OPERATIONAL RESEARCH AND ENVIRONMENTAL MANAGEMENT: A NEW AGENDA

Enhancing the Contribution of Operational Research to Environmental Planning and Management: A Report to the OR Society

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We are indebted to the Operational Research Society for having the vision to commission this project, and for providing the necessary financial backing. The University of Hull Business School also provided considerable support for the project, not least in the form of a congenial and stimulating research environment. In particular we would like to thank Robert Clarke, the Research Secretary in the Business School, for his unfailing help with the administrative side of the work.

Finally, we should make it clear that the views presented in this report are those of the authors, interviewees and workshop participants, and not necessarily those of the Operational Research Society.

Table of Contents

BOXES

Executive Summary

Context

A great deal of work undertaken in recent years to support environmental planning and management can be described in operational research (OR) terms: for example, External Cost Estimates, Environmental Impact Analyses, Multicriteria Mapping, global simulation modelling using System Dynamics, etc. Although much of this work has been innovative and often influential, it is rarely identified as being OR. Meanwhile, the imperatives of environmental management have changed considerably, particularly in the last decade. There is a wider remit of concern relating to 'sustainable development', which requires people to address in an integrated manner the 'economic', the 'social' as well as the 'environmental' dimensions to development. In our view, and also in the view of the vast majority of the participants in our research, OR has the potential to become a broad-based, dynamic, applied practice of central relevance to environmental management for both government and industry—and can also support the growing demands of environmental activists in the 'third' (voluntary) sector.

Amidst considerable debate and reflection regarding the past achievements and long-term future of OR as a discipline, it is appropriate that OR practitioners give serious consideration to the shifts in interests and potential demands for OR development. There is a need for an agenda for the use of OR in environmental planning and management that makes the actual and potential contribution of OR more visible, and which sets out the changes needed in OR practice if this potential is to be realised.

The Purposes of the Project

In October 1999, work started on a one-year project at the Centre for Systems Studies (based in the Business School at the University of Hull) to create an agenda for the future role of OR in environmental planning and management. The project had three primary 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 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.

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

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

5 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.

Methodology

Critical Systems Thinking (CST) was used as the guiding methodological perspective (e.g., Midgley, 2000), and methods were drawn from a variety of other approaches and mixed as required. These other approaches included 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). See Chapter 1 for further details of methodology.

Research Process

The study ran through four phases:

- **Phase 1:** 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 how the missions might be enacted. 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; OR42 (the Operational Research Society Annual Conference); and the Industrial Ecology 2000 Conference in Berkeley, USA. 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 a summary will also be made available on the Centre for Systems Studies web site.[1] Future articles in refereed journals and practitioner magazines are planned, and the researchers intend to collaborate on a book based on the project, orientated to both environmental management and operational research audiences.

Findings

The traditions of OR and environmental planning share some common concerns. First, both have wide boundaries in terms of clientele, range of methodological approaches used, and

[1] http://www.hull.ac.uk/hubs/css/

attention to multiple and often conflicting values. Second, both traditions have an interest in fostering purposeful interdisciplinarity. Third, both OR and environmental planning are concerned with the *implementation* of, as well as the *design* of, planning strategies.

Three generic issues were found to recur in both the environmental management literature and the interview data generated in our study:

1 *Complexity and uncertainty* (regarding the unpredictability of natural and social phenomena);

2 *Multiple and often conflicting values* (of those involved in environmental planning); and

3 *Political effects* (on those not involved in planning processes, including non-human nature).

An examination of how these generic issues are perceived in the different sectors (public, business and pressure groups) revealed clear patterns:

- Each sector can be shown to have concerns relating to each of the three issue categories (complexity and uncertainty; multiple, conflicting values; and political effects).

- For each sector, there is considerable conflict between interpretations of how each issue category should be addressed. For example, in dealing with issues of complexity and uncertainty, some businesses are seeking to adopt and promote a 'learning culture', taking heed of wider economic/social/environmental affairs in long-term planning. However, others still reduce the idea of 'sustainability' to short-term economic prosperity.

- Issues of complexity and uncertainty dominate the public sector, with attention primarily focused on developing appropriate 'indicators'. Competing values are the main concern of business organisations, with attention being paid to minimising risks by improving stakeholder interaction. Political issues dominate the third sector, with concerns about representing marginalised interests and widening the net of meaningful participation in planning processes. These might be termed the *primary* issue categories associated with each sector.

- For each sector the two *secondary* issue categories tend to cluster around the primary issue category. For example, in the public sector, conflicting values and issues of social exclusion tend to be dealt with *in relation* to the formation of indicators to deal with complex and uncertain realities.

The issues discussed above are generic and therefore arguably quite abstract. Substantive issues like transport, green belt policy, pollution, energy, waste, genetically modified organisms—and even wider concerns relating to sustainable development, global warming, world trade, population growth, the elimination of poverty, etc.—can be more specifically examined using the same parameters. That is, any environmental issue being addressed could potentially involve each of the three user groups (from the public, business and third sectors), as well as some form of 'expert' function. Likewise, any substantive issue might be analysed in terms of all three generic issue types as discussed above.

Clearly, in the increasingly complex, interdisciplinary and politicised world of environmental planning, if we want to enhance expert support using OR, it will be vital to do more than just deal with the technical difficulties associated with modelling the natural world. This is not to say that the technical issues are trivial or unimportant (far from it), but it will also be necessary to address the more messy social worlds of values and ethics in which both OR

support and environmental issues are embedded. A major challenge for OR practitioners will be to develop methodologies and methods that are capable of dealing with *all three* of the generic themes identified in this research: complexity and uncertainty, multiple values and political effects.

Developing the Agenda for Operational Research

Through the workshops and mini-conference, three distinct (though strongly interrelated) agendas took shape:

- **Agenda 1:** *Develop OR* (with a focus on methodological issues);
- **Agenda 2:** *Promote Interaction* (with a focus on issues of interdisciplinarity, intersectoral co-operation, etc.); and
- **Agenda 3:** *Promote Public Participation* (with a focus on issues of accountability and social inclusion).

Each agenda was subject to a process of 'conceptual modelling' at the mini-conference. Participants asked themselves, what is the transformation being sought? Who are the intended beneficiaries? Who or what might be made a victim (and should something be done about this)? Who should act to implement the agenda? What worldview underlies the agenda? Who should those implementing the agenda be accountable to? And what environmental constraints will have to be taken as given? The answers to these questions led the group to define key activities needed to realise the stated purposes of the agendas.

For agenda 1 (*Develop OR*), the activities centred on establishing an on-going research project to relate methods with problem situations relevant to environmental management. The need for extensive testing of OR methods in case studies was stressed, as was the need to communicate the results of these tests to enhance the OR knowledge base for environmental management. Importantly, however, the idea of relating methods to problem contexts was not conceived as the production of a mechanical rule book for OR practice. Rather, it was seen as involving the *reconceptualisation of OR* as a reflective practice; questioning purposes (not taking purposes presented by clients as given); focusing on the big picture; involving multi-sectoral thinking; involving multiple agents in defining problems; drawing upon and mixing multiple methods; and embracing environmental issues alongside social ones.

In agenda 2 (*Promote Interaction*), activities centred on developing 'skills', 'knowledge' and 'communication channels'. Whilst interaction was mainly focused on important issues of interdisciplinarity, the agenda was also concerned with promoting intersectoral relationships. The transformation was seen to require OR to move from being a primarily 'backroom', problem-solving form of expertise to being a more pro-active discipline where raising awareness of issues amongst stakeholders and problem structuring are key activities. Also, it will require OR practitioners to be more outward looking and facilitative than is currently the norm.

Agenda 3 (*Promote Public Participation*) recognised the difficulties of having a catch-all public participation remit: it is not realistic to try to engage 'the public' in improving OR in general. Rather, the emphasis needs to be on local participation in projects, taking care to differentiate between general public expressions of concern and special interest group involvements.

The three agendas can usefully be regarded as nested systems: agenda 3 nesting in agenda 2, which in turn nests in agenda 1. Therefore, ensuring local public participation in projects is one aspect of keeping OR interactive and outward looking, and should have an impact on

how interdisciplinary and intersectoral communications are conducted. Similarly, both of these agendas have important implications for developing the methodology of OR.

Recommendations

The action plans for each of the agendas are arguably the primary outputs of this research, together with the bond formed amongst the participating OR practitioners. However, the group was intent on keeping its feet on the ground, and realised that enthusiasm in a mini-conference will not automatically translate into actual change unless some preparatory actions are taken. These are necessary primarily because there is currently an insufficient critical mass of activists in the OR community with an interest in environmental management to make all the plans a reality. However, concrete steps for changing this situation, with (in our view) a high probability of success, have been identified.

