementing important aspects of the Convention on Biodiversity and Convention on Climate Change. An ICM approach had thus, at that time, become wide-spread in its application to a variety of different coastal issues in a case-specific manner, while maintaining some convergence on some accepted standards or guidelines that applied universally. ICM had evolved to a point where ICM training was prolific, and networks were encouraged between institutions, through joint study programmes. This led Olsen to comment on the evolution of ICM as an increasingly sophisticated discipline:

> "*We have progressed since the early 1970s from coastal zone management, which recognised some of the more obvious development 'mistakes' and social conflicts along the shorefront and responded with various forms of regulation, to ICM that attempts to*

address the assumptions and policies underlying the development process and to experiment with new approaches to governance at the community level and with the agencies of central government" (Olsen, 1995, as cited in, Vallega, 1997).

4.1 Intellectual influence

With the development of the idea of 'Integrated Coastal Management,' the 1990's saw the idea of integration advanced even further. While the literature on coastal management had began as multi-disciplinary, and progressed to interdisciplinary in the 1980s, by the late 1990's there were some calls for coastal planning to be viewed through the 'transdisciplinary' lens. That is, rather than simply having various disciplines in dialogue across their boundaries, coastal management is the destruction of disiciplinary boundaries and the creation of a new meta-discipline. Costanza *et al* (1999) noted that ICM was transdisciplinary across the natural and social sciences, and those studying the policy process; reflecting an influence from intellectual traditions across all three. Related to the ideas of (a) coastal management as a transdiscipline, (b) coastal management as steered by ecological principles, and (c) coastal management as the allocation of the coastal commons, a number of authors began linking Integrated Coastal Management with ecological economics (Costanza, et al., 1999; Glavovic, 2008a). Finally, the 1990's also saw the influence of 'development studies' within coastal management, particularly the way in which coastal management programmes accommodate the poorer communities living on the coast, and their livelihood strategies (Glavovic, 2006).

5. Integrated Coastal Governance? 2000 and beyond

A decade after Rio, the September 2002 World Summit on Sustainable Development (WSSD) in Johannesburg brought renewed interest in the accomplishments and experiences within ICM worldwide. Over 420 participants from 61 countries came together in December 2001 at a global conference convened by UNESCO (Global Conference on Oceans and Coasts at Rio+10) to review experience and recommend future actions in ocean and coastal management. Donors, government leaders and ICM professionals asked how the next wave of investment in ICM should be designed and allocated, what methods and principles had emerged from past ICM experiences, and what the pressing issues were for the future. The scant progress in establishing national ICM programmes and the continued degradation of the coast led again to the reformulation of the challenge and of the prescription (Tobey & Volk, 2002).

The WSSD endorsed 'ecosystem-based management' as a way of augmenting the ICM framework, such that management considers the entire ecosystem, including humans, and seeks to maintain the ecosystem in a healthy and resilient state so that it can provide all of the services humans need. Rather than focussing on singular species, sectors or activities, even in a coordinated way, it looks at the cumulative effect of all activities together. Associated with ecosystem-based management, the WSSD recommended a further expansion of the spatial scope of ICM efforts to include more regard for the open ocean (sometimes referred to as Integrated Coastal and Oceans Management or ICOM), and strengthen the links between the terrestrial and oceanic environments – a ‘white water to blue water’ approach. This echoes similar evolutions in coastal management in the 1980’s (Forst, 2009).

Finally, like at Rio, WSSD expected leadership for ICM programmes to lie with the respective governments (the state), however it also more fully recognised the roles that civil society and the private sector have in taking actions within different institutional settings, which influence the way in which humanity interacts with its natural environment. In this way, coastal authors have increasingly begun talking in terms of ‘coastal governance’ rather than coastal management; the difference is significant (Glavovic, 2008a). Management implies a process whereby human and material resources are harnessed to achieve a known goal within a known institutional structure; park management or business management for instance. Governance, on the other hand, encompasses all of society’s institutional settings, including those within which ‘management’ is practiced. It questions the fundamental goals of the various sectors of society, and the way in which they interact in implementing their goals. It is a process that engages all elements of society simultaneously within multiple settings, and mediates across their various interests, rights and obligations. The governance of our coasts thus extends beyond government, and includes the interactions between all coastal stakeholders and their coastal environment. Since 2000, a growing number of coastal management writers have used theories such as ‘interactive governance’ theory as a lens through which to view coastal governance, as interactions between stakeholder groups within a governing system for instance (see example Stojanovic and Barker (2008), and Jentoft (2007)). This may see future initiatives on the coast defined in terms of Integrated Coastal Governance, as a further evolution of what began as Coastal Zone Management in the 1960’s.

5.1 Intellectual influence

Since 2000, coastal management has had two significant intellectual developments, which can be distinguished in terms of ‘the system-to-be-governed’ and the ‘governing system,’ to use terminology of those extending ideas of ‘governance’ to coastal management (Jentoft, 2007). The system-to-be-governed has increasingly been defined through principles from ecology, as testament by the WSSD endorsement of ecosystem-based management. These principles carry with them ideas of a complex melange of societal and natural systems, and the significant uncertainty this brings. This necessitates a different way of viewing resource management and planning as ‘governance.’

What does ‘governance’ mean for coastal management? Kooiman (1999), a leading author on governance, noted the multiple different ways the concept of governance has been applied, and its increasing popularity; referring to at least 10 different approaches to governance across different disciplines (see Chapter 1). The field of ICM has drawn upon ideas from across the broad spectrum of the governance literature, with some specific circles influenced by ideas of social-political or ‘interactive governance,’ ‘adaptive governance,’ ‘governance of the commons,’ ‘new public management’ and ‘corporate governance’ (see Chapter 2). While all of these models can provide useful insights into the complexity of coastal governance, this thesis focuses on the model of ‘interactive governance’ as a particularly compelling way of viewing coastal management (see Chapter 2).

6. ICM as a reflexive field

As becomes evident in this appendix, ICM can be described as a ‘*reflexive*’ field, with this reflexivity able to be understood as a relationship between the coastal managers practicing ICM principles within specific contexts, and the parallel scholarship of ICM reflecting on this practice. The reflexive evaluation of ICM initiatives constitutes decades of data on broader ICM principles, as well as on institutions, tools and mechanisms for giving effect to these principles; ranging from formal decision-making processes, to informal norms of communication and collaboration. Such practice-based theory-building can be well described in terms of an ‘action research’ approach (see the Introduction). Action research is a research inquiry which brings together researchers and practitioners and leads them to transgress the disciplinary, social and cultural boundaries of knowledge, along an iterative and cyclic process of action–reflection. Such research processes respond to practical concerns of communities by implicating the researcher in the problematic, by crossing theory and practice, by constructing the knowledge in a collaborative way, and thus by admitting the existence of social, historical and cultural influences while searching solutions (Greenwood & Levin, 1998; Reason & Bradbury, 2001; Stringer, 2007)

Figure 14 below conceptually represents the reflexive evolution of ICM[131]. It demonstrates across three tiers[132] the transference of ICM principles into practice within a specific ICM initiative, and the resultant learning both within the local community (or ‘governing system’) and within the wider scholarship of ICM. The first tier represents the broad principles of ICM. These principles are given effect within a specific governing system (to the degree that local

[131] This conceptualisation is based in a perspective of ICM taken from the theory of ‘Interactive Governance,’ which steers the discussion in this thesis. The meaning of the terms ‘principles, institutions, interactions and governing system’ in this figure are therefore drawn from the Interactive Governance literature.
[132] These three tiers equate to the three orders of governance discussed by Kooiman in the model of ‘Interactive Governance,’ and explained in Chapters 1 and 2.

stakeholders deem them relevant to their context); either through the augmentation of existing institutional structures and processes, or through the design of new ICM institutions. These institutions represent the second tier. As shown by the interaction between institutions and the governing system, institutions are a function of the unique and complex socio-political condition of the governing system; the existing political interactions between stakeholders according to the existing stock of both formal governance institutions, and informal cultural norms. It is more than just having the human, financial and technical resources available to implement ICM institutions; it extends to there being a receptive organisational culture or social norms for instance. A coastal context with a culture of mistrust between the state and civil society will struggle to give effect to ICM principles of participation and cooperation for example. Therefore, the 'quality' of institutions can be equally discussed in terms of how well they give effect to the principles of ICM, and how contingent they are to the local context.

The quality of institutions, in turn, determines the quality of the interactions between stakeholders within these institutions, toward collective decision-making for their coastline; with such interaction representing the third tier. ICM initiatives have long had high-quality collective decision-making at their core (see the Introduction), and to this end have encouraged institutional settings wherein diverse stakeholders can interact for decision-making. Again, Figure 14 demonstrates how the quality of stakeholder interaction is also influenced in large part by the historical context of a particular coastal community or governing system. Previous collaboration, between stakeholders, facilitators and barriers to participation, and power asymmetry will influence the likelihood of conflict resolution and collective decision-making.

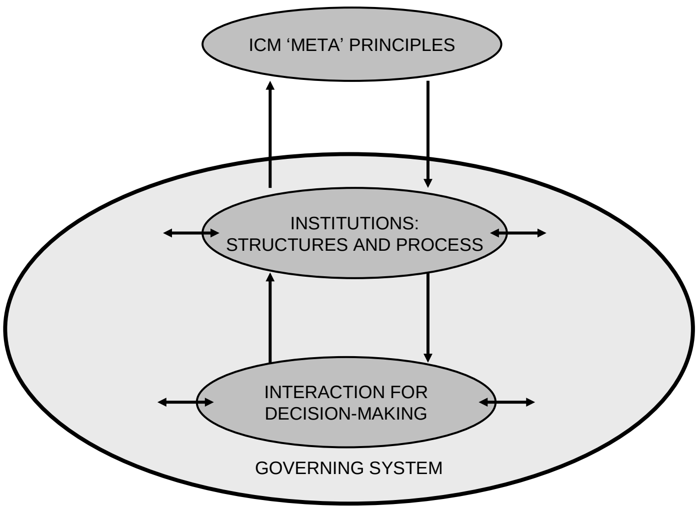

Figure 14: ICM as a reflexive field: demonstrating the mutually-influencing relationship between ICM principles (scholarship), and the institutions and stakeholder interactions (practice) within a governing system context.

A reflexive feedback loop is provided from the interactions for decision-making within an ICM initiative, to the foundational principles of ICM study; emphasising the importance of evaluation and learning to both ICM practice and scholarship. ICM initiatives typically include a formal evaluation step to allow for reflection on the quality of decision-making and action toward collectively determined goals, and the performance of institutions for facilitating the necessary stakeholder interaction. Such evaluation enables learning on which institutions have proven effective within the context, and an associated refinement in institutions; building institutional capacity, and improving institutional quality to better enable interaction. This demonstrates the incremental adaptation of ICM initiatives within a certain context as stakeholders 'learn-by-doing;' representing the on-going re-construction of increasingly effective institutions according to lessons learned. Moreover, lessons learned within one governing system context provide more generalizable insights about the quality or worth of certain institutions and principles, leading to adjustment of the foundational ICM principles. The field of ICM has developed significantly on the inductive lessons of countless instances of coastal management.

Figure 14 is thus a useful heuristic for conceptualising the two different scales of learning; both amongst coastal managers and stakeholders refining coastal management institutions within a specific governing context, and more widely within the scholarship of ICM. On a cautionary note however, it is important not to expect that a governing system's institutional and interactional capacity will inevitably grow over time, leading to ever better quality decision-making. This fails to account for the complexity associated with a governing system, which may see the influence and success of an ICM initiative 'ebb and flow;' as various stakeholders enter or exit the system, or where decision-making institutions are more or less successful in shaping quality decisions.

Appendix B: Concepts of 'rationality' for social choice: environmental management versus environmental governance

This appendix briefly addresses the use of rationality for natural resource and environmental management generally. In arriving at 'social choices' on how society interacts with the natural environment, there is a widespread assumption that such decisions must be rational. As members of society, many of us would hope that there is a *reason* for making choices that affect all of us, and that such choices are not made arbitrarily. The following discussion introduces rationality in Sections (1), (2) and (3) by defining what we mean by rationality, by analysing the place of rationality in 'modern' society, and by looking at ways that we can reconcile conflicting notions of reason. Following this very brief introduction, Sections (4) and (5) look at how rationality takes form within two different models of 'rational' collective decision-making; environmental management and environmental governance.

1. Defining rationality as 'based on reason'

To begin from a dictionary definition, to be 'rational' is to act, make decisions or plan, "consistent with or based on reason,"[133] with 'reason' inversely defined as "a basis or cause, as for some belief, action, fact, event."[134] Therefore, put simply, a person is said to think or act 'rationally' where they have a *reason* for thinking or acting that way, though these reasons may vary from person to person. As Popper (1994) noted in 'The Myth of the Framework,' rationality is a personal attitude, which in principle all sane people are capable of sharing. As a minimum principle, it "assumes no more than the adequacy of our actions to our problem situations as we see them." That is, for any situation, an individual will have certain information from which they will derive reason, which will guide their actions and beliefs in a way we can call rational.

Popper goes beyond this concept of rationality by adding another element; that of critical reflection. Through his writing on 'critical rationalism,' Popper argued in addition that any rational individual is ready to critically discuss and reflect on their actions or beliefs, and correct them in light of new insights. In short, rationality is "a readiness to listen to critical arguments, to

[133] http://dictionary.reference.com/browse/rational (accessed 7 June 2010)
[134] http://dictionary.reference.com/browse/reason (accessed 7 June 2010)

search for one's own mistakes, and to learn from them" (Popper, 1994, p. xii). For Popper, an individual that is not willing to change their beliefs in the face of irrefutable facts to the contrary is not acting in a rational way; they are a lost soul, doomed to repeat their mistakes over and over.

As such, Popper in 'Conjectures and Refutations' (Popper, 1963, p. 216) notes that across almost all knowledge systems used as a basis for rational decisions and action, that is to say as a source of reason, "the method of learning by trial and error – of learning from our mistakes – seems to be fundamentally the same". To this end the advent of science, specifically 'normal science' to use the term of Kuhn (1962), brought with it an epistemology possessing a particularly advanced system of criticism and correction, "as a procedure whose rationality consists in the fact that we learn from our mistakes" (Popper, 1963, p. 222). For this reason Popper described, and defended, science as an increasingly dominant source of reason to support rational decision-making in a modern world, with a number of prominent authors exploring what that means for modern society, particularly through the lens of critical theory.

2. Rationality in a modern world: how do we inform our social choices?

There are multiple forms of reason that individuals, and society collectively, utilise as the basis for beliefs, decisions and action, however as Elling (2008) describes, modernisation has seen the asymmetrical dominance of one specific form of reason; purposive or 'instrumental rationality.' This is particularly the case where society must collectively make a 'social choice,' owing to the need to externalise constituent's personal forms of reason, and institutionalise them in support of a choice that is, as much as possible, consistent with what they may all have chosen individually. According to instrumental rationality society is deemed rational to the extent that it selects and effects actions in successful pursuit of some *ends*. Thus rationality essentially refers to the success of goal attainment, whatever those goals may be. It does not invite critique into the nature of the goals (the ethical basis for a goal for instance), with decisions seen as rational solely on the basis of goal attainment. Instrumental rationality is based in the ability to 'know' and predict the behaviour of other people and objects in the environment, such that the outcomes of certain actions can be planned for. Central then to instrumental rationality are the assumptions that one: (a) has a clear conception of their goals; (b) has full knowledge of the situation; and therefore (c) has a clear conception of the most efficient way in which to achieve their goal. This has brought science to the fore.

As science has matured throughout modernity, it has pushed back the frontiers of humanities ignorance with simplified models of Nature, and society's interaction with Nature; typically constructed in causal linear fashion. It is via such an understanding of the world that science has made it increasingly possible to make instrumentally rational decisions. No longer does society need to make choices based solely in tradition, myth or divine-inspiration; it can more efficiently focus on the satisfaction of scientifically defined goals, with well calculated interventions into a well-understood system. Therefore, it is in parallel with the growing fashion of science, that there has been an increasing appeal to instrumental reason (Elling, 2008), and its attendant principles of 'efficiency,' effectiveness' and 'optimisation.' Furthermore, through the introduction of social sciences has come the scientification of the human world, including the way in which people employ reason in support of their beliefs and actions. As Popper (1994) described, instrumental rationality has become an underlying assumption of rational human behaviour in the majority of modern social science models and theories; as embodied in the 'Principle of Rationality.' To use Newell's (1982) definition of this principle, "If an agent has knowledge that one of its actions will lead to one of its goals, then the agent will select that action." Moreover, an individual, organisation or society is expected to select the action that will optimally satisfy their set of goals, in the most efficient manner.

Early last century Max Weber's (1968) influential work 'Economy and Society,' first noted how in the modern world purposive or 'instrumental' reason had risen to become the dominant basis for social choices; exposing what he perceived to be the scientification of society's decision-making embodied in its public administration or bureaucracy. Joining this discussion in the 1970/80's, Jurgen Habermas (as cited in Outhwaite, 1996, p. 44) wrote how the increasing power of science – with systemic models for example – began to assert itself over all other forms of reason, in a technocratic model:

> "*It is only recently that bureaucrats, the military, and politicians have been orienting themselves to strictly scientific recommendations in the exercise of their public functions – indeed this practice has only existed on a large scale since World War II. This marks a new…stage of that rationalisation which Max Weber had already comprehended as the basis for the development of bureaucratic domination*."

That is to say that society has increasingly made its decisions through a technocratic bureaucracy, according to scientifically supported instrumental reason, such that as Dryzek noted, following Weber, "bureaucracy has sometimes been regarded as the hallmark of rationality in social and political organisation" (Dryzek, 1987). Social structures, such as a bureaucracy, operate according to a desired function, as encapsulated in one of society's values, and can be deemed 'functionally rational' to the extent that it implements means for achieving value (ends):

> "*To describe a human social structure as functionally rational means, first and foremost, that its organisation is such as to consistently and effectively promote or produce some value. Functional rationality, therefore, constitutes a standard for evaluation and*

design. A rational firm produces profits; a rational legal system resolves disputes… Any form of functional rationality embodies both a value and a mode of behaviour appropriate to the attainment of that value" (Dryzek, 1987, p. 25)

To Weber (1968) however, being constricted to instrumental or functional rationality serves to entrap society within an 'iron cage,' which at the same time as it increases the effectiveness of society, deprives modern life of other meaning. While acknowledging the creeping influence of instrumental rationality and science within the bureaucracy, Weber exposed the 'division of labour' between the technical advisors who operated according to science and instrumental reason, and the politicians who were more likely to employ other forms of reason stemming from their ethical or emotional self. As Habermas (as cited in Outhwaite, 1996, p. 45) later noted:

"*As much as the objective knowledge of the expert may determine the techniques of rational administration…and thereby subject the means of political practice to scientific rules, practical decisions in concrete situations cannot be sufficiently legitimated through (instrumental) reason. Rationality in the choice of means accompanies avowed irrationality (sic) in orientation to values, goals and needs.*"

"*A scientized society could constitute itself as a rational one only to the extent that science and technology are mediated with the conduct of life through the minds of its citizens*" (Outhwaite, 1996, p. 52)

This serves to demonstrate that there are indeed other forms of reason upon which we as ordinary citizens; be it voters or politicians, employ as a basis for our thinking and action. Weber (1968) revealed an alternative to '*Zweckrational' or* instrumental rationality which he labelled '*Wertrational'* or value/belief-oriented rationality. This alternative form of rationality draws from reasons intrinsic to an individual, and may range from their ethical, religious or aesthetic beliefs, to their feelings or emotions, to ingrained habits and traditions passed down through society. Importantly, Weber noted such reasons have throughout time been an important determinant of our actions, even though such rationality does not always lead to successful goal attainment.

Habermas (Elling, 2008; Outhwaite, 1996), building on the ideas of Weber, described what he perceived to be a division between the harsh objectivity of instrumental reason, and the other more subjective forms of reason based in a person's social context. He discussed society comprising its inhabitants and their social context/institutions in terms of their 'lifeworld;' while distinguishing a subset of society that has freed itself from this social context in the pursuit of an abstracted knowledge of the world, comprising scientists, bureaucrats and other experts for example, and labelled the 'system.' The abstracted 'system,' provides an effective means for artificially conceiving society to build knowledge and effectively satisfy society's goals through administration and bureaucracy. However, while a subset of the 'lifeworld,' the 'system' is becoming more and more abstracted and dissimilar, such that the two occupy completely different parallel existences. The system is dominated by cognitive-instrumental reason, governed by technical rules based on empirical knowledge and using context-free language to frame social choices as goal attainment. Conversely, the lifeworld is dominated by moral-practical and aesthetic-expressive rationality. It uses ordinary language grounded in social norms that are collectively built in a consensual manner; stemming from reciprocal discussion and mutual understanding. Reason based in the lifeworld is deemed legitimate owing to its generation through free communication. Habermas mapped the colonisation of the lifeworld with elements of the system, with instrumental rationality displacing other forms of rationality, even though elements of the 'wholeness of reason' survive in communicative everyday practice. Habermas urged new forms of rationality within social choice fora, which allow a dialogue across both the lifeworld and system, and employ reason in all its forms.

Finally, similar to Habermas and Weber, Beck divides rationality as 'scientific' and 'social,' with science dominant owing to its ability to appeal to objective reason, over other more subjective forms (Elling, 2008). However, he argues that science cannot maintain its isolation from its social context, and that eventually science must be appropriated by society. In this way, science and other knowledge systems are able to engage in a dialogue to mobilise all forms of reason in support of our decisions and actions.[135] Beginning from Habermas and Beck, Elling (2008) reiterates how modernisation has led to the bifurcation of reason and demands a new modernisation that is based on the wholeness of reason rather than one ruled by instrumentalism:

> "*It is communication that abolishes the split of knowledge into expert knowledge and lay knowledge, in which the former has always triumphed over the latter…It is communication that will rise above the division of rationality…in which the instrumental form is supposed to fulfil all the functions*" (Elling, 2008, p. 166).

[135] In the book 'Rational Ecology,' (Dryzek, J. S. (1987). *Rational Ecology: Environment and Political Economy*. Oxford and New York: Basil Blackwell Ltd.), Dryzek discusses five broad forms of rationality that are typically employed in environmental management:
a) *Economic rationality*: dominant in contemporary industrial societies, it is grounded in instrumental rationality with a focus on utility calculations. Social choices are judged economically rational when net utility is maximised across an aggregation of individuals;
b) *Legal rationality*: social choices are governed by formal rules, with the focus on conflict resolution, and the construction of a complete system of rights and rules;
c) *Social rationality*: social choices are deemed rational where they nurture social harmony, participation and integration as the prime value(s), generally achieved through processes of inter-personal adjustment and persuasion, and usually quite separate to formal calculations;
d) *Ecological rationality*: social choices are deemed ecologically rational where they support the capacity of ecosystems to consistently and effectively provide the good of human life support; and
e) *Political rationality*: this is less easily defined, but can be described in terms of the political 'intelligence' of those participating in problem-solving. Therefore social choices are deemed to be rational where they improve the effectiveness of participants to participate and to reach consensus on different problems.

3. Reconciling conflicting notions of rationality; Habermas vs Foucault

A broad dichotomy has been drawn between two conflicting perspectives on the way in which the plurality of reason is reconciled for rational social choice through communication. The first is often attributed to Foucault, and argues that power underlies all interaction for collective decision-making and therefore also defines which reason 'counts.' The second, often attributed to Habermas, argues in favour of 'true' communication

3.1 The rationality of power

The rationality of power (as opposed to the power of rationality appealed to by Francis Bacon) is discussed in length by a number of authors in the tradition of Machiavelli, Nietzsche and Foucault, with Bent Flyvbjerg (1998) providing an enlightened discussion in his book 'Rationality and Power.' For Flyvbjerg, decisions are deemed rational according to the power relations within a context: "Rationality is context-dependant. The context of rationality is power." Similar to 'political rationality,' decisions or actions are deemed rational as far as they meet the expectations of the powerful; power determines 'reality' and what counts as knowledge – power collects knowledge that supports its position but ignores contrary information. In this way, power determines which forms of rationality will prevail, be it instrumental, social, ecological or otherwise, and is thus the underlying 'reason' for decisions; "rationalisation presented as rationality is a main strategy of power." Other forms of rationality play an illusory role employed by power, as the only true form of reason; where there is an open confrontation between power and other forms of rationality, power always prevails. In this way Flyvbjerg argues, "Instead of thinking of modernity and democracy as rational means of dissolving power, we need to see them as practical attempts at regulating power and domination" (Flyvbjerg, 1998, p. 236).

3.2 Practical, pragmatic or communicative rationality

There are a line of scholars, stretching from as far back as Aristotle, to Dewey and more recently Habermas, who discuss rational thinking and action in terms of free and frank dialogue employing the many different forms of reason. Aristotle saw the realm of politics in terms of practical reason (praxis), which promotes the collective cultivation of virtuous behaviour, and where the greatest argument prevails; employing concurrently 'logos' (logical argument), 'ethos' (ethical character of the forum) and 'pathos' (passion of the debate) (Dryzek, 1987). For Dewey and Habermas, pragmatic or communicative models discourage the continued artificial separation between politics (the 'lifeworld'), and the technical expertise of advisors (the 'system'), in favour of critical interaction (Outhwaite, 1996). Communication between experts and political agents bases the scientific means of decision-making in the traditions, values and reality of society, while reflecting on and critiquing this social reality in light of science. Counter to the trends of modernity, practical rationality places scientific instrumental rationality alongside other ethical, personal or traditional forms of reason, which have a less scientific way of being expressed. It thus extends beyond discussing ‘optimal’ goal satisfaction, to discuss also the actions that are ‘most just,’ ‘most ethical,’ most pious’ or the ‘most in keeping with society’s perception of itself.’ Dryzek explains:

> “*The (modern) society deals only in the exercise of instrumental problem-solving; purpose is arbitrary. In contrast, the ideal speech situation can be applied to discourse about morality as well as about truth. Norms themselves can be discursively generated and validated. Any individual contemplating action based on a normative principle can be called to account for that principle*” (Dryzek, 1987, p. 202).

For achieving dialogue within which all participants enter into deliberation, and can employ all forms of reason, Habermas wrote of the ‘ideal speech situation.’ Within such fora, “The only resource available to participants is argument, and the only authority is that of a better argument. It is critical too that all participants possess roughly equal degrees of communicative competence” (Dryzek, 1987, p. 201). Counter to those espousing the rationality of power, Habermas and others entertain a faith in society to enter into dialogue wherein power is (where possible) neutralised as the underlying form of reason, such that participants’ true forms of reason are employed on their own face value. Therefore, for proponents of communicative rationality, decisions and actions are deemed rational where they have resulted from effective dialogue that has balanced all options against all forms of reason.

Having provided a brief overview of rationality in the modern world, this Appendix goes on to compare particular models of reaching rational social choices for the use and development of the natural environment; the ‘modernist’ model of environmental management, and the deliberative model of environmental governance. The former is steered predominantly by an instrumental rationality, while the latter embodies communicative rationality.

