Chapter 1: Introduction

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1.1 Context

Environmental issues increasingly provide a source of contention for scientific as well as political and business debates. The boundaries of these debates have been irrevocably extended to 'sustainable development', encompassing issues of the 'economy' and 'society' as well as the 'environment'. What is sometimes referred to as the current 'environmental crisis' reflects the defects of existing development models and associated systems of production and consumption. In the global economy such defects, particularly evident in developing countries, can be summarised as follows:

"Increasing levels of poverty, exploitation of human and natural resources for the primary benefit of outside interests, a decline in agricultural production particularly in the subsistence sector, uncontrollable urban growth, unequal distribution of land and other assets, increased land use conflicts and widespread environmental degradation" (Atlhopheng *et al*, 1998).

In 1992 world leaders met at the UN Conference on Environment and Development—the 'Rio Earth Summit'—to formulate a common agenda for improving environmental sustainability by addressing associated concerns of economic development. 'Agenda 21' was the output from the Earth Summit. The agenda consists of a large set of declarations including, for example, adoption of the 'precautionary principle' (the principle that technological innovations should not be introduced unless or until there is evidence of their safety); a commitment to the eradication of poverty and reduction of disparities in living standards; a commitment to reducing and eliminating unsustainable patterns of production and consumption; a statement supporting citizen participation in environmental management; etc. On a more concrete level, the Summit also produced a number of Conventions. These included Conventions on Biological Diversity, Climate Change, Desertification, Forestry, and the Commission on Sustainable Development. The full Agenda 21 programme was costed at $128 billion, which was considered to be affordable by the World's nations in light of the fact that it is just one

tenth of the global arms budget. However, to this date, only a small fraction of the budget has been committed.

In the UK, recent Government initiatives have sought to carry forward the Agenda 21 declarations. In 1999, the Government produced *A Better Quality of Life: a Strategy for Sustainable Development in the UK* (DETR, 1999) which includes proposals for translating Agenda 21 principles into action at the local level. The methodological emphasis has largely been on monitoring and control: how local planners can set targets and monitor change as part of the environmental management process. Nevertheless, there have been disputes over defining 'best value', 'headline', 'quality of life' and 'sustainable development' indicators, both in relation to Local Agenda 21 plans and wider international development initiatives serving poverty elimination. Also, with the collapse of the Seattle World Trade Organisation talks in 1999, and the continuing debate in the media over the use of genetically modified organisms in food production, there is a growing appreciation of the need for planners to address issues of public trust. The idea that planners can and should set targets, and monitor the attainment of these, without first engaging in pubic discussion about basic values, has been brought into question.

Notwithstanding the considerable input of operational research (OR) to global modelling and land-use planning (see, for example, the work of the International Institute for Applied Systems Analysis, IIASA, as represented by Makowski, 2000), OR appears to have kept a low profile in this discourse about appropriate methodologies and methods for environmental management. In our view, the methodological focus of operational research (OR) is of great value, primarily because it is so broad: it embraces a technical focus (e.g., on monitoring and control), ideas about participation and communication between stakeholders, *and* reflection on values. Therefore, it is our belief that OR can help realise the potential of environmental management to become a broad-based, dynamic, applied practice of central relevance to both government and industry. This is why we decided to initiate the research reported here.

However, both 'operational research' and 'sustainable development' are contentious terms. At the risk of sanitising debate, working definitions of each are provided below:

1. Operational research involves the application of inquiry techniques to the management of complex systems involving *people* and *resources*. OR seeks to produce an understanding of managerial problems and to

develop models which will enable the consequences of decisions to be investigated.[1]

2. Sustainable development is concerned with the capacity to appreciate and respond to ever changing environmental and social issues, to adapt and invent purposeful activities for economic, social and environmental improvement, serving particularly the interests of vulnerable groups, including future generations. Sustainable development is not the search for some illusory optimal (stationary) state of equilibrium.[2]

The question is, how might the practices of OR and environmental planning be more purposefully aligned to address issues of sustainable development?