Therefore, the following recommendations are made. Some—especially those intended to prepare the ground for future activities—are most relevant to the Operational Research Society, which is the obvious source of charitable funding to take this work forward. However, other recommendations relate to how the agendas might be pursued by OR practitioners more generally once a critical mass of activists has been formed. All the recommendations derive from discussions in the mini-conference.

Recommendations to be considered by the Operational Research Society:

1. Recruit a short-term worker to kick-start the identified initiatives. A key responsibility of this worker should be to liase with several of the Operational Research Society study group co-ordinators who have expressed a desire to amalgamate their groups. There are a number of study groups with a focus on social improvement and/or sustainable development, but none enjoy a critical mass to sustain sufficient activities to thrive. Groups whose co-ordinators (or other prominent members) have expressed a desire to join a much larger group include Environment, Community OR, Development, Complex Systems, and Agriculture. Amalgamating these groups should bring together a critical mass of activists, making the new study group viable into the future. If it is considered appropriate, the worker might also liase with the Operational Research Society to seek the views of the ordinary membership of these study groups before any action is taken.

2. One of the actions proposed as part of agenda 1 (*Develop OR*) is to establish a longer-term co-ordinating function to give leadership, and to ensure that the agenda is taken forward. Ideally, this was envisaged as a Unit, preferably independent from existing institutions. This independence was seen as important because the Unit should not be viewed as having any vested interests (which it might be if it was attached to a pressure group or a business). Also, it is preferable for the Unit to be based outside the University sector (although academics could work with it), because its role should not be hampered by stereotypes of academia being projected onto it. Establishing this Unit as a viable enterprise will take substantial funding beyond the resources of the Operational Research Society: the lottery is a possible source of funding, but it is most likely that money will have to be brought together from a variety of sources. Therefore, an intensive period of fundraising is needed. The Operational Research Society could usefully support this by providing money for a one year period to cover the salary of a person with experience of applying for charitable funding. This person may eventually become Director of the Unit, or may hand over the reigns to someone else depending on the circumstances.

3. The literature on the past OR contributions to environmental planning and management is large, but is scattered widely throughout a variety of journals. Also, four out of five applications published in the environmental management literature never mention OR,

despite the fact that they are using OR methods. We have attempted to begin consolidating the field by presenting examples of good OR practice in environmental management that illustrate the diversity of relevant methodological approaches (see Chapter 4). Nevertheless, more is needed—especially to reach environmental management audiences who are not currently familiar with OR. As part of its next round of charitable funding, the Operational Research Society could consider providing a sum of money to an experienced academic who is able to present OR in an accessible manner to other disciplinary audiences. The money should be sufficient to buy out his or her teaching and administrative duties for a period of a year, enabling him/her to write a series of articles evaluating the substantial contributions that OR has already made to the field of environmental management. These should be directed, not only to new initiates in the field of OR, but also to readers of environmental planning journals.

Wider recommendations:

4. It should be clear that interactions with people in other disciplines relevant to environmental planning and management, and with people in the three sectors (public, business and the third sector), will need to feed back to transform OR methodology. Therefore, agenda 1 in this report should be viewed as a *provisional* basis for action. It has been formulated by OR practitioners in the light of substantial dialogues between the researchers and user groups in the various sectors, but it should not be set in stone. Agenda 2 asks OR practitioners to engage in *on-going* dialogues with planners and managers as part of the development process, so there will no doubt be considerable scope for further elaborating the activities to be pursued. To enable communication, further action plans will need to be phrased without resorting to OR or other academic jargon. As we see it, however, one emphasis of the dialogues with planners and managers can usefully be on the employment and integration of multiple methods in OR to serve the variety of demands in environmental management.

5. It will be important to identify potential funders for different aspects of the action plans, including academic and non-academic sources. The fundraiser for the Unit may assume a central role here, but some of the activities can usefully be distributed across a collaborative network of activists to avoid over-dependence on one person. Bids can be constructed for different funding agencies taking into account the agenda item for which support is being sought and the interests of potential benefactors.

6. In saying that, in general, OR practice will need to change, we have tried to emphasise the positive attributes that it should embody if it is to become more responsive to the complexities of environmental management. However, there is also value in identifying aspects of existing OR approaches in environmental planning and management that represent a barrier to good practice, and especially to public participation. Therefore, more 'critical' research should be encouraged (critical in the sense of highlighting weaknesses and proposing positive alternatives). Also, it is important not to become complacent and assume that an enhanced OR practice can do everything that is needed. It will be necessary to explore and document those areas of environmental planning where OR is *not* able to deliver effective support.

7. An important aspect of the strategy for raising awareness of OR is the establishment of local pilot projects for environmental development, each of which should have a steering group bringing together local stakeholders and OR practitioners. Good practice in local projects can then be publicised. A starting set of pilot projects might be identified with the collaboration of the Community OR Network, the regional Groundwork offices, and regional development agencies.

8. It will no doubt be easier to establish pilot projects with the co-operation of the public sector and business organisations simply because many of these organisations have resources to pay for OR support. Therefore, to keep a balance and ensure the

involvement of the third sector, it may be necessary for Community OR practitioners to specifically seek out environmentally-orientated community groups and explore the possibilities of OR support with them.

9. While comprehensive plans for enhancing the role of OR in environmental planning and management were generated through the project reported in this document, the issue of monitoring implementation was not explored in any detail. It will be necessary for those taking forward this agenda to consider how implementation should be monitored so that any unanticipated side-effects can be identified and addressed.

10. Finally, we recommend undertaking a comprehensive review of the agenda's successes and shortcomings in three years time, with a view to identifying further possibilities for new directions.

Chapter 1:
Introduction

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:

- 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.[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.[3]

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.

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

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

5 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.

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

[3] 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).

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 factual 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, made up 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:

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

- *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

- *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 how the missions might be enacted. 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; OR42 (the Operational Research Society Annual Conference); and the Year 2000 Industrial Ecology Conference in Berkeley, USA. 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.[4] Future articles in refereed journals and practitioner magazines 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: OR practitioners (as 'professional experts') associated with environmental planning; 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

[4] http://www.hull.ac.uk/hubs/css/

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 define 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 own 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:

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

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

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

- 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).

- 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, 2000);

- The Operational Research Society Annual Conference at Swansea, in the 'OR for Social Change' stream (14th September, 2000); and

- The Industrial Ecology 2000 Conference, "Maximising Shareholder Value: Lessons from the Natural World", held at the Haas School of Business, University College Berkeley, California (5th-8th October, 2000).

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.

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.

The Industrial Ecology 2000 Conference enabled us to share our findings with an international audience, including a number of delegates working in environmental management who were not familiar with Operational Research.

It is hoped that several papers coming out of the study can be published in refereed journals and practitioner magazines 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 well as 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: first, 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'! Second, 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 people's 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 they 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 London and Sheffield workshop outputs in the design (in Hull) 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 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.

Chapter 2:
Operational Research and Environmental Issues

This chapter has two purposes: (i) to indicate the potential for mutual learning between the OR and environmental management communities; and (ii) to begin to bring some cohesion to the existing literature on operational research (OR) and environmental planning and management, which tends to be fragmented across a variety of journals. Three generic issues encountered repeatedly when dealing with environmental problems are identified, and some responses of OR to these issues (plus criticisms of these responses) are reviewed. A picture is generated of a considerable number of OR successes, and yet there are methodological and ethical issues that OR practitioners still need to address if they are to make further headway in establishing OR as a key, visible contributor to environmental planning and management.

2.1 OR Imperatives

In relating OR to other disciplines and practices, the President of the Operational Research Society in the year 2000 enjoys a scenic description:

> "The picture is of a frog and a pike living in a lily pond. From time to time, the frog would hop from one lily pad to another and the pike would stealthily swim to the pad. The pike's intent was clear: he wanted to eat the frog and would snaffle the lily pad if necessary. As the pike opens its jaws to swallow its prey, the frog leaps onto another pad to live a little while longer. For the definition, OR is the frog and what we do is the lily pad. Other groups will always snaffle what we've been doing - and this is a compliment" (Pidd, 2000, p.16).

The environmental planning community is a pike, and OR frogs have sat on a variety of environmental lily pads over the years, each of which has been hungrily consumed. It is clear that a great deal of work undertaken to support environmental planning—from modelling the Earth as a whole system, thereby making a case for limiting economic growth (Meadows *et al*, 1972; Meadows *et al*, 1992) to more recent applications of Multicriteria Mapping in support of risk management in the production of genetically modified foods (Stirling and Mayer, 1999)—can be described in OR terms. Our own literature search reveals that, for every paper on environmental planning and management that is explicit about using OR methods, there are at least five making claims to methodological innovation that are using the same or similar methods without any reference to OR. This is clear evidence of the wholesale consumption of lilypads.