4. Modernist environmental management

The modernist tradition of environmental management is born of the enlightenment tradition originating in the 18th century, when ‘reason’ became the primary source of legitimacy for authority (Friedmann, 1987). Modernist, or technocratic, management values science as the dominant form of knowledge able to provide objective and reliable ‘truth’ to enable instrumentally rational decision-making for the common good (Funtowicz & Strand, 2006). The modernist model begins from a simplified model of a ‘context;’ reducing it to its constituent parts and exploring these parts through separate scientific disciplines. The interaction between the constituent parts is assumed to follow simple, linear causality, allowing for the prediction of future outcomes, and their effective ‘management’ (Funtowicz & Strand, 2006; O'Connor, et al., 1996; J. P. Van der Sluijs, 2007). Against this context, institutions for supporting decision-making are scientific in nature. This saw the rise of 'policy analysis' in the 1950's as the 'science' of creating rational and instrumental tools for governance; specifically the rational and linear 'decision-making process' (Colebatch, 2005). To this end, policy analysts as technocrats operate the decision-making process, progressing in rational stages that define the 'problem,' clarify the local values of society, formulate alternatives, predict the degree to which each alternative achieves the values of society, and selects the 'optimal' alternative according to its instrumentality. Such a process relies significantly on scientific inputs which are provided across the 'science-policy interface.' Where possible, this process also requires the reduction of all values down to a small number of quantifiable denominators (utility defined in monetary terms for example) to allow for comparison and Pareto optimisation (Colebatch, 2005).

In the modernist tradition, scientific institutions often support decision-making according to representative democracy (De Marchi & Ravetz, 1999; Schlager & Blomquist, 1996; Schulock, 1999). In this way, the 'political elite' are entrusted with the power and responsibility for making the final decisions that are binding on all society; with their decision drawing rationality and democratic legitimacy from (a) the objective knowledge of each alternative's outcomes (the hard facts), and their ability to Pareto optimally satisfy (b) the aggregated preferences of their constituents (the soft values); both provided to them through the policy process. In this way, the policy process traditionally provides only a few, strictly defined avenues for wider participation; usually in terms of expressing their preferences on the set of prepared alternatives according to the information provided by the policy analysts. Thus in general, modernist public participation is reduced to the aggregation of individual citizens' preferences or value-statements relative to each policy alternative; rather than in the collection of knowledge on the policy issue and/or the choice of alternatives (Schulock, 1999). This aggregation is the focus of the public choice literature.

Public choice applies the theory and methodology of economics to political interaction for collective decision-making (Mueller, 1989), as Buchanan (1978, p. 5) notes:

> *The building blocks are living, choosing, economising persons. If these persons are allowed to have differing preferences, and if we so much as acknowledge that some aspects of life are inherently collective or social rather than purely private, the central problem of public choice jumps at you full blown. How are differing individual preferences to be reconciled in reaching results that must by definition, be shared jointly by all members of the community?*

Public choice begins from the assumption that all political actors are rational utility maximisers, such that each individual is deemed to prefer alternatives that advance their personal utility, and are deemed to have rational sets of preferences such that if they prefer alternative A over B, and B over C, then they should also prefer A over C, for example. How best then to aggregate individual preferences to get to a collective social choice? The most evident method is for individuals to vote on each alternative, with a majority vote indicating that which best satisfies the preferences of society (a utilitarian philosophy) (Feldman & Serrano, 2006). However, as widely recognised (Buchanan, 1978; Craven, 1992; Self, 1993), the Condorcet voting paradox showed that it is possible for a vote to be caught in a 'cycle,' where majority 'pairwise' voting cancels out any preferred option, failing to deliver the rationality we expect; for example, voting may show alternative A over B, B over C, and C over A. Indeed, the method of voting is so fickle that whoever sets the voting agenda is largely able to influence which alternative receives the majority vote (Buchanan, 1978; Self, 1993). This has led to a large literature on how else to aggregate individual choices to 'the social choice.' However, as Arrow (1970) demonstrated (mathematically) through his aptly named 'impossibility theorem,' there can be no method that aggregates individuals preferences to achieve both a rational list of transitive preferences (the A<B, B<C, A<C example), and also meet a number of reasonable democratic criteria.[136] In other words, as Sager (2002) succinctly notes, in order to avoid 'cycling' or 'arbitrary' decisions, and to arrive at a rational 'transitive' set of social preferences, a degree of power needs to be exerted to restrict democracy. Thus, any means of aggregation, from complex algorithms to cost-benefit analysis, places power in the 'agenda setter' who defines those alternatives which are to be included or excluded, or which societal principles, values or goals will carry the most weight.

It quickly becomes evident from a brief over-view of the modernist tradition where the power lies, and to what degree this influences what is deemed to be a rational collective decision. The influences of liberalist representative democracy, neo-classical economics, and positivist science combine to set the dominant modernist paradigm (De Marchi & Ravetz, 1999); with individuals robbed of their values and experiential knowledge to become, "nothing more than a set of preferences; a utility function" (Buchanan, 1978, p. 4). The 'best' collective decision is an instrumentally rational one, that can maximise the utility of as many individuals as possible, as demonstrable by natural and policy 'scientists' across the science-policy interface. Power is placed squarely in the hands of scientists, technocrats and the political elite, who are able to define the problem and its possible solutions, and set the agenda for establishing a rational set of social choices, owing to their supposed privileged access to objective scientific truth (Schulock, 1999). This shifts the emphasis of decision-making from 'soft values' to 'hard facts,' in the assumption that universal knowledge trumps the fleeting and fickle preferences of the public (O'Connor, 1997, 1999b). However, it fails to address a fundamental barrier, as noted by Arrow (1970), that an individual's values and preferences and utility are ordinal, and non-comparable as long as there is more than one denominator, or the denominator cannot be

[136] Arrows theorem demonstrated that it was impossible to simultaneously satisfy the four criteria of: (i) Unanimity; (ii) Transitivity; (iii) Independence; and (iv) The absence of a 'dictator' (power).

quantified (which arises in the majority of cases). We do not know of a single method yet which can aggregate the individual choices to arrive at a legitimate social choice.

Perhaps the most lamentable loss in favour of liberalism has been that of the ethic of reciprocity. As utility-maximisers, there is little to be said for reciprocity beyond the completion of an exchange (Self, 1993). Indeed, social choice theorists are apt to model cooperation relative to strategic game theory, through now well-known exercises such as 'the prisoners' dilemma,' recognising the strategic value in 'tit-for-tat' behaviour (Self, 1993). However, reciprocity is one of the underlying foundations of society and communication, and without it governance will continue to be according to the competing interests of individuals. Mill himself noted it should be natural for an individual to realise that the common good leads to our own individual happiness, or as Hegel wrote, "The extent to which he looks after his own interests must also be matched by the extent to which he serves others, and so far as he serves others, so far is he taking care of himself…" (pgs 342-343 of the 1977 translation, as cited in, O'Connor, 1997). This lack of reciprocity finds expression in 'the tragedy of the commons' (Hardin, 1968).

Table 13: Demonstrating two different governance models across three dimensions

Governance models	Three dimensions		
	Governance Context	**Institutions (Means):**	**Collective decisions (Ends):**
Modernist Environmental Management	Realist epistemology Linear causality Reductionism Society/Nature duality Ecosystem equilibrium Homogenous behaviour Predictability Uncertainty as risk	Rational and instrumental, linear decision-making process Technocrats as advisors Objective science providing 'truth' Consultation with utility-maximising individuals for preferences Aggregate preferences into transitive 'social choices' Compartmental institutions with a short-term efficiency focus	Representative democracy Instrumental rationality Pareto optimal alternative which maximises the utility according to social choice
Deliberative Environmental Governance	Relativist epistemology Irreducible complexity Holism Social-ecological system Heterogeneous value and knowledge systems Unpredictability Uncertainty as ignorance	Adaptive management Technocrats as facilitators Participatory deliberation fora Includes multiple knowledge systems – socially negotiate knowledge quality, including science Open debate of multiple values Integrated and ecosystem-based institutions, with a long-term, effectiveness focus	Participatory democracy Communicative rationality Alternative agreed to through deliberation; consensus or vote

5. A shift toward deliberative environmental governance

The post-modern movement began to permeate ideas of environmental governance from the 1970's and changed whole epistemological landscapes deceptively quickly (Blaikie, 1996), with two key insights: (a) that the governance context is in fact infinitely complex; and (b) collective decisions should be arrived at in the 'participatory and deliberative mode.' Through ecology, chaos and complexity theories, post-modernism challenged the dominance of the positivist and objective 'meta-narratives;' perceiving of the governance context as irreducibly complex, with some aspects frankly 'unknowable.' Society's pervasive environmental issues could not be understood and managed solely through the collection of more science; the dynamic and complex workings of Nature, and society's interaction with Nature, were beyond the means of the scientific method alone. Post-modernism brought with it a more relativist perception of reality; no longer could scientists "speak truth to power' within an objectively 'real' world. Instead they were forced to socially negotiate knowledge with other valid perspectives; knowledgeable locals or indigenous communities for example (Blaikie, 1996; Henrickson & McKelvey, 2002). Indeed, at its extreme this revolution turned the positivist account of reality inside out, with a constructivist epistemology as a complex tangle of individual's perceptions of reality, or stories. Human behaviour could thus not be described in terms of causal connections with each other and Nature, based on structural variables, but rather "an infinitely variable and subjective set of accounts from actors who reflect upon and try to make sense of their worlds" (Blaikie, 1996, p. 82).

Such a revolution added emphasis to Arrow's conclusion that societal actors' individual perspectives are fundamentally incommensurable via structured scientific means, and lent credibility to the greater involvement of a wider spectrum of actors in the collective decision-making process. This accompanied calls for a more participatory form of 'strong' democracy (Barber, 1984), in coordination with representative models. Communitarian citizenship was encouraged that charged citizens with greater responsibility than simply voting for their preferences; they were to take an active role in the governance of their society (Forgie, et al., 1999). As van den Hove (2006, p. 12) noted, this role extended to deliberating social choices, ''Insistence on plurality of legitimate standpoints usually leads to advocacy of some form of deliberative institutions within which the weight of different reasons that appeal to incommensurable values for and against different options can be considered."

Post-modernity has given rise to new concepts of the 'governing system' and its interactions with a complex context, or social-ecological 'system to be governed' (see e.g. (Jentoft, 2007; Jentoft & Chuenpagdee, 2009)). The governing system does not conform to modernist views of structured sectors of society petitioning their political representatives. Rather it draws from social network theory (see e.g. (Wasserman & Faust, 1994; Wellman, 1991)), and maps governance as a network of interactions among stakeholders that transcends the state to include actors from the private sector and civil society, with science in a supporting role (Kooiman & Bavinck, 2005; Lemos & Agrawal, 2006). This recognises the diminishing superiority of the state, with its objective knowledge of the 'public good' and it's supposed altruistic motives, for a more pluralistic and heatedly political arena of stakeholders and their wider constituencies. Power and rationality are dispersed, with a plurality of legitimate perspectives possessing of important knowledge of the system-to-be-governed and important value-positions that need to be recognised. This means that for all but the simplest environmental issues, which may remain the domain of the state and science-based decision-making, collective decision-making needs to involve dialogue across all these perspectives.

Within these concepts of a governing system, institutions provide the means of nurturing participatory deliberation. To this end, a number of different governance models have emerged that have interaction as the base unit of collective decision-making, including: planning (particularly collaborative planning see e.g Innes and Booher (2004), Sager (2002) and Lane (2005)), policy analysis (particularly those writers influenced by political science describing policy analysis as 'discursive,' see e.g. Schlager and Blomquist (1996), Colebatch (2005) and Madison (2000)), interactive environmental governance theory literature (see e.g. Jentoft (2005), Kooiman and Bavinck (2005), Lemos and Agrawal (2006) and Duit and Galaz (2008)), governance of the 'commons' (see e.g. Dietz *et al* (2003), and Ostrom (1990)), institutional ecological economics (see e.g. Paavola and Adger (2005)), adaptive governance (see e.g. Armitage (2005), Berkes, Colding and Folke (2003), Lebel *et al* (2006), Olsson *et al* (2006), Walker *et al* (2004)), post-normal science for governance (see e.g. De Marchi and Ravetz (1999)), and other 'applied' environmental governance fields such as Integrated Coastal Management (see e.g. Glavovic (2008a), Chuenpagdee, Kooiman and Pullin (2008), Jentoft and Chuenpagdee (2009), Jentoft (2007), Mahon, McConney and Roy (2008)). Related to this dialogic approach, many of these areas of scholarship also encourage institutions with an integrated and holistic ecosystem-based approach to environmental governance, in a move away from compartmentalised management, and toward understanding Nature as a complex whole, necessitating dialogue across sectors.

Participatory and deliberative approaches to governance constitute attempts to arrive at collective decisions that are both rational and democratic (Sager, 2002). Drawing heavily on the Habermasian (1984, 1987) concept of 'communicative rationality,' deliberative approaches attempt to put rationality back into the hands of the public; with all stakeholders able to make arguments based on 'facts' and justified 'value' statements. Thus discourse and reflection among stakeholders has both a substantive and a normative element. Substantively, it allows for a wider pool of knowledge to be collected, constructed and mobilised for governance of complex and uncertain contexts. Normatively, it attempts to escape the problems of aggregating social choice, and encourage the return of reciprocity, by allowing for disparate perspectives to be deliberated and common ground discovered. As Sager (2002) and Dryzek (1994, 2002) note however, this requires a discursive forum that adheres to strict rules designed to ensure democracy and annul power play; including a commitment by all stakeholders to engage in sincere and truthful dialogue, rather than strategic 'game-play.' These rules mirror the notion of 'constitutions' used by social choice theorists who sought ways to set rules for dialogue, to ameliorate the adverse effects of power and ensure the sincerity of any preferences expressed (Buchanan, 1978; Self, 1993). In addition, Sager notes that in many cases deliberation will need to be accompanied by more traditional preference aggregation, such as voting, because deliberation alone, without any obvious power-influence, has been demonstrated as being rarely able to reach consensus.

A number of commentators, drawing from political science, refuse to believe that any deliberative forum can exist in the complete absence of power. Planning theorists such as

Flyvbjerg and Richardson (Flyvbjerg, 1998; Flyvbjerg & Richardson, 2002), and Sager (2002), have argued that indeed rationality itself is a source of power, and those best able to wield rationality will control any collective decision-making. The communicative rationality ideal, they argue, depends on a set of (constitutional) rules that are unrealistic; within all attempts at collective agreement, "power is always present" (Foucault, 1988, as cited in Flyvbjerg & Richardson, 2002). In any attempt to reach a consensus that escapes the Condorcet 'cycle,' and thus provides a 'rational' set of societal preferences, Sager argues the ideals of democracy will need to be relaxed. Someone will need to give weight to one value over another, and it will usually be the state. As Hajer (1995) notes, the rationality of the new modernist paradigm – what Hajer calls 'Ecological Modernisation' – remains a dominant support for anyone engaged in an environmental discourse. Certain forms of discourse remain dominant to others within deliberative fora, because of their perceived instrumental rationality.

Appendix C: The concept of 'capital' and its use for describing stakeholder interaction

This appendix provides background information on the concept of capital, and the various ways it has been appropriated as a tool for describing and evaluating the way actors interact, make decisions and take action within a political setting. The concept of 'capital' has found varied expression across a kaleidoscope of fields, with Schuller (2001, p. 90) noting, "The list of different types of capital is growing fast: to natural, physical and financial capitals are added organizational, intellectual, environmental and many others. Many of these overlap or duplicate each other. Some are used pragmatically, others purely metaphorically." Appendix C aims to supplement and add depth to the discussion on 'interactive quality' in Chapter 2, by traversing this varied literature and exploring the meaningfulness of 'capital' as a descriptive concept.

Section 1 presents the origins of capital as an economic concept, before Section 2 maps its emergence in the social and political sciences and Section 3 finishes by discussing in detail the three forms of capital used by this thesis as indicators of high quality stakeholder interaction.

1. Capital as an expanding economic concept

The concept of capital is originally derived from classical economics and essentially describes a "*stock that yields a flow of useful goods and services into the future*" (Costanza & Daly, 1992). Classical economics identified three types of capital stock: land, labour and manufactured capital (often just called 'capital'), which were considered to have the properties of being accumulative, rentable, and substitutable. Later, neo-classical economics in its representation of production functions omitted land and only focused on labour and capital (Etkins, et al., 2003), while also introducing a fourth important form of capital in 'financial capital.' However, an increasing awareness of the scarcity of environmental resources as a limiting factor to growth saw other fields of economics which sought to re-appropriate the concept of capital.

Ecological economics emerged as a 'transdisciplinary' field of study in the latter half of last century to addresses the relationships between ecosystems and economic systems in the broadest sense. This saw them extending on the concept of 'capital' and broadening the traditional definitions of the three 'classical' capital stocks, to accommodate notions from ecology for instance, as can be seen in the definitions of Costanza and Daly (1992):

Natural capital: meaning the stock of renewable and non-renewable resources provided by Nature, and including the ecological processes (ecosystem services) governing their existence and use, such as waste assimilation, the production of soils, and the hydrological cycle for example.
Human capital: as the stock of education, skills, culture and knowledge stored in human beings themselves.
Manufactured capital: includes the factories and buildings and other physical artefacts usually associated with 'capital.'

Describing sustainability in terms of capital

In extending the concept of capital, ecological economics gave it a new character; using it as a concept to describe and evaluate the sustainability of society's relationship with the wider environment. In classical and neoclassical economic thought, only manufactured stocks were considered capital because of the superabundance of natural capital in a world largely 'empty' of human development. Society was deemed able to grow perpetually in terms of material wealth and consumption, in complete isolation from the ecological context upon within which it is nested (Daly, 1996). Now, thanks to the rapid growth in the scale of human activities, the world is better described as 'full,' and natural capital is becoming the scarce limiting factor (Costanza & Daly, 1992). Ecological economics emphasises that to sustain the goods and services humanity needs, the stock of natural capital needs to be maintained. This does not mean an un-changed physical stock, but rather an undiminished potential to support present and future human generations; defined in terms of critical ecological processes and structures (Folke, Hammer, Costanza, & Jansson, 1994). Society needs to physically limit its size relative to the carrying capacity of the ecology.

Viewing capital as complimentary: strong sustainability

In discussing sustainability, ecological economics encouraged a more sophisticated discussion on how stocks of capital relate to each other. In the past natural capital was ignored because of the tenet of neoclassical economic theory, that reproducible capital (human-made) is a near perfect substitute for natural capital. For ecological economists this is not logical (Costanza & Daly, 1992); if manufactured capital is a perfect substitute for natural capital, then the opposite must also be true. However if that is the case, then what is the point of creating manufactured capital? Why build a factory if there is already a natural alternative? This, Costanza and Daly emphasise, shows that manufactured capital is in fact *complementary* to natural capital rather than a *substitute*. Related, ecological economists describe production as a 'transformation process;' of natural capital being transformed into goods and services *in combination with* stocks of 'human-made' capital; human and manufactured capital. If we consider an example of fishing boats and fishermen as the manufactured and human capital respectively, which transform open-water schools of fish as natural capital, into fish fingers as the product. We can see that these three forms of capital complement each other in producing the product and that if there are no more fish in the sea, then it will not matter how many boats or fishermen we have on our oceans, we will still be without fish fingers. This emphasises the maintenance of the natural capital stock, rather than substituting it with other forms of capital, in what ecological economists (see e.g. Etkins *et al* (2003) and Hediger (2000)) describes as 'strong sustainability;' "a declining capital stock is an unambiguous indicator of unsustainability in the flow of goods and services that derive from it" (Etkins, et al., 2003, p. 167). In contrast, 'weak sustainability' is founded in neo-classical capital theory and agrees that we should strive to maintain capital stocks, but accepts substitution as viable (Hediger, 2000).

Human-made capital in support of collective decision-making

Ecological economics also opened a broader discussion on human-made capital, as stocks humanity can draw on in defining the character of our society and its interaction with Nature. Folke and others (1994, p. 4) write, "As a part of nature, humans with our skills and manufactured tools not only adapt to but modify natural capital, just like any other species in self-organising ecosystems". Equally, those appropriate ecological economic concepts for governance like Brondizio, Ostrom and Young (2009, p. 259) note, "The essential role of human-made capital in creating differential conditions for human well-being, including the management of ecosystems, is frequently acknowledged, but is often poorly understood." In this way we see capital evolve from a 'factor of production,' to stocks that support society's collective decision-making and social choices. Brondizio, Ostrom and Young (Brondizio, et al., 2009, p. 259) argue that such a perspective on capital shifts importance away from 'financial capital' to look, for instance, at stocks of "time and energy spent by individuals in building tools and facilities, learning skills, and establishing regularised patterns of relationships with others." Indeed for ecological economists, the ecologically sustainable scale of society and socially fair distribution of resources within society are interconnected, introducing ecological economics' parallel projects in market and political economics (Folke, et al., 1994).

Cultural capital

To this end ecological economics began to develop new concepts of capital. Berkes and Folke (1994, p. 130) conceived of an all-encompassing 'cultural capital;' "…as those factors that provide human societies with the means and adaptations to deal with the natural environment and to actively modify it." Culture is used in the general anthropological sense as rules for society. Culture implies commonality, providing a basis for collective action, and recognises that there are many different societies with different cultures, representing a diversity of ways for dealing with the environment. Thus "Cultural capital…includes factors such as social/political institutions, environmental ethics (world view), and traditional ecological knowledge in a society" (Berkes & Folke, 1994, p. 128).

The sharpening focus within ecological economics on human-made capital - including human, manufactured, and latterly cultural and social capital - as a means for describing and evaluating society's capacity to self-determination and adaptation in a forever changing environment was influenced by parallel developments in the social and political sciences.

2. The emergence of capital in the social and political sciences

In parallel with the expansion of the capital concept in economics, scholars in the social and political sciences sought a concept to describe the cohesiveness of a community and its social organisation, which allows individuals to co-exist within society, collectively make decisions and take action that is congruent with the common good (Putnam, 1993, 2000). To this degree, scholars turned to the concept of 'capital;' most notably through social capital.

Social capital

The roots of social capital have been traced back to the classic authors like Adam Smith and Montesquieu, to the works of Marx, and even Aristotle (Lehtonen, 2004; Schuller, 2001). The contemporary use of the term is, however, most often attributed to the writings of Pierre Bourdieu (1986), James Coleman (1988) in educational sociology, and Francis Fukuyama's (1995) work in economic history and sociology; though it arguably owes its prominence mainly to the work of Robert Putnam (1993, 2000) in political science. Social capital has been variously defined, though is generally discussed in terms of networks, norms and trust, and how they allow actors and institutions to be more effective in achieving common objectives (Schuller, 2001). The specific definition of Putnam (2000, p. 19) is well-used, as "connections among individuals—social networks, and the norms of reciprocity and trustworthiness that arise from them." In this way we can see that social capital, similar to cultural capital, look at stocks of capital that exist communally across society, rather than situated within individuals as for human capital. Proponents of social capital therefore make a strong case for social capital being an essential precursor to healthy democracy, and for getting beyond the typical challenges of pluralism and egotistic self-interest in promoting collective decision-making (Pretty, 2003). More is written on social capital in Section 4 below.

Institutional capital

Some authors such as Sirven (2008) draw links between social capital and the idea of institutions, as social constructions guiding stakeholder interaction, asserting that they are effectively synonymous. However a distinction can be made. Social capital looks at both (a) the network of interactions within society and (b) the informal social structures (norms) that nurture these interactions. Institutions however do not refer to the network of interactions, only those structures for facilitating interactions, and includes both formal (e.g. legal) *and* informal institutions. To this extent, around the same time that social capital found prominence, Ostrom (1990) introduced a new concept in 'institutional capital,' to describe the total supply of organisational structures, formal and informal; literally the capital of institutions that society has at its disposal. Sirven describes how a robust stocks of institutions is essential for enabling societal interaction and a collective determination of its trajectory, noting (Sirven, 2008, p. 376) "a close collaboration between formal and informal institutions is a key for a better society."

Political capital

In parallel with, and in counter balance to, the concept of social capital, some scholars began to talk about 'political capital,' to emphasise that there is a political dimension to every collective decision; and that a significant stock of political capital is necessary to successfully navigate toward a collective choice. Political capital focuses on the informal power relations between stakeholders, with society described *a priori* as a 'political settlement;' comprising a fragile and evolving balance of power that allows for a structure of rights and privilege (Baumann, 2000). Political capital has been expressed in two ways. The first looks the stock of political awareness and involvement in individuals and society at large, including attitudes supportive of democracy (citizenship, political interest and involvement, a concern with the public interest/public good, political tolerance, the ability to compromise, and confidence in political institutions), and behaviour that would engage citizens with the state and each other in channelled ways (Booth & Richard, 1998; Newton, 2001). Such capital can be measured using indicators such as democratic norms, voting, campaign activism, and contacting public officials (Booth & Richard, 1998).

The second way of looking at political capital is as the ability of individuals to use power in support of political or economic positions and so enhance their status in collective decision-making; usually generated through participation in interactive political processes linking civil society to the political system (Baumann & Sinha, 2001; E. Sorensen & Torfing, 2003). Sorensen and Torfing (2003) attribute the term political capital with three factors related to political actors' ability to engage in political decision making: (a) their 'endowment' as their rights of access to the political process; (b) their 'empowerment' through their various political capacities including self-confidence, political know-how, organizational talent, and the ability to create meaning in the political process; and (c) their perception of themselves as political actors – their political identity. In this way, political capital is shown to have close similarities with Bourdieu's (1986) conceptualization of 'cultural capital' (not to be confused with that of Berkes and Folke), as 'the knowledge, skill, education and advantages someone has to give them status in society.' Proponents of political capital argue that democracy needs a population with a high level of political capital. Political capital is enhanced through political interaction in societies with accessible political institutions and political identities; where citizens are expected to play an active role in societal decision-making. Finally, it remains to emphasise the difference between political capital, as a measure of political adeptness within a political arena, and social capital as a measure of social cohesion.

There have been many other forms of capital emerge with fields of social and political science, as highlighted by Schuller (2001) at the beginning, from organisational to intellectual capital for instance. This appendix stops short at highlighting social, institutional and political capital, as those most relevant for looking at questions of collective-decision-making.

The parallel development of the capital concept in economics and other social and political sciences has seen it gain credence for describing and evaluating the stocks on which society draws for environmental management and governance, including within fields of planning, policy analysis, development studies, disaster management, adaptive governance, and governance of the commons. An overview of this literature is provided in Chapter 2 and will not be expanded on here. Suffice to unpack further the stocks of capital used in this thesis.

3. A focus on financial, social and human capital as indicators of interactive quality

A noted in Chapter 2, this thesis draws on three stocks of capital as indicators of high quality stakeholder interaction; financial capital, human capital and social capital. These forms of capital are expanded on in some detail below, but in short, financial capital is a measure of the funds allocated to facilitating effective deliberation, and stakeholder 'buy-in' to the process; human capital is a measure of the competence among the individual political actors for reasoned deliberation; and social capital is a measure of the social cohesiveness of political actors, including the norms of trust and reciprocity that facilitate more effective dialogue for collective decision-making. These three stocks of capital are considered to work complimentarily with each other, such that stakeholders can draw on them to yield collective decision-making. In turn, high quality interaction is deemed to contribute to the accumulation of these three capital stocks. On the other hand, where stakeholders have been seen to mine these capital stocks until there is nothing left, then it is conceivable that collective decision-making would be much more difficult.