1.2 Aims of the Project

In October 1999, the Centre for Systems Studies (CSS) at the Hull University Business School, with financial support from the Operational Research Society, embarked on a one-year study to support the design of a future agenda for the use of OR in environmental planning and management. The study had three objectives:

1. To make more visible existing good OR practice in environmental planning and management;

2. To explore the further potential of using OR techniques (including systems methodologies and methods) for environmental planning; and

3. To ask how OR would have to be further developed if it is to make an increased and sustained contribution to expert support for environmental management.

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[1] This definition is adapted from the 'editorial policy' section of the European Journal of Operational Research.

[2] This expands on the widely quoted definition given by the World Commission on Environment and Development: "…development that seeks to meet the needs and the aspirations of the present without compromising the ability of future generations to meet their own needs" (World Conference on Environment and Development, 1987, p.43).

Points two and three represent an agenda for development and change. Two action-orientated, subsidiary aims also informed the study:

- To engender commitment from OR practitioners to the agenda through a process by which they were able to participate in its generation.

- To produce a development plan for improving the institutional infrastructure that will enhance the ability of interested OR practitioners to undertake the work set out in the agenda.

The OR practitioner is explicitly regarded in this study as an *expert*, contributing to *expert support*. We recognise that this is a controversial assertion (indeed, it was the subject of debate in several of the workshops in our study), so we will use a couple of paragraphs to make clear why we are saying this.

First, in our view, an expert is not necessarily someone who 'knows best'. Although this is a popular understanding of expertise, it results in experts becoming, and being seen as, arrogant and unresponsive to other stakeholders' concerns. We argue that the role of the professional expert is to provide some level of guarantee or assurance in support of the planning process (relating, in this case, to environmental management). We also assume that such guarantees can never be taken as absolute in support of the successful implementation of a plan. The best that can be achieved is a significant contribution *towards* assuring successful implementation.

A working model of expertise used during this study identifies 3 strongly interrelated dimensions of support: *technical* support for modelling reality and people's ideas for change; *facilitating* support for promoting interaction between stakeholders; and *critique* (e.g., through the exploration of values informing intervention). In terms of guarantees, these might be translated into 3 categories providing, respectively, levels of assurance towards *objectivity*, *mutual understanding* and *social legitimacy* (see Reynolds, 1998, for further details).

The reason some of the participants in this study felt uncomfortable about us saying that OR is 'expert support' is because of public scepticism about the status of experts, based on the popular assumption that experts believe they know best (which is, of course, quite different from experts believing that their role is to offer assurances of quality in relation to

objective analysis, the promotion of mutual understanding, and the establishment of legitimacy). In the face of this public scepticism, some participants argued that the term expertise should be abandoned altogether. However, we disagree with this on the grounds that the OR practitioner, in common with many other professionals, has a very influential role. The term 'expert' signals this influence, and allows the OR practitioner to be made accountable for it. Refusing to use the term 'expert', and pretending (as some writers do) that the OR practitioner is just another participant in debate, is to risk making the often substantial influence of the OR practitioner invisible. After all, the OR practitioner *does* bring in knowledge of techniques that others are unlikely to possess (at least initially), and therefore assumes a pivotal position within an intervention. In our view, it is only if this is recognised (and use of the term expert achieves this) that questions can be raised about how the OR practitioner's knowledge is to be used in an empowering rather than an arrogant or manipulative fashion.

1.3 The Steering Group

Right at the beginning of this research, a multi-agency steering group was formed comprising of representatives from the Operational Research Society; BG Technology; the Department for Environment, Transport and Regions; the Orchard Park Environment Redevelopment Association (OPERA); and Forum for the Future. When it came to it, the representative from BG Technology proved unable to participate because he was relocated to the USA, and he was replaced after the first meeting by representatives from Unilever and the Town & Country Planning Association. See the Acknowledgements at the front of this report for people's names. The steering group met three times in total to review our methodology and all our written outputs (including this final report).

1.4 Methodology

Critical systems thinking (CST), as represented in the work of Midgley (1996, 2000), provided the guiding methodological framework for the research. Key CST principles are:

1. *Improvement*—defined temporarily and locally, but in a widely informed manner, taking issues of power (which may affect the definition) into account;

2. *Boundary critique*—regularly questioning and exploring value and boundary judgements, both with respect to the methodological approach adopted and the substantive subject matter being investigated; and

3. *Methodological pluralism*—learning from other methodologies and drawing in methods from those methodologies.