Nevertheless, as Daniel *et al* (1997) argue, practitioners of OR and environmental management can usefully learn from one another, and both disciplines will be enriched through a dialogue in which the contribution of each is respected. The question is whether greater benefits might be gained by all interested parties if future methodological developments in OR are more actively directed and mobilised, instead of simply leaving the frog to jump whenever the pike bites.

Three OR imperatives for a more purposeful engagement with environmental planning and management can be identified:

- To explore challenging territory in extending the boundaries of OR application;
- To promote more meaningful interdisciplinarity; and

- To challenge the divide between 'planning' and 'implementation' (this challenge is implicit in the very notion of operational research).

Below, we discuss each of these imperatives in turn. First, the boundaries of OR have already been extended in four dimensions:

(i) There has been a diversification in the client base, encompassing the military, industry, agriculture, public services (such as health and welfare), international development, and community organisations. Therefore, OR practitioners have had to address an ever wider set of complex problem situations over the years;

(ii) There has been a widening of disciplinary engagement, with OR practitioners dealing with subjects ranging from mechanical engineering to political philosophy;

(iii) A plethora of methodological paradigms have been generated, encompassing the use of quantitative and qualitative techniques, and embracing a range of theories from 'hard' cybernetics (geared towards problem-solving) to 'soft' and 'critical' participatory ideas (geared towards problem structuring); and

(iv) OR has become more responsive to multiple perspectives, even in the use of quantitative methods (e.g., using techniques such as those associated with Multicriteria Decision Analysis).

It is arguably a natural extension of OR to take on environmental planning and management (indeed, many practitioners are already doing so, as will become apparent later in this chapter), especially as environmental issues are increasingly moving to the centre stage of political and business practice.

Second, OR is a well-established expression of formalised interdisciplinarity: a problem-determined, as distinct from a discipline-determined, endeavour (Miser, 1999a,b). The close connection between OR and systems practice also reinforces this (Keys, 1991). Elsewhere, one of the authors of this report has argued that successful interdisciplinary and transdisciplinary practice requires a focus on methodological pluralism, or 'multimethodology' as it is often called in the OR literature (Midgley, 1998, 2001). Arguably, OR writers are well in advance of disciplinary scientists in exploring the theory and practice of multimethodology (see, for example, Friend and Hickling, 1987; Flood and Jackson, 1991a; Jackson, 1991, 2000; Flood and Romm, 1996a; Mingers & Gill, 1997; Midgley, 2000; Taket and White, 2000). Much of the work in this area connects with wider debates on modernity and rationality, of importance across the whole range of social sciences—including those most closely associated with environmental management. Putting together the OR focus on interdisciplinarity, methodological pluralism and social theory, we argue that OR has a great deal to bring to the environmental planning community that is different from what the disciplinary sciences can offer.

Third, in being a problem-determined practice, OR is especially concerned with implementation. For many OR practitioners, this is not just a narrow concern with satisfying the paying client, but attention is also focused on possible adverse effects on people and things not directly involved in the planning process (Churchman, 1970). This generates questions regarding the legitimacy of OR intervention in serving particular interests. In recognising the importance of these questions, some branches of OR and systems practice have become more explicitly involved with the political dimensions of intervention (see, for example, Flood & Jackson, 1991a; Flood & Romm, 1996a; Midgley, 2000).[5] As will become apparent later in this chapter, these are recurrent concerns in the environmental planning and

[5] In particular, the Centre for Systems Studies at the University of Hull has been at the forefront of exploring the theory and practice of Critical Systems Thinking (see http://www.hull.ac.uk/hubs/css/ for details).

management literature too. Therefore, we argue that the focus of OR on implementation (and the wide understanding of this that is often embraced) will be of particular value to many people working in environmental management.

In our view, OR can gain a great deal from engaging with environmental planning and management: there is the potential for working with new clients, and for demonstrating its effectiveness in handling problems that are of increasing importance to governments, businesses and third sector groups throughout the world. OR can gain so much *primarily because it has so much of relevance to give*: it is a well-established interdisciplinary and multimethodological practice with a strong focus on implementation. Arguably, these are strengths that give OR a relatively unique competitive advantage.

2.2 Imperatives for Environmental Planning and Management

Importantly, many of the imperatives for the environmental planning and management community mirror those of OR. First, the boundaries of environmental management are wide and fuzzy, just like those of OR:

(i) The client base for environmental management has traditionally been focused on key users of natural resources. However, in the past 40 years, with the increasingly high profile of environmental concerns, just about all sectors of society are required to address issues of environmental management.

(ii) Since the publication of the Brundtland Report *Our Common Future* (WCED, 1987) and the Rio Earth Summit's *Agenda 21* (UNCED, 1992), the boundaries of environmental management have been irreversibly extended to incorporate concerns of the economy and society as well as the environment. These three realms are brought together through the principle of 'sustainable development', first enunciated by the World Conservation Union (now the International Union for the Conservation of Nature) in the 1980 World Conservation Strategy.

(iii) Several distinct paradigmatic approaches to sustainable development have crystallised in recent years. Smith (1992) usefully identifies three perspectives. First, a neo-liberal approach of resource accounting based on neo-classical economics, which contrives to translate environmental concerns into economic values so that they can be dealt with through market mechanisms and be addressed by fiscal policy design (e.g., Pearce *et al*, 1990). Second, an essentialist, populist (sometimes anti-industrialist) approach associated with minimising intervention (e.g., Richards, 1983), often invoking ideals of 'deep ecology', 'eco-feminism' and 'Gaia'. A third structuralist approach is more politically orientated, suggesting that power relations need to be addressed as an essential aspect of sustainable development (e.g., Redclift, 1992).

(iv) Environmental management increasingly needs to be responsive to multiple perspectives in order to acquire legitimacy (Foster, 1999).

Second, like OR, environmental planning and management is essentially interdisciplinary. It demands not just a broadening of the disciplinary front as suggested by Bryant and Wilson (1998)—often only cosmetically addressed through the commissioning of multidisciplinary teams—but also a more integrated system of communication and expert self-reflection. Spash (1997a), for example, talks of the need for environmental managers to unify interests, and advocates an interdisciplinarity which is operational in individuals rather than in teams of mono-disciplinary members.

Third, environmental management is essentially about bridging the divide between 'planning' and 'implementation'. The literature is rich in examples of unintended effects of plans on

vulnerable groups, and many writers have identified the need to prevent such effects. Three categories of affected groups can be identified: first, existing communities which bear the brunt of environmental costs by virtue of their geographical location and/or socio-economic status; second, future generations, typically identified as the key stakeholders in the mainstream definition of 'sustainable development'; and third, non-human nature. At one level, the frustrations in bridging the gulf between planning and implementation are expressed through the increasing legitimacy ascribed by many groups to non-violent direct action (NVDA) as manifest, for example, through activities of Reclaim the Streets and 'guerrilla gardening' (Jones, 2000). With respect to the concerns of experts, the emergence of the 'environmental justice movement' (Fischer, 1995) and debates regarding subjugated discourses associated with substantive environmental issues (Lohmann, 1993; Healey, 1993; Skollerhorn, 1998; Brand, 1999; Darier, 1999; Foster, 1999) reflect a rich and continuing tradition of critical thought regarding the role and legitimacy of professional and lay expertise in bridging the gap between planning and implementation.

In our view, so many of the imperatives of environmental planning and management mirror those of OR that the scope for mutual learning is genuinely significant and should not be underestimated.

2.3 Environmental Issues: From the Substantive to the Generic

There are many substantive environmental issues facing planners. Just three are mentioned below. Then a case is made for moving the focus of analysis from these substantive concerns to more generic issues encountered in environmental planning and management.

One substantive issue is the widely acknowledged link between environment and poverty. The discriminating effects of global warming and climate change on poorer countries have been illustrated in stark relief with 'natural' disasters of hurricanes, cyclones and floods in recent years. Whilst access to key natural resources such as fertile land, healthy drinking water and clean air might be linked with issues of population growth, they are also more significantly linked to factors of social distribution at local, national and global levels—including, most significantly, the effects of the Third World debt crisis. Similarly, issues of transport and energy have distributional as well as environmental effects.

Another substantive issue is found in the recognition that, whilst problems of climate change, pollution and waste disposal affect *existing* social groups in discriminate ways, they also significantly affect *future* generations. Likewise, policies on transport and energy must take into account long-term scenarios as well as short-term demands if they are to be sustainable.

Third, there are substantive issues relating to the integrity of nature itself. Most prominent recently is the debate over the use of genetically modified organisms in food production, as well as more general issues regarding the maintenance of biodiversity (e.g., Polunin and Grinevald, 1988; Leakey and Lewin, 1996).