Obviously choosing these three capital stocks is to the omission of other forms of capital. Firstly natural and manufactured capitals are omitted as being of the wrong 'sort' of capital required to nurture quality interaction or effective decision-making. Natural capital is less essential for transforming dialogue into a 'product' of rational and democratic decisions. Arguably, natural capital is the stock from which political actors draw sustenance – food and shelter – and identity, but this is an indirect link that is omitted in this thesis. Which brings us to manufactured capital; to what degree do manufactured artefacts like a comfortable meeting room, or technology like computers and a projector contribute to deliberative decision-making? Undoubtedly to some degree, but again the contribution is seen as less direct, less important, and dependent on the specific situation. One can conceive that collective decision-making in a small Amazonian village may well be undertaken sitting around a fire, or conversely that stakeholders in a large inner-city development project may have access to advanced modelling software to structure their conversation. This research considers financial capital as a more appropriate and fluid indicator, which allows for manufactured capital to be purchased as required.

Similarly institutional and political capitals are omitted as they are determined to be already constituent within the other measures. Institutional capital is measured in both (a) the institutional quality measures detailed in Chapter 2; and (b) social capital measures which look at informal institutions like cultural norms and trust for example. Political capital is considered to be measured as part of the inclusive definition of human capital, which includes the growing political capacities and identities of individual actors as they participate in collective decision-making. This concurs with the analysis of Throsby who considers political and Bourdieu's cultural capital as contained within individuals (Throsby, 1999).

This Appendix finishes by looking in more detail at the three particular capital stocks engaged as indicators of interactional quality within this research.

a) Financial Capital

One key indicator of increased interactional quality is the increased financial capital that it attracts to support participation; with financial capital defined as 'financial assets, such as currency, bank accounts, bonds, and stock that can be used to store wealth and to purchase goods and services or other forms of capital.' Financial capital presents an easily quantifiable measure of how much stakeholders value a decision-making process or initiative, assuming that they will contribute more financial capital to a process that they are confident in. Chapter 2 presents the shortfalls of this stock however.

b) Social Capital

A second indicator of interactional quality is the degree to which it has created the conditions within which interactions flourish; social capital. As noted, Putnam defined social capital as "connections among individuals—social networks, and the norms of reciprocity and trustworthiness that arise from them" (Putnam, 2000, p. 19). Since Putnam popularised the term in the mid 1990's, social capital has become an increasingly important measure of the quality of social relationships, both owing to its emphasis on networks and interactions, and to a literature demonstrating social capital as an important pre-requisite of co-management (see e.g. Plummer and FitzGibbon (2007) and Pretty (2003; 2001)) and adaptive capacity, with Adger writing "social capital is a necessary glue for adaptive capacity" (Adger, 2003, p. 382). Despite a lack of detail on how it does so, Plummer and FitzGibbon note a general intuitive sense that social capital strengthens communities (Plummer & FitzGibbon, 2007), by increasing socio-economic well-being and reducing the selfish utility-maximising behaviour expected of us by neo-classical economists and game theorists (Adger, 2003; Grafton, 2005; Paldam, 2000; Pretty, 2003; Pretty & Ward, 2001; Western, Stimson, Baum, & Van Gellecum, 2005). This means emphasising the positive informal institutions, such as trust, within the context of entrenched positions of power of a specific context (Galaz, 2005). Ultimately, as Paldam (2000) notes, this reduces the costs of transactions between governance actors, and the monitoring costs of compliance. Social capital is not, however, without its criticisms as discussed by Plummer and FitzGibbon (2007). It has been accused of being too vague a concept to be considered alongside other more quantifiable forms of capital, with dissention on the indicators to be evaluated. Associated with a lack of clear definitions, and causal links, it has been also said to confound causality, with too many success stories attributed to social capital unjustifiably.

As evident from the above definitions, social capital can be divided into two categories of variables (seen before in the governance terminology); (i) the pattern of networks; and (ii) the norms that structure the interactions. A second division can be made between those networks and norms associated with formal institutions, such as a policy process, and those that emerge from informal interactions within the community; those bonds of love and friendship for instance (Western, et al., 2005). Paldam (2000) raises the debate between those who argue that formal institutional mechanisms can contribute directly to social capital, and those who argue that social capital can only grow from within a community; indeed that third-party intervention is diametrically opposed to social capital. A widely adopted position, however, is that the institutional context creates an arena favourable to interactions conducive to building social capital, which is in turn essential to governance (Paldam, 2000; Plummer & FitzGibbon, 2007; Pretty & Ward, 2001).

Pretty and Ward (2001) describe networks as the interactions between actors, which may be described in terms of trade, the sharing of knowledge, provision of loans, collective action and so on. Social capital is increased where interactions are increased, with greater value placed on two-way and continually-updated relationships. Three forms of interactions are described by authors writing on social capital. 'Bonding' interactions describe the tightly-woven clusters typical within families or close-knit groups of friends, which are informal in nature (Grafton, 2005; Plummer & FitzGibbon, 2007). 'Bridging' interactions link the diverse bonded clusters, within the same community for example, and are more likely to be formal in nature (Plummer &

FitzGibbon, 2007; Pretty, 2003). Bridging is less strong than bonding, but important for knowledge dissemination and broadening the perspectives of stakeholders (Grafton, 2005). External 'linking' crosses scales, and can be 'vertical' in terms of interactions with central government, or 'horizontal' with neighbouring communities addressing the same issue for instance (Grafton, 2005). Linking is often associated with issues of power and the ability to influence policy or leverage resources (Plummer & FitzGibbon, 2007; Pretty, 2003). Importantly for Paldam (2000) and Woolcock (2001), all forms of interactions are necessary to facilitate social capital; bonding alone may create insular groups that foster anti-social behaviours (gangs) or represent entrenched interests hostile to adaptability.

There are a number of 'norms' that are measured as indicators of a growing social capital. The two most commonly cited norms associated with social capital are trust (Adger, 2003; Grafton, 2005; Paldam, 2000; Plummer & FitzGibbon, 2007; Pretty, 2003; Pretty & Ward, 2001; Resilience Alliance, 2007a; Western, et al., 2005) and reciprocity (Adger, 2003; Paldam, 2000; Pretty, 2003; Pretty & Ward, 2001; Western, et al., 2005), which are common within informal interactions, but can also grow within the course of formal interactions. Other norms have been raised in the social capital literature which are more symptomatic of relationships formed in a formal setting, including: (a) 'common rules' of acceptable behaviour (Adger, 2003; Plummer & FitzGibbon, 2007; Pretty, 2003); (b) a feeling of unity and shared values of 'what's important' (Plummer & FitzGibbon, 2007; Western, et al., 2005); (c) collective action (Grafton, 2005; Paldam, 2000; Resilience Alliance, 2007a; Worldbank, 2009a, 2009b); (d) shared knowledge (Folke et al., 2002; Plummer & FitzGibbon, 2007; Worldbank, 2009a, 2009b); and (e) empowerment toward decision-making (Grafton, 2005; Resilience Alliance, 2007a; Worldbank, 2009a, 2009b).

The two categories of 'networks' and 'norms' are also evaluated differently, as discussed by Western *et al* (2005), Plummer and FitzGibbon (2007) and Paldam (2000) for example. Networks are evaluated according to their size, density, openness and homogeneity. Network analysis uses a combination of qualitative and quantitative data on voluntary participation or group membership to build 'network maps' with weighted links, and may use mathematical tools such as 'Putnam's instrument'. Alternatively, norms are usually evaluated through qualitative interviews, though the difficulty remains in formulating questions evaluating trust or reciprocity for example. This combination of attitudinal and membership survey has been widely endorsed, including by the OECD (Plummer & FitzGibbon, 2007). Distinctively, most evaluations of social capital have been undertaken community-wide, rather than focussing on the governing system surrounding a specific issue (Western, et al., 2005; Worldbank, 2009a, 2009b).

c) Human Capital

A third key indicator of increased interactional quality is the increased capabilities and competencies of the individual stakeholders to work with other forms of capital in a productive manner, for effective collective decision-making. This can be labelled 'human capital,' and defined as 'the stock of education, skills, culture and knowledge stored in human beings themselves' (Costanza & Daly, 1992). The Resilience Alliance (2007b) and Muyanga (2007) for example, have stressed that a diverse and adequately educated and skilled network of stakeholders is essential to governance capacity. Though there are multiple measures of human capital, they can be roughly divided into (a) health and socio-economic measures, and (b) measures of education, skills, or experience. The measure of health and socio-economic standing is a relatively intuitive concept; a stakeholder must be healthy and have sufficient resources at their disposal if they are to participate in governance. As Buckle, Marsh and Smale (2000) explained, a community is only as resilient as its most vulnerable members, meaning building governance capacity begins by ensuring a community has the most basic needs. These needs met, individuals should also have access to other forms of capital if they are to participate effectively; social capital in the form of social networks and community support, and financial capital in the form of financial resources for example (Buckle, et al., 2000).

The perspectives of individuals will be informed by the knowledge associated with their level of education, their skills or trades, and their life experiences. The Resilience Alliance thus emphasised that human capital is enhanced where there is both an abundance of knowledge associated with highly educated and trained individuals, and a diversity of knowledge associated with different types of education and experience (Resilience Alliance, 2007a, 2007b). The combined experience within a community can be depicted as a 'social memory' of the dynamic changes within a context, and is essential to informed adaptive management. This introduces the sub-concept of 'political capital' (effectively contained within individuals and thus here treated as part of human capital), representing their competency and nous for negotiating the power relations between stakeholders. It is their use of power in support of political or economic positions and to enhance their status in collective decision-making; with it deemed that an increase in political capital across stakeholders is essential for effective governing systems (Baumann & Sinha, 2001; E. Sorensen & Torfing, 2003). A final characteristic of human capital deemed extremely important by many commentators on governance, is the presence of leadership within a governance network (Resilience Alliance, 2007a; B. Walker & Salt, 2006).

Essential to a growing human capital and governance capacity is the concept of 'social learning;' defined as "the collective action and reflection that occurs among different individuals and groups as they work to improve the management of human and environment interrelations"

(Keen, Brown and Dyball, 2005, as cited in Plummer & FitzGibbon, 2007). Though 'social learning' operates at the group (social capital) and the individual (human capital) scale, here it is discussed as human capital as individuals are the agents for social collectives; "Therefore social learning does not occur until individuals encode what they have learned in social memory" (Diduck, Bankes, Clark and Armitage, 2005, as cited in Plummer & FitzGibbon, 2007). Based in constructivist and pragmatist traditions, social learning promotes the active learning that occurs by bringing together diverse perspectives within a participatory and dynamic process of action and reflection around an issue. A stakeholder thus learns relative to interactions with their environment, and interactions with other stakeholders, with feedback in both cases essential to the learning process. Furthermore, the quality of learning is determined to a large extent by the learning environment; both in terms of the deliberative forum, and in terms of the wider socio-institutional context (Kilvington, 2007; Plummer & FitzGibbon, 2007). Social learning occurs at different levels; with 'single-loop' learning constituting the correction of emergent errors relative to existing interactions between stakeholders and the environment, while 'double-loop' learning constitutes a fundamental change in the values and principles that steer these interactions (Plummer & FitzGibbon, 2007). Koppenjan and Klijn (2004) categorised social learning according to three different types of knowledge:

(1) Cognitive learning: an improved understanding of the nature of the issue;
(2) Strategic learning: an improved understanding of the values of diverse stakeholders and their strategies for resource management. This can lead to a realisation of mutual dependency and a coordination of strategies; and
(3) Institutional learning: an improved understanding of the network of stakeholders surrounding an issue, and the 'rules of the game' in terms of institutional norms structuring interactions.

Appendix D: The conceptual framework of analysis and evaluation

Table 6: Characteristics of the post-normal science approach (from Chapter 5)

1) Focussed on the science-policy interface in support of decision-making for issues characterised by uncertainty, plurality and high stakes.
2) Complex social-ecological systems perspective.
3) Epistemological' uncertainty is explicitly recognised as inevitable and irreducible.
4) Dialogic setting wherein knowledge is mobilised and negotiated as 'evidence' in support of normative arguments.
5) Participatory setting admitting a plurality of equally valid perspectives.
6) Relativize, and where possible reconcile, conflicting perspectives according to principles of reciprocity and co-existence
7) Conflicting perspectives are evaluated for their *'quality'* in terms of supporting decision-making for an issue. Quality is the organising principle of science rather than 'truth.'
8) Stakeholders as members of an 'extended peer community,' which collectively evaluate knowledge according to collectively-derived criteria of quality; 'extended peer review.'
9) Reflexive
10) Social learning orientation in pursuit of understanding rather than truth
11) Adaptive cyclic process, with outcomes judged on the quality of the process.
12) Strategic, long-term perspective

Table 4: Evaluation framework for Integrated Coastal Management as interactive governance (from Chapter 2)

Institutional quality	Interactional quality		
	Financial Capital	**Social Capital**	**Human Capital**
Cooperation Contingency Participation Comprehensive Precautionary Adaptability Incremental Strategic Long-term	1) Has there been increased funding of coastal management following an ICM initiative? 2) Has the ICM initiative created a sustainable source of financial capital?	3) Has there been an increase in the connectivity and density of stakeholder interactions associated with an ICM initiative? 4) Have new stakeholders begun participating in coastal management as a result of an ICM initiative? 5) Do interactions constitute 'bonding,' 'bridging' and 'linking?' 6) Do stakeholders perceive increased levels of trust and reciprocity within their interactions associated with an ICM initiative? 7) Do stakeholders perceive a change in 'acceptable behaviour' associated with problematic resource use patterns? 8) Have there been examples of 'collective action' as a result of an ICM initiative?	9) Do stakeholders have the wherewithal to participate in an ICM initiative? 10) Have adequate expertise been accumulated associated with the ICM initiative? 11) Is there an increased diversity of stakeholders participating in an ICM initiative? 12) Have leaders emerged as a result of an ICM initiative? 13) Do stakeholders recognise that, over the course of an ICM initiative, they have learnt more about: a) the issue of concern; b) the values of other stakeholders; c) the network of stakeholders and rules of their interactions?

Appendix E: EU Eight Principles of Good ICZM

A European Parliament and Council Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe was adopted on 30 May 2002. It outlines steps which the Member States should take to develop national strategies for ICZM, based on the following eight common ICZM principles.[137]

Principle 1:

A broad overall perspective (thematic and geographic) which will take into account the interdependence and disparity of natural systems and human activities with an impact on coastal areas.

Principle 2:

A long-term perspective which will take into account the precautionary principle and the needs of present and future generations.

Principle 3:

Adaptive management during a gradual process which will facilitate adjustment as problems and knowledge develop. This implies the need for a sound scientific basis concerning the evolution of the coastal zone.

Principle 4:

Local specificity and the great diversity of European coastal zones, which will make it possible to respond to their practical needs with specific solutions and flexible measures.

Principle 5:

Working with natural processes and respecting the carrying capacity of ecosystems, which will make human activities more environmentally friendly, socially responsible and economically sound in the long run.

[137] http://www.coastalwiki.org/coastalwiki/EU_ICZM_Recommendation accessed on 16 October 2010

Principle 6:

Involving all the parties concerned (economic and social partners, the organizations representing coastal zone residents, non-governmental organisations and the business sector) in the management process, for example by means of agreements and based on shared responsibility.

Principle 7:

Support and involvement of relevant administrative bodies at national, regional and local level between which appropriate links should be established or maintained with the aim of improved coordination of the various existing policies. Partnership with and between regional and local authorities should apply when appropriate.

Principle 8:

Use of a combination of instruments designed to facilitate coherence between sectorial policy objectives and coherence between planning and management.

Appendix F: New Zealand's science-policy interface for environmental management: a context within which to discuss coastal management

Chapter 7 presents an empirical study which sought to map the diverse ways in which the science-policy interface is engaged for coastal management across New Zealand nationally. However, given the tight integration between the management of the coastal and terrestrial environment in New Zealand, it is important to couch this discussion within a wider appreciation of the science-policy interface for environmental management more generally. *This appendix thus provides some important background for a reading of Chapter 7*. As part of the review of New Zealand's national experience, the study undertook an extensive desktop study. This unlocked a wealth of knowledge contained within New Zealand government reviews on how knowledge has been mobilised in support of policy-making; for environmental management and otherwise. This informed the discussion below.

Effective environmental management in New Zealand has been hindered significantly by a poor science-policy. In 2002, a report from New Zealand's Parliamentary Commissioner for the Environment (2002) summarised this impediment:

> *'[An] impediment [to sustainable development] is insufficient knowledge and capacity to support the implementation of sustainable development. This is knowledge in its broadest sense - research, information, indicators and people with the technical and organisational capabilities. There appears to be a lack of accessible information and a gap in terms of translating information that does exist into material that can be used by the community to facilitate debate and understanding of sustainable development issues.'*

Since the late 1990's, this has led to a growing discussion, usually through central government department reports, on how best to mobilise knowledge in support of the current resource and environmental management framework (see e.g. the Parliamentary Commissioner for the Environment (PCE) (2001, 2003, 2004, 2007), and the Ministry of Research Science and Technology (MoRST) (2001, 2004, 2007, 2009)). Importantly, these reports principally focus their discussion on the mobilisation of formal, disciplinary, 'normal' science, as distinct from other forms of local or traditional knowledge. This demonstrates the strong bias towards ‘science-based management,’ and the principal role of science within New Zealand’s science-policy interface.

Since restructuring the government according to principles of New Public Management in the mid-1980’s, many government agencies have progressively relinquished their in-house scientific capacity, and been forced to purchase all of their science (Parliamentary Commissioner for the Environment, 2003). Subsequent government reviews have found that this represents not only a reduction in internal scientific capacity, but also a weakening of the capacity of government agencies to engage with science to inform policy (State Services Commission, 1999, as cited in Parliamentary Commissioner for the Environment, 2007). This noted, the more operational environmental management agencies such as regional authorities, DOC and the Ministry of Fisheries, represent the branches of the public sector which have retained some form of in-house capacity, and subsequently a better ‘engagement’ with the scientific system compared to the ‘policy ministries’ like the Ministry for the Environment (Ministry of Research Science and Technology, 2004). However, the same report found that only three regional authorities had significant in-house capacity and a good engagement with the science, with variable capacity across the other 13 Councils; owing mainly to variable rating and asset bases across the regions (Ministry of Research Science and Technology, 2004). Research has found most regional authorities purchase 40-50% of their science requirements; usually in the form of specific issue-based scientific reports to inform a policy instrument (Bremer, 2009; Ministry of Research Science and Technology, 2004).

The effective mobilisation of science for environmental policy is in large part impeded by a lack of a scientific knowledge base on many important environments, including the coast. For many this is symptomatic of two shortfalls. Firstly, New Zealand’s public-good science funding is fully contestable, and in 2004 was found to be insufficient for effective environmental management (Parliamentary Commissioner for the Environment, 2004). Though funding has since increased (Parliamentary Commissioner for the Environment, 2007), there remains a lack of scientific cooperation driven by the competitive nature of the funding, and a lack of certainty over long-term funding leading to short-term scientific outputs (Parliamentary Commissioner for the Environment, 2004). Secondly, there has been a lack of standardised State of the Environment monitoring framework. It wasn’t until 2007 that a national list of State of the Environment indicators was established; with regional authorities collecting and publishing a diversity of information over short-time series before then. This has resulted in a disintegrated and patchy knowledge-base for many environments, which has been the source of criticism during a recent OECD review (Parliamentary Commissioner for the Environment, 2007).

A number of government reports written in the late 1990’s and early 2000’s found that science that was generated for environmental management in New Zealand was reductionist in nature, and lacked competence or capacity to employ an integrated approach; such as interdisciplinarity. In 1999 the State Services Commission (as cited in Parliamentary Commissioner for the Environment, 2003, p. 58) found that across New Zealand's public sector, "Information is typically generated in departmental silos as there are few incentives to share information and resources." Similarly, the Parliamentary Commissioner found, in 2004, that there is a lack of experience and willingness from individuals in both the policy and scientific fields to explore the other's terrain and bridge the boundary between the two (Parliamentary Commissioner for the Environment, 2004). There was found to be a shortage of policy advisers who were highly skilled in information management and who could bridge the science/policy divide (State Services Commission, 1999, as cited in Parliamentary Commissioner for the Environment, 2003).

However, the past decade has brought improvement. By 2007, the PCE was prepared to concede, "it appears that relationships between policy makers and science providers are becoming more robust, strategic and long term…" while noting, "the competitive model, along with capacity and resourcing issues, continues to restrict this" (Parliamentary Commissioner for the Environment, 2007, p. 29). Given the lack of in-house capacity there are a growing number of alliances between policy and science organisations, both formal and informal (Parliamentary Commissioner for the Environment, 2007), and the emergence of 'boundary organisations' to encourage interaction between science and policy (Parliamentary Commissioner for the Environment, 2007). Similarly, the science and policy of regional authorities is increasingly becoming accountable to peer review, with an increase in the use of independent technical and advisory groups/panels (Parliamentary Commissioner for the Environment, 2004). Finally the MoRST in 2007, released their Environmental Research Roadmap which sought to promote adaptive management, predictive forecasting and enhanced communication tools for advising decision-makers (Ministry of Research Science and Technology, 2007). To even capacity across the regions, MoRST created the $1.9 million Envirolink fund in 2005 to fund regional council science projects, with reported success.

Increasingly, the environmental science-policy interface is characterised in terms of the need to proceed in the face of (at times irreducible) uncertainty. To this end, the precautionary principle and associated concept of probabilistic risk have become a basis for resource management in New Zealand (Ministry of Research Science and Technology, 2001). It is explicit in a number of pieces of legislation and implicit in others, such the Fisheries Act or the RMA, where environmental effects are assessed on the probability of their occurring and their scale. Peart (Peart, 2007), in her analysis of three coastal plans, found that all were influenced by a precautionary approach that restricted the use of the marine area on the basis of poor knowledge. This reflects the political urgency associated with producing a policy document that provides for procedural and development certainty, while not providing time for the research required to reduce uncertainty (MoRST, 1998, as cited in, Parliamentary Commissioner for the Environment, 2004).

Finally, despite a focus on science as the key form of knowledge mobilised for environmental management, there has been an increasing focus on how significant uncertainty necessitates an approach that is more open to public scrutiny, (MoRST, 1998, as cited in, Parliamentary Commissioner for the Environment, 2004, p. 22). Subsequently, a number of widespread environmental issues, including the lifting on the moratorium on genetically engineered plants, led to significant criticism of the opaque science-policy interface employed for these issues, and the lack of deliberation. In 1998, MoRST noted, "There [was] a lack of clear procedures that would enable the scientific input to policies to be clear and open to scrutiny" of public dialogue. These processes shook public trust in the science informing policy and led to significant rivalry and antagonism between stakeholder groups (Parliamentary Commissioner for the Environment, 2004). This led MoRST to declare in a report in 2001 that the provision of information through participatory means was determined to be the best means of resolving the problem (Ministry of Research Science and Technology, 2001). However, five years later, the PCE noted public discussion and deliberation over contentious policy issues that involve scientific input are more often characterised by a combative debate, than an in-depth dialogue (Parliamentary Commissioner for the Environment, 2004).

Appendix G: Presenting the analysis and exploration of the New Zealand local-scale case studies

Chapter 8 presents an empirical study on three case studies at the New Zealand local scale, which gave effect to an approach resembling 'post-normal science' (PNS). This chapter sought to:

(a) *Analyse* the specific science-policy interface utilised across the three case studies to examine the degree to which they give effect to the post-normal science perspective;
(b) *Explore* the degree to which the science-policy interface within the three case studies have contributed to the success of Integrated Coastal Management within their local context, relative to measures of institutional quality and interactional quality.
(c) *Compare* the experiences across the three case studies, and identify common features.

However, the amount of space needed to meaningfully undertake this analysis and exploration meant that Chapter 8 grew to an unmanageable size that made it difficult for a reader to follow and distil interesting insights. Chapter 8 was thus shortened to an introduction of the three case studies and a final extended discussion section, which summarises some of the key findings and facilitated a comparison between the three case studies. The detailed analysis of the three initiatives and exploration of their contributions to institutional and interactional quality were shifted to this Appendix G. *Therefore, this appendix provides the important detail that should accompany a reading of Chapter 8.*

In this appendix, each of the three case studies is addressed in the order introduced in Chapter 8. Firstly, each case study is analysed using a PNS lens to reveal the degree they emulate characteristics of this approach.[138] Secondly the appendix presents an exploration of the contributions of each case study to high quality institutions espousing principles of ICM.[139] Thirdly, the case studies are explored relative to their contributions to high quality stakeholder interaction, according to stocks of financial, social and human capital.[140] On its own, this

[138] See Appendix D for a concise list of 12 characteristics that describe the post-normal science approach to framing the science-policy interface.
[139] See Appendix D for a list of the key guiding principles of ICM, which can be appropriated as measures of institutional quality.
[140] See Appendix D for a list of criteria that can be used to measure stocks of human, social and financial capital, as indicators of interactional quality.

analysis has limited value, but when read in relation to Chapter 8 it serves to provide the much-needed enrichment of the discussion.

1. Whangamata Harbour and Catchment Plan and the Iwi and Care Stakeholder Forum

1.1 Analysing the Iwi and Care Stakeholder Forum through a post-normal science lens

A) The complexity of the mangrove issue and its uncertainties

The Forum represented an opportunity to shift the focus of the mangrove issue from 'the problem that needs solving' to a more holistic appreciation for the interacting social and natural systems that have given rise to a rapid increase in mangroves. A number of respondents noted that at the beginning Whangamata locals were arguing, "The bloody mud's in our back-yard. I couldn't care where it's been. Here is where it is now and I want to get shod of it." However, through the Forum, all stakeholders found that they adopted a wider and more systemic perspective. For tangata whenua, this was their primary motivation for entering into the Forum; "we were interested in the overall wellbeing of the harbour and actually looking at what driving forces there were that impacted…we wanted to get back to first principles..." Indeed, for two respondents an explicit recognition of the complexity of the issue allowed for conflicting understandings, even among ecologists, and lent credence to the notion of 'epistemological uncertainty;'[141] that ignorance whereby society cannot agree on what it does not know, or on the best means of reaching a better understanding. There were disparate views on the degree of uncertainty associated with the issue, insofar as uncertainty was either used as a tool in political discourse, "to say let's not do anything, or let's do everything;" or left un-communicated by scientists. For example, one stakeholder wanting to retain mangroves argued; "the quality of information, particularly around mangrove removal has some gaps…if you tutu[142] with that (mangrove distribution), you have to tutu with it in a way that is well thought through."

B) A plurality of legitimate perspectives in a high-stakes political arena

There was general accordance across all respondents that there was a plurality of legitimate perspectives, posing dilemmas of social choice; "I personally think that there's a greater understanding of how complex the issue is, and how you're never going to get 100% resolution; you're always going to have disparate and diverging views and it's going to be very difficult for someone to make a decision." In addition, at least four respondents explicitly recognised that perspectives were comprised of both values, and the knowledge that is employed in support of

[141] Funtowicz and Ravetz argue that many uncertainties are 'epistemological,' and necessitate a post-normal science approach
[142] Interfere

the values, with this made even more clear through the Forum process; “never let the facts get in the way of a good opinion.” These multiple perspectives were often grouped according to three positions by respondents: (i) the anthropocentric perspective of Whanagmata locals; (ii) the ecocentric perspective of Maori and environmental NGO’s; and (iii) the science-centric perspective of state agencies. The clash between the anthropocentric and ecocentric perspectives in Whangamata represents a long history of high-stakes political conflict; and extends from divergent ontological and epistemological notions, to divergent values, language and culture. For two respondents, while the Forum was ostensibly a worthwhile endeavour, it was endangered from the beginning by this underlying political division, such that the Forum was less an opportunity for collective deliberation, and more a ‘means to an end.’ As this became apparent through the process, stakeholders became discouraged; “It was hijacked by Iwi, the whole process. They felt they needed special consultation...And so the other stakeholders felt a bit isolated by that…And then when you found out that the councillor; his main agenda for setting up the Forum was to push the mangrove issue ahead; it was just so politicised. It just wasn’t a true democratic process…there were a few people that had hidden agendas.” Another stakeholder noted, “For me it wasn’t genuine interaction because when you step out of the Forum attitudes just go straight back.”