Participants in this study did not just define improvement in terms of environmental *protection*, but also the more proactive improvement of approaches to environmental and associated social *development*. Boundary critique proved crucial, as what counts as an environmental issue was a thorny and recurring question addressed in locally meaningful ways throughout the project. Also, participants generated many insights into the ways in which OR methods can either marginalise or empower stakeholders in environmental management projects. Finally, the practice of methodological pluralism enabled us to ensure that our methods remained flexible and responsive to the great variety of situations we faced. The methods we used were drawn from Qualitative Applied Social Science (e.g., Silverman, 2000), Interactive Planning (Ackoff, 1981), Soft Systems Methodology (Checkland, 1981; Checkland and Scholes, 1990) and Critical Systems Heuristics (Ulrich, 1983).

In this report, we have chosen not to provide any further details of the enactment of the CST principles: that will be the task of a future paper for submission to an academic journal. Rather, we focus on the findings of the research.

Altogether, the study ran through four phases:

- **Phase 1:** Groundwork and stakeholder analysis. Four stakeholder groups were identified: *professional experts* associated with environmental planning; and users of professional expertise including agencies of *government*, *business*, and *pressure groups* (each operating at local, national, and international levels of planning).

- **Phase 2:** Interviews. Two cycles of semi-structured interviews were undertaken: one with stakeholders identified in phase 1, and a second with significant others suggested by those interviewed in the first

cycle. Fifty respondents agreed to be interviewed in forty six interview sessions. Phase 2 culminated in the production of an interim report offering feedback to respondents and providing a stimulus to initiate phase 3.

- **Phase 3:** Workshops and mini-conference. Two one-day workshops (in London and Sheffield) took place. Interested parties were invited to explore how better expert support could be provided, based on the outputs of Phase 2. The workshops were designed to establish ideal 'mission statements' associated with possible future agendas, and to explore the ideal parameters in which such statements might be realised. The two regional workshops provided source material for a two-day mini-conference in Hull at which an agenda for future collaboration was more fully developed.

- **Phase 4:** Reporting. Three working documents were produced during the course of the study: an interim report, a workshops report and a mini-conference report. These were designed to elicit feedback from interviewees and other participants to support the learning process. Presentations (eliciting feedback) were also made to the Manchester Chamber of Commerce and Industry Environmental Committee; a meeting of the Operational Research Society Environmental Study Group; and the Operational Research Society Annual Conference. Martin Reynolds (with the support of the Open University) will also be addressing the Industrial Ecology Conference in Berkeley, USA, between 5-8 October 2000. The report you are now reading is the final output produced during the one year period of research funded by the Operational Research Society. Copies will be issued to all respondents, and will also be available on the Centre for Systems Studies web site. Future articles in refereed journals are planned, and the researchers intend to collaborate on a book based on the project, orientated to both environmental management and operational research audiences.

Below, we provide more detail of the methods and processes adopted in these phases.

1.5 Phase 1: Groundwork and Stakeholder Analysis

A review of the literature on OR and environmental planning and management was undertaken, and Chapter 2 represents our findings from

this. Also, Appendix 1 provides a glossary of frequently used terms in the literature, supplemented during phase 2 with other terms used by respondents from the stakeholder groups.

Four broad stakeholder groups were identified: 'professional experts' associated with environmental planning (represented in this study by OR practitioners); and users of professional expertise including the 'public sector', 'business', and 'pressure groups' (constituting what is sometimes referred to as the third sector). It was decided that interviews should cover representatives from all four sectors, including organisations operating at local, national, and international levels of planning.

1.6 Phase 2: Interviews

Two cycles of semi-structured interviews were undertaken over a 5 month period: one with the stakeholders identified in phase 1, and a second with significant others suggested by those interviewed in the first cycle.

Interviews were arranged mainly through telephone calls to relevant organisations supplemented by a brief one-page 'flyer' outlining the main purposes of the project (usually sent out as an e-mail attachment or by fax after an initial introduction by phone). Appendix 3 provides the interview schedules used for each sector. Complete confidentiality was assured to all respondents before interview: we said that we reserved the right to use quotations in our report, but would not identify the source of the viewpoints expressed. Similarly, we said we would acknowledge the participation of all the organisations whose staff agreed to be interviewed (see Appendix 2), but we would not name individuals. Recordings of the interviews were requested by the interviewer beforehand with the assurance that these would not be made publicly available. After agreeing to be interviewed, respondents were sent a brief customised sketch of the areas we wished to address. Interview times varied between 1 to 2 hours.