Actually, the substantive issues are so diverse (especially at the local level) that it would be a hugely complex task to try to list them all and show how OR might address them. Any such list would inevitably be incomplete and would rapidly go out of date. In our view, it is more fruitful to identify generic issues that recur in the literature, regardless of the substantive issue being discussed. Examples of how OR can address these generic issues can then be adapted for use in different circumstances.

Our literature search on OR and environmental management has revealed three generic issues that repeatedly recur. These are:

- Issues of *complexity* in relationships between phenomena, and *uncertainty* with regards to the relevance and activity of component variables (e.g., Daniel *et al*, 1997; Martell *et al*, 1998; Weintraub and Bare, 1996);

- Issues of *multiple* and often *competing values* held by different stakeholders, particularly concerning conflicts between environmental and economic goals (e.g., Martell *et al*, 1998; Weintraub and Bare, 1996; Ramanathan, 1998); and

- Political issues of *power relationships* where ethical decisions have to be taken regarding who benefits and who bears the costs of environmental management (e.g., Njiforti *et al*, 1991; Douglas, 1992a; Sudhir *et al*, 1996).

Below, we examine in general terms how operational researchers have addressed each of these generic issues as part of their environmental planning and management practice. The aim is to show the current state of play regarding the role of OR.

2.4 Complexity and Uncertainty

Operational researchers address issues of complexity by attempting to make analyses as *comprehensive* as possible, typically (but not exclusively) through the use of systems thinking. Issues of uncertainty, on the other hand, tend to be addressed through the promotion of *transparency*, typically through processes of modelling and by the selection of indicators (for example, in optimisation studies).

2.4.1 Comprehensiveness and Systems Modelling

The concern for comprehensiveness reflects the historic link between OR and systems thinking (Keys, 1991). Many commentators have pointed to the systemic nature of environmental issues and the importance of taking a systems approach (e.g., Pollock, 1990; Grossmann and Watt, 1992; Dzidonu and Foster, 1996; Straussfogel and Becker, 1996; Hendrickson and Tuttle, 1997; Ravetz, 2000). Some systems writers respect complexity by acknowledging that "we cannot presuppose that we can know 'the whole system' but only that we can undertake a critical effort to reflect on the inevitable lack of comprehensiveness in our understanding and design for (social) systems" (Ulrich, 1983, p.21). This tradition embraces the idea that complex issues can never be comprehended perfectly, and there are therefore no absolutely correct solutions (Churchman, 1970; Ulrich, 1983; Midgley, 2000). Hence, the methodological focus tends to be on interpretations and viewpoints about complex situations (given the absence of perfect knowledge), supporting processes of mutual learning and thereby enabling purposeful action (Churchman, 1970; Checkland, 1981). A key component of systems practice, derived in large measure from operational research, is the use of modelling techniques which, whilst attempting to make complexity more comprehensible, serve also to alleviate uncertainty by clarifying key issues.

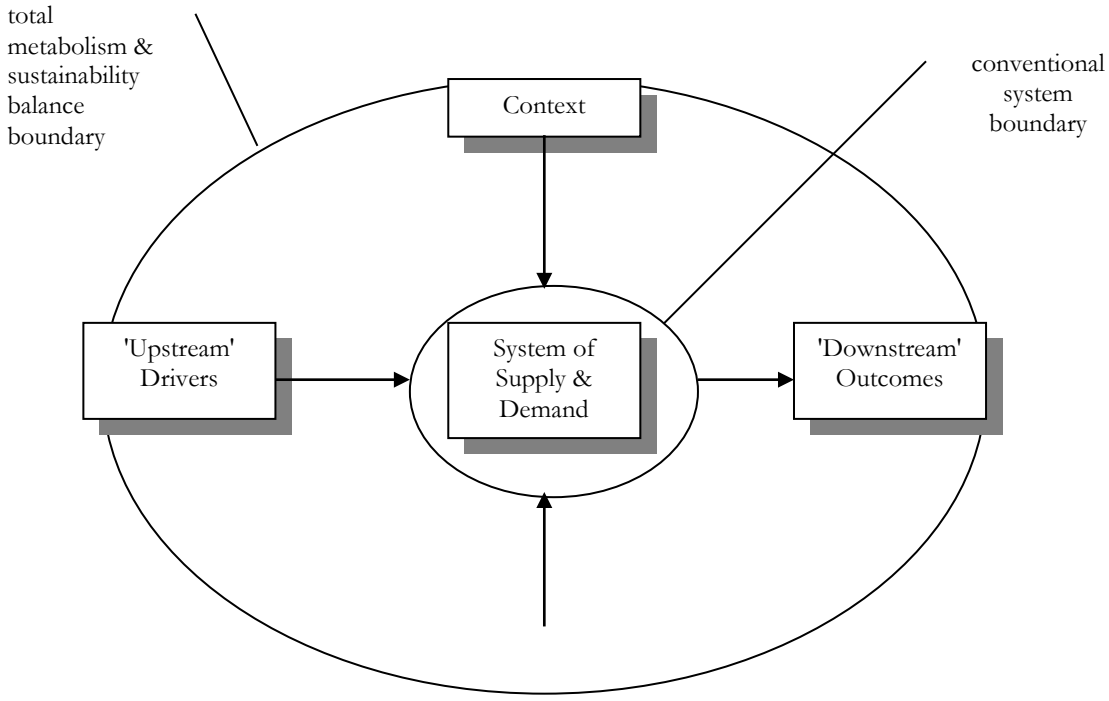
Bloemhof-Ruwaard *et al* (1995), in reviewing the literature on OR and environmental management, categorise issues into those that relate to the "supply chain" (the business process that takes inputs from the environment, makes products, and sends outputs back into the environment) and those that relate to the "environmental chain" (the environmental and human activity processes by which 'waste materials' interact with the environment and are eventually assimilated into it). The authors suggest that much traditional OR is associated with the supply chain: it provides tools for life-cycle and risk assessments, distribution and product recovery management, and routing and siting of waste disposal. The challenge here is for OR is to integrate environmental issues into supply chain modelling: a shift is needed from 'corrective' to 'preventative' measures by, for example, extending life-cycle assessments to produce more environmentally aware 'cradle to grave' models (see also Andersson *et al*, 1998).

Whilst supply chain modelling principally serves the business sector, environmental chain modelling serves the wider national and international policy domain of planning. When people work on environmental chain issues they tend to be providing tools for monitoring and assessing impacts, managing scarce resources, and generating models of future scenarios of environmental change. The challenge for OR practitioners engaged in environmental chain modelling, which is much less likely to have an explicit OR focus than supply chain modelling, is to demonstrate the value of OR to the traditional domains of environmental management.

While this analysis makes some sense in terms of explaining the traditional foci of OR and environmental management, enabling people to see where mutual learning might be most productive, in our view there is an issue over whether the distinction between the supply and environmental chains is itself a problem. Arguably, these two 'chains' are more usefully seen as nested systems: business systems nested within wider environmental systems requiring political planning if problems are to be prevented or averted. The separation of supply and environmental chain modelling actually reflects a past OR emphasis on serving *either* the business sector *or* the public sector. However, in dealing with many environmental problems, these sectors have to be seen as systemically interrelated: serving a client in one sector without taking account of the activities of, and impacts on, the other sector can lead to unforeseen side-effects of intervention.

An alternative 'sustainability' model (Figure 2.1) which *integrates* the supply and environmental chains is offered by Ravetz (2000). Ravetz puts together an approximate chain of cause and effect from *upstream* needs (in terms of socio-cultural values that are translated into economic 'supply and demand' pressures and flows) to *downstream* outcomes (in terms of environmental pressures and human impacts). National and international policies, regulation, markets and technology provide the overall *context* of assumptions, and local responses may alter the links in the system.

Figure 2.1: Sustainability Model ("Total Metabolism")
(Ravetz, 2000 p.18)



The model has the advantage of combining the economic, social and environmental into one overall picture of sustainability, and it extends beyond conventional industrial and government sectoral boundaries. In our view, an automatic use of the "conventional system boundary" (referred to in the diagram), which is most often synonymous with an organisational boundary (perhaps including customers, but rarely the wider environment), is unsystemic: other possibilities for making boundary judgements should at least be considered (Midgley, 1994, 1996, 2000). The broader boundary suggested by Ravetz provides a useful model to work with in further assessing OR relationships with environmental planning. Also, the idea resonates with a recent wave of interest in the use of OR to inform sustainable land-use planning.[6] The model provides a potential framework for assessing 'hard' supply-demand modelling in the centre, as well as both 'hard' and 'softer' systems analyses of social and cultural values at the periphery.