C) Dialogic mobilisation of knowledge as ‘evidence’ in support of value positions

The Forum was an exercise to mobilise knowledge for decision-making, alongside expressing a collective community vision for the future of the Whangamata Harbour and catchment. This distinguishes the Forum from being purely a means of achieving consensus, by emphasising its other role as a dialogic form of ‘science-policy interface.’ For many stakeholders, this latter function was the most successful, with one stakeholder noting; “We’ve gone to a huge amount of trouble to sort out what in actual fact is fact, and what’s fiction, and I think that’s probably been the biggest benefit of sorting this.” Another stakeholder said, “It was really useful to bring together the facts because I think a lot of the debate that had occurred in the past had not been based on facts, but rather on preferences.” All stakeholders interviewed made it explicit that the Forum acted as a dialogic setting within which knowledge could be negotiated as evidence relative to value-positions. This evidential function of knowledge was especially stark in the Forum, where two conflicting positions sought to establish and defend their advantage. To this end, it was agreed that the Forum facilitated high quality dialogue between the diverse knowledge perspectives of stakeholders present; with stakeholders noting “robust debate;” “endless opportunities for dialogue;” and “open discussion.” In addition, all stakeholders made mention of a number of factors that supported this dialogue, including: (i) independent and skilled facilitation, (ii) allowing participants to formally present their perspective, and (iii) the use of collective mapping exercises.

D) A participatory Forum; inclusive of all knowledge perspectives

The Forum was inclusive of a range of knowledge perspectives as legitimate for forming a common understanding of the mangrove issue and its values; broadly split into (i) scientific, (ii) traditional and (iii) local knowledge. Many respondents felt, however, that science was the dominant form of knowledge discussed within the Forum, with EW providing the majority of knowledge; mostly in scientific form. Other science was seen to come from other state agencies, from private consultants employed by stakeholder groups, and from scientists studying the Harbour from Massey and Waikato Universities. Stakeholders espousing alternative knowledge perspectives were often frustrated by the 'science-centric' focus of local government; which gave precedence to scientific evidence as being more legally defensible in an often litigious decision-making arena, and moved local government to quantify qualitative knowledge. "We see (local government) go, 'oh well we need to get the scientists out there,' and the locals say 'well we just told you what the answer is, why do you need someone to go and measure it'…(Locals) know what the answer is to them, they often struggle to quantify it."

In addition to science, a number of respondents recognised the contribution of Maori traditional knowledge to the Forum, however Maori noted; "There's a lot of knowledge that we have had around the harbour that never did have the opportunity to be fed into that process." For Maori, their traditional knowledge offered a parallel knowledge system to local government science, which could be used together in support of decision-making without 'scientising' Maori knowledge; "The science is important…however we do have dreams about fully utilising the information available, in *our* frame." Local knowledge was also admitted to the Forum, with a number of stakeholders recognising the value of the historical and experiential nature of this knowledge system; "…they wander around in those mangroves everyday, they're in it up to their knees…and to give them their credit they understand what they see, they understand the processes pretty well." However there was frustration from the locals that their experiential knowledge was discredited by critics external to the local context. It was argued, "A lot of (knowledge) came from the community, from observation rather than theoretical…and that was being criticised by people who didn't really know what they were talking about, and who don't actually live here." Like Maori, Whangamata locals attempted to reconcile their local knowledge with science to lend it credibility and legitimacy; employing consultants to support their position, and seeking other scientific support from the universities.

E) Reconciling diverse perspectives according to notions of reciprocity and co-existence

All stakeholders interviewed recognised a degree of reciprocal dialogue within the Forum, and to a lesser extent, an attitude of co-existence among conflicting perspectives. All stakeholders recognised that dialogue within the forum had given rise to an increasing understanding of other perspectives, and a greater tendency to compromise. "Ultimately everyone in that forum has come to a point where they understand each other's point of view, and have been able to, almost on every issue, compromise or accommodate each other." Stakeholders also recognised increased levels of respect and recognition; "Everyone heard each other's views, (though) it didn't necessarily change each other's views." However, some respondents noted that, "it got more entrenched in opinions as time went on, not necessarily facts," such that the deep political division over mangroves proved a significant barrier. A second barrier to reconciliation according to notions of reciprocity and co-existence was the dominance posed by formal science, and a tendency to reconcile perspectives within the framework of science. Besides representing the most voluminous source of knowledge, science was also recognised as the highest quality knowledge from a local government perspective, leading to the active quantification of knowledge presented qualitatively. This spurred many stakeholders to attempt to reconcile their knowledge perspective within the 'scientific framework' to lend them credibility and legitimacy; "I think what we tended to fall back on…was actually what we know, and what the science is telling us and melding those two together."

F) Review by the Extended Peer Community

The stakeholders had divergent views on the way in which knowledge quality was collectively evaluated, and the extent to which the Forum represented an 'extended peer community.' One respondent noted that up until the Forum, "…we had no collective approach to (a knowledge quality assessment) process. EW was the judge and jury on that." One intention of the Forum was thus to make knowledge quality assessment a collective activity; "By going back to the Forum…it allows them very much to filter (knowledge) quality, relevance and legitimacy and express their opinions..." To this end, EW convened the Forum comprising a cross-section of key stakeholders knowledgeable about the harbour and catchment, and able to "engage at a slightly more detailed level." In this, EW sought to seat itself as an equal participant in the Forum. One respondent criticised the limited membership of the Forum however; "What we were surprised with was how narrow the groups invited were…it wasn't really representative of the community I don't feel. Because I don't know that that was the intent."

All participants within the Forum were able to both provide their knowledge perspective, and collectively review the knowledge presented, and in this way the Forum went some way to achieving an 'extended peer review.' Knowledge quality review first and foremost came through dialogue, which comprised an element of critique. In support of this dialogue, stakeholders described the value of having all stakeholders communicate their perspective in a formal presentation, which was then open for questioning and discussion. A second useful tool widely cited by stakeholders was the use of maps as a means to reconcile different perspectives, and enter into a discussion of their quality. As a result, a number of stakeholders interviewed felt that the Forum had led to the mobilisation of better quality knowledge in support of decision-making; even in the absence of any consensus. "Our politicians now have a lot more information now than they did before…all of our councillors have been involved in a rather robust debate with the best information."

The interviews revealed that power relations undermined notions of an 'extended peer community.' Firstly, some stakeholders felt that EW had not relinquished its power as 'knowledge quality assessor' and that it dominated any discussion on quality; "EW were the sort of objective meat in the sandwich if you like, trying to decipher the information." Even as EW attempted to participate as an equal stakeholder, participants knew that the final decision on the quality of knowledge rested with EW. Secondly, the dominance of science meant knowledge within the Forum was often evaluated for its quality relative to the scientific framework; that is, relative to scientific norms of quality. This does not constitute an extended peer review because only one measure of quality is utilised, that of science. Thirdly, political divisions meant that some forms of knowledge were criticised as poor quality *a priori,* and urgency meant that a comprehensive review of knowledge quality was not able to be undertaken. One respondent noted, "I don't think we had enough rigorous discussion around (quality)."

G) Reflexive social learning

All respondents felt that the Forum had allowed for a greater and more common understanding across stakeholders; (i) of the issue, (ii) of the diverse perspectives, and (iii) of the decision-making process; with the associated benefits of better informed decision-making. "They learnt a lot talking with other stakeholders, so they had some information, some facts, that other people said 'oh ok.'" However, with this understanding came frustration and dissatisfaction with the realities of a highly politicised arena; whereby decisions seem to be deferred indefinitely: "I think most of them have been very frustrated with the process and the results of the process." To the degree that the Forum enabled learning, and the establishment of a common understanding, it was encouraging of reflexivity. That is, it allowed stakeholders to reflect on their own perspective in light of the dialogue they had with others; leading them to change their perspective and potentially reconcile it with other perspectives. This was summed up well by one respondent; " The facts backed up what people were saying, people wanted the same outcome but in a different process…So (they were) on divergent paths but they crossed at some point." Ultimately however, almost all respondents felt that this understanding was undermined by the entrenched political positions of stakeholders at the opposite ends of the 'spectrum,' such that after they left the Forum, their attitudes and perspectives 'reverted back.'

H) A strategic, long-term and adaptable process

There is a general accordance across all respondents that the Forum, together with the Plan, has allowed for a long-term, and adaptable, strategy for the collection of knowledge; both for the issue of mangroves, and for the wider catchment. Specifically, this structure allowed for bringing together and mobilisation of that knowledge already held by stakeholders, however the initiative did not put a significant emphasis on adaptive management, or adapting to a changing conception of the issue. Two respondents felt that the time spent in deliberation would gave been better spent clearing mangroves and closely monitoring the effects, to build a substantial knowledge-base. Other respondents emphasised the vision it set for the future by identifying gaps in the knowledge and strategically planning for future knowledge collection. For instance, the Plan supported local Maori in their aspirations to create a non-statutory 'Iwi Management Plan' to make clear their views on the catchment, including Maori-run monitoring programmes for shellfish.

1.2 Exploring the influence of the Forum on the quality of institutions

A) Cooperation

By bringing together all stakeholders associated with the management of the Whangamata Harbour and catchment, the Forum performed as an effective and representative coordination mechanism between state organisations. All respondents felt that the Forum and Plan had made decision-making more cooperative between State agencies; one respondent asserted, "if the decision was simply between the councils and the government departments, it would have happened a long time ago." Indeed, with EW stepping down as 'lead-agency,' and rendering itself as a Forum participant, it levelled the playing field, which encouraged collaborative decision-making across agencies. The result is a structure that mobilises the knowledge from across agencies, translates it into prioritised actions, and isolates the agencies responsible for the actions. However, one respondent felt that the Forum had not encouraged vertical cooperation, with 'local' agencies willing to enter into open-minded deliberation and compromise, while national agencies were entrenched in the 'official position.'

B) Contingent

Three respondents felt that the initiative signalled a change in the way knowledge is used to support resource management in New Zealand; away from the primacy of science-centric documents to a greater appreciation of community information and local observation. This has furnished a greater knowledge of the context, with most stakeholders more confident that they have a contingent appreciation of the issue at an appropriate scale. This has shaped and defined the Harbour and Catchment Plan to include qualitative local knowledge alongside quantified science, which is largely placed within appendices. As such the process and policy output is, "much more localised, (and) much more relevant to the people," with an expectation that it will provide better policy. However, two respondents felt that the process had been 'hijacked' by mangroves, which found dominance out of context with the rest of the issues within the harbour. For some, they felt that the process was a thinly veiled attempt to find consensus on the mangrove issue, rather than starting 'at the beginning' with an equal appreciation for all of the issues and their interrelatedness.

C) Participatory

All respondents felt that decision-making had been made more participatory as a result of the Forum initiative, however there remained variable stakeholder satisfaction with the level of participation; "Yes it's made it *more* participatory. Whether it's participatory is another question." All respondents were able to point out groups that did not have effective representation on the forum, and most respondents felt that insufficient resources had inhibited the best possible participation. This noted, almost all respondents spoke of the Forum as an effective conflict resolution mechanism, and a body for 'collective and collaborative decision-making,' or co-management. Most stakeholders emphasised the quality of dialogue and effective independent facilitation, with stakeholders able to achieve consensus on a great majority of the broader matters within the Plan. However, the dialogue continually returned to the contentious issue of mangroves, which split consensus, to the point where; one respondent noted "I'm not going to buy in to the other issues if we can't resolve the mangrove issue."

Outside of consensus, the Forum did replace the traditional science-centric science-policy interface, with a more participatory appreciation for local and traditional evidence. State agencies became more accepting of informal knowledge perspectives, particularly in the absence of formal science. Moreover, knowledge was to a large degree accepted as 'evidence' in support of value statements; "I think the discussion and the information about preferences and where people wanted to be in the process shaped the policy and provided for involvement in monitoring and evaluation." The participatory nature of the process has reflected itself in the Plan, which includes the qualitative information that was received alongside quantitative science. Similarly, the strategy for future knowledge collection is participatory in that stakeholders are responsible for collecting information.

D) Comprehensive

The Forum led to a more comprehensive understanding and treatment of the mangrove issue by all stakeholders; "I think that (compared to) those original days there is a very good appreciation of what the cause of the problem is." For all stakeholders this understanding was anticipated to lead to better decision-making, with five stakeholders identifying direct implications for policy. Indeed this can be seen in the way that the Plan was transformed from a long and technical draft, to a trimmed-down version, which reflected the qualitative knowledge discussed by the Forum. This comprehensive understanding was derived from a combination of different knowledge perspectives within the Forum. A significant quantity of science was used to provide the baseline for deliberation, though many respondents argued that in the New

Zealand context, there are significant gaps in the formal science on mangroves. This necessitated the Forum as a move to 'ground-truth' research on mangroves in terms of observations, local and traditional knowledge. It represented a participatory step to extend knowledge beyond the scientific baseline, improve the learning and understanding across stakeholders, and where possible arrive at a commonly agreed conception of the mangrove issue in Whangamata. To most respondents, this inclusion of traditional and local knowledge was non-trivial, and represented a significant divergence from science-based management.

In parallel with the Forum, the initiative has provided a framework for the comprehensive collection of knowledge. On one hand, there has been a focus on scientific monitoring of small case studies, in an attempt to collect field-science on the effects of removing mangroves. To this end, the Forum has drawn on knowledge collected from other harbours in the region which have removed mangroves, and from a number of small resource consents granted in Whangamata. On the other hand, the knowledge collection process has now entered a phase of attempting to quantify the local and traditional knowledge through applied scientific research. Indeed, two respondents felt that a participatory forum was crucial to any knowledge collection process; with local knowledge meaning science is better steered and informed.

E) Precautionary

The majority of respondents recognised that the mangrove issue had been approached in a very precautionary manner. Indeed two participants felt that EW, as the lead agency, had been too precautionary in seeking "the luxury of maximum certainty," which manifested itself as inaction; a "lack of confidence on behalf of the decision-makers to boldly go forth." One respondent felt that by failing to act early, with an adaptive approach to careful action and close monitoring, EW had foregone the opportunity to collect valuable scientific data, and instead the forum had been dominated by values and anecdotal knowledge. Another respondent agreed that the few small resource consents issued thus far, with stringent conditions, represented a precautionary approach forward, though perhaps too precautionary. Three participants felt that the forum was itself a precautionary step forward; it encouraged participants to exercise a precautionary approach to collective decision-making.

F) Incremental and adaptable

Participants were asked whether management of Whangamata Harbour had adapted incrementally as new knowledge came to light; in short, 'adaptive management.' For four respondents, they felt it was too early to say, and that indeed no 'new' information had emerged within the Whangamata context. Instead, two respondents noted how use had been made of the scientific monitoring results from other harbours nearby where mangroves are being removed. For one respondent the means of mobilising knowledge had adapted, into a "different way of listening to that knowledge (that already exists with the context) and making use of it." Central to an adaptive approach is incremental action accompanied by close monitoring and evaluation, however until now this has been relatively limited; with the stringent monitoring of the three resource consents for small scale mangrove removal the most significant expressions. This was largely due to the risk adversity of EW, who has been reluctant to make a very political decision without a significant degree of certainty. Three respondents felt that the initiative was gaining momentum in terms of monitoring, by quantitatively evaluating the qualitative knowledge put forward by local and Maori participants: "let's get the stuff we need to back up any future decisions, as robustly as possible." Moreover, three respondents discussed the role of future resource consents as means for well-controlled adaptive management 'experiments.'

G) Long-term and strategic

For all seven respondents the knowledge collection process had introduced a more long-term focus to decision-making for the mangrove issue, and for five respondents, a more strategic focus also. This was a long-term perspective both in the understanding of the multiple facets of the issue, and in the planned interventions. In this, some stakeholders cited the upcoming Plan, which outlined a list of priorities for the Whangarei Harbour and catchment, the stakeholders responsible for action, and potential resources that could be mobilised in support. Moreover, the majority of respondents felt that the knowledge mobilised in the Forum would have concrete implications for other future policy documents. For one respondent, the strategic aspect of the initiative was its influence on an already growing national consciousness, "that something has to be done about the mangrove problem." Three respondents had reservations about how strategic the process was in terms of bringing stakeholders out of their entrenched positions. Without a degree of consensus, or at least accepted co-existence, they felt it is difficult to plan for the long-term strategically. One respondent felt The Plan would have limited applicability, and would likely sit as a draft plan. Another felt that it would have a significant impact on future policy, but emphasised that a decision remained to be made.

H) Integration with the decision-making process

Respondents were asked whether the knowledge collection process is well integrated with the decision-making process? For five respondents, they felt that the knowledge collection process was well integrated with the decision-making process, with two stakeholders pointing out that the knowledge process set a structure to subsequently guide the decision-making process. For one respondent, they felt that it was too early to say, given a final decision hadn't yet been made, while another respondent felt the two processes were not well linked together.

Related to this, respondents were asked whether the knowledge collection process has led to a more effective decision-making process and policy? All participants confirmed that the knowledge collection process led to either a more effective decision-making process or decision itself. For five respondents it led to more effective policy; "it is more effective policy given you're involving a lot of stakeholders, and local stakeholders in the process." Another stakeholder noted, "The statutory policy that arises out of the Forum is more effective for having gone through this process. It's much more localised, it's much more relevant to the people." A third stakeholder said; "I don't want to ditch the idea of a Forum because I think that kind of approach is critical in any knowledge collection process… it leads to a more effective decision-making process, whether its heard or not."

1.3 Exploring the influence of the Forum on the quality of stakeholder interactions

The quality of stakeholder interactions for collective decision-making is measured in this research relative to measures of financial, social and human capital.

A) Financial capital

The Forum initiative did not give rise to an increased stock of financial capital from the spectrum of stakeholders. Most financial capital was provided by EW as the convener of the Forum, and lead agency in preparing the Plan, with some minor resources supplied by other state agencies after the initiative began.

B) Social capital

The Forum initiative did encourage a greater degree of interaction between those with a stake in the mangrove issue in Whangamata. This is interaction in the broadest sense; encompassing the mobilisation of knowledge, decision-making, and coordinating of action for instance. To a small degree, this increased interaction came as a result of 'new' stakeholders taking an interest and participating in deliberation for the mangrove issue. The Forum did not encourage the participation of many new stakeholders however because it was initiated after 14 years of political debate, whereby most stakeholders were already well-established in a network around the mangrove issue. Nevertheless, respondents noted that the Forum encouraged the inclusion of between one and eight new stakeholders or stakeholder groups, predominantly from the private sector and the scientific community. To a much greater degree, the Forum was encouraging of an increased connectivity and density of interactions within the network of stakeholders that were already active and participating. Importantly, this increased interaction was not limited to within the Forum setting itself, where interaction was total, but extended to stakeholder interactions within other institutional settings as well. These increased interactions were described as a percentage increase on those interactions that predated the initiative, with respondents depicting an increase of interactions ranging from 5%, to 91%, with the majority of respondents noting an increase of between 30-50%. These new interactions were typically 'bridging' disparate stakeholder groups at the local scale, though some stakeholders also revealed some 'linking' interactions with similar mangrove initiatives in nearby harbours, particularly in Tauranga Harbour.

Together with an increased connectivity and density of interactions between stakeholders, social capital is defined by the norms of reciprocity and trustworthiness that arise from them. Respondents revealed that the Forum initiative had mixed success in nurturing bonds of trust between stakeholders. Five respondents felt that there had been an increase in trust between all stakeholders that participated in the Forum, one respondent felt that there had been no change, while one stakeholder felt they had less trust for other participants because they found the process very political. Conversely, all respondents felt that there had been an increase in reciprocity in stakeholder interactions. Stakeholders were also asked whether the Forum had led to any positive changes in stakeholder behaviour with regard to the Whangamata Harbour and mangrove issue. Generally respondents talked of changes in behaviour in two senses. Firstly, respondents talked about changes in the attitudes and behaviour among stakeholders within the decision-making arena; with five noting an increased 'maturity,' appreciation for the issue, and a higher likelihood of compromise. Second, respondents talked about a change in interactions with the natural environment exhibited outside the decision-making arena, though they were unsure if the Forum initiative had any great influence on peoples actions.

C) Human Capital

For most respondents, a major barrier to the effective and on-going participation of stakeholders was a lack of wherewithal (viz. time and resources) across some participants. Three respondents noted how under-resourced and over-stretched Maori representatives were, given their wide-ranging statutory commitments, and that they needed to travel for every Forum meeting. Three other respondents felt that more generally the time able to be given from the unpaid participants was limiting, though the Harbourcare group was noted as well represented by retirees, who were passionate, well educated, and most importantly had the time to devote to the Forum. Associated with this, respondents were asked whether the Forum was encouraged by the emergence of any leaders across the stakeholder groups, with all respondents noting that leaders had emerged to drive the initiative. EW staff, the local EW councillor, and the Hauraki Maori Trust board were cited as the stakeholders who exhibited the greatest leadership.

Stakeholders were questioned whether the Forum initiative had increased the diversity of experiences, education and expertise in decision-making. Generally all respondents felt that the initiative did represent an adequately diverse cross-section of perspectives, though all respondents were able to point out one or two perspectives that were not well represented, such as Surfbreak Society. Stakeholders were also asked to what extent the Forum had increased the expertise among stakeholders, relative to participating in a collaborative process. Three of the respondents felt that there is adequate expertise now amongst the stakeholders to address the issue, while two were accepting that it could always be better where there is more time and money. Conversely, three other respondents felt that the expertise was 'patchy' and was not spread evenly over all parties. One respondent felt that it was really only the state stakeholders that held adequate expertise, as led by EW. The majority of respondents however felt that there had been a growth in expertise across all stakeholders as a result of the initiative; "I think everyone's a bit better informed as to what the situation is than they were previously, and I don't think people would be making the same rash statements that they were making 14 years ago." Finally, all respondents acknowledged that the Forum had led to social learning across all stakeholders, of the issue, the plurality of perspectives and the decision-making process.

2. Waikaraka Estuary Managers Inc

2.1 Analysing the Waikaraka Estuary Managers initiative through a post-normal science lens

A) The complexity of the mangrove issue and its uncertainties

The WEM initiative developed an increasing appreciation for the complex and integrated nature of interacting social and ecological systems, and that mangroves were a symptom of more pervasive systemic problem. As was noted; "…at the outset…a lot of the (Waikaraka community) started by being a bit narrowly focussed on mangroves, but then they started talking to EBOP, and maybe even Landcare and DOC…who've always from the outset encouraged them to take a more holistic view of the issue." At the same time the WEM initiative was encouraging of a 'humans-in-nature' perspective, particularly given the significant participation of Piriraku; "when you see the fruits of the human world understanding the dynamics of the natural world…that's really encouraging." Associated with this complexity, all respondents recognised that WEM was initiated within the context of significant uncertainty, and has been shaped by this uncertainty. It was widely acknowledged that prior to the WEM initiative, local state agencies held a pro-mangrove position that had filtered down from out-dated science, taken from overseas experiences, which had not been 'ground-tested' in the New Zealand context. As one respondent noted, "we needed to control an activity that no one really knew that much about; having to base everything on what was understood, or we could prove to happen at the time."

Uncertainty allowed a number of conflicting perspectives on the mangrove issue to emerge, with lack of consensus on what exactly was uncertain, and how best to reduce uncertainty. Locals promoted action-based ‘learning-by-doing,’ while state agencies promoted science-based studies; “(locals have) got theories about it, but if it’s something that hasn’t had any study behind it then it really can’t be given that much weighting.” This ‘epistemological uncertainty’ was used as a political tool in early Waikaraka public meetings to delay the removal of mangroves; particularly by state agencies that were taking a precautionary approach. Within this context, WEM “really pushed for the science to develop.”

B) A plurality of legitimate perspectives in a high-stakes political arena

The Waikaraka estuary has significant value for a number of stakeholder groups, and the trade-offs between the diverse perspectives on habitat value, amenity value, aesthetic value and cultural value have found expression through high-stakes political interaction; “the political environment in Tauranga at the time was quite interesting.” Waikaraka represents, however, a unique case in that it is relatively secluded and lightly populated, thus limiting the number of stakeholders and increasing the potential for dialogue. During the earlier meetings, stakeholders in Waikaraka found themselves dividing into three camps; those who wanted mangroves removed, those opposed to removal, and those who could appreciate both positions and demanded more evidence. It was this latter group that drove the WEM. A number of respondents also drew attention to a specific political debate between state agencys’ science-centric pro-mangrove perspective, and those representing other local or traditional perspectives. The perceived ‘entrenched position’ of state agencies was based on science taken from international experience, however this frustrated locals who thought they could see ‘ground-tested’ evidence to the contrary. For WEM, this brought recognition that “knowledge is power,” and that they needed to engage scientific evidence. “We tactically played a little game with them, and we ‘out-scienced’ them; we used our PhD’s against their Masters and Bachelors.” Respondents generally felt, however, that political positions softened throughout the initiative, through dialogue and learning-by-doing; “It’s just called democracy; everyone’s given a chance to speak can make their own mind up, and their point of view is respected.”

C) Dialogic mobilisation of knowledge as ‘evidence’ in support of value positions

WEM was initiated by the community with a focus on high quality dialogue across diverse perspectives, as a collective endeavour to acquire *evidence* in support of decision-making; marking a departure from a model of pure conflict resolution or consensus building. WEM public settings therefore represented a form of participatory and dialogic ‘science-policy interface.’ At its inception, WEM was characterised by bi-cultural dialogue between local residents’ and tangata whenua perspectives, and the evidence they could muster. This was significantly owing to a co-leadership arrangement between a Piriraku kaumatua[143] and a

[143] Kaumatua refers to a tribal elder, and is often associated with great experience and knowledge.

retired local; "they worked well in consultation…those two rangatira[144], they had an open dialogue." Evidence was used as a means to galvanise Maori and non-Maori by bringing together their evidence as complimentary perspectives on estuary restoration; "We were using it as a way of brokering a marriage of understanding, between Maori and non-Maori." Subsequently, WEM broadened their participation to include state agencies; both as a source of knowledge and in their role as the 'administrative arm of the community,' to formalise decision-making. At this point, it became clear that more formal decision-making institutions demanded evidence of a scientific nature to legitimise positions, leading to the close involvement of the scientific community. In this way, there emerged two parallel, yet interacting, settings within the broader WEM initiative; (i) the community-based, non-statutory setting that negotiated evidence in all its forms – traditional, local and scientific – and (ii) the state-based statutory setting, wherein dialogue was dominated by experts, and evidence was primarily of a scientific nature.

All respondents recognised community-based WEM settings as nurturing dialogue between knowledge systems, through 'regular and systematic' meetings that were open to all stakeholders, including state agencies and the scientific community. As the initiative developed, this dialogue was supported by effective facilitation from Landcare, by a series of seminars, and other scientific documents and newsletters which have framed and encouraged dialogue. For two respondents, dialogue extended beyond meetings to the WEM social events, and to the working days; "You spend four hours working alongside clearing the mangroves, and discussing points of view." In parallel with this, respondents described improved dialogue between state agency stakeholders themselves, and the expert community, around mangroves. Within the formal institutional setting, however, evidence was limited to the negotiation of competing scientific evidence, and values were supposedly 'left at the door.'