Appendix 2 (Part 1) provides a chronology of scheduled interview dates and workshops attended in relation to the project. 50 respondents agreed to be interviewed in 46 interview sessions (i.e., 4 sessions were undertaken with pairs of respondents). A sectoral breakdown of agencies reveals 11 government, 13 business, 13 third sector, and 11 academic. Appendix 2 (part 3) provides an alphabetical list of agencies involved with phase 2. Phase 2 culminated in the production of an interim working document offering feedback to respondents and initiating phase 3.

During this phase, several practitioner workshops were attended (see Appendix 2, part 1). These were useful on two counts: first, as a means of gaining access to key respondents for interviews; and second, as a source of first-hand information regarding difficulties encountered by experienced practitioners in the field of environmental management.

1.7 Phase 3 (Part 1): Workshops

Two one-day workshops were held: one in London on 3rd July, and the other in Sheffield on 10th July, 2000. All respondents were invited to attend these events along with others who were interested in moving an agenda forward. Appendix 2 (part 2) provides a list of workshop and mini-conference participants. Appendix 5 contains copies of the announcements for the two workshops (Part 1) and mini-conference (Part 2).

The two workshops followed the same general programme of activities:

1. Discussion of environmental issues and OR support, as presented in the interim report which all participants had received;

2. Review and discussion of the history of OR;

3. Identifying ideal purposes ('mission statements') relevant to a future agenda for the use of OR in environmental planning and management (using Ackoff's, 1981, 'idealised design' method from his methodology of Interactive Planning); and

4. Answering key questions about the missions in terms of (i) motivation for pursuing them, (ii) how their pursuit should be controlled, (iii) the expertise that should be involved, and (iv) the grounds for regarding the missions as legitimate (using Ulrich's, 1983, Critical Systems Heuristics questions). This allowed the missions to be fleshed out.

In producing the mission statements (activity 3 above), the following criteria (adapted from Ackoff, 1981) were suggested as relevant to the task:

- If everybody agrees with it straight away, it's worthless! E.g., "an agenda to help improve support for environmental planning" is too general to have any real use;

- A mission should defining a new rather than an existing area of engagement—that is, something that is not shared by other known agendas. In this case OR is the differentiating item; and

- It ought to be exciting and inspiring—a motivating statement for those whose participation in its pursuit is sought. It does not have to appear 'feasible' at this stage, only 'desirable' (feasibility will be discussed later).

The questions about 'control' and 'expertise' in activity 4 were adjusted for the Sheffield workshop in the light of misunderstandings arising in the first London workshop (see Appendix 4, part 1). The answers to the London questions were later standardised to the Sheffield format (see Appendix 4, part 2) to ensure consistency.

A Workshops Report was then written. This collated the ideas generated in both the workshops, and provided the starting material for attempts to model and activate a future agenda during the 2-day mini-conference held in Hull.

1.8 Phase 3 (Part 2): Mini-Conference

Work at the mini-conference proceeded from 1.30pm to 6.30pm on Thursday 27th July, and recommenced from 9am to 3.30pm on Friday 28th July 2000. The programme consisted of 4 sessions:

1. Discussion of the Workshops Report;
2. Defining the agendas;
3. Conceptual modelling of the agendas; and
4. Discussion of key action points.

The first two sessions were covered on the Thursday, whilst the last two were covered on the Friday.

To generate the agendas (session 2 above), we drew upon a method from Checkland and Scholes's (1990) Soft Systems Methodology. For each of the missions outlined in the Workshops Report (which brought together insights from the London and Sheffield workshops), participants were asked to produce a 'system definition' using the CATWOE mnemonic. CATWOE stands for:

C*ustomers*: the intended beneficiaries of the proposed transformation;

A*ctors*: those who should make the transformation happen—the people involved in making the system work;

T*ransformation*: the purpose of the system—what input is changed into what output?

W*orld-view*: the perspective (including values) from which the transformation looks meaningful and desirable;

O*wners*: those who have the power to stop the transformation happening (to stop the system from working); and

E*nvironmental constraints*: those factors that have to be taken as given in designing a system.