2.4.2 Problem Solving or Problem Exploring?

Several authors have pointed to the value of OR primarily as a means of revealing and exploring, as against solving, problems. Starfield and Bleloch (1983) and Mercer (1995) all see this as the principal role for expert systems in environmental management. Petrovic and Kralj (1993) describe Power Dispatch Modelling as *revealing* issues of concern rather than addressing them. In discussing the use of Multi-Objective Goal Programming, Foran and Wardle (1995) suggest that, while many of the scenarios produced might be plainly wrong, opening them to discussion provokes useful action and reaction. Brown and Jacobs (1996) draw a distinction between *conventional* Environmental Impact Assessment and Management (EAM) and more *proactive* EAM used for community-based management. Conventional EAM are based on independent reviews, regulations, risk assessments, legal enforcements, formal public hearings, etc. In contrast, the more proactive EAM use environmental and social needs assessments, scenario building and strategic planning within an iterative framework involving a constant revision of plans. Here, the EAM is used to promote *learning* rather than to provide authoritative, one-off answers. The Local Environment Analysis and Assessment of Rural Needs (LEARN) project in Cameroon also operates on the same iterative basis, where understandings of the problem situation are continually revised by rural participants' engagements with landscape and urban planning (Njiforti *et al*, 1991). Furthermore, a similar aim to promote comprehensive understanding by exploring levels of ignorance and revealing uncertainties in rural communities lies behind the systemic practice of Rapid Rural Appraisal (RRA) (Chambers *et al*, 1989) and Participatory Rural Appraisal (PRA) (Chambers, 1992).

The idea of surfacing uncertainties as a means of managing complexity is made explicit in both Strategic Choice (Friend and Hickling, 1987) and Robustness Analysis (Rosenhead, 1989a). Both work on the idea of translating uncertainties into manageable transparent entities, scores, or 'indicators', forming a basis for rational decision making between planning options. Strategic Choice was one of many significant OR developments to emerge from the highly influential Institute for Operational Research (IOR) launched by the Tavistock Institute for Human Relations in 1963 (Faludi and Mastop, 1982). Much of the IOR work supported local authorities in producing development plans, and provided a significant and continuing source of synergy between OR and public sector town and regional planning

[6] Yewlett (2001), in an assessment of synergy between OR and town (land use) planning, identifies three 'waves of enthusiasm' for post-war planning in the UK. Following the first wave initiated in 1947 through the Town & Country Planning Act, and the second 'radical' wave for public involvement in planning initiated in the mid-1960s, the current third wave began in the early 1990s and has rejuvenated planning in the wake of widespread concern for sustainable development issues.

(Friend, 1997). The IOR also provided the stimulant for many of the subsequent problem structuring (or 'soft') OR methods developed in the 1970s and 1980s.

2.4.3 The Pros and Cons of Quantification

Having mentioned a couple of the 'soft' OR approaches that are very explicitly concerned with the promotion of learning rather than the production of one-off answers, we should nevertheless point out that the majority of OR techniques used in environmental planning and management are quantitative. An example is Data Envelopment Analysis, an evaluation method which has been promoted by OR practitioners as of particular use when there is a need to compare the performance of units with similar outputs (e.g., in power generation) (Linton, 2000). One of the most commonly used quantitative approaches involves defining environmental indicators and then monitoring performance (e.g., Zhao *et al*, 1991; Qingzhen *et al*, 1991; Ellis *et al*, 1996; Spengler *et al*, 1997). Quantitative indicators have the enduring value of offering transparency to otherwise obscure or ill-defined phenomena (Stirling, 1999), and the achievement (or failure to achieve) targets becomes unambiguous when those targets are expressed in quantitative terms. Because of this transparency, which as we shall see in Chapter 3 is highly valued (particularly in the public sector), quantitative OR techniques are likely to remain in demand.

Nevertheless quantification is not always straightforward. In highlighting the difficulties below, we do not intend to imply that quantification is wrong, or that 'soft' approaches are superior to 'hard'. Our view, in common with many other OR practitioners (see Mingers and Gill, 1997, for some edited readings), is that both quantitative and qualitative methods are useful for different purposes. However, it is important to be aware of potential problems because, in the area of environmental planning and management, some of the limitations of quantitative methods become particularly apparent.

It is simply the case that some environmental problems are so complex and uncertain that they resist quantification using even the most sophisticated methods (Weintraub and Bare, 1996). It is particularly important to note that this warning comes from authors who are themselves using quantitative methods, not from those with a paradigmatic aversion to them. Also, accepting 'limited' environmental damage that *appears* quantifiable could have unforeseen systemic consequences in the longer term: there are always uncertainties. In short, OR practitioners who are *only* prepared to use quantitative methods run the risk of "treating the pulsating uncertainties of the strategic as if they can, indeed must, be fossilized as certainties or at least tranquillised into probabilities" (Rosenhead, 1989b, p.7).

In a similar vein, Fischer (1995) warns against more general technocratic tendencies in transforming political issues of hazard into expert-driven, depoliticised questions of risk assessment. While OR can certainly provide "rational tools in otherwise irrational and emotional debates on environmental issues" (Bloemhof-Ruwaard *et al*, 1995, p.231), there is clearly also a need to continually appreciate that good quality quantification and measurement are dependent on making the right choices of measures. These choices require people to make value judgements. In other words there is a need for OR practitioners to appreciate that there are uncertainties surrounding *competing values*, not just uncertainties about the natural world (Friend and Hickling, 1987; Rosenhead, 1989b; Midgley, 2000).

Our point is not that there is anything inherently wrong with the use of quantitative methods—on the contrary, it would be impossible to address major technical issues, such as planning to meet the peaks and troughs of electricity demand (Petrovic and Kralj, 1993), without them—but we should be wary of simplistic interpretations of their use. In particular, we need to think of such methods as a *support to learning* rather than revealing *the* truth: models can provide debatable evidence so that people can make better judgements. We should also

resist trying to quantify the unquantifiable. Most importantly, however, we need to remember that quantitative methods should not *replace* value judgements about the right course of action to take: for example, designing indicators to reveal whether you are heading in a particular direction is only of use once you know where you want to be going.

2.5 Multiple Values

Most Western societies are highly pluralistic, containing people with a diverse variety of value allegiances. Environmental planning and management is an area where value differences can be particularly acute. Our literature survey suggests that a key source of conflict is between economic and environmental values, with a great many papers discussing the use of OR methods to support two or more stakeholder groups in exploring their differences and/or reaching accommodations. Interestingly, the conflict between economic and environmental values permeates professional practice in OR and environmental management as much as in the wider public arena. The division between 'supply' and 'environmental' chain modelling (Bloemhof-Ruwaard *et al*, 1995), for example, reflects distinct orientations towards supporting business advantage or governmental regulation of the environment.

Referring to the distinction between the supply and environmental chains, Daniel *et al* (1997) conclude that the relationship between OR and environmental planning should be "dynamic and interactive in the sense that they 'push' each other towards the development of both scientific fields" (p.259). In other words, to be more holistic, each field has to take account of the other, but the tension between economic and environmental values is never actually resolved. Similarly, Petrovic and Kralj (1993) trace the history of OR involvement with Power Dispatch Modelling which, from the early 1930s to the 1960s, was focused almost exclusively on generating optimum economic returns, but from the late 1960s became gradually more focused on environmental protection. The authors reveal the difficulties OR practitioners had in reconciling environmental with economic imperatives in the modelling process—but they stress that OR practitioners were very willing to accept the challenge.

2.5.1 Quantifying Environmental Costs

One prevalent, long-standing way of reconciling values is by translating environmental concerns or 'costs' into economic values: for example, through Cost-Benefit Analysis (Rycroft *et al*, 1988), Contingent Valuation (Pearce *et al*, 1990; Lindsey *et al*, 1995), and Summative Evaluation (Butler and Nelson, 1994). The term "external costs" has been coined to make Cost-Benefit Analysis (and other variants on the same theme) relevant to environmental management: instead of just calculating the costs and benefits accruing to one organisation, both 'internal' (for the organisation) and 'external' costs (for the environment) are taken into account. The advantage of External Cost Estimates is that they express choices in a standardised, quantitative form that is familiar to decision makers operating in a market environment. Thus, External Cost Estimates provide the basis for the 1992 European Commission 'ExternE Project' (Mirasgedis and Diakoulaki, 1997); the World Bank's adoption of 'Debt-for-Nature' and SWAPS (sell with a purchase[7]); and the 'flexibility mechanisms' of the 1997 Kyoto Protocol, which aim for a net reduction of global greenhouse gas emissions (Parkinson, 2000).