D) A participatory setting; inclusive of all knowledge perspectives

In general, the WEM initiative was successfully inclusive of multiple knowledge perspectives as legitimate for decision-making, from across traditional knowledge, local knowledge, formal science, and 'hands-on,' practical land-management knowledge. More specifically however, a distinction can be drawn between (a) the non-statutory WEM settings, wherein all forms of knowledge were equally admitted and deliberated, including a combination of qualitative and quantitative knowledge; and in parallel, (b) the statutory decision-making settings, wherein quantifiable scientific knowledge was dominant to the exclusion of other perspectives. This latter setting was dominated by scientists, planners and other members of the expert community, who exhibited, on occasion, a 'professional arrogance' towards the inclusion of other stakeholders.

[144] Rangatira refers to a leader or chief.

The WEM meetings, working days and social occasions provided opportunity for the communication of all knowledge perspectives in reaching a more comprehensive understanding of the estuary and its mangroves. Maori traditional knowledge made an important ‘qualitative’ contribution by providing the history of use and stewardship within the estuary; “we brought 150 years of history.” At the same time, all respondents recognised that the local residents of Waikaraka represented a rich source of local knowledge, based in experience and observation. Drawing similarities with local knowledge, respondents also recognised the mixture of formal science and informal knowledge that was contributed by the environmental NGO’s, including Forest and Bird and the Ornithological Society. The scientific community and state agencies brought with them scientific knowledge of mangroves in other New Zealand estuarine environments, and what limited data that existed for the Tauranga Harbour. Finally, a number of community respondents pointed to the significant contributions made by Landcare and the land-management officers of EBOP, who provided ‘hands-on’ practical advice on methods of land-management. Importantly, all knowledge perspectives were admitted as equally legitimate for supporting decision-making; “We weren’t just tokenistically involved…We were equally involved in sharing that knowledge, and we were equally involved in learning from that knowledge.”

E) Reconciling diverse perspectives according to notions of reciprocity and co-existence

For most respondents, the WEM initiative made possible the reconciliation of diverse knowledge perspectives according to notions of reciprocity and co-existence, such that all knowledge systems were extended respect for their unique and relative contribution to a common understanding of the mangrove issue. As one respondent noted; “A lot of work went on, exchanging of information, to the benefit of possibly all those on both sides of the groups that got involved.” In addition to this general notion of reciprocity, there emerged through the WEM an ethic of partnership between disparate knowledge systems. In the first instance this emerged as a bi-cultural partnership between the Piriraku people, and the non-Maori residents of Waikaraka, in accordance with a Maori proverb; “Your kite[145] of knowledge and my kite of knowledge, go a long way to finding the truth.” In the second instance, a partnership was nurtured between the local and traditional knowledge in Waikaraka, and the scientific knowledge of NIWA. There was a realisation that science on its own was ‘unpalatable’ to local estuary-care groups - the ‘science uptake gap’ – while local knowledge on its own was unpalatable to scientists or state agencies. This encouraged NIWA and WEM to work in partnership to accumulate knowledge with some wider legitimacy in both community settings and more formal academic or legal settings. This knowledge was distilled into resources, such as pamphlets and videos, to allow wide dissemination. Central to this reciprocal respect, and in

[145] Basket

acknowledgement of their co-existence, knowledge perspectives in the WEM settings were evaluated relative to their own criteria of quality. For example, Maori knowledge was accepted as legitimate and credible based on the fact that it was derived from the oration of a respected kaumatua, with this the relevant 'measure of quality' for Maori; "You can't challenge the knowledge of whakapapa[146] because it's been handed down for generations; it doesn't need to be (scientifically) scrutinised."

However, in parallel with the reciprocal dialogue within the WEM settings, a distinct lack of reciprocity was evident within the statutory institutional settings. The interviews revealed a strong bias within state agencies towards science as the most 'high quality' source of knowledge, stemming from its demonstrated superiority within the litigious, statutory decision-making process. Within these settings local and traditional knowledge was dismissed as 'anecdotal' or 'emotive.' At the same time, community stakeholders expressed distrust of science, particularly where it was done 'behind closed doors,' or was not 'ground-tested; "Its basically people that are at the coalface as against people that are sitting way back and just read the books." Interestingly, the interviews revealed the powerful influence that the statutory, state-centred setting had on the non-statutory, community-based WEM setting, through a process of scientisation. This scientisation was revealed through: (a) a new scientifically-defined, holistic conceptualisation of the mangrove issue; (b) a more science-centric approach to assembling evidence, in partnership with the scientific community; and (c) the scientisation of knowledge collection, through scientific monitoring practices. This noted, for three respondents, an increase in reciprocity was described in terms of an increasing respect toward the use of local and traditional knowledge in state agencies, and the statutory decision-making process.

F) Review by the Extended Peer Community

The interviews revealed that the WEM initiative did allow for some degree of 'extended peer review,' but that this was limited to the community-led, non-statutory WEM settings. With Landcare as an independent facilitator, all stakeholders were equal participants in an 'extended peer community' that extended all perspectives reciprocal respect, gave all stakeholders a role in the collective critique of knowledge put forward. Extended peer review occurred via both (a) dialogue between stakeholders, and (b) through interaction with the estuary itself. As to the former, at least three respondents described the way in which WEM facilitated high quality dialogue with a view to distilling high quality knowledge; "We took that debate carefully through and gave the evidence of it, and we used the scientists where we could, and we used the regional and the district council as we could." As to the latter, WEM stakeholders spoke to great length of the way, "we actively drew the people on to ground-base their research." Implicit to both of these approaches were notions of experimentation and peer review; "we weren't in a

[146] Whakapapa refers to genealogy or lineage and is central to the Maori culture.

position to say we were absolute. It was only…we confirmed and confirmed and tested and tested and got other people to look at it…"

However, within the more formal science-policy interface setting framed by state agencies, knowledge quality was measured to the degree that it would be robust evidence within a formal decision-making process, relative to scientific norms and criteria. In this way, all diverse knowledge perspectives were reconciled into a single, scientific framework, which determined their quality; "Evaluate quality? You're talking about relying on the science that has been peer-reviewed, published pieces of work, where it has been undertaken, when it was undertaken and so on." In this sense, peer review was seen as a very narrow activity, undertaken by scientists and experts, who evaluated to what degree the 'observations' of locals or tangata whenua, 'counted' as scientific or not. Indeed, increasingly, this science-centric focus began to influence the form of the other non-statutory WEM settings. WEM adopted 'research' as a central ethos and began actively seeking scientific advice, implementing a monitoring scheme that was heavily based in scientific method; "(local government) helped them to design their monitoring programme to ensure it was of a high enough quality; scientific-like quality."

G) Reflexive social learning

The WEM initiative enabled stakeholders to be reflexive relative to their knowledge of the mangrove issue, and the social context within which they deliberated. For instance, the Waikaraka community was seen to shift their focus from mangroves to a broader and more holistic perspective, while state agency stakeholders reconsidered their previous scientific evidence against more 'ground-tested' research. Indeed, in reflecting on the mangrove issue, stakeholders have been forced to confront their role in contributing to it; "We've had to really look at ourselves, because we've been as much part of the problem as anyone else in this environment." In terms of the broader social context, stakeholders exhibited a reflexive appreciation for the evolution of stakeholder interaction and perspectives. In this way, respondents recognised the changing political environment within which the WEM Initiative evolved; "Its evolved through trust…and as there was a step forward in trust, there was a step forward in releasing more knowledge." Similarly, stakeholders showed a deep appreciation for the fundamental differences between knowledge perspectives, with reflection on, the parallel cultures of Maoridom and New Zealand non-Maori. At the same time, it saw recognition of the power of science within the statutory decision-making setting.

In parallel with, and in part owing to, increased reflexivity, the WEM initiative encouraged 'social learning' toward a common understanding of the (i) mangrove issue, (ii) the diverse values and perspectives of stakeholders, and (iii) the decision-making process. All respondents said that they had learnt much about the mangrove issue, with this learning mutual as noted by the Piriraku respondent for instance, "on both sides…it hasn't just been one way learning. We've been learning as much from this process as our Caucasian cousins." At the same time, all stakeholders felt that they had a greater understanding of the plurality of perspectives stemming from an increased 'openness' and reciprocity where groups were willing to accommodate other perspectives. Finally, all respondents recognised that stakeholders had learnt about the decision-making process, recounted as a positive experience within the WEM, and a frustration with the bureaucracy within the litigious statutory process.

H) A strategic, long-term and adaptable process

The WEM initiative was unique in that it was the first meaningful attempt at removing mangroves within the Tauranga Harbour, against a background of significant uncertainty and precaution. Within this context, the WEM initiative offered an opportunity to extend the boundaries of knowledge on mangroves, by instigating precautious removal as 'learning-by-doing.' "We took the initiative…and really in many ways have been given 'free hand,' because ours has really been a situation of adaptive management." To achieve this, however, WEM was required to acquiesce to a strictly controlled work schedule, heavy monitoring, and to ensure that their data was robust enough to fit to scientific norms. For two respondents, the WEM initiative has spurred an on-going, strategic and long-term opportunity to collect knowledge on mangroves; "There are a number of unknowns, and through this process some of those knowledge gaps are being plugged…more understanding is gained of the bigger picture." Waikaraka thus held a 'keystone' role in a wider strategic plan to gather knowledge on mangroves in Tauranga Harbour; which was being pieced together incrementally; "The monitoring reports for the estuaries are coming in. There is an expectation that sometime during the life of the consents, some organisation is going to have the spare capacity, either money or time, to put them together and see if any long-term trends have developed." The WEM initiative can therefore be seen to have a long-term focus on the mobilisation of knowledge in Waikaraka; which both stretches deep into history, through the richness of experience from Piriraku, and far into the future, as monitoring comes to fruition.

2.2 Exploring the influence of the WEM initiative on the quality of institutions

A) Cooperation

All respondents remarked that the WEM initiative had improved cooperation and coordination between state agencies relative to Tauranga Harbour and sedimentation broadly, and mangroves more specifically. In particular, two respondents noted the way in which EBOP and DOC had begun to collaborate closely both at the level of scientific research, and at the policy level. This improved coordination was instigated by WEM action at the community level, and their initiative to bring together diverse stakeholders from across the full spectrum, including EBOP and DOC. As one respondent noted, the non-statutory WEM initiative set the foundations for the statutory decision-making process between state agencies; “WEM in the outset brought forth the knowledge they did have, and values, to the issue, to then form the basis on which to set the whole consenting of managing the issue.”

B) Contingent

For most respondents, the WEM initiative has allowed for estuary management that is contingent to the specific context of Waikaraka. Indeed, a number of respondents noted that the WEM initiative was born of a desire for ‘locally-grounded,’ learning-by-doing initiatives, to critically question the dominant attitude of state agencies that was drawn from international experience. Community respondents emphasised WEM stakeholder participation, and the process of interaction and decision-making as core to its contingent nature. In this way, they emphasised the diversity of stakeholders and expertise within the Waikaraka community; “we had a potpourri of our community.” At the same time, much was made of the unique bi-cultural partnership forged between the Piriraku Hapu and the local non-Maori, epitomised by the close dialogue between the initiative’s two co-leaders – one Maori one non-Maori. Finally, locals also noted the importance of an ‘organic’ process based in Maori tikanga; “the whole structure of this WEM group in tackling the mangrove issue has been so organic that we haven’t had to put it in much of a structured process. And that’s attractive to Maori.” Indeed, for one respondent, it was this specific social context in Waikaraka that had made it so uniquely successful, and so difficult to emulate, “They had a total community buy-in because they had a very small community.”

C) Participatory

All stakeholders interviewed felt that the WEM initiative had led to a more participatory means of collective decision-making. “It was just a question of empowerment of observable knowledge;” by empowering alternative knowledge perspectives to science, all stakeholders felt that they were able to contribute to a shared understanding of the issues. Moreover, in nurturing the conditions for a participatory ‘science-policy interface,’ WEM also created a space for participatory decision-making. These conditions included; (i) starting from a shared understanding of the issue; (ii) acting transparently and personalising the initiative by taking a diversity of stakeholders into the confidence of the group; (iii) building norms of trust, reciprocity, and collaboration; and (iv) infusing Maori protocol or tikanga into an ‘organic’ process that evolved as the participants did; and (v) trusting in strong leadership. As to this latter point, the bi-cultural leadership within WEM ensured that the process was not weighed down by circular discussion; “We saved a lot of time trusting in that leadership. Where if we had to go through hui[147] after hui, there are too many hui and no ‘do-i.’ Decisions were made quickly, and decisively.” For state agencies, the non-statutory WEM process, and its informal interaction

[147] A hui is a congregation, assembly or meeting

paved the way for an effective statutory process, which was not afflicted with conflict, indecision, and misunderstanding. Furthermore, by nurturing participatory settings within which state agencies could also participate, this went some way to a maturing ethic of co-management, according to three respondents.

D) Comprehensive

The WEM initiative was brought about by a collective desire of the Waikaraka community to address the well-being of the estuary, but a lack of evidence to inform public deliberation. This dilemma was amplified by the significant uncertainty characterising the position of state agencies toward mangroves, and a 'science-uptake gap' between that knowledge generated within the scientific community, and the action of civil society groups and state agencies so dependent on this science. Faced with this challenge, respondents felt WEM had enabled a much more comprehensive and holistic common understanding of the mangrove issue, and its wider socio-ecological system context. The knowledge generated by the initiative has been transferable to multiple different institutional settings. For instance, this knowledge is equally relevant to decision-making on the marae, as to decision-making for a resource consent. Finally however a caveat; all stakeholders recognised that the WEM initiative had, with the encouragement of state agencies become more 'science-based.' This introduces a danger that WEM departs from its community-based and participatory beginnings, to become an instance of science-based management, and in so doing, becomes less transferable.

E) Precautionary

All respondents recognised that the collective deliberation, decision-making and action within WEM initiative was steered by a principle of precaution, however a distinction was made between state agencies and the Waikaraka community. Within state agencies, their default position prior to WEM had been one entrenched in significant precaution toward the clearing of mangroves, given the little overseas science they had. For them, WEM did not make them any more precautionary, and may have made them less precautionary. Against this background of uncertainty and precaution, community stakeholders recognised, "it was tenuous, and we were very careful with what we did. We didn't go suddenly and decimate it; we worked progressively, we started at this end, and we staged it in such a way…" In parallel with physical management of the estuary, the WEM deliberation and decision-making process itself was described as precautionary, incremental and transparent. In this way, the dialogue and the action within the WEM initiative progressed as the knowledge progressed – "You're responsible for what your knowledge is, so we had to act on what we knew."

F) Incremental and adaptable

All stakeholders asserted that the WEM initiative represented an instance of adaptive management. As noted, WEM recognised the significant uncertainty associated with mangroves in the Waikaraka estuary, but collectively agreed that this was not an excuse for inaction, and that mangrove removal should progress in a carefully staged and monitored precautionary manner. At the same time this uncertainty provided a drive for innovation; extending to the innovative design of comprehensive and robust monitoring strategies based on a scientific method but adapted, such that locals could undertake the monitoring with training, and data was simultaneously furnished on a number of different indicators, and their interaction. This led to the preparation of a set of guidelines and other resources in partnership with NIWA. In this way, WEM espoused a 'learning-by-doing' approach, whereby cautious action to remove mangroves presents a low-risk opportunity for learning. These incremental actions progressed as resources and the political or legal environment allowed, and were coordinated by the strategic and long-term vision collectively set out within the estuary management plan, to ensure that progress was not ad hoc.

G) Long terms and strategic

All respondents concurred that the WEM initiative had led to a more long-term and strategic means of mobilising knowledge, making decisions and taking action; as represented by their estuary management plan. For the state agency respondents this strategic approach stemmed from the high quality dialogue within the WEM meetings and other settings, which allowed all stakeholders the opportunity to collectively reach a shared understanding of the issue. This included: (i) distilling the community's key values; (ii) distilling the knowledge that was available on mangroves, and the uncertainties; (iii) incrementally constructing a picture of the issue from the knowledge that does exist; and (iv) prioritising research to plug knowledge gaps, and prioritising estuary management action. WEM represents an opportunity for the long-term collection of knowledge on the effects of mangrove removal, and in this way represents a significant component within a broader strategy to manage sedimentation in Tauranga Harbour. Indeed, at least in Waikaraka, this strategy for the future draws on the historical knowledge and whakapapa of the Piriraku; "history is a really good benchmark to compare how it was, to what we are trying to get it back to." At the same time, for community stakeholders, their representation of WEM as long-term and strategic was based on increases in collaboration, and improved stocks of human and social capital (see also Section 4.4). This was epitomised by the Waikaraka bi-cultural partnership; "there's been such a foundation built that this work will be carried on for generations I think I can confidently say that." Finally, respondents noted changing attitudes within local state agencies, which are becoming more receptive to local perspectives, and embracing a co-management approach.

H) Integration with the decision-making process

All stakeholders agreed that the WEM means of mobilising knowledge was well integrated with decision-making. As one stakeholder noted, the two processes were intertwined; "The knowledge collection occurred to address matters of concern raised during the decision-making process, and effectively they both depended on one another, at least at the early stage." Another respondent noted how the non-statutory dialogue of WEM had set the basis for the statutory decision-making process. A third stakeholder commented on integration, "I really do not think we could have done more."

Respondents were also asked whether the WEM initiative had led to a more effective decision-making process and policy, with a general consensus that the initiative had led to a more effective process, by their own individual measures. For the Piriraku respondent, the inclusion of Maori tikanga was novel and vital; "because tikanga are good cornerstones of environmental awareness. And I'm sure you would get agreement from our Caucasian cousins about the importance of tikanga in that group." Another stakeholder valued it for its profusion of knowledge; "I probably haven't been involved with any resource management decisions with more science-based information, coming out left-right-and-centre." A third respondent valued it for the shared understanding, which resolved conflict, and set a solid basis for a decision: "I think it was effective due to the lack of any major conflict, and also the fact that they had worked together, these things which led to a shared understanding." For this reason, the WEM initiative has been used as a template or model approach for instigating similar caregroup initiatives in other reaches of Tauranga Harbour.

2.3 Exploring the influence of the WEM initiative on the quality of stakeholder interactions

A) Financial capital

The WEM initiative has, quite literally, secured 'buy-in' from a diversity of stakeholders. As a result of participating within the WEM initiative, a significant number of the stakeholders have contributed financial resources, from across local government, the universities and crown research institutes, the local community and Iwi.

B) Social capital

The WEM initiative served to greatly increase the number of stakeholders participating in the management of the Waikaraka estuary, and to increase the degree of interaction between stakeholders. The WEM was initiated as a public deliberation, and developed as a partnership between Piriraku and the wider Waikaraka community, with all other stakeholders "actively asked to come on board." At the same time, all stakeholders revealed an increase in stakeholder connectivity as a result of the initiative. That is, the initiative had forged new interactions between stakeholders that had not existed prior to WEM and that extended beyond the WEM settings themselves. This increase in stakeholder connectivity ranged from a 30% increase to a 200% increase in the number of interactions. Four respondents depicted an increase in interactions of between 80% and 200%.

There was also a general recognition across stakeholders that the WEM initiative positively influenced the norms that shaped the interactions between stakeholders. For five respondents, WEM nurtured increased trust in the interactions between stakeholders. Two particular instances of increased trust were elucidated; (a) the trust-based partnership between Piriraku and Waikaraka locals; and (b) the increased trust between state agencies and the local community. Meanwhile, all respondents could see an increase in reciprocity shaping the interactions between stakeholders, and their attitudes toward one another. In particular, three respondents made specific mention of an increasingly reciprocal relationship between state agencies addressing mangroves in Tauranga Harbour, while three respondents noted increased reciprocity in the relationship between state agencies and the community. A number of respondents recognised the increased norms of collaboration and partnership that have accompanied the WEM initiative, as given effect through the collective action of WEM and the wider Waikaraka community in restoring the estuary. Finally, all respondents noted some changes in the behaviour of stakeholders toward each other and the estuary as a result of the WEM initiative. For four respondents, this change in behaviour was seen in an increased awareness of the issue at a holistic scale, and the appropriate means of managing the estuary. For one respondent, this change in behaviour was best seen in the “improved understanding and relationship between Maori and Pakeha” at the estuary, while another stakeholder noted the relationship building between local government and the community. Ultimately, WEM forced stakeholders to reflect on the health of the estuary, and their own role in contributing to the problem, as the Piriraku respondent admitted; “We’re the ones that have been chucking our rubbish down there. We’re the ones that have been allowing the sprays and silt to come; not just non-Maori. We had to put our hand up and realise we are part of the problem too.”

C) Human capital

Globally, respondents felt that the stakeholders within the WEM initiative had adequate ‘wherewithal’ to enable effective participation, and allow the initiative to fulfil its potential. All respondents noted, however, the strains that an initiative like WEM can place on the time and financial resources of the community, and other voluntary groups like the Ornithological Society, who must balance their involvement in estuary management alongside their jobs and other commitments; “you get a bit thin on the ground because we’re all voluntary.” Waikaraka was noted, however, to have a unique demographic; comprised significantly of retirees and professionals, who were able to devote time, and some financial resources. Within the

Waikaraka community there is a group of 70 volunteers that regularly donate their time to work in the estuary, and an even larger support network. In addition, a number of leaders were shown to have emerged through the WEM initiative, though the two most prominent leaders espoused the partnership between Piriraku and the wider Waikaraka community; a Piriraku kaumatua, and a local non-Maori resident. “These two had an open dialogue. And because we were represented by our leader, and I guess the community lot were represented by theirs…Its only as good as your leadership; and we had two good leaders. We saved a lot of time trusting in that leadership.” Landcare and NIWA were also identified as taking a leadership role in the collection of science, while some EBOP staff took a leadership role in promoting WEM.

The WEM initiative mobilised a diversity of stakeholders, which brought with them a diversity of backgrounds, education and expertise; adding to the richness of perspectives through which to understand the issue, make decisions, and action them. Stakeholders confirmed that the initiative had encouraged the participation of the full diversity of stakeholders, “from one end of the spectrum to the other.” Moreover, respondents were quick to note that the diversity of expertise employed was essential to the successful instigation of WEM; “This group could solve any problem in the world. We’ve got the expertise, we’ve got the knowledge, business acumen, we’ve got the intellect, we’ve got the indigenous cultural diversity; its all there.” Beyond this, stakeholders described how the WEM initiative had brought in additional expertise from Landcare and NIWA, and how learning among participants had increased the depth of expertise: “Its perhaps given them a better understanding how to achieve a project and argue a point…They can step back and actually see the reason, and the counter-arguments.”

3. The Gisborne Wastewater Adjournment Review Group

3.1 Analysing the WARG process through a post-normal science lens

A) The complexity of the wastewater issue and its uncertainties

The WARG process brought together a diversity of stakeholder perspectives on the wastewater issue and in so doing brought an increased appreciation for the complexity of the issue, and new thinking on the interactions between the community and their natural environment. Prior to WARG, there was criticism that the GDC held fast to a science-centric, linear and utilitarian view of the environment as a sink; “In-process-out sort of stuff.” This represented a narrow understanding of the effects of the discharge on Poverty Bay, as defined within a few scientific parameters, and a permissive approach that understated uncertainty. WARG allowed other stakeholders to introduce a more holistic, systemic and cyclic model of the issue, as complex interactions between social and natural systems. Key to this was the idea of ‘biotransformation’ as the core biological process used within the BTF, which created a metaphor for understanding nature more broadly; “…you take man and you take his waste, the whole idea inherent in a lot of it is to put as many biological cycles in between…one of our problems here is that we're short-circuiting it by putting it in the bay." Despite this, tangata whenua and environmental NGO respondents felt that the reductionist and linear perspective of local government has prevailed to some extent.

The WARG participants acknowledged that the wastewater issue held a lot of uncertainties; "Take one example of an anti-bacterial in soaps, its bio-accumulative, and its in our sewage… And all the medicines. There is a cocktail of thousands of chemicals in there; many of which we haven't got a clue what the effect either together or synergistically is." For most respondents however, the WARG provided "a framework of how we could manage those gaps," collaboratively. Stakeholders revealed that at its core uncertainty was 'epistemological,' to the extent that it did not stem from a paucity of knowledge so much as from a plurality of knowledge perspectives; "If I've got a whole lot of facts, and you've got a whole lot of different ones, we haven't compared them and we're acting from them, then we're not going to agree on a higher level." Ultimately, this arose through the discontent of Maori with GDC's tendency to scientifically quantify uncertainties in terms of acceptable risk; "it isn't on a scale of zero to one hundred…it's a yes or no phenomenon; there isn't an acceptably unhealthy environment."

B) A plurality of legitimate perspectives in a high-stakes political arena

Respondents recognised that the WARG was initiated within the context of deep political division, whereby stakeholders interaction was almost singularly played out within a court setting, and that in 2005, the wastewater debate was again heading for an expensive court case. At its core were the conflicting perspectives of tangata whenua and the GDC; based on different ontological understanding of the world, on different ways of knowing the world, toward different values and principles, as recounted through different vocabulary. GDCs position was to achieve optimum quality wastewater, defined over some scientific parameters, for the minimum financial cost. For Maori, the discharge was an affront and a threat to their well-being; "Its putting (sewage) into the pataka-kai – the food-basket – and its contaminating spiritually the whole place." For one respondent, the wastewater issue represented a more insidious disparity within the Gisborne community; "It sort of symbolised to many Maori around here Pakeha insensitivity, colonisation, arrogance, domination, exploitation." The WARG process therefore acted as an instrument to bring together these plural perspectives such that a collective 'social choice' could be made, rather than a legally enforced one. It became apparent that land disposal was not possible given the soil types and local climate, meaning that it would need to be a long-term goal, if at all possible. In recognising this, tangata whenua agreed to continue discharging wastewater to the Bay, in trusting that GDC will continue to strive for land-based discharge in the future, as technology and other circumstances allow.

C) Dialogic mobilisation of knowledge as 'evidence' in support of value positions

Stakeholders recognised the WARG as a dialogic initiative to overcome political division and arrive at a collective decision, however most stakeholders recognised the role that knowledge played in both facilitating consensus, and ensuring that any decision was well-informed. WARG thus posed a participatory and dialogic science-policy interface forum, to channel knowledge from various sources to the decision-making table. Stakeholders noted that prior to the WARG, knowledge had been mobilised as evidence in support of personal political positions; "knowledge and information was used as reinforcements for their viewpoint." However, through WARG participants realised that as long as stakeholders were operating according to different knowledge bases, and employing different sources of evidence, it would be difficult to reach a collective decision. Within the WARG, evidence was negotiated through dialogue; "…knowledge has become shared. And so people have actually said to the owners of the knowledge, 'what does it mean?' So knowledge has become more jointly owned." Indeed the WARG sought a consensus view on all evidence tabled, demonstrating stakeholders' desire to share their knowledge, to listen to other perspectives as legitimate, and to challenge each other's evidence. For this reason, some stakeholders felt that the emphasis of the WARG was on negotiating evidence, rather than political trade-offs. There was some concern, however, that at times the technical evidence was beyond challenge, and that the holders of the knowledge were less inclined to listen to other non-technical evidence.