It was suggested that the outputs from the 2 workshops (Appendix 6) could be used as source material for constructing the CATWOEs. Cross reference markers were provided to help the participants relate the workshop outputs with the CATWOEs (see Chapter 5, section 5.1.3, for details).

After some discussion regarding the terminology used by Checkland and Scholes, it was decided that we should modify the mnemonic to BATWOVE. This stands for:

B*eneficiaries*: 'immediate' and 'ultimate' beneficiaries of the proposed transformation;

A*ctors*: those who should make the transformation happen—the people involved in making the system work;

T*ransformation*: the purpose of the system—what input is changed into what output?

W*orld-view*: the perspective (including values) from which the transformation looks meaningful and desirable;

O*wners*: those who have the power to stop the transformation happening (to stop the system from working);

V*ictims*: those affected in a negative way (in their terms) by the transformation; and

E*nvironmental constraints*: those factors that have to be taken as given in designing a system.

Participants were advised that a logical order for defining a system (in this case an agenda for OR in relation to environmental planning and management) is TWBAOVE. It was suggested that agendas should be defined as much as possible in the 'ideal' mode since we would move on later to discuss issues of feasibility (and make modifications to the agendas in the light of the issues raised). Participants were also encouraged to use the realigned data output from the workshops (Appendix 6) to address the BATWOVE questions.

Although Checkland and Scholes (1990) recommend moving on to produce a root definition (a single statement embodying all the CATWOE answers), we did not attempt this because of the limited time available and the fact that (following Gregory and Midgley, 2000) we thought it would not add much value. We did not want to get too bogged down in semantics: the BATWOVEs provided enough of a learning experience to allow participants to explore and harmonise their understandings of terminology.

Having completed a BATWOVE for each proposed agenda, the participants then used another of Checkland's methods—conceptual modelling—to show the core activities that would be needed to pursue them in practice. Before starting the conceptual modelling exercise, the researchers presented the following information about key features of the method:

1. A conceptual model encapsulates key *activities* which must be undertaken to fulfil the transformation expressed in the agenda;

2. Resulting models are derived directly from the BATWOVE (i.e., we are still working in the 'ideal' mode);

3. Two sets of activities are component to the model (i) a normal *operating* system and (ii) a *monitoring and control* sub-system;

4. Given the limited human capacity to grasp complexity, it is often recommended that a conceptual model of the operating system should consist of 7±2 activities. Increased complexity can be modelled by

'opening up' an activity and doing another conceptual model of the sub-activities that make it up (i.e., in systems jargon, we can move to a new level of recursion).

5. Checkland bases the monitoring and control sub-system on criteria of *efficacy* (measures of short-term transformation), *efficiency* (most cost-effective use of resource input for desired transformation output), and *effectiveness* (measure of long term transformation brought about by the system). Other criteria have been suggested in the literature including *elegance* and *equity* (Ormerod, 2000). We might also wish to add *environmental sustainability*. The criteria to be used in this study can be derived from the 'measures of success' defined in the earlier workshops (see Appendix 4).

The following stages are followed in conceptual modelling:

1. Identify activities which have to happen if the transformation is to take place (make sure that each activity starts with a verb, or 'doing word');

2. Seek out the main logical dependencies (interactions or connections) between these activities; and

3. Consider each activity and ask "what activities must go on directly prior to this?" and add these where they are felt to be important.

The result is a set of interacting activities that can be used to guide action planning.

Normally, the 'monitoring and control' activities are added as a sub-system to the model. Due to time constraints this was not possible in our mini-conference but, as suggested in Chapter 6, this will be an important task for the future.

Finally, we moved on to action planning. This involved relating the conceptual models back to participants' understandings of the current situation (informed by our interviews with stakeholders in phase 2) to check them for feasibility. At this point people realised that certain key actions had to be prioritised because the agendas were largely dependent on the activities of a critical mass of activists which did not currently exist. Therefore, getting this critical mass in place (and building other aspects of the organisational infrastructure) was of central concern. Other activities in pursuit of the agendas could then follow. The key

recommendations for action made by the mini-conference participants are reproduced in Chapter 6.