Criticisms of these measures are levelled on three fronts. First, as mentioned previously, it is impossible to fix a meaningful 'value' in some cases, particularly on resources which are non-tradable (Weintraub and Bare, 1996) or non-renewable. Indeed, we would go further and say that some forms of economic valuation can actually be viewed as immoral, such as when an

[7] Commercial banks sell debt at a reduced rate to independent organisations (e.g., the World Wildlife Foundation, Conservation International and the World Bank) which then work with debtor nations, using local currency, to encourage rainforest preservation in exchange for debt forgiveness. This provides an alternative to the production of exports in the quest for foreign exchange.

economic value is placed on human lives and then these are traded off for financial gain. This is what happened in the Ford Pinto case, when Ford calculated that it would be more expensive to recall faulty cars than to pay out compensation to the dead and injured following accidents (Gioia, 1992).

The second criticism levelled against External Cost Estimates is that there is often wide disagreement on the financial costs being ascribed, depending on the values of the actors concerned. For example, the loss of a species of insect might be trivial to one person but of almost incalculable significance to another.

Thirdly, it is argued that External Cost Estimates, made in relation to global issues, reinforce existing market relations of power and therefore perpetuate the trade dominance of the industrialised countries. After all, the estimates are usually done without the participation of people in non-industrial societies (Amin, 1992; Redclift, 1992; Mulberg, 1996; Mirasgedis and Diakoulaki, 1997; Parkinson, 2000).

Despite these criticisms, we should acknowledge that External Cost Estimates have been so widely used because, generally speaking, a controversial estimate of environmental costs is perceived by most organisations as better than no estimate at all. It is only in recent years that alternatives, allowing a more detailed consideration of different values, have been evolved by OR practitioners.

2.5.2 Multi-Criteria Techniques

Generally, optimisation techniques only consider one objective in making planning decisions—and this is, of course, problematic when multiple values are in play. Ideally, it should be possible to devise an OR method which can help people construct win-win scenarios where people make compromises in order to fulfil a range of objectives being pursued by different stakeholders. This is exactly the intention behind the development of a family of techniques, an umbrella term for which is Multi-Criteria Decision Analysis (MCDA). MCDA has been widely used in environmental planning and management in recent years: particular approaches include Multicriteria Analysis (Siskos & Hubert, 1983; Mirasgedis and Diakoulaki, 1997); Multicriteria Evaluation (Munda *et al*, 1994); Multicriteria Power Generation Dispatch (Petrovic and Kralj, 1993); Multicriteria Mapping (Stirling, 1999); Multicriteria Methodology with Analytic Hierarchy Process (Ramanathan, 1998); Multi-Criterion Decision Techniques (Özelkan and Duckstein, 1996); and Multi-Objective Goal Planning (Foran and Wardle, 1995).

All these techniques involve considering a range of values and objectives, and making trade-offs. This can be done with just one organisation or stakeholder group to enable people to deal with conflicts between objectives (e.g., commercial and environmental priorities), or it can be done through conversations between a variety of stakeholder groups. MCDA may also involve the consideration of different future environmental scenarios in relation to the various priorities of stakeholders (Andrews, 1992).

Research into the use of MCDA in environmental management, with its trade-offs between objectives and win-win compromises, has bloomed in the last fifteen years. This is because it answers the major criticism levelled against many OR methods that they are redundant in the face of value conflicts—or worse, that they force a situation where one set of values is relentlessly pursued without debate (Jackson, 1991).

However, this blooming of research has not gone without criticism. Two issues in particular have been raised. First, putting quantification *before* the dialogical resolution of conflicts has been seen as a problem (Weintraub and Bare, 1996). In our view, however, this is as much an issue of the process of application of MCDA as anything else: if MCDA is conducted through a dialogue between stakeholders, it is possible for people to iterate between dialogue

and quantification, which represents a substantial improvement over previous methods. See Chapter 4 for an example of good practice in this regard.

Arguably, a much more serious criticism has been raised by Spash (1997a): the principle of using a 'trade-off' rationality goes against the 'rights-based' (or 'deontological') rationality implicit in many environmentalist philosophies. Environmentalists tend to see certain things (e.g., species they wish to preserve) as having an absolute value that should never be traded for gains in other areas. Therefore, according to Spash, methods like MCDA are not ideologically neutral: they favour liberal and market values where trade-offs are accepted as a normal fact of life.

2.5.3 Problem Structuring Approaches

One way of avoiding ideological conflicts is to attempt to work from a supposedly neutral, consensual starting point. The Natural Step (TNS), using Cyclic Socio-Ecological Systems Thinking (Robert *et al*, 1994), attempts this by identifying 4 "incontrovertible" scientific principles which are translated into 4 system imperatives: (i) the Earth's crust should not be depleted (ecological); (ii) the production of synthetics should not exceed their destruction (social); (iii) harvesting should be matched by renewal (ecological); and (iv) resource efficiency should be matched by resource distribution (social). The technique has been adopted by the UK-based non-governmental organisation, Forum for the Future, as a means of developing a learning approach to sustainable development for private and public sector agencies. The approach has been influential in generating ideas on *Natural Capitalism* (Hawken *et al*, 1999), which professes universal appeal based on the claim to have discovered a "trans-ideological" approach that reconciles economic growth with environmental sustainability. However, in *Factor Four* (Weizsäcker *et al*, 1998), the practical guide to implementing natural capitalism, the authors end by admitting that the reconciliation cannot endure indefinitely, and that we need a change in *values* away from consumerism!

This kind of contradictory thinking lends weight to the argument of some critical systems thinkers that *methods and processes*, as well as the contents, of analyses may embody values that may or may not be conducive to sustainable development (Ulrich, 1983; Midgley, 2000). It is not the case that methods are value-neutral and only the contents of analyses are value-laden. Spash's critique of MCDA is perhaps the clearest example of how a method can support the rationality of one set of stakeholders (those who are happy to deal in trade-offs) and suppress other rationalities (such as those which assert a level of environmental integrity that should never be contravened).

A set of alternatives to External Cost Assessments, MCDA and the illusion of value-neutrality comes in the form of *problem structuring methods* that focus on *dialogue* (see Rosenhead, 1989b, for a fairly representative selection). These seek to make visible the values and other assumptions underpinning plans or decisions. Most problem structuring methods are purely qualitative (e.g., Checkland's, 1981, Soft Systems Methodology; Ackoff's, 1981, Interactive Planning; and Ulrich's, 1983, Critical Systems Heuristics), but some include an element of quantification too (e.g., Mason and Mitroff's, 1981, Strategic Assumption Surfacing and Testing). The more sophisticated methodologists (e.g., Ackoff, 1981; Ulrich, 1983; Friend and Hickling, 1987; Flood, 1995; Taket and White, 2000) are explicit about the value of dialogue, so don't pretend to neutrality. They actively advocate participation as a value in itself.

Some significant applications uncovered by our literature survey are two uses of Game Analysis (Schlange, 1995; Hipel *et al*, 1997); some modelling of institutional communication channels between private, public and voluntary sectors (Misra, 1999; Wood *et al*, 1999); an application of Soft Systems Methodology to the production of specially-bred earthworms for land recovery (Frederickson and Frederickson, 1997); the use of Emergent Practice in three environmental management cases (McClintock *et al*, 1997); and the use of a dialogical

approach to resolving value conflicts in an environmental development project in India (Sudhir *et al*, 1996).

Like all the other approaches reviewed so far, we do not want this discussion of problem structuring methods to pass without the surfacing of criticisms. However, as all the above cases of the application of problem structuring are so recent, no critiques in the area of environmental management have yet been published (as far as we are aware). However, plenty of critical analysis has been produced in the more general OR literature. Some approaches (e.g., Soft Systems Methodology and Interactive Planning) have been criticised for pushing stakeholders towards agreement, whether or not this is in their best interests (Jackson, 1982). Similarly, it has been pointed out by numerous authors that hidden forces of coercion can distort dialogue so that the views of the powerful prevail, regardless of whether they are in everybody's interests (or in the interests of sustainability)—again see Jackson (1982) for a typical argument along these lines. Also, planners are at a distinct advantage when engaging in dialogue with ordinary citizens who have no experience of the language of planning, and who might not have a clear view of their position worked out in advance (Ulrich, 1983). It is for this reason that Ulrich (1983) produced his method of Critical Systems Heuristics which provides a set of questions about values that planners and ordinary citizens can both answer, thereby creating a more level playing field. Nevertheless, even the use of this problem structuring method can be distorted by hidden coercive forces (Midgley, 1997).