D) A participatory setting; inclusive of all knowledge perspectives

Prior to the WARG initiative, stakeholder perspectives were fragmented into their own settings (the Council chamber or the marae for example), and where there was communication, it was within a court setting where, "The dialogue that occurred…was past each other, because the language being spoken, it could have been two completely different languages…" WARG set out to provide an inclusive non-threatening to bring together all perspectives as legitimate. Within the WARG there was a full diversity of knowledge perspectives equally included. As one recognised, all participants were 'laymen' relative to the complexity of the issue, with no one having knowledge of all dimensions and facets; "A group of laypeople with skills in limited areas… the knowledge of particular areas was limited to particular people." Maori provided their traditional knowledge of Poverty Bay and the issue, through their cultural frame of reference. Likewise, existing science and technical wastewater treatment knowledge was employed by stakeholders to support the deliberation, and where this lacked, applied scientists and consultants were introduced to the WARG. Scientific expertise predictably came from the state agencies though also less expectedly from the Oho Ake participant who exhibited a deep knowledge of wastewater issues. Finally, local knowledge formed a significant part of the deliberation, though this came from all stakeholder groups, as all participants were local residents within what is a small and closely networked Gisborne community. This noted, for civil society and tangata whenua participants, the scientific and technical knowledge at times dominated the discussion.

E) Reconciling diverse perspectives according to notions of reciprocity and co-existence

The WARG saw stakeholders reach a point where they accepted other knowledge perspectives as legitimate, within a dialogic setting that nurtured greater understanding of other perspectives and greater empathy, as embodied within the group's ability to reach consensus. For one respondent this began from a willingness to enter into an inclusive process; "at the start we already intuitively knew that we would be dealing with concepts from different philosophical belief systems." Moreover, it came from recognising that each of these perspectives offered something of use to deliberation and decision-making; "a primary assumption on the part of people…that nobody had a complete monopoly over what was right; that everybody had perspectives… there was an implicit recognition that everybody contributes something to the group." Also key to reciprocity was the significant degree of common understanding and with it a degree of trust. Finally reciprocity stemmed from critical communication and listening; questioning perspectives (including one's own) rather than dismissing them. In this way, tangata whenua took on the science, and GDC recognised that not all concerns are scientifically measurable for instance. This was especially true relative to the notion of biotransformation, which acted as a focus for reconciling disparate traditional and scientific knowledge systems while critically analysing them; However, one respondent felt that tangata whenua and environmentalist concerns had to compete with the dominance of the science-centric perspective, which pervaded WARG.

F) Review by the Extended Peer Community

The WARG initiative was able to assemble an extended peer community comprising different knowledge systems, different experiences and different expertise. In this way, stakeholders played both the role of an expert in their given field and a knowledgeable lay-person other areas. Moreover where knowledge was identified as lacking, particularly relative to the technical engineering of wastewater treatment plants, additional stakeholders were brought into the WARG to contribute their perspective. As noted, the WARG provided a dialogic setting for stakeholders to both share their evidence and collectively critique the evidence of other stakeholders.

As an extended peer community, the WARG allowed for the reciprocal extension of legitimacy to all forms of knowledge, while at the same time demanded that all knowledge contributed was of a high quality for decision-making; "…a recognition that everybody contributes something to the group, but there wasn't a right of rubbish." This meant that while all stakeholders extended respect to each other's knowledge, they also actively challenged and critiqued it; "not questioning their knowledge, but questioning the evidence." Thus the WARG exhibited a form of 'extended peer review'; "The fact that we had a group that was talking though it is what got us there. We didn't at the end of the day have time to (scientifically) peer review our information, but I think we almost had a peer review amongst all the parties, because we had such a wide range of views." In this way, all respondents noted that there were multiple measures of knowledge quality exercised within the WARG, "…because you're talking about a compromise I suppose, between hard science and cultural values, if you really want to put them on a spectrum." At one end of the spectrum, engineers were introducing quantitative measures of wastewater quality and statistical risk, while at the other end tangata whenua were discussing qualitative scales of cultural wellbeing, though all knowledge quality assessment was allowed to co-exist. As noted, the WARG operated according to a consensus model such that the group would table a piece of evidence and debate its quality relative to the issue until they could arrive at consensus, with such debate especially active around the notion of biotransformation.

G) Reflexive social learning

For respondents, the WARG represented an on-going opportunity to learn and come to a collective understanding of the issue, with increased learning corresponding closely to increased trust, tolerance, and respect for other perspectives. As stakeholders felt 'safer' to share their knowledge learning resulted; "we began to share understandings because there was a willingness…to listen." For three respondents, this learning was embodied within the notion of biotransformation. Maori introduced what was to them a metaphysical notion of biophysical change, as the domain of their cultural deities and norms, which the scientific community saw equivalence in the theory and practice of biotransformation. Tangata whenua, for instance, were willing to learn about the science of biotransformation and give their cultural view on its significance; "the science that they provided us told us that there was a change of state somewhere." Beyond biotransformation, stakeholders widely reported that they learnt about both the wastewater issue and why other stakeholders held their perspective. Responses indicated increased empathy, particularly between tangata whenua and GDC. Finally, respondents indicated that they learnt more about the decision-making process; both the litigious framework and more intimately, the WARG process of shared decision-making through dialogue.

To the extent that the WARG nurtured social learning, it encouraged stakeholders to reflect on the plural understandings of the issue and the social context. In terms of the issue, WARG saw stakeholders question their previous ontological, epistemological and methodological framings. For example, the GDC developed a new holistic perspective of Poverty Bay, accepting that, "the truth or the reality of things is not just scientific or measurable." In terms of the social setting, the WARG saw stakeholders question their old practices of debating within a litigious court setting, and instead embrace a new dialogic setting. Equally it saw them question the tenets of representative democracy in favour of participatory democracy.

H) A strategic, long-term and adaptable process

Respondents recognised that the WARG was a small step within a much longer journey that stretches back to the early 1990's and will stretch forward across generations. The journey is one of coming to understand biotransformation over the long term, and what it means to the various stakeholders. In this way, the WARG represents both a short-term political 'sticking plaster' to reach consensus and more significantly, a long-term and strategic commitment to build relationships, with the inter-generational goal of collectively understanding biotransformation, and ultimately removing wastewater from Poverty Bay. "There was a feeling that this part of the solution has been passed on to the next generation…to a time when these alternative solutions are feasible and can be afforded." The WARG has put a lot of emphasis on remaining flexible and adaptable, and trusting in decisions made in good faith. At a high level, the WARG was seen to have 'adaptive ends,' because there is an expectation that the treatment and discharge of wastewater will change in the future as technology, social, economic and environmental factors change. There was also a more immediate adaptability built into the initiative with regular monitoring and review; "Everybody tells us, and you read all the literature, yeah it should work, but we don't know for sure. So the safety valve to that are review provisions."

3.2 Exploring the influence of the WARG on the quality of institutions

A) Cooperation

Prior to the WARG process there had been poor cooperation or coordination between state agencies around the issue of Gisborne's wastewater discharge, both 'horizontally' at the local level, and 'vertically' with central government agencies. Indeed, one stakeholder asserted that central government had held a lot of animosity toward GDC around its wastewater discharge, "…they weren't about to reward (GDCs) bad behaviour by subsidising them or giving them any help; so there was just a legacy of dreadful decision-making." However, as a result of the shared decision-making within the WARG initiative, stakeholders agreed that there had been increased cooperation, particularly between GDC and the Department of Conservation, with the Minister of Conservation expressing confidence in GDC by delegating decision-making to the Council. As one stakeholder noted, "if we didn't have that integration, I don't think we would have been able to…by consensus, come to the agreement." This noted, one stakeholder argued that it was still important to distinguish between the decision-making that continues at multiple levels; from the WARG group, to the local council 'holding the purse-strings,' to the members of the community asking "Can we afford this? Do we want to do it?"

B) Contingent

All stakeholders felt that the WARG process had mobilised knowledge and enabled decision-making that was contingent to the Gisborne context. Predominantly this contingency was seen to stem from the diversity of perspectives included within the WARG, and the commitment that participants demonstrated through striving to understand the other perspectives. This expressed itself through the way participants were able to communicate concerns from the perspective of other stakeholders for example; “non-Maori will make a comment about the cultural appropriateness of something, and the Maori reps will say, ‘that doesn’t make sense scientifically, what are you talking about?’ So that people aren’t just talking about their little pockets.” State agencies felt that the WARG process was made more contingent by effectively broadening the scope of decision-making to look at of the different ‘well-beings’ composed within the concept of sustainable development; environmental, social, cultural and economic. Previously decision-making had been framed by the litigious Resource Management Act framework, which was limited to ‘how much quantifiable pollution is there?’

C) Participatory

All stakeholders agreed that the WARG had enabled much more participatory decision-making than had occurred previously relative to the wastewater issue, with the WARG able to provide an “all-inclusive” decision-making setting; “it has been a much more participatory process, and has certainly opened it up to people that wanted to contribute; and many have in different ways.” Indeed, one stakeholder argued that without the participation and knowledge-sharing, there never would have emerged a legitimate decision; “Now here we’ve got a group who are actually saying, ‘we don’t compromise our belief systems or our fundamental goals. But as a pathway to us all getting there, we’re prepared to compromise...we haven’t all agreed on the destination, but we’ve agreed on a process, a journey.’” To the extent that the WARG has been viewed as successful, a number of stakeholders have sought to have it emulated for other ‘tricky’ issues in the future, with GDC exploring options for co-management with tangata whenua. There were two barriers to initiating a participatory WARG however. Firstly, the group met stiff resistance from the elected local politicians, who saw the power being taken out of their hands, as the WARG reported directly to the independent resource consent ‘commissioners.’ Secondly, there were a number of important stakeholders who were absent from the WARG, particularly industry stakeholders, though subsequent iterations (the WORG and the WTAG) have succeeded in including industry.

D) Comprehensive

There was widespread stakeholder recognition that the WARG process has changed the way that stakeholders use their knowledge; encouraging them to share knowledge and communally build a more comprehensive picture of the issue, rather than “keeping the powder dry” for a court-room battle. Central to this was a reflexivity exhibited by most stakeholders in questioning the way they ‘know’ the world, and coming to understand the intertwined knowledge and values of other stakeholder perspectives. Traditional and local knowledge holders were increasingly accepting of science, while science was willing to cede that it did not represent the totality of knowledge relevant to decision-making; “I think it’s made us question what science is…people aren’t looking for a scientific explanation for everything they see, but they’re prepared to say, ‘there might be some (formal) science that might be useful.’” Coupled with this, stakeholders recognised that a comprehensive understanding of the issue needs to be communicated to society via several different channels; “what’s the message that we need to deliver…to our respective constituencies. Some constituencies need a science base, some constituencies need a cultural base, and some constituencies need a warm fuzzy explanation.”

In general, stakeholders felt that the WARG had broadened the knowledge base to support decision-making. This both included more formal science, but also a greater amount of local and traditional knowledge: “Science is much more involved, but its broadened our base way out; It’s probably not more science-based, just more science and more of everything.” Moreover, the WARG has broadened the range of factors considered in making a decision; including social, economic and cultural impacts alongside the environmental impacts previously given primacy. Nevertheless, there remain significant knowledge gaps, necessitating a process that is cautious, flexible, and learning-focussed, with biotransformation presenting the focus of learning; “It may well be that we describe (biotransformation) with a cultural and a science-based approach.”

E) Precautionary

There were mixed reactions from stakeholders on whether the WARG initiative embodied precaution when making decisions. For one environmentalist stakeholder this represented one of the central debates; while a number of community groups recognised the uncertainties and preferred to err on the side of caution, GDC was seen to embody a ‘permissive principle.’ To this extent, some stakeholders reported that the WARG was less precautionary than before because of an increase in trust and agreement on proceeding with caution; “the trust has built up so that people will take a punt.” In this way, uncertainty was not seen as a barrier to ‘progress.’ On the other hand, some stakeholders emphasised that the WARG had included precaution at the centre of the decision, as reflected in the regular review conditions in the process; “it’s what’s called a ‘living consent;’ So there are a whole lot of checks and balances throughout it.”

F) Incremental and adaptable

The WARG initiative began in early 2006, and has evolved iteratively in three stages over the past four years; as the WARG, WORG, and WTAG. At each stage, the group has been faced with a different type of decision; adapting to new information as it has become available, taking on different roles, and progressing incrementally toward a defined future goal. However, though the WARG has changed name and shape, the knowledge, experience and trust has carried through. Stakeholders defined this flexibility in 'personnel' and 'institutional' terms. As to personnel flexibility, the WARG initiative has evolved as new stakeholders have become involved, such that it's later iterations have brought about the participation of industry stakeholders. For others, the WARG process has evolved as a result of a change of staff at the GDC, which has seen an increasing 'open-mindedness' toward other perspectives. As to 'institutional' flexibility, two factors emerged. Firstly, there have been a suite of review conditions built into the resource consent, which will feedback information to support subsequent decision-making. Secondly the WARG has made a commitment to on-going learning, specifically centred around biotransformation, in a continual search for alternatives to an ocean-based outfall. Stakeholders have described the decision-making process as a 'journey,' of which the treatment plant is just the first step; "they realised…all this generation could achieve is to put in a wastewater treatment plant…But they also wanted the council to understand that this is only an interim work."

G) Long-term and strategic

For almost all stakeholders, the WARG initiative has enabled a more strategic and long-term focussed decision-making setting. While previous debates had been over two or three year resource consents, the WARG stakeholders agreed to a 35-year, 'living' resource consent. This means that while a decision has been made for the long term, stakeholders have collectively agreed that the wastewater 'solution' will change over time in accordance with new knowledge, new technologies, financial budget, and community willingness. Through trust and good faith, GDC has agreed with WARG stakeholders to enter into a long-term learning endeavour on the process of biotransformation, and the potential for removing the outfall from Poverty Bay. The Gisborne community has prioritised its long-term goals and set in motion a process whereby they have agreed to take incremental steps toward these goals as future circumstances allow.

H) Integration with the decision-making process

Within the WARG setting, all stakeholders accepted that the process of mobilising knowledge was well integrated with the process of decision-making; "Clearly our decisions were based on those shared knowledges." Indeed two stakeholders recognised that the mobilisation of knowledge was an essential precursor to a decision; "if it hadn't been for the knowledge sharing you wouldn't have got the decision." For another stakeholder, this integration has been instituted into the future through a suite of review conditions as a continual feedback from implementation to decision-making. For one stakeholder however, there was some concern that the common understanding generated within the WARG was not effectively channelled to decision-making in other settings or among other constituencies; particularly 'up' the hierarchy to the local politicians, or 'down' to the wider community members.

Respondents all agreed that the WARG initiative represented a more effective means of mobilising knowledge and reaching a collective social choice, than their litigious and adversarial experience in the courtroom; "People have listened and seen the benefit of listening. So you've seen the council change over time because they've seen this as a way of avoiding conflict in the environment court…people have bought in to that process and liked it; it has created a social capital that wasn't here before." The WARG was similarly praised for nurturing cooperation and sharing between diverse perspectives according to an ethic of co-existence, to promote a common understanding to support decision-making; "being part of the process, I believe, has assisted us to understand not only the council side of things, but other community groups, and a whole lot of things where we had a shared understanding about things, but possibly a different view of things." Given the outcome of the initiative, a number of stakeholders, including those from the GDC, asserted that the WARG would provide a model for future processes; "as a reasonable way of dealing with 'tricky' issues."

3.3 Exploring the influence of the WARG process on the quality of stakeholder interactions

A) Financial capital

Primarily the WARG process was funded by GDC as the applicant and as the regulator, however both tangata whenua and local industry were also mentioned as providing some financial capital. For two respondents financial capital was minimal compared to the time volunteered by all participants.

B) Social capital

The interview responses indicated that the WARG process had increased the stock of 'social capital' within the network of stakeholders involved in the wastewater issue. In the first place, it increased the number and diversity of stakeholders active in governance, particularly in its later iterations as WORG and WTAG. This extended participation beyond GDC and tangata whenua, as the two central protagonists, to include the Department of Conservation and central government, scientists and the expert community, and local industry. At the same time, WARG increased the connectivity of interactions within the stakeholder network, and improved the quality of pre-existing interactions from being litigious to constructive. While the WARG setting itself enabled total connectivity, most respondents also recognised an increase in interactions outside WARG settings. Taking the median value, it may be suggested that interactions within the stakeholder network increased by 75%, with these interactions encompassing increased 'bonding' within stakeholder groups, 'bridging' between stakeholder groups, and even 'linking' with stakeholders at central government scale.

Besides improving the participation in governance, and the connectivity of stakeholder interactions, WARG was seen to improve the quality of interactions relative to their norms. All stakeholders made explicit that they have increased trust for the other stakeholders involved in the deliberation, and that this trust shapes their interactions with the others. One respondent went further to say that this trust is bound up with knowing the other stakeholders and respecting them, which has developed over time; "trust is about having realistic expectations of people." All respondents recognised increased reciprocity in their interactions as a result of the WARG initiative. For two respondents, this reciprocity extended to subsequent projects and initiatives involving WARG participants, which have progressed much more smoothly. Another respondent noted that the reciprocity developed within the WARG setting had spread to other interactions; "…it spreads out to all your other relationships." Finally, respondents were asked to what extent the WARG had led to a positive change in behaviour of stakeholders and the community at large. For all respondents, this change in behaviour was discussed relative to a measured change in the behaviour of GDC staff, and interaction between GDC and the community. A change in staff, and new leadership, signalled a wider change in the attitudes of the Council to more informal interaction, and a willingness to listen to other conflicting perspectives with openness, rather than suspicion and contempt. It also signalled a shift to notions of collaborative management; investing in collaboration rather than in resource management lawyers to defend the Councils position.

C) Human capital

The WARG process was able to assemble and grow a significant stock of human capital. However, as is typical of processes such as the WARG, the participants were divided into those paid to attend as part of their normal employment, and those unpaid members of the community that had to donate their time and resources. The under-resourced participants expressed this as a possible criticism of the WARG; "a long battle, and voluntary stuff takes it out of you because sometimes you do it for too long." This noted, some respondents argued that GDC had gone some way to resolving this issue, and retaining high participation, by agreeing to pay some fees to under-resourced stakeholders that they collectively wanted at the table.

The WARG encouraged diverse participation to lend the process credibility and legitimacy, although two perspectives were recognised by stakeholders as conspicuously absent; local industry and the 'wider community.' For four stakeholders, the challenge was to incorporate the perspective and interests of the wider community not part of any interest group; "We had to make some leaps by saying ‘we’re people that actually want to be interested.’” One stakeholder justified the WARG, stating; “It was kind of like a little mirror image of Gisborne’s community anyway, sitting around the table.” Moreover the WARG built on the assembled expertise, knowledge and experience of participants through the social learning that occurred, and through bringing in expertise as it was identified (i.e. applied scientists and consultants conversant with BTF technology). Two barriers to the effective mobilisation of expertise highlighted were the difficulties unpaid participants had in donating their time, and the intimidation of laymen faced with the technical and scientific intricacies of the BTF. Finally, as indicated, the WARG process grew significantly out of a change in leadership at GDC, which in turn inspired leadership among other stakeholder groups. To the extent that the WARG process was successful, leadership was crucial. The GDC played the greatest leadership role both in its capacity as applicant and regulator, by initiating the WARG and driving it. Beyond GDC, most respondents noted the leadership exhibited by tangata whenua, or more particularly TROTAK, and Oho Ake.

Bibliography

Adger, W. N. (2000). Social and ecological resilience: are they related? *Progress in Human Geography, 24*(3), 347-364.

Adger, W. N. (2003). Social Capital, Collective Action, and Adaptation to Climate Change. *Economic Geography 79*(4), 387-404.

Allen, T. F. H., & Starr, T. B. (1982). *Hierarchy: Perspectives for Ecological Complexity*. Chicago: The University of Chicago Press.

Allison, H., & Hobbs, R. (2006). *Science and Policy in Natural Resource Management*. Cambridge: Cambridge University Press.

Amin, A., & Hausner, J. (1997). Interactive governance and social complexity. In A. Amin & J. Hausner (Eds.), *Beyond Market and Hierarchy: Interactive Governance and Social Complexity*. Cheltenham: Edward Elgar Publishing Ltd.

Ansell, C., & Gash, A. (2007). Collaborative Governance in Theory and Practice. *Journal of Public Administration Research and Theory, 18*, 543-571.

Antunes, P., & Santos, R. (1999). Integrated environmental management of the oceans. *Ecological Economics, 31*, 215-226.

Armitage, D. (2005). Adaptive Capacity and Community-Based Natural Resource Management. *Environmental Management, 35*(6), 703-715.

Armitage, D. (2008). Governance and the commons in a multi-level world. *International Journal of the Commons, 2*(1), 7-32.

Armitage, D., Berkes, F., & Doubleday, N. (2007). Introduction: Moving beyond Co-Management. In D. Armitage, F. Berkes & N. Doubleday (Eds.), *Adaptive Co-management: Collaboration, Learning and Multi-Level Governance*. Vancouver: UBC Press.

Armitage, D., Marschke, M., & Plummer, R. (2008). Adaptive co-management and the paradox of learning. *Global Environmental Change, 18*(1), 86-98.

Arnold, A. C. (2004). *A review of public attitudes towards marine issues within and beyond New Zealand*. Wellington, N.Z.: Dept. of Conservation.

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners, 35*(4), 216-224.

Arrow, K. (1970). *Social Choice and Individual Values* (2nd ed.). New Haven: Yale University Press.

Barber, B. (1984). *Strong Democracy: Participatory Politics for a New Age*. Berkeley and Los Angeles: University of California Press.

Baumann, P. (2000). *Sustainable livelihoods and political capital: Arguments and evidence from decentralisation and natural resource management in India*. London: Overseas Development Institute.

Baumann, P., & Sinha, S. (2001). Linking development with democratic processes in India: political capital and sustainable livelihoods analysis. *Natural Resource Perspectives, 68*, 1-4.

Beck, U. (1992). *Risk Society: Towards a new modernity*. London: Sage.

Bennett, J., Lawrence, P., Johnstone, R., & Shaw, R. (2005). Adaptive management and its role in managing Great Barrier Reef water quality. *Marine Pollution Bulletin 51*, 70-75.

Berkes, F. (1999). *Sacred ecology: Traditional ecological knowledge and resource management*. Philadelphia: Taylor and Francis.

Berkes, F., Bankes, N., Marschke, M., Armitage, D., & Clark, D. (2005). Cross-scale Institutions and Building Resilience in the Canadian North In F. Berkes, R. Huebert, H. Fast, M. Manseau & A. Diduck (Eds.), *Breaking Ice: Renewable Resource and Ocean Management in the Canadian North*. Calgary: University of Calgary Press.

Berkes, F., Berkes, M. K., & Fast, H. (2007). Collaborative Integrated Management in Canada's North: The Role of Local and Traditional Knowledge and Community-Based Monitoring. *Coastal Management, 35*(1), 143-162.

Berkes, F., Colding, J., & Folke, C. (2003). Introduction. In F. Berkes, J. Colding & C. Folke (Eds.), *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*. Cambridge: Cambridge University Press.

Berkes, F., & Folke, C. (1994). Investing in Cultural Capital for Sustainable Use of Natural Capital. In A. M. Jansson, M. Hammer, C. Folke & R. Costanza (Eds.), *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. Washington DC: Island Press.

Berkes, F., Mathias, J., Kislalioglu, M., & Fast, H. (2001). The Canadian Arctic and the Oceans Act: the development of participatory environmental research and management. *Ocean & Coastal Management, 44*, 451-469.

Berkes, F., Reid, W., Wilbanks, T., & Capistrano, D. (2006). Conclusions: Bridging Scales and Knowledge Systems. In W. V. Reid, F. Berkes, T. J. Wilbanks & D. Capistrano (Eds.), *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington: Island Publishing.

Bille, R. (2007). A dual-level framework for evaluating integrated coastal management beyond labels. *Ocean & Coastal Management, 50*, 706-807.

Bille, R. (2008). Integrated coastal zone management: four entrenched illusions. *Surveys and Perspectives Integrating Environment and Society, 1*, 75-86.

Blaikie, P. M. (1996). Post-modernism and global environmental change. *Global Environmental Change, 6*(2), 81-85.

Boesch, D. F. (1999). The role of science in ocean governance. *Ecological Economics, 31*, 189-198.

Bohman, J. (1998). The Coming of Age of Deliberative Democracy. *The Journal of Political Philosophy, 6*(4), 400-425.

Booth, J. A., & Richard, P. B. (1998). Civil Society, Political Capital, and Democratization in Central America. *The Journal of Politics, 60*(3), 780-800.

Botsford, L. W., Castilla, J. C., & Peterson, C. H. (1997). The Management of Fisheries and Marine Ecosystems. *Science, 277*, 509-514.

Bourdieu, P. (1986). Forms of Capital. In R. J. G. (Ed.), *Handbook of Theory and Research for the Sociology of Education*. New York: Greenwood.

Bremer, S. (2009). *Evaluating the State of New Zealand's Coastal Management: Application of Integrated Coastal Management Indicators at the National and Local scale.* Palmerston North: NZCEE.

Bremer, S., & Glavovic, B. C. (2009). *Evaluating the state of New Zealand's coastal management*. Paper presented at the Coasts and Ports '09 Conference.

Brondizio, E. S., Ostrom, E., & Young, O. R. (2009). Connectivity and the Governance of Multi-level Social-Ecological Systems: The Role of Social Capital. *Annu. Rev. Environ. Resour., 34*, 253-278.

Bruckmeier, C. (2005). Interdisciplinary Conflict Analysis and Conflict Mitigation in Local Resource Management. *Ambio, 34*(2), 65-73.

Buanes, A., Jentoft, S., Karlsen, G. R., Maurstad, A., & Søreng, S. (2004). In whose interest? An exploratory analysis of stakeholders in Norwegian coastal zone planning. *Ocean & Coastal Management, 47*, 207-223.

Buchanan, J. (1978). From Private Preferences to Public Philosophy: The Development of Public Choice. In Buchanan et al (Ed.), *The Economics of Politics*. London: IEA Readings 18.

Buckle, P., Marsh, G., & Smale, S. (2000). New approaches to assessing vulnerability and resilience. *Australian Journal of Emergency Management, Winter*, 8-14.

Burbridge, P. R. (1997). A generic framework for measuring success in integrated coastal management. *Ocean & Coastal Management, 37*(2), 175-189.

Burgoyne, J. (1994). Stakeholder Analysis. In C. Cassell & G. Symon (Eds.), *Qualitative methods in organizational research: a practical guide* (pp. 187-207). London: Sage.

Campbell, S., & Fainstein, S. (2003). Introduction: The Structure and Debates of Planning Theory. In S. Campbell & S. Fainstein (Eds.), *Readings in Planning* (2nd ed.). Malden, USA: Blackwell Publishing.

Capra, F. (1996). *The Web of Life: A New Scientific Understanding of Living Systems*. New York: Anchor Books.

Carolan, M. (2006). Science, Expertise, and the Democratization of the Decision-Making Process. *Society and Natural Resources, 19*, 661-668.

Carvalho, A. (2007). Ideological cultures and media discourses on scientific knowledge; Re-reading news on climate change. *Public Understanding of Science, 16*(2), 233-243.

Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., et al. (2003). Knowledge systems for sustainable development. *PNAS, 100*(14), 8086-8091.

Checkland, P., & Scholes, J. (1990). *Soft systems methodology in action*. Chichester, New York: Wiley.

Cheong, S.-M. (2008). A new direction in coastal management. *Marine Policy, 32*, 1090-1093.

Christie, P. (2005). Is Integrated Coastal Management Sustainable? *Ocean & Coastal Management, 48*, 208-232.

Chua, T.-E. (1993). Essential Elements of Integrated Coastal Zone Management. *Ocean & Coastal Management, 21*, 81-108.