1.9 Phase 4: Reporting

Three discussion documents were produced during the course of the study:

- *An Interim Report*: This was issued to all interviewees as well as others who were invited to attend the workshops and mini-conference. The report summarised initial findings from the first two phases of the study. Chapter 3 in this final report is an extended and revised version of the interim report.

- *A Workshops report*: This provided a summary of workshop proceedings and was issued to all participants in the two regional workshops.

- *A Mini-Conference Report*: this provided a summary of the outputs from the mini-conference, and was issued in the first instance to participants in the event. Then three weeks later, after opportunities were given for participants to revise or correct outputs, copies of the report were issued to all participants from the two preceding workshops. Chapter 5 in this final report is a revised version of the workshops and mini-conference reports.

Outside of workshop and mini-conference deliberations, dissemination activities included presentations to:

- The Manchester Chamber of Commerce and Industry (MCCI) Environmental (now 'Sustainable Development') Committee, Manchester (2nd February 2000);

- The Operational Research Society Environmental Study Group at the London School of Economics (18th May); and

- The Operational Research Society Annual Conference at Swansea, in the 'OR for Social Change' stream (14th September);

The MCCI Committee has welcomed further engagement and information regarding future outputs from the project. The Chair asked for a copy of the final report for circulation and for possible inclusion as a

Committee agenda item for discussion as to how future collaboration might be taken forward.

Ms Seonaihd McDonald, the acting Group Leader for the Operational Research Society Environmental Study Group, convened a meeting at the London School of Economics on 18th May in an attempt to relaunch the Group which had fallen into inactivity. The meeting centred on a presentation of the project's work to date by Martin Reynolds. Notwithstanding the low attendance of just six participants (despite considerable advertising efforts), there was good constructive discussion during the meeting.

The Operational Research Society Annual Conference at Swansea afforded an opportunity to present the workshop and mini-conference outputs. The conference also enabled the researchers to discuss with OR activists interested in 'community' and 'development' how the agendas defined through our research might be relevant to them.

Martin Reynolds (with the support of the Open University, where he has now taken up employment) will also be presenting the findings from the project at the Industrial Ecology 2000 Conference, "Maximising Shareholder Value: Lessons from the Natural World". This will be held in California at the Haas School of Business, University College Berkeley, on October 5-8, 2000.

It is hoped that several papers coming out of the study can be published in refereed journals during 2001-2. It has also been agreed that the researchers will continue collaboration with a view to producing a higher profile publication developed from this final report orientated to an environmental management (as opposed to an OR) audience.

1.10 Evaluation of the Methodological Approach

Establishing a steering group for the project was invaluable. The principle behind setting up a multi-agency steering group lies in the experience of Community OR (amongst other areas of OR practice) where it has been found more useful for the practitioner to talk about "dealing with an issue" than "serving a client" (Midgley, Ritchie and White, 1994). This is because it is often in the interests of all the stakeholders to collaborate on problem-solving, and if one organisation uses its status as fee-payer to reserve the right to set the agenda, this can prevent the establishment of

an effective partnership between stakeholders. Collaborative and/or participative multi-agency group-work not only encourages the generation of creative solutions to complex problems, but when ideas come from collaboration with the communities of people who have to live with the outcomes of OR activity, then implementing the change proposals is much more likely to be feasible (Sudhir *et al*, 1996). Although we encountered the usual difficulties when trying to recruit members for a steering group (most people are already coping with onerous workloads), the standard of critical dialogue, practical assistance, helpful insights and general support proved highly influential, and bodes well for implementing the results of this study.

Whilst difficulties were also inevitably encountered in scheduling interviews with professional personnel with many other pressing commitments, the interviews undertaken were generally very constructive with valuable feedback. E-mail questionnaires were sent to two overseas personnel: one at the Sustainable Livelihoods Department at the United Nations Development Programme in New York, and another at the Institute for Sustainability and Technology Policy in Perth, Western Australia (Appendix 3, Part 5). Unfortunately, neither questionnaire was returned, despite assurances of a willingness to engage with the project. The reasons for this, it might be assumed, are twofold: firstly, an e-mail questionnaire based on semi-structured interview schedules is difficult to construct in a user-friendly fashion, and certainly it would be stretching credibility to describe our questionnaires as 'user-friendly'! Secondly, however user-friendly an e-mail questionnaire is, it remains very demanding for people to volunteer time (possibly an hour) to undertake a monological task like this (dialogues are more rewarding and therefore more likely to be engaged with).