Finally it should be noted that, while problem structuring methods can help people explore values and can give rise to consensual action plans, they tend to be fairly blunt instruments when it comes to doing other things. For example, once an action plan has been agreed and implemented, problem structuring methods have little to say about evaluating effects (for instance, on the environment). Certainly, some methods (such as Critical Systems Heuristics) ask stakeholders to specify evaluation measures, but then other (often quantitative) methods are necessary to actually perform an evaluation. Therefore, in common with a number of other OR writers (e.g., Friend and Hickling, 1987; Flood and Jackson, 1991a; Jackson, 1991, 2000; Flood and Romm, 1996a; Mingers and Gill, 1997; Midgley, 2000; Taket and White, 2000), we advocate *methodological pluralism*: drawing upon and mixing a variety of methods to fulfil different purposes. This is in contrast to some of the authors of problem structuring methods who have advocated their approaches *instead* of quantitative methods, or have allocated the latter only a very minor role within their own methodologies.

2.6 Political Effects

A significant portion of the work in the environmental planning and management literature has been focused on risk management—see Rycroft *et al* (1988), Barnthouse (1994), Rao (1995) and Shrader-Frechette (1998) for some methodological contributions. Risk management is usually seen as a purely technical function[8]: the risks inherent in different scenarios need to be assessed (and sometimes quantified in financial terms) to inform decision making. Risk assessors are generally loath to accept the possibility that whether or not a risk is worth taking involves making a *value* judgement (Douglas, 1992b).

Schuurman (2000) reminds us that risks are unequally distributed, both geographically and socially. He further suggests that the discourse on risk distracts attention from emancipatory projects directed at the 'global underclasses'. His critique follows similar sentiments expressed elsewhere on the dominating effects of the global environmental discourse, which often requires sacrifices by people in developing countries that those in the developed world would not contemplate. Authors making this point stress the need to resist such hegemony by supporting vulnerable groups, including non-human nature (e.g., Shiva, 1990; Sachs, 1992; Hildyard, 1993; Lohmann, 1993). Despite the growth of non-government organisations

[8] Although it should be noted that there are a few exceptions to this generalisation (e.g., Shrader-Frechette, 1998).

which claim to represent the interests of those affected by mainstream environmental planning (particularly since the 1992 UN 'Earth Summit'), there is evidence to suggest that what Habermas (1984) calls the "new social movements" are being dominated by the middle-classes, and are thereby being neutered by the mainstream systems of power (Dickens, 1996; Rawcliffe, 1998).

Specific examples of political effects can be cited. In environmental management, Imperial (1999) argues that, when 'problems' are identified, these are predominantly issues of the co-ordination and integration of programmes rather than with their implementation, where issues of 'the affected' are more likely to be raised. Stirling (1999) discusses the fact that producing adequate sustainability indicators is seen as problematic by the vast majority of writers (a claim supported by our own literature review), yet this consensus of opinion is not being transmitted to those interested parties who stand to be affected by the practical decisions informed by such indicators. Brown and Jacobs (1996) document the need to stop transferring forms of environmental impact assessment designed for affluent countries into less developed countries where they can have significantly negative effects. Sagasti (in Luck and Walsham, 1982) describes the misuse of OR in Peru over a ten year period, highlighting issues like "escapism in figures", "clouding issues to make them unintelligible", "giving scientific backing to predefined policies", "using a cannon to kill a fly", "model fetishism", "focusing on the wrong issues", "satisfying ego trips of foreign researchers", and still more!

The problem here is an ethical one. It demands paying attention to the *effects* of planning and decision making on people and the environment. A variety of authors have identified a 'divide' between the world of planners and the worlds inhabited by those affected by their plans. Churchman (1979) talks about the systems approach needing to learn from its "enemies". Ulrich (1983) talks about "systems rationality" (the technical rationality of planners) and the "social (ir)rationality" of community members that should be swept into planning processes. Some authors in the field of environmental management (e.g., Healey, 1993) choose to use Habermas's (1984) distinction between the "system" (of money, law and power) and the "lifeworld" (the language of the community of ordinary citizens) as a means of identifying the same issue: in Habermas's view, the key problem faced by modern societies is the fact that the system is *colonising* the lifeworld—people are increasingly being forced to live their lives according to the dictates of money, law and power. Planners, including environmental planners, can choose whether to work for the institutions of colonisation or alternatively work to empower communities of citizens to reclaim some autonomy.

Schlange (1995) argues that the 'divide' between planners and ordinary citizens is to some extent inevitable, and therefore there is a need to set up distinct OR processes for 'planners' (e.g., using systems thinking) and 'users' (e.g., using Game Analysis). Indeed, the principle of creating separate space for those affected by plans is common to a variety of OR methodologies (see, for example, Mason and Mitroff, 1981; Beer, 1994; Gregory *et al*, 1994; Midgley, 2000). The key is to remain aware, through dialectical engagement between theory and practice, that there is an ever-present political dimension to intervention. This is fundamental to much of the work undertaken under the banner of Critical Systems Thinking (e.g., Ulrich, 1983; Midgley *et al*, 1998; Midgley, 2000), which provides some useful ways to conceptualise the politics of OR practice.

According to Friend (1997), the history of OR has indeed been characterised by a continual dialogue between theory and practice. There has always been a concern for making OR more relevant and useful to the less well off and less privileged sections of society, and in the 1980s 'Community OR' was officially born (Ritchie, 1994). Community OR is sometimes described as the use of OR with community groups and/or voluntary organisations, although in practice Community OR has also been undertaken with a variety of health and welfare organisations as well as multi-agency groups serving the community (Midgley and Ochoa-Arias, 1999). For 26 representative case studies of Community OR, see Ritchie *et al* (1994). Rosenhead (1989b) suggests that community OR became an antidote to the high level

managerial involvement with, and dominance over, OR techniques (such as Game Analysis, mentioned above).

The question is, should there be equivalent formal developments in OR to serve those affected by environmental planning? There have certainly been none yet, although there are examples in the literature of people arguing for methodological developments to ensure that the affected are taken into account in environmental planning and management. For example, Stirling (1999) suggests that there is a need to develop tools for 'political sensitivity mapping' as a means to counter the implementation effects of expert-driven sustainability indicators. Spash (1997a) suggests designing an ethically based 'political model' for public debate to give formal expression to the dialectic between the 'natural science approach' and the 'neo-classical economic approach'. Paden (1999) wants to promote 'deliberative groups' for urban planning, which are different from 'focus groups' in that the former are designed to specifically address the concerns of those affected by plans. In deliberative groups, the affected are kept separate from decision makers so they can express their ideas without fear of reprisals. In India, Sudhir *et al* (1996) identify a need to examine the *informal* economy of waste pickers, itinerant buyers, small scrap dealers, wholesalers and households to design more effective forms of urban solid waste management. Similarly, work in Trinidad and Tobago reveals the need to design a more *community based* environmental management system (Brown and Jacobs, 1996). Finally, case studies in Washington and the Alberta province in Canada reveal the effectiveness of a permanent 'citizens clearing house' to provide views that can be considered alongside experts' risk assessments for the disposal of hazardous waste (Fischer, 1995).

There are certainly many writers in OR and environmental management with a commitment to account for the effects of planning on people and the environment. In our view, in considering whether a formal sub-discipline of OR specialising in this should be established (like Community OR has been established to work with community groups and voluntary organisations), it is worth asking whether this is going to *raise awareness* of the need for OR practitioners to deal with the political effects of environmental planning, or whether it is going to *marginalise* these concerns. As we see it, if OR practitioners are going to have any success in establishing their specialism as a key contributor to environmental planning and management, they have to be able to deal with *all three* of the recurrent, generic issues uncovered by this research: complexity and uncertainty; multiple values; and political effects. Political effects are no more and no less important than the other two.

2.7 Conclusions

There have clearly been extensive uses of OR in environmental planning and management: the references cited in this chapter represent only a small sample of an expansive body of literature. However, the literature is spread across a wide variety of journals with only a handful of review papers bringing any cohesion to the field. Also, there are many applications of methods that do not acknowledge their origins in OR: five such applications for every one that does acknowledge its origins. Finally, there is little evidence of a consciousness amongst environmental planners that OR could be a source of methodological inspiration for their work, and yet the commonalties between environmental management and OR suggest that mutual learning could be very fruitful.

It is also clear that understandings of environmental issues have changed rapidly in the past few decades, both with respect to their higher public profile and to a broadening of what constitutes an 'environmental issue'. This has been particularly true since the discourse on sustainable development took hold in the public consciousness.

Because of the extraordinarily wide range of substantive issues that are considered to have an environmental dimension, we chose, in this research, to focus our attention on the *generic* properties of environmental issues that recur most often in the literature: *complexity &*

uncertainty; *multiple values*; and *political effects*. We argue that, if OR practitioners are able to show that they can deal with all three of these generic properties, then they will be in a good position to make an effective and sustained contribution to environmental planning and management. They will also be in a good position to raise the profile of OR for the future.