Chuenpagdee, R., Fraga, J., & Euan-Avila, J. (2004). Progressing Toward Comanagement Through Participatory Research. *Society and Natural Resources, 17*, 147-161.

Chuenpagdee, R., Kooiman, J., & Pullin, R. (2008). Exploring governability in capture fisheries, aquaculture and coastal zones. *The Journal of Transdisciplinary Environmental Studies, 7*(1), 1-20.

Cicin-Sain, B., & Knecht, R. W. (1998). *Integrated coastal and ocean management : concepts and practices* Washington, D.C. :: Island Press.

Clark, J. R. (1998). *Coastal seas : the conservation challenge / John R. Clark*. Oxford ; Malden, MA: Blackwell Science.

Clark, W. C., & Majone, G. (1985). The Critical Appraisal of Scientific Inquiries with Policy Implications. *Science, Technology, & Human Values, 10*(3), 6-19.

Clements, F. E. (1916). *Plant Succession: An Analysis of the Development of Vegetation* (Vol. Publication Number 242). Washington: Carnegie Institute of Washington.

Cobb, R. W., & Elder, C. D. (1971). The Politics of Agenda-Building: An Alternative Perspective for Modern Democratic Theory. *The Journal of Politics, 33*(4), 892 - 915.

Colebatch, H. K. (2005). Policy analysis, policy practice and political science. *Australian Journal of Public Administration, 64*(3), 14-23.

Coleman, J. S. (1988). Social capital in the creation of human capital. *Am. J. Sociol., 94*, 95-120.

Collingridge, D., & Reeve, C. (1986). *Science Speaks to Power*. London: Printer.

Costanza, R. (1999). The ecological, economic, and social importance of the oceans. *Ecological Economics, 31*, 199-213.

Costanza, R., Andrade, F., Antunes, P., van den Belt, M., Boesch, D., Boersma, D., et al. (1999). Ecological economics and sustainable governance of the oceans. *Ecological Economics, 31*, 171-187.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., et al. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*, 253-260.

Costanza, R., & Daly, H. (1992). Natural Capital and Sustainable Development. *Conservation Biology, 6*, 37-46.

Costanza, R., Kemp, M., & Boynton, W. (1995). Scale and biodiversity in estuarine ecosystems. In C. Perrings, K. G. Mäler, C. Folke, C. S. Holling & B. O. Jansson (Eds.), *Biodiversity loss: economic and ecological issues* (pp. 84-125). Cambridge: Cambridge University Press.

Craven, J. (1992). *Social choice: A framework for collective decisions and individual judgements*. Cambridge: Cambridge University Press.

D'Incao, F., & Reis, E. G. (2002). Community-based management and technical advice in Patos Lagoon estuary (Brazil). *Ocean & Coastal Management, 45*, 531-539.

Daly, H. (1996). *Beyond Growth*. Boston: Beacon Press.

Daniels, S., & Walker, G. (1996). Collaborative Learning: Improving Public Deliberation in Ecosystem-Based Management. *Environmental Impact Assessment Review, 16*(2), 71-102.

Daniels, S., & Walker, G. (2001). *Working Through Environmental Conflict: The Collaborative Learning Approach*. Westport: Praeger Publishers.

De Marchi, B., & Ravetz, J. (1999). Risk management and governance: a post-normal science approach. *Futures, 31*(7), 743-757.

De Santo, E. M. (2010). 'Whose science?' Precaution and power-play in European marine environmental decision-making *Marine Policy, 34*, 414–420.

New Zealand Coastal Policy Statement (1994).

Department of Conservation. (2005). *Protecting our seas : an overview of New Zealand's marine biodiversity conservation and the role of Marine Protected Areas = Tiakina a Tangaroa*. Wellington, N.Z.: Marine Conservation Unit Dept. of Conservation.

deReynier, Y. L., Levin, P. S., & Shoji, N. L. (2010). Bringing stakeholders, scientists, and managers together through an integrated ecosystem assessment process *Marine Policy, 34*, 534–540.

Diamond, J. (2005). *Collapse : how societies choose to fail or succeed*. New York: Viking.

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *Science, 306*(5652), 1902-1912.

Dillenbourg, P. (1999). What do you mean by 'collaborative learning'? In P. Dillenbourg (Ed.), *Collaborative-learning: Cognitive and Computational Approaches* (pp. 1-19). Oxford: Elsevier.

Doody, J. P. (2003). Information required for integrated coastal zone management: conclusions from the European demonstration programme. *Coastal Management, 31*(163-173).

Driessen, P., Glasbergen, P., & Verdaas, C. (2001). Interactive policy-making - a model of management for public works. *European Journal of Operational Research, 128*, 322-327.

Dryzek, J. S. (1987). *Rational Ecology: Environment and Political Economy*. Oxford and New York: Basil Blackwell Ltd.

Dryzek, J. S. (1994). *Discursive Democracy: Politics, Policy and Political Science*. New York: Cambridge University Press.

Dryzek, J. S. (2001). Legitimacy and Economy in Deliberative Democracy. *Political Theory, 29*(5), 651-669.

Dryzek, J. S. (2002). *Deliberative Democracy and Beyond: Liberals, Critics and Contestations*. New York: Cambridge University Press.

Duit, A., & Galaz, V. (2008). Governance and Complexity—Emerging Issues for Governance Theory. *Governance: An International Journal of Policy, Administration, and Institutions, 21*(3), 311-335.

Edelenbos, J., & Klijn, E.-H. (2005). Managing Stakeholder Involvement in Decision Making: A Comparative Analysis of Six Interactive Processes in the Netherlands. *Journal of Public Administration Research and Theory, 16*, 417-446.

Egler, F. (1970). *The Way of Science: A Philosophy of Ecology for the Layman*. New York: Hafner Publishing Company.

Ehler, C. N. (2003). Indicators to measure governance performance in integrated coastal management. *Ocean & Coastal Management, 46*, 335-345.

Elling, B. (2008). *Rationality and the Environment: Decision-making in Environmental Politics and Assessment*. London: Earthscan.

Ellsworth, J. E., Hildebrand, L. E., & Glover, E. A. (1997). Canada's Atlantic Coastal Action Program: A community-based approach to collective governance. *Ocean & Coastal Management, 36*(1-3), 121-142.

Elton, C. (1927). *Animal Ecology*. London: Sidgwick and Jackson.

Etkins, P., Simon, S., Deutsch, L., Folke, C., & De Groot, R. (2003). A framework for the practical application of the concepts of critical natural capital and strong sustainability. *Ecological Economics, 44*, 165-185.

Everett, S. (2003). The Policy Cycle: Democratic Process or Rational Paradigm Revisited? *Australian Journal of Public Administration 62*(2), 65-70.

Fabricus, C., Scholes, R., & Cundill, G. (2006). Mobilizing Knowledge for Integrated Ecosystem Assessments. In W. V. Reid, F. Berkes, T. J. Wilbanks & D. Capistrano (Eds.), *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington: Island Publishing.

Feldman, A. M., & Serrano, R. (2006). *Welfare Economics and Social Choice Theory* (2 ed.). New York: Springer.

Fletcher, S., Potts, J., & Ballinger, R. C. (2008). The pedagogy of integrated coastal management. *The Geographical Journal, 174*(4), 374-386.

Flyvbjerg, B. (1998). *Rationality and Power: Democracy in Practice*. Chicago: The University of Chicago Press.

Flyvbjerg, B., & Richardson, T. (2002). Planning and Foucault: In Search of the Dark Side of Planning Theory. In P. Allmendinger & M. Tewdwr-Jones (Eds.), *Planning Futures: New Directions for Planning Theory* (pp. 44-62). London and New York: Routledge.

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change, 16*, 253-267.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L. H., Holling, C. S., Walker, B., et al. (2002). *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations*. Stockholm: The Environmental Advisory Council to the Swedish Government.

Folke, C., Colding, J., Olsson, P., & Hahn, T. (2007). Interdependent Social-Ecological Systems and Adaptive Governance for Ecosystem Services. In J. Pretty, A. S. Ball, T. Benton, J. S. Guivant, D. R. Lee, D. Orr, M. J. Pfeffer & H. Ward (Eds.), *The SAGE Handbook of Environment and Society*. London: SAGE Publications Ltd.

Folke, C., Hammer, M., Costanza, R., & Jansson, A. M. (1994). Investing in Natural Capital - Why, What and How? In A. M. Jansson, M. Hammer, C. Folke & R. Costanza (Eds.), *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. Washington DC: Island Press.

Fontalvo-Herazo, M. L., Glaser, M., & Lobato-Ribeiro, A. (2007). A method for the participatory design of an indicatorsystem as a tool for local coastal management. *Ocean & Coastal Management, 50*, 779-795.

Forgie, V., Cheyne, C., & McDermott, P. (1999). *Democracy in New Zealand Local Government: Purpose and Practice*. Palmerston North: Massey University School of Resource and Environmental Planning.

Forst, M. F. (2009). The convergence of Integrated Coastal Zone Management and the ecosystems approach. *Ocean & Coastal Management, 52*, 294–306.

Frame, B., & Brown, J. (2008). Developing post-normal technologies for sustainability. *Ecological Economics, 65*(2), 225-241.

Francis, G. (2006). “Models” for Sustainability Emerge in an Open Systems Context. *Integrated Assessment Journal, 6*(4), 59-77.

Friedmann, J. (1987). *Planning in the Public Domain: From Knowledge to Action*. New Jersey: Princeton University Press.

Fritz, J.-S. (2010). Towards a ‘new form of governance’ in science-policy relations in the European Maritime Policy *Marine Policy, 34*, 1-6.

Fukuyama, F. (1995). *Trust: The Social Virtues and the Creation of Prosperity*. New York: Free Press.

Fuller, S. (2007). *The Knowledge Book*. Stocksfield: Acumen Publishing Limited.

Funtowicz, S. O., & O'Connor, M. (1999). The passage from entropy to thermodynamic indeterminacy: a social and science epistemology for sustainability. In K. Mayumi & J. M. Gowdy (Eds.), *Bioeconomics and sustainability: essays in honor of Nicholas Georgescu-Roegen*. Cheltanham: Edward Elgar.

Funtowicz, S. O., & Ravetz, J. R. (1990). *Uncertainty and Quality in Science for Policy* (Vol. 15). Dordrecht: Kluwer Academic Publishers.

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures, 25*(7), 739-755.

Funtowicz, S. O., & Ravetz, J. R. (1994). The worth of a songbird: ecological economics as a post-normal science. *Ecological Economics, 10*(3), 197-207.

Funtowicz, S. O., & Ravetz, J. R. (1997). The Poetry of Thermodynamics: Energy, Entropy/Exergy and Quality. *Futures, 29*(9), 791-810.

Funtowicz, S. O., Ravetz, J. R., & O’Connor, M. (1998). Challenges in the use of science for sustainable development. *International Journal for Sustainable Development, 1*(1), 99-107.

Funtowicz, S. O., & Strand, R. (2006). Models of Science and Policy. In T. Traavik & L. C. Lim (Eds.), *Biosafety First: Holistic Approaches to Risk and Uncertainty in Genetic Engineering and Genetically Modified Organisms* (pp. 263-278). Trondheim: Tapir Academic Press.

Galaz, V. (2005). Social-ecological Resilience and Social Conflict: Institutions and Strategic Adaptation in Swedish Water Management. *Ambio, 34*(7), 567-572.

Gerhardinger, L., Godoy, E., & Jones, P. J. S. (2009). Local ecological knowledge and the management of marine protected areas in Brazil. *Ocean & Coastal Management, 52*, 154-165.

GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). (1996). *The Contributions of Science to Integrated Coastal Management* (Vol. 61): GESAMP Reports and Studies.

Giarini, O., & Stahel, W. R. (1993). *The Limits to Certainty, Facing Risks in the New Service Economy* (2nd ed.). Dordrecht: Kluwer Academic Publishers.

Gibbons, M. (1999). Science's new social contract with society. *Nature, 402*.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The New Production of Knowledge*. London: SAGE Publications.

Gibbs, M. T. (2008). Network governance in fisheries. *Marine Policy, 32*, 113-119.

Gibbs, M. T. (2009). Resilience: What is it and what does it mean for marine policymakers? . *Marine Policy, 33*, 322-331.

Gibbs, M. T., & Cole, A. (2008). Oceans and Coasts as Complex Adaptive Systems. In M. Patterson & B. C. Glavovic (Eds.), *Ecological Economics of the Oceans and Coasts*. Cheltenham: Edward Elgar Publishing Ltd.

Glaser, B. G. (2004). Remodeling grounded theory. *Qualitative Social Research, 5*(2), 20.

Glavovic, B. C. (2006). Coastal Sustainability - An Elusive Pursuit?: Reflections on South Africa's Coastal Policy Experience. *Coastal Management, 34*(1), 111 - 132.

Glavovic, B. C. (2008a). Ocean and Coastal Governance for Sustainability: Imperatives for Integrating Ecology and Economics. In M. Patterson & B. C. Glavovic (Eds.), *Ecological Economics of the Oceans and Coasts*. Cheltenham: Edward Elgar Publishing Ltd.

Glavovic, B. C. (2008b). Sustainable Coastal development in South Africa: Bridging the chasm between rhetoric and reality. In R. R. Krishnamurthy, B. C. Glavovic, A. Kannen, D. R. Green, A. L. Ramanathan, Z. Han, S. Tinti & T. S. Agardy (Eds.), *Integrated Coastal Zone Management*. Singapore: Research Publishing Services.

Gleason, H. A. (1917). The Structure of Development of the Plant Association. *Bulletin of the Torrey Botanical Club, 44*(10), 463-481.

Gleason, M., McCreary, S., Miller-Henson, M., Ugoretz, J., Fox, E., Merrifield, M., et al. (2010). Science-based and stakeholder-driven marine protected area network planning: A successful case study from north central California. *Ocean & Coastal Management, 53*, 52-68.

Gleick, J. (1987). *Chaos: Making a New Science*. New York: Penguin Books.

Grafton, R. Q. (2005). Social capital and fisheries governance. *Ocean & Coastal Management, 48*, 753-766.

Greenberg, G. D., Miller, J. A., Mohr, L. B., & Vladeck, B. C. (1977). Developing Public Policy Theory: Perspectives from Empirical Research. *The American Political Science Review, 71*(4), 1532-1543.

Greenwood, D. J., & Levin, M. (1998). *Introduction to Action Research: Social Research for Social Change*: Sage Publications Ltd.

Grimble, R., & Wellard, K. (1997). Stakeholder Methodologies in Natural Resource Management: a Review of Principles, Contexts, Experiences and Opportunities. *Agricultural Systems, 55*(2), 173-193.

Gunderson, L. H. (2003). Adaptive Dancing: interactions between social resilience and ecological crisis. In F. Berkes, J. Colding & C. Folke (Eds.), *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change* (pp. 33-52). Cambridge: Cambridge University Press.

Haas, P. M. (1992). Introduction: epistemic communities and international policy coordination. *International Organisation 46*(1), 1-35.

Habermas, J. (1984). *The Theory of Communicative Action; Volume 1: Reason and Rationalisation in Society* (T. McCarthy, Trans.). Boston: Beacon Press.

Habermas, J. (1987). *The Theory of Communicative Action Vol. 2: Lifeworld and System: A Critique of Functionalist Reason* (T. McCarthy, Trans.). Cambridge: Polity Press.

Hajer, M. A. (1995). *The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process*. New York: Oxford University Press.

Hardin, G. (1968). The Tragedy of the Commons. *Science, 162*, 1243-1248.

Harremoes, P., & Turner, R. K. (2001). Methods for integrated assessment. *Regional Environment Change, 2*(2), 57-65.

Hastie, J. (2007). The Role of Science and Scientists in Environmental Policy In J. Pretty, A. S. Ball, T. Benton, J. S. Guivant, D. R. Lee, D. Orr, M. J. Pfeffer & H. Ward (Eds.), *The SAGE Handbook of Environment and Society* (pp. 519-535). London: Sage Publications Ltd.

Heater, D. (1990). *Citizenship: the civic ideal in world history, politics, and education*. London: Longman.

Hediger, W. (2000). Sustainable development and social welfare. *Ecological Economics, 32*, 481-492.

Hennessey, T. M. (1994). Governance and Adaptive Management for Estuarine Ecosystems: The Case of Chesapeake Bay. *Coastal Management, 22*, 119-145.

Henocque, Y. (2003). Development of process indicators for coastal zone management assessment in France. *Ocean & Coastal Management, 46*, 363-379.

Henrickson, L., & McKelvey, B. (2002). Foundations of ‘‘new’’ social science: Institutional legitimacy from philosophy, complexity science, postmodernism, and agent-based modeling. *PNAS, 99*(3), 7288-7295.

Hinrichsen, D. (1998). *Coastal Waters of the World: Trends, Threats and Strategies*. Washington D.C.: Island Press.

Hjortsø, C. N., Christensen, S. M., & Tarp, P. (2005). Rapid stakeholder and conflict assessment for natural resource management using cognitive mapping: The case of Damdoi Forest Enterprise, Vietnam. *Agriculture and Human Values, 22*, 149-167.

Hoffmann, J., & Löser, N. (2008). Indicators for ICZM – Overview and lessons learned based on the Oder Estuary Region in the south-western Baltic Sea. In R. R. Krishnamurthy, B. C. Glavovic, A. Kannen, D. R. Green, A. L. Ramanathan, Z. Han, S. Tinti & T. S. Agardy

(Eds.), *Integrated Coastal Zone Management*. Singapore: Research Publishing Services.

Holland, J. H. (1998). *Emergence: From Chaos to Order*. Reading: Addison-Wesley.

Holling, C. S. (1973). Resilience and Stability of Ecosystems. *Annual Review of Ecology and Systematics, 4*, 1-23.

Holling, C. S. (1995). What Barriers? What Bridges? In L. H. Gunderson, C. S. Holling & S. S. Light (Eds.), *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. New York: Colombia University Press.

Hommes, S., Hulscher, S. J. M. H., Mulder, J. P. M. H. S., Otter, H. S., & Bressers, H. T. A. (2009). Role of perceptions and knowledge in the impact assessment for the extension of Mainport Rotterdam *Marine Policy, 33*, 146– 155.

Hooper, R. J., & Chong, K. (2006). *Developing the NZ marine infrastructure*. Paper presented at the Royal Society of New Zealand Conference: New Zealand's oceans and its future: knowledge, opportunities and management.

Human, B. A., & Davies, A. (2010). Stakeholder consultation during the planning phase of scientific programs *Marine Policy, 34*, 645–654.

Hutchcroft, D. P. (2001). Centralization and Decentralization in Administration and Politics: Assessing Territorial Dimensions of Authority and Power. *Governance: An International Journal of Policy and Administration, 14*(1), 23-53.

IFREMER. (2010). *SPICOSA Third Year Scientific Activity Report: Deliverable D14.7*: IFREMER.

Imperial, M. T., Hennessey, T. M., & Robadue, D. (1993). The Evolution of Adaptive Management for Estuarine Ecosystems: the National Estuary Program and its Precursors. *Ocean & Coastal Management, 20*, 147-180.

Innes, J. (1999). Evaluating Consensus Building. In L. Susskind, S. McKearnan & J. Thomas-Larmer (Eds.), *The Consensus Building Handbook: A Comprehensive Guide to Reaching Agreement*. Thousand Oaks: SAGE Publications.

Innes, J., & Booher, D. (2004). Reframing Public Participation: Strategies for the 21st Century. *Planning Theory & Practice, 5*(4), 419-436.

International Oceanographic Commission. (2006). *A handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management*: UNESCO.

Janssen, P. H. M., Petersen, A. C., Van der Sluijs, J. P., Risbey, J. S., & Ravetz, J. R. (2005). A guidance for assessing and communicating uncertainties. *Water Science and Technology, 52*(6), 125-131.

Jasanoff, S. (1990). *The fifth branch: science advisors as policy-makers*. Cambridge, MA.: Howard University Press.

Jasanoff, S. (2003). Technologies of humility: citizen participation in governing science. *Minerva, 41*(3), 223-244.

Jentoft, S. (2005). Introduction - Part II. In J. Kooiman, M. Bavinck, S. Jentoft & S. Pullin (Eds.), *Fish for Life: Interactive Governance for Fisheries*. Amsterdam: Amsterdam University Press.

Jentoft, S. (2007). Limits of governability: Institutional implications for fisheries and coastal governance. *Marine Policy, 31*, 360-370.

Jentoft, S., & Chuenpagdee, R. (2009). Fisheries and coastal governance as a wicked problem *Marine Policy, 33*(4), 553-560.

Jones, S. (2002). Social constructionism and the environment: through the quagmire. *Global Environmental Change 12*, 247-251.

Jørgensen, S. E., Patten, B. C., & Straskraba, M. (1992). Ecosystems emerging: toward an ecology of complex systems in a complex future. *Ecological Modelling, 62*(1-3), 1-27.

Juday, C. (1940). Tha annual budget for an island lake. *Ecology, 21*(4), 438-450.

Jude, S. (2008). Investigating the Potential Role of Visualization Techniques in Participatory Coastal Management. *Coastal Management, 36*, 331–349.

Kasper, W., & Streit, M. E. (1998). *Institutional Economics: Social Order and Public Policy*. Cheltenham: Edward Elgar.

Kauffman, S. A. (1993). *The Origins of Order: Self-Organisation and Selection in Evolution*. New York: Oxford University Press.

Kay, J. J., Regier, H. A., Boyle, M., & Francis, G. (1999). An Ecosystem Approach for Sustainability: Addressing the Challenge of Complexity. *Futures, 31*(7), 721-742.

Keen, M., Brown, V., & Dybal, R. (2005). *Social Learning in Environmental Management*. London: Earthscan.

Keen, M., & Mahanty, S. (2006). Learning in sustainable natural resource management: challenges and opportunities in the Pacific. *Society and Natural Resources, 19*(6), 497-513.

Kendra, J. M. (1997). Seaport development versus environmental preservation: the case of Sears Island, Maine, USA. *Marine Policy, 21*(5), 409-424.

Kilvington, M. (2007). Social learning as a framework for building capacity to work on complex environmental management problems. Retrieved 18 November, 2008, from www.landcareresearch.co.nz

Kingdon, J. W. (1984). *Agendas, Alternatives and Public Policies*. Boston: Little Brown.

Kingsley, G. T. (1996). Perspectives on devolution. *Journal of the American Planning Association, 62*(4), 419.

Klauer, B., & Brown, J. D. (2004). Conceptualising imperfect knowledge in public decision making: ignorance, uncertainty, error and 'risk situations'. *Environmental Research, Engineering and Management, 27*(1), 124-128.

Klein, J. T. (2000). *Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society - An Effective Way for Managing Complexity*. Basel: Birkhäuser.

Knol, M. (2010). Scientific advice in integrated ocean management: The process towards the Barents Sea plan *Marine Policy, 34*, 252–260.

Kooiman, J. (1999). Social-Political Governance. *Public Management Review, 1*(1), 67-92.

Kooiman, J. (2003). *Governing as Governance*. New Delhi: SAGE Publications Ltd.

Kooiman, J., & Bavinck, M. (2005). The Governance Perspective. In J. Kooiman, M. Bavinck, S. Jentoft & R. Pullin (Eds.), *Fish for Life: Interactive Governance for Fisheries*. Amsterdam: Amsterdam University Press.

Koppenjan, J., & Klijn, E.-H. (2004). *Managing Uncertainties in Networks: A network approach to problem solving and decision making*. London: Routledge.

Korfmacher, K. S. (2002). Science and ecosystem management in the Albemarle–Pamlico Estuarine Study. *Ocean & Coastal Management, 45*, 277-300.

Kuhn, T. (1962). *The structure of scientific revolutions* (3rd ed.). Chicago: University of Chicago Press.

Lane, M. (2005). Public Participation in Planning: an intellectual history. *Australian Geographer, 36*(3), 283-299.

Laszlo, E. (1983). *Systems Science and World Order: Selected Studies*. Oxford: Pergamon Press.

Leach, W. D., Pelkey, N. W., & Sabatier, P. A. (2002). Stakeholder Partnerships as Collaborative Policymaking: Evaluation Criteria Applied to Watershed Management in California and Washington. *Journal of Policy Analysis and Management, 21*(4), 645-670.

Lebel, L., Anderies, J. M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T. P., et al. (2006). Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems. *Ecology and Society, 11*(1), 19.

Lee, K. N. (1993). *Compass and Gyroscope: Integrating Science and Politics for the Environment*. Washington D.C: Island Press.

Lehtonen, M. (2004). The environmental–social interface of sustainable development: capabilities, social capital, institutions. *Ecological Economics, 49*, 199-214.

Lemos, M.-C., & Agrawal, A. (2006). Environmental Governance. *Annual Review of Environment and Resources, 31*, 297-325.

Lindblom, C. E. (1977). *Politics and Markets – The Worlds Political-Economic Systems*. New York: Basic Books.

Lindblom, C. E. (1979). Still Muddling, Not Yet Through. *Public Administration Review, 39*(6), 517-526.

Lindeman, R. L. (1942). The Trophic-Dynamic Aspect of Ecology. *Ecology, 23*(4), 399-418.

Lorenz, E. N. (1963). Deterministic Nonperiodic Flow. *Journal of the Atmospheric Sciences, 20*, 130-141.

Lowry, K. S. (2002). The Landscape of ICM Learning Activities. *Coastal Management, 30*(4), 299 - 324.

Luks, F. (1999). Post-normal science and the rhetoric of inquiry: deconstructing normal science? *Futures, 31*(1), 705-719.

Mabudafhasi, R. (2002). The role of knowledge management and information sharing in capacity building for sustainable development—an example from South Africa. *Ocean & Coastal Management, 45*, 695-707.

Madison, J. J. (2000). Agenda-Building and Big Science. *Policy Sciences, 33*, 31-53.

Mahanty, S., Stacey, N., Holland, P., Wright, A., & Menzies, S. (2007). Learning to learn: Designing monitoring plans in the Pacific Islands International Waters Project. *Ocean & Coastal Management, 50*, 392-410.

Mahon, R., McConney, P., & Roy, R. N. (2008). Governing fisheries as complex adaptive systems. *Marine Policy, 32*, 104-112.

Makino, M., Matsuda, H., & Sakurai, Y. (2009). Expanding fisheries co-management to ecosystem-based management: A case in the Shiretoko World Natural Heritage area, Japan. *Marine Policy, 33*, 207-214.

Max-Neef, M. (2005). Foundations of Transdisciplinarity. *Ecological Economics, 53*(1), 5-16.

May, R. M. (1972). Will a Large Complex System be Stable? *Nature, 238*, 413-414.

May, R. M. (1974). Biological Populations with Non-Overlapping Generations: Stable Points, Stable Cycles and Chaos. *Science, 186*(4164), 645-647.

Mayunga, J. S. (2007). Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach. Unpublished A draft working paper prepared for the summer academy for social vulnerability and resilience building, 22 – 28 July 2007, Munich, Germany. Texas A&M University.

McCreary, S., Gamman, J., Brooks, B., Whitman, L., Bryson, R., Fuller, B., et al. (2001). Applying a Mediated Negotiation Framework to Integrated Coastal Zone Management. *Coastal Management, 29*(3), 183 - 216.

McFadden, L. (2007). Governing Coastal Spaces: The Case of Disappearing Science in Integrated Coastal Zone Management. *Coastal Management, 35*(4), 429 - 443.

McFadden, L. (2008). Exploring the challenges of integrated coastal zone management and reflecting on contributions to 'integration' from geographical thought. *The Geographical Journal, 174*(4), 299-314.