Interviewees were each assured of receiving a copy of the interim report to which they were encouraged to provide feedback. Providing assurances to respondents at the outset that their feedback on the research findings would be taken into account provided a useful 'carrot' when eliciting agreement to take part in the initial interviews. It also provided an essential iterative component to the research process and, additionally, a few interviewees became even more interested and then attended the workshops and mini-conference.

Two respondents provided detailed written critical responses to the interim report. These were supplemented with responses from people attending the regional workshops. The comments referred to both content and presentation. Comments on the content of the report centred on

omissions and misinterpretations. These are discussed in detail in Chapter 5 (section 5.2). With regard to presentation, the interim report was designed as a condensed summary of the research findings from the interviews and literature review. As presented, the report was undeniably a 'difficult read'. We have tried to make this material a little more discursive in Chapter 3 of the current report.

With regard to the workshops and the mini-conference, time was always a limiting factor. One consequence of this was the omission of post-workshop evaluation sessions for the two regional workshops. A very brief and limited session was enabled at the end of the mini-conference (by which time several of the participants had had to depart). Originally, the mini-conference was scheduled for three complete days. However, given the anticipated difficulties in eliciting peoples' time (as evidenced during the interview phase as well as initial returns from invitations to the single-day workshops), it was considered unreasonable to expect a critical mass of participants for three days. We therefore reduced the mini-conference to a two-day event. Notwithstanding the frustration of continually speeding things along during the course of the mini-conference, the impression given was that the trade-off (between time and numbers of participants) worked to the benefit of a successful two days.

Several specific evaluative points emerged from participants attending the mini-conference:

- A suggestion was put forward that participants could have been invited beforehand to comment on the proposed methodology to be used at the conference, as participants might have been able to offer alternative approaches for achieving similar outputs with less time being consumed.

- Facilitators' time management might have been better, particularly at the workshops where (in some participants' opinion) too much time was allocated to discussing controversial issues at the expense of covering all the Critical Systems Heuristics questions in sufficient depth.

- Possibly more use might have been made of the workshop outputs in the design of the BATWOVEs and conceptual models. However, this would have required much more time.

- Several participants expressed satisfaction with the level of interesting and provocative debate that emerged during the proceedings.

- Some participants were also particularly interested in, and valued, the experience of engaging with the methods we used (particularly the methods from Soft Systems Methodology).

- A concern was also expressed that the Soft Systems Methodology methods "could do with quite a lot of tightening up for application outside their core clientele"—that is, they are usually used in the service of organisations with clearly defined boundaries, not groups of loosely affiliated OR practitioners.

- In the conceptual models, it was noted that insufficient attention was paid to the arrows between activities (i.e., how to move from one activity to the next). Again, this reflected the time pressures we were under, as it would have been perfectly possible (given another day or two) to go into the conceptual models in much greater detail.

- Overall, however, a great deal of enthusiasm for the outputs of the project was expressed, and several people said that they were personally committed to taking action on the basis of the agendas they defined.

1.11 The Structure of the Report

The rest of this report is presented in six chapters:

- Chapter 2 provides a review of the literature on OR and environmental management. Three generic categories of issues are identified as recurring throughout the literature: (i) managing complexity and uncertainty; (ii) dealing with multiple and often conflicting values; and (iii) addressing political effects on people and things excluded from concern by planners.

- Chapter 3 explores how these themes are manifest in the concerns expressed by the four broad stakeholder groups surveyed in our research: the public sector, business, third sector, and professional experts (OR practitioners).

- Chapter 4 provides three very different case studies of good OR practice in environmental management. Each case study is briefly evaluated according to how the methods used enabled people to deal

with complexity and uncertainty, multiple values and political effects. The exposition reveals strengths and weaknesses of the different methods used in the case studies.

- Chapter 5 records the outputs from the two regional workshops and the mini-conference. Three interrelated agendas are identified, providing guidelines for future activities.

- Chapter 6 reports on the key recommendations coming from the study, based on the views of the participants in the workshops and mini-conference.

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