McKay, J. (2006). *Fisheries resource management, knowledge and opportunities: Has the emperor got no clothes?* Paper presented at the Royal Society of New Zealand Conference: New Zealand's oceans and its future: knowledge, opportunities and management.

McKenna, J., & Cooper, A. (2006). Sacred cows in coastal management: the need for a 'cheap and transitory' model. *Area, 38*(4), 421-431.

McKenna, J., Cooper, A., & O'Hagan, A. M. (2008). Managing by principle: A critical analysis of the European principles of Integrated Coastal Zone Management (ICZM). *Marine Policy, 32*, 941-955.

McNiff, J., & Whitehead, J. (2006). *Action Research*. London: SAGE Publications Ltd.

Ministry for the Environment. (2005). *Getting our priorities right : the role of information in setting priorities for management of New Zealand's ocean*. Wellington, N.Z.: Ministry for the Environment.

Ministry of Research Science and Technology. (2001). *Science and Society: A Policy Perspective Background*. Wellington: Ministry of Research Science and Technology.

Ministry of Research Science and Technology. (2004). *Evaluation of the environmental output class*. Wellington: MoRST.

Ministry of Research Science and Technology. (2007). *Roadmaps for science: Environment research*. Wellington: MoRST.

Ministry of Research Science and Technology. (2009). *Survey of urban councils and research*. Wellington: MoRST.

Morin Dalton, T. (2006). Exploring Participants' Views of Participatory Coastal and Marine Resource Management Processes. *Coastal Management, 34*, 351-367.

Moss, S. (2002). Agent Based Modelling for Integrated Assessment. *Integrated Assessment, 3*(1), 63-77.

Mueller, D. (1989). *Public Choice*. Cambridge: Cambridge University Press.

New Zealand Office of the Parliamentary Commissioner for the Environment. (1999). *Setting course for a sustainable future : the management of New Zealand's marine environment*. Wellington N.Z.: Parliamentary Commissioner for the Environment.

Newell, A. (1982). The knowledge level. *Artificial Intelligence, 18*, 87-127.

Newton, K. (2001). Trust, Social Capital, Civil Society, and Democracy. *International Political Science Review, 22*, 201-214.

Nicholls, R. J., & Branson, J. (1998). Coastal Resilience and Planning for an Uncertain Future: An Introduction. *The Geographical Journal, 164*(3), 255-258.

Nicolescu, B. (2002). *Manifesto of Transdisciplinarity*. New York: SUNY Press.

Norgaard, R. B., Kallis, G., & Kiparsky, M. (2009). Collectively engaging complex socio-ecological systems: re-envisioning science, governance, and the California Delta. *Environmental Science & Policy, 12*, 644-652.

Nowotny, H., Scott, P., & Gibbons, M. (2001). *Re-thinking science: knowledge and the public in an age of uncertainty*. Cambridge: Polity Press.

O'Connor, M. (1997). John Stuart Mill's utilitarianism and the social ethics of sustainable development. *The European Journal of the History of Economic Thought, 4*(3), 478-506.

O'Connor, M. (1999a). Dialogue and debate in a post-normal practice of science: a reflexion. *Futures, 31*(7), 671-687.

O'Connor, M. (1999b). Mana, magic and (post-)modernity: dissenting futures in Aotearoa. *Futures, 31*, 171-190.

O'Connor, M. (2006). The ‘‘Four Spheres’’ framework for sustainability. *Ecological Complexity, 3*, 285-292.

O'Connor, M., Bureau, P., & Reichel, V. (2007). *Deliberative Sustainability Assessment with the on line KerDST Deliberation Support Tool*. Guyancourt: Centre d’Economie et d’Ethique pour l’Environnement et le Développement.

O'Connor, M., Faucheux, S., Froger, G., Funtowicz, S. O., & Munda, G. (1996). Emergent Complexity and Procedural Rationality: Post-Normal Science for Sustainability. In R. Costanza, O. Segura & J. Martinez-Alier (Eds.), *Getting Down to Earth: Practical Applications of Ecological Economics*. Washington D.C: Island Press.

O'Neill, R. V., DeAngelis, D. L., Waide, J. B., & Allen, T. F. H. (1986). *A Hierarchical Concept of Ecosystems*. Princeton: Princeton University Press.

Oceans Policy Secretariat. (2001). *Healthy sea, healthy society : towards an oceans policy for New Zealand : report on consultation undertaken by the Ministerial Advisory Committee on Oceans Policy, 30 September 2001*. Wellington N.Z.: Oceans Policy.

Odum, E. P. (1969). The Strategy of Ecosystem Development. *Science, 164*(3877), 262-270.

Odum, E. P. (1971). *Fundamentals of Ecology* (Third ed.). Philidelphia: W. B Saunders Company.

Odum, E. P. (1993). *Ecology and our Endangered Life-Support Systems* (Second ed.). Sunderland: Sinauer Associates.

Odum, H. T. (1971). *Environment, Power and Society*. New York: John Wiley and Sons.

Olsen, S. B. (2000). Educating for the governance of coastal ecosystems: the dimensions of the challenge. *Ocean & Coastal Management, 43*, 331-341.

Olsen, S. B. (2002). Assessing Progress Toward the Goals of Coastal Management. *Coastal Management, 30*(4), 325 - 345.

Olsen, S. B. (2003a). Frameworks and indicators for assessing progress in integrated coastal management initiatives. *Ocean & Coastal Management, 46*, 347-361.

Olsen, S. B. (Ed.). (2003b). *Crafting Coastal Governance in a Changing World*. Narragansett: University of Rhode Island Coastal Resources Center.

Olsen, S. B., Page, G. G., & Ochoa, E. (2009). *The Analysis of Governance Responses to Ecosystem Change: A Handbook for Assembling a Baseline* (Vol. 34). Geesthacht: LOICZ, GKSS Research Centre.

Olsen, S. B., Tobey, J., & Hale, L. Z. (1998). A Learn-based Approach to Coastal Management. *Ambio, 27*(8), 611-619.

Olsen, S. B., Tobey, J., & Kerr, M. (1997). A common framework for learning from ICM experience. *Ocean & Coastal Management, 37*(2), 155-174.

Olsson, P., Gunderson, L. H., Carpenter, S. R., Ryan, P., Lebel, L., Folke, C., et al. (2006). Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems. *Ecology and Society, 11*(1), 18.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.

Outhwaite, W. (1996). *The Habermas Reader*. Cambridge: Polity Press.

Paavola, J., & Adger, W. N. (2005). Institutional Ecological Economics. *Ecological Economics, 53*(3), 353-368.

Pahl-Wostl, C. (2002). Participative and Stakeholder-Based Policy Design, Evaluation and Modeling Processes. *Integrated Assessment, 3*(1), 3-14.

Pahl-Wostl, C. (2005). Actor based analysis and modeling approaches. *Integrated Assessment Journal, 5*(1), 97-118.

Pahl-Wostl, C., & Hare, M. (2004). Processes of Social Learning in Integrated Resources Management. *Journal of Community & Applied Social Psychology, 14*(3), 193-206.

Paldam, M. (2000). Social Capital: One or many? Definition and Measurement. *Journal of Economic Surveys, 14*(5), 629-653.

Parliamentary Commissioner for the Environment. (2001). *Key lessons from the history of science and technology: knowns and unknowns, breakthroughs and cautions*. Wellington: Parliamentary Commissioner for the Environment.

Parliamentary Commissioner for the Environment. (2002). *Creating Our Future: Sustainable Development for New Zealand*. Wellington: Parliamentary Commissioner for the Environment.

Parliamentary Commissioner for the Environment. (2003). *Illuminated or blinded by science? A discussion paper on the role of science in environmental policy and decision-making*. Wellington: Parliamentary Commissioner for the Environment.

Parliamentary Commissioner for the Environment. (2004). *Missing Links: Connecting science with environmental policy*. Wellington: Parliamentary Commissioner for the Environment.

Parliamentary Commissioner for the Environment. (2007). *Outcome evaluation: Missing links: Connecting science with environmental policy*. Wellington: Parliamentary Commisioner for the Environment.

Patterson, M., & Glavovic, B. C. (2008). Summary and Future Challenges for an Ecological Economics of the Oceans and Coasts. In M. Patterson & B. C. Glavovic (Eds.), *Ecological Economics of the Oceans and Coasts*. Cheltenham: Edward Elgar Publishing Ltd.

Peart, R. (2005). *Looking out to sea : New Zealand as a model for ocean governance*. Auckland, N.Z.: Environmental Defence Society.

Peart, R. (2006). *Managing New Zealand's coastal development: the role of national policy* Paper presented at the Coast to Coast 2006 conference.

Peart, R. (2007). *Beyond the Tide: Integrating the management of New Zealand's coasts*. Auckland: Environmental Defence Society Incorporated.

Peel, D., & Lloyd, M. G. (2008). Governance and planning policy in the marine environment: regulating aquaculture in Scotland. *The Geographical Journal, 174*(4), 361-373.

Pickaver, A. H., Gilbert, C., & Breton, F. (2004). An indicator set to measure the progress in the implementation of integrated coastal zone management in Europe. *Ocean & Coastal Management, 47*(9-10), 449-462.

Pielke, R. A. (2007). *The Honest Broker: Making Sense of Science in Policy and Politics*. Cambridge: Cambridge University Press.

Pierre, J., & Peters, B. G. (2000). *Governance, Politics and the State*. London: MacMillan Press Ltd.

Plummer, R., & Armitage, D. (2007). A resilience-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world. *Ecological Economics, 61*, 62-74.

Plummer, R., & FitzGibbon, J. (2007). Connecting Adaptive Co-Management, Social Learning and Social Capital through Theory and Practice. In D. Armitage, B. F. & N. Doubleday (Eds.), *Adaptive Co-management: Collaboration, Learning and Multi-Level Governance* (pp. 38-61). Vancouver: UBC Press.

Poitras, J., Bowen, R., & Wiggin, J. (2003). Challenges to the use of consensus building in integrated coastal management. *Ocean & Coastal Management, 46*, 391-405.

Polanyi, M. (1967). *The tacit dimension*. New York: Doubleday.

Popper, K. R. (1963). *Conjectures and Refutations: The Growth of Scientific Knowledge* (5th ed.). London and New York: Routledge.

Popper, K. R. (1994). *The Myth of the Framework: In defence of science and rationality*. London: Routledge.

Pretty, J. (2003). Social capital and the collective management of resources *Science, 302*(3), 1912.

Pretty, J., & Ward, H. (2001). Social Capital and the Environment. *World Development, 29*(2), 209-227.

Pritchard, L., & Sanderson, S. E. (2002). The Dynamics of Political Discourse in Seeking Sustainability. In L. H. Gunderson & C. S. Holling (Eds.), *Panarchy*. Washington D.C: Island Press.

Putnam, R. D. (1993). *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton: Princeton University Press.

Putnam, R. D. (2000). *Bowling alone: the collapse and revival of American community*. New York: Simon & Schuster.

Ramírez, R. (1999). Stakeholder analysis and conflict management *Concept: Society*: International Development Research Centre.

Ravetz, J. R. (1971). *Scientific Knowledge and its Social Problems*. London: Oxford University Press.

Ravetz, J. R. (1999). What is Post-Normal Science? *Futures, 31*(7), 647-653.

Ravetz, J. R. (2006). Post-Normal Science and the complexity of transitions towards sustainability. *Ecological Complexity, 3*(4), 275-284.

Ravetz, J. R., & Funtowicz, S. O. (1999). Post-Normal Science—an insight now maturing. *Futures, 31*, 641-646.

Rawls, J. (1993). *Political Liberalism*. New York: Colombia University Press.

Reason, P., & Bradbury, H. (2001). Broadening the Bandwidth of Validity: Issues and Choice-points for Improving the Quality of Action Research. In P. Reason & H. Bradbury (Eds.), *Handbook of Action Research*. London: Sage Publications Ltd.

Refsgaard, J. C., Van der Sluijs, J. P., Højberg, A. L., & Vanrolleghem, P. A. (2007). Uncertainty in the environmental modelling process: A framework and guidance. *Environmental Modelling & Software, 22*, 1543-1556.

Reid, W. V., Berkes, F., Wilbanks, T. J., & Capistrano, D. (2006). Introduction. In W. V. Reid, F. Berkes, T. J. Wilbanks & D. Capistrano (Eds.), *Bridging Scales and Knowledge*

Systems: Concepts and Applications in Ecosystem Assessment. Washington: Island Publishing.

Resilience Alliance. (2007a). *Assessing and managing resilience in social-ecological systems: A practitioners workbook: Version 1.0*: Resilience Alliance.

Resilience Alliance. (2007b). *Assessing Resilience in Social-Ecological Systems: A Workbook for Scientists: Version 1.1*: Resilience Alliance.

Rijsberman, F. R. (1997). *'Integrated coastal zone management: review of progress in selected OECD countries.'*. Paris: OECD.

Risbey, J. S., van der Sluijs, J. P., Kloprogge, P., Ravetz, J. R., Funtowicz, S. O., & Quintana, S. C. (2005). Application of a checklist for quality assistance in environmental modelling to an energy model. *Environmental Modeling and Assessment, 10*, 63-79.

Rittel, H. W., & Weber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*(2), 155-169.

Roca, E., Gamboa, G., & Tabara, J. D. (2008). Assessing the Multidimensionality of Coastal Erosion Risks: Public Participation and Multicriteria Analysis in a Mediterranean Coastal System. *Risk Analysis, 28*(2), 399-412.

Rockloff, S. F., & Lockie, S. (2006). Democratization of Coastal Zone Decision Making for Indigenous Australians: Insights from Stakeholder Analysis. *Coastal Management, 34*(3), 251 - 266.

Rosier, J. (2004). *Independent review of the New Zealand coastal policy statement : a report for the Minister of Conservation, May 2004*. Palmerston North, N.Z.: School of People Environment and Planning Massey University.

Rotmans, J. (1998). Methods for IA: The challenges and opportunities ahead. *Environmental Modeling and Assessment 3*, 155-179.

Rudel, T. K., & Gerson, J. M. (1999). Postmodernism, institutional change, and academic workers: a sociology of change. *Soc. Sci. Q., 80*(2), 213-228.

Runhaar, H., & van Nieuwaal, K. (2010). Understanding the use of science in decision-making on cockle fisheries and gas mining in the Dutch Wadden Sea: Putting the science–policy interface in a wider perspective. *Environmental Science & Policy, In Print*.

Russett, C. E. (1966). *The Concept of Equilibrium in American Social Thought*. New Haven: Yale University Press.

Ruth, M. (2008). Integrative Economy-Ecology Models for Marine Management. In M. Patterson & B. C. Glavovic (Eds.), *Ecological Economics of the Oceans and Coasts*. Cheltenham: Edward Elgar Publishing Ltd.

Sager, T. (2002). *Democratic Planning and Social Choice Dilemmas: Prelude to institutional planning theory*. Aldershot: Ashgate Publishing Ltd.

Sarda, R., Avila, C., & Mora, J. (2005). A methodological approach to be used in integrated coastal zone management processes: the case of the Catalan Coast (Catalonia, Spain). *Estuarine, Coastal and Shelf Science, 62*(3), 427-439.

Sarewitz, D. (2004). How science makes environmental controversies worse. *Environmental Science & Policy 7*(5), 385-403.

Schlager, E., & Blomquist, W. (1996). A Comparison of Three Emerging Theories of the Policy Process. *Political Research Quarterly, 49*(3), 651-672.

Schuller, T. (2001). The complimentary roles of human and social capital. *Canadian Journal of Policy Research*, 89-105.

Schulock, N. (1999). The Paradox of Policy Analysis: If It Is Not Used, Why Do We Produce So Much of It? *Journal of Policy Analysis and Management, 18*(2), 226-244.

Scottish Executive Central Research Unit. (2001). *Indicators to Monitor the Progress of Integrated Coastal Zone Management: A Review of Worldwide Practice*. Edinburch: Scottish Executive.

Self, P. (1993). *Government by the Market? The Politics of Public Choice*. London: The MacMillan Press Ltd.

Sirven, N. (2008). Social Capital: a critique and extension. In J. B. Davis & W. Dolfsma (Eds.), *The Elgar Companion to Social Economics*. Cheltenham: Edward Elgar Publishing Ltd.

Smith, H. D. (2002). The role of the social sciences in capacity building in ocean and coastal management. *Ocean & Coastal Management, 43*, 573-582.

Sorensen, E., & Torfing, J. (2003). Network Politics, Political Capital, and Democracy. *International Journal of Public Administration, 26*(6), 609-634.

Sorensen, J. (1993). The International Proliferation of Integrated Coastal Zone Management Efforts. *Ocean & Coastal Management, 21*, 45-80.

Sorensen, J. (2002). *Baseline 2000 Background Report: The Status of Integrated Coastal Management as an International Practice - Second Iteration*.

SPICOSA Project. (May 2010). *SPICOSA Description of Work: Annex I*.

Stafford, T., Carlson, M., & Hart, Z. (2009). Stakeholder Collaboration and Organizational Innovation in the Planning of the Deschutes Estuary Feasibility Study. *Coastal Management, 37*, 514-528.

Stojanovic, T. A. (2007). *Guidelines for Implementing Local Information Systems at the Coast*. Cardiff: COREPOINT and Cardiff University.

Stojanovic, T. A., Ball, I., Ballinger, R. C., Lymbery, G., & Dodds, W. (2009). The role of research networks for science-policy collaboration in coastal areas *Marine Policy, 33*, 901–911.

Stojanovic, T. A., Ballinger, R. C., & Lalwani, C. S. (2004). Successful integrated coastal management: measuring it with research and contributing to wise practice. *Ocean & Coastal Management, 47*(5-6), 273-298.

Stojanovic, T. A., & Barker, N. (2008). Improving governance through local Coastal Partnerships in the UK. *The Geographical Journal, 174*(4), 344-360.

Strauss, A. L., & Corbin, J. M. (1990). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks: SAGE Publications.

Stringer, E. T. (2007). Theory and Principles of Action Research. In E. T. Stringer (Ed.), *Action Research*. Thousand Oaks: Sage Publications Ltd.

Tansley, A. G. (1935). The Use and Abude of Vegetational Concepts and Terms *Ecology, 16*(3), 284-307.

Thomas, J. (1995). *Public Participation in Public Decisions*. San Francisco: Jossey Bass Publishers.

Throsby, D. (1999). Cultural Capital. *Journal of Cultural Economics, 23*, 3-12.

Ticehurst, J. (2008). Evolution of an approach to integrated adaptive management: The Coastal Lake Assessment and Management (CLAM) tool. *Ocean & Coastal Management, 51*, 645–658.

Tintore, J., Medina, R., Gomez-Pujol, L., Orfila, A., & Vizoso, G. (2009). Integrated and interdisciplinary scientific approach to coastal management. *Ocean & Coastal Management, 52*, 493–505.

Tobey, J., & Volk, R. (2002). Learning Frontiers in the Practice of Integrated Coastal Management. *Coastal Management, 30*(4), 285 - 298.

Tool, M. R. (1993). Introduction. In M. R. Tool (Ed.), *Institutional Economics: Theory, Method, Policy*. Boston: Kluwer Academic Publishers.

Torell, E. (2000). Adaptation and Learning in Coastal Management: The Experience of Five East African Initiatives. *Coastal Management, 28*, 353-363.

Tribbia, J., & Moser, S. C. (2008). More than information: what coastal managers need to plan for climate change. *Environmental Science & Policy, 11*, 312-328.

Turner, R. K. (2000). Integrating natural and socio-economic science in coastal management. *Journal of Marine Systems, 25*(3-4), 447-460.

Turner, R. K., Lorenzoni, I., Beaumont, N., Bateman, I. J., Langford, I. H., & McDonald, A. L. (1998). Coastal Management for Sustainable Development: Analysing Environmental and Socio- Economic Changes on the UK Coast *The Geographical Journal, 164*(3), 269-281.

University of Otago. (2005). *The impact of rising property prices on coastal settlement communities*. Dunedin: Dept. of Geography University of Otago.

US National Research Council. (2007). *Analysis of global change assessments: lessons learned*. Washington DC: National Academies Press.

Vallega, A. (1997). *Fundamentals of integrated coastal management*. Dordrecht, Netherlands ; Boston, MA :: Kluwer Academic Publishers.

Van Asselt-Marjolein, B. A., & Rijkens-Klomp, N. (2002). A look in the mirror: reflection on participation in Integrated Assessment from a methodological perspective. *Global Environmental Change, 12*(3), 167-184.

Van de Kerkhof, M. (2006). A dialogue approach to enhance learning for sustainability—A Dutch experiment with two participatory methods in the field of climate change. *Integrated Assessment Journal, 6*(4), 7-34.

Van den Hove, S. (2006). Between consensus and compromise: acknowledging the negotiation dimension in participatory approaches. *Land Use Policy 23*, 10–17.

Van den Hove, S., & O'Connor, M. (1997). Social perceptions of environmental issues: a case study looking at peoples representations of environmental issues. *International Journal for the Environment and Pollution, 7*(4), 560-577.

Van der Sluijs, J. P. (2001). Integrated Assessment Models and the Participatory Challenge: The case of Climate Change. In W. N. Dunn, M. Hisschemoller, R. Hoppe & J. R. Ravetz (Eds.), *Knowledge, Power, and Participation in Environmental Policy Analysis*.

Van der Sluijs, J. P. (Ed.) (2002a) Encyclopedia of Global Environmental Change (Vols. 4). Chichester: John Wiley & Sons Ltd.

Van der Sluijs, J. P. (2002b). A way out of the credibility crisis of models used in integrated environmental assessment. *Futures, 34*(2), 133-146.

Van der Sluijs, J. P. (2007). Uncertainty and precaution in environmental management: Insights from the UPEM conference. *Environmental Modelling & Software, 22*, 590-598.

Van der Sluijs, J. P., Craye, M., Funtowicz, S. O., Kloprogge, P., Ravetz, J. R., & Risbey, J. S. (2005). Combining Quantitative and Qualitative Measures of Uncertainty in Model-based Environmental Assessment. *Risk Analysis, 25*(2), 481-492.

Van der Weide, J., & Van Koningsveld, M. (2001). Enabling Mechanisms for Integrated Coastal Management. In B. Cicin Sain, I. Pavlin & S. Belfiore (Eds.), *Sustainable Coastal Management: A Transatlantic and Euro-Mediterranean Perspective*. Dordrecht: Kluwer Academic Publishers.

Varghese, K., Ganesh, L. S., Mani, M., Anilkumar, P. P., Murthy, R., & Subramaniam, B. R. (2008). Identifying critical variables for coastal profiling in ICZM planning—A systems approach. *Ocean & Coastal Management, 51*, 73-94.

Verweij, M., Douglas, M., Ellis, R., Engel, C., Hendriks, F., Lohmann, S., et al. (2006). Clumsy Solutions for a Complex World: The Case of Climate Change. *Public Administration, 84*(4), 817-843.

Vesely, W. E., & Rasmuson, D. M. (1984). Uncertainties in Nuclear Probabilistic Risk Analyses. *Risk Analysis, 4*, 313-322.

von Bertalanffy, L. (1975). *Perspectives on General System Theory: Scientific-Philosophical Studies*. New York: George Braziller.

Waldrop, M. M. (1992). *Complexity: The Emerging Science at the Edge of Order and Chaos*. London: Penguin Books.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, Adaptability and Transformability in Social–ecological Systems. *Ecology and Society, 9*(2), 5.

Walker, B., & Salt, D. (2006). *Resilience thinking: Sustaining Ecosystems and People in a Changing World*. Washington: Island Press.

Walker, W. E., Harremoes, P., Rotmans, J., Van der Sluijs, J. P., Van Asselt, M. B. A., Janssen, P., et al. (2003). Defining uncertainty a conceptual basis for uncertainty management in model-based decision support. *Integrated Assessment, 4*(1), 5-17.

Warren, J. (2005). *Stakeholder views about the marine environment and its protection*. Wellington, N.Z.: Science & Technical Pub. Dept. of Conservation.

Wasserman, S., & Faust, K. (1994). *Social Network Analysis: Methods and Applications*. New York: Cambridge University Press.

Weber, M. (1968). *Economy and society; an outline of interpretive sociology*. New York: Bedminster Press.

Weiss, C. (2007). Defining Precaution: UNESCO's World Commission on the Ethics of Scientific Knowledge and Techonology Report: The Precautionary Principle. *Environment, 49*(8), 33-36.

Wellman, B. (1991). Structural analysis: from method and metaphor to theory and substance. In B. Wellman & S. D. Berkowitz (Eds.), *Social Structures: A Network Approach*. New York: Cambridge University Press.

Western, J., Stimson, R., Baum, S., & Van Gellecum, Y. (2005). Measuring community strength and social capital. *Regional Studies, 39*(8), 1095-1109.

Wheeler, P., & Peterson, J. (2010). Exploring Stakeholder Views Regarding Spatial Information and Enabling Technology Use for ICZM: A Case Study from Victoria, Australia. *Coastal Management, 38*, 1-21.

Wilbanks, T. J. (2006). How Scale Matters: Some Concepts and Findings. In W. V. Reid, F. Berkes, T. J. Wilbanks & D. Capistrano (Eds.), *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington: Island Press.

Williams, B. A., & Matheny, A. R. (1995). *Democracy, Dialogue, and Environmental disputes: The Contested Languages of Social Regulation*: Yale University Press.

Willis, G. (2003). Oceans Management at the Local Level. Unpublished Report prepared for the Oceans Policy Secretariat.

Wood, R. S. (2006). *The 96% solution: resources on and beneath the ocean floor*. Paper presented at the Royal Society of New Zealand Conference: New Zealand's oceans and its future: knowledge, opportunities and management.

Woolcock, M. (2001). Microenterprise and social capital: a framework for theory, research and policy. *Journal of Socio-Economics 30*, 193-198.

World Commission on the Ethics of Scientific Knowledge and Technology. (2005). *The Precautionary Principle*. Paris: United Nations Economic, Scientific and Cultural Organization,.

Worldbank. (2009a). Measuring the Dimensions of Social Capital. Retrieved 16 July 2009, from http://go.worldbank.org/TC9QT67HG0

Worldbank. (2009b). Social Capital Measurement Tools. Retrieved 16 July 2009, from http://go.worldbank.org/LHI4AYZEF0

WWF - New Zealand. (2004). *Shining a spotlight on the biodiversity of New Zealand's marine ecoregion : Experts Workshop on Marine Biodiversity, 27-28 May 2003, Wellington, New Zealand*. Wellington, N.Z.: WWF-New Zealand.

WWF - New Zealand. (2005). *New Zealanders' views on threats and protection in the marine environment: Results of a Colmar Brunton national survey.* Wellington: WWF - New Zealand.

Wynne, B. (2005). Reflexing Complexity: Post-genomic knowledge and reductionist returns in public science. *Theory, Culture and Society, 22*(5), 67-94.

Wynne, B. (2006). Public engagement as a means of restoring public trust in science - Hitting the notes, but missing the music? *Community Genetics, 9*(3), 211-220.

Yao, H. (2008). Lessons Learned from ICOM Initiatives in Canada and China. *Coastal Management, 36*(5), 458-482.

Zermoglio, M. F., van Jaarsveld, A., Reid, W. V., Romm, J., Biggs, O., Yue, T. X., et al. (2005). The multi-scale approach *Millenium Ecosystem Assessment: Multiscale assessments - Findings of the Sub-Global Assessments Working Group* (Vol. 4, pp. 61-83). Washington D. C.: Island Press.