OR practitioners have typically (but not exclusively) addressed complexity by attempting to make analyses as *comprehensive* as possible through the use of systems thinking. Issues of uncertainty, on the other hand, tend to be addressed through the promotion of *transparency*, typically through processes of modelling and by the selection of indicators (for example, in optimisation studies). There has been a useful focus on *revealing* (rather than solving) problems, and the value of OR modelling as a contribution to *learning* about the management of environmental issues has been stressed. Many OR methods that have been designed to handle complexity and uncertainty are quantitative in nature, and with good reason: they have the enduring value of offering transparency to otherwise obscure or ill-defined phenomena. However, there has been debate about the limitations of such methods in the face of some environmental issues which are *so* complex that they resist quantification. In addition, there is a concern that OR methods might be used to promote technical answers to what are basically ethical or moral questions. Our own answer to these criticisms is that it all depends how quantitative methods are used. We should obviously resist trying to quantify the unquantifiable, and we should think of these methods as a support to learning (rather than as a means for uncovering 'the' truth). Most importantly, however, we should remember that quantitative methods should not *replace* debate about values—but once this debate has taken place, and a way forward identified, they can provide vital support for further clarifying issues and monitoring performance.

This takes us onto the second recurring, generic theme in environmental management: multiple (and often conflicting) values. One approach to handling these is to aggregate all the (internal and external) costs of implementing a plan to see whether or not these outweigh the benefits (again, costed financially). Of course, this means making a judgement on costs which others may disagree with. Therefore, multiple values are essentially handled by the imposition of one value system translated into costings, thereby allowing optimisation to take place (at least, optimisation from one point of view). There have been many criticisms of these kinds of approaches, but until relatively recently there have been few alternative methods available. However, once Multi-Criteria Decision Analysis (MCDA) was introduced into the environmental management literature by OR practitioners, all this changed. MCDA allows multiple purposes to be considered in planning so that win-win scenarios can be constructed. These techniques have been subject to less criticism than earlier ones based on optimisation, but there has still been some scepticism surrounding the quantification of values and, most importantly in the context of environmental planning, it has been realised that MCDA is not value-neutral: it tends to disadvantage environmentalists who, unlike business and public sector managers, are not always willing to accept trade-offs. Finally, we should mention another OR response to the need to handle multiple, conflicting values: problem structuring methods. These are mostly qualitative, and support people in debating values and modelling action plans. However, their emphasis on dialogue leaves them open to accusations that they cannot account for the effects of hidden coercion in relationships between stakeholders. Also, in our view, we should be sceptical about claims that, in most circumstances, problem structuring methods should *replace* the more traditional, quantitative OR techniques: rather, we argue that they should both be seen as useful for different purposes.

The third and final recurring generic theme in environmental management is a recognition of the need to account for the political effects of planning on people and non-human nature. In the OR literature, the 'divide' between planners and the communities they serve has been recognised for many years, and some useful theoretical and practical approaches have been developed to support planners in sweeping in the concerns of the affected (see, for example, some of the work in Critical Systems Thinking). While there are many examples of OR practitioners proposing methodological developments to achieve this, we raised a question about whether or not people's interests in dealing with the political effects of environmental

planning should be formalised into an explicit sub-discipline of OR (equivalent in status to Community OR): this may promote awareness of the issue of political effects, or it may marginalise it.

In reflecting on the contents of this chapter, it seems to us that OR does indeed have a great deal to offer environmental planning and management. Hopefully, the identification of the three generic themes (complexity and uncertainty; multiple values; and political effects) focuses attention both on where OR has already made a contribution, and where it needs to direct its attention in future. The problem is, complexity, multiple values and political effects rarely occur in isolation from one another: it is not possible to produce a simple methodological grid which allocates different methods to the different themes and expect this to answer all our problems. Most often, complexity is *complicated* by multiple values and different perceptions of political effects—in other words, in many situations faced by environmental planners, the three are tangled up together. This means that a huge challenge faces OR as a discipline: developing methodologies and methods that can deal with all three themes simultaneously. However, the prize for accepting this challenge is great: if we are able to produce such methodologies and methods, and can communicate them successfully to environmental planners, we will have made a major contribution. In our view, this gives us the best chance of securing the place of OR as a key contributory discipline to environmental planning and management.

In the next chapter, we present the results of our empirical research into the views of environmental managers in the public, business and third sectors. For each sector, we organise the data into issues connected with the three generic themes identified in this chapter. Later, in Chapter 5, we present the responses of OR practitioners who came together to reflect on how OR would have to be developed to meet the challenges of environmental planning and management. You will see that many of their conclusions are complementary to those coming out of our review of the literature, although they have taken the debate much further, and have confronted head-on the implications and practicalities of change.

Chapter 3:
Stakeholder Perceptions of Environmental Issues

Notes on Reading this Chapter

- Appendix 2 provides a full list of interview dates and the names of the organisations that provided interviewees. It also contains details of the venues of workshops and conferences convened and attended (along with lists of participants).
- Many of the interviews with 'local level' stakeholders were undertaken in the Greater Manchester area and hence some of the local issues are likely to show a North West regional bias.
- All quotations retain anonymity, and place names have been removed to facilitate this.
- It is inevitable that the meanings intended by the interviewees have been subject to the interpretations of the authors in constructing the narrative in this chapter, and we have drawn on the literature as a source of information to supplement the interview data. As a partial corrective to these potential sources of bias, we gave the interviewees the chance to comment on a first draft (in the form of an interim report).
- Many of the issues discussed in this chapter were subject to multiple (often opposing) interpretations by different stakeholders, and where possible we have tried to give a balanced portrait of both sides. However, in some cases there was much more interview material available to support one side as compared with the other, and our narrative inevitably reflects this.
- Some of the feedback we received on a previous version of this chapter suggested that our analysis privileges the views of third sector representatives—which was certainly not intended. We believe that this impression stems from the fact that we have done more than simply explain what those in each of the three sectors think they are doing in relation to the three generic themes. We have also attempted to provide *critical interpretations* of their activities so that the dilemmas people face become clear. Of course, most of this critical material came from third sector representatives because their role, and their primary interest, is in highlighting the *political effects* of what people are doing (as will become clear). They were even critical about their own activities. This does not mean we always support their interpretations, but it *does* mean that they reveal dilemmas that the public and business sectors need to be aware of if they are going to enter into dialogues, and try to reach compromises, with their stakeholders.
- Numbers in parentheses refer to terms described in a glossary constituting Appendix 1. The glossary describes selected techniques, methodologies and approaches, and was designed primarily to assist the authors in keeping track of terminology during research. Apologies are extended to specialists who might question some of the descriptions offered, and we acknowledge that full consensus on terminology is an illusory goal. Nevertheless we hope that the glossary has some heuristic value.

3.1 The Four Sectors

Four stakeholder groups were identified for the purposes of this research—three sub-groups of 'planners' (users of professional expertise) and one sub-group of professional 'experts' (OR practitioners):

1. Users of professional expertise in environmental management:
   - Planners in the public sector;
   - Planners in the business/industrial sector; and
   - Planners and campaigners in the voluntary or 'third' sector.
2. Professional experts:

- OR practitioners.

As stated in Chapter 1 (section 1.2), the role of the professional expert is assumed in this study to provide some, though not an absolute, level of guarantee or assurance in support of the planning process.[9] Although we acknowledge that the separation of OR practitioners (as experts) from sector-based user groups is to some extent artificial, since many of the former actually work in one of the three sectors, we think it is still important to make the conceptual distinction for the purpose of this study. The primary reason is that the distinction reflects the possibility that OR practitioners may have different interests when wearing a 'planning' hat (whether in the public, business, or third sector) than when they are wearing a 'professional OR' hat.

3.2 The Flow of Information about Environmental Issues

Figure 3.1 maps the information flow associated with environmental issues, stakeholder groups and planning. The diagram traces the information transfer (represented by arrows) from sources to destinations for consumption (both represented by closed boxes) through key activities or functions (represented by oval or ellipse shapes) and the establishment of transient information stores (represented by open-ended boxes).

Several features of the diagram can be highlighted:

- As implied above, many of the user groups have their own expert component. For the purpose of this study, placing operational researchers in a separate box serves to make visible the expert function whether operating from academia, from consultancy companies, or from user groups directly.

- We have represented three 'orders' of planning in the diagram ('ideal', 'objectives' and 'goal/means' planning). These indicate increasing restrictions on the planning process from the relative freedom of 'ideal' planning to the most restrictive operational level of 'goal/means' planning (75, 76). 'Incremental' planning is arguably a fourth level or type of planning, particularly associated (as suggested by one respondent) with aspirations of non-government agencies in the UK. In the diagram this is represented by immediate feedback from 'communities' to second order ('objectives') and third order ('goal/means') planning. It is assumed that even incremental planning has built-in assumptions and ideals from which plans are generated, thereby making redundant the appearance of a direct feedback loop to first order planning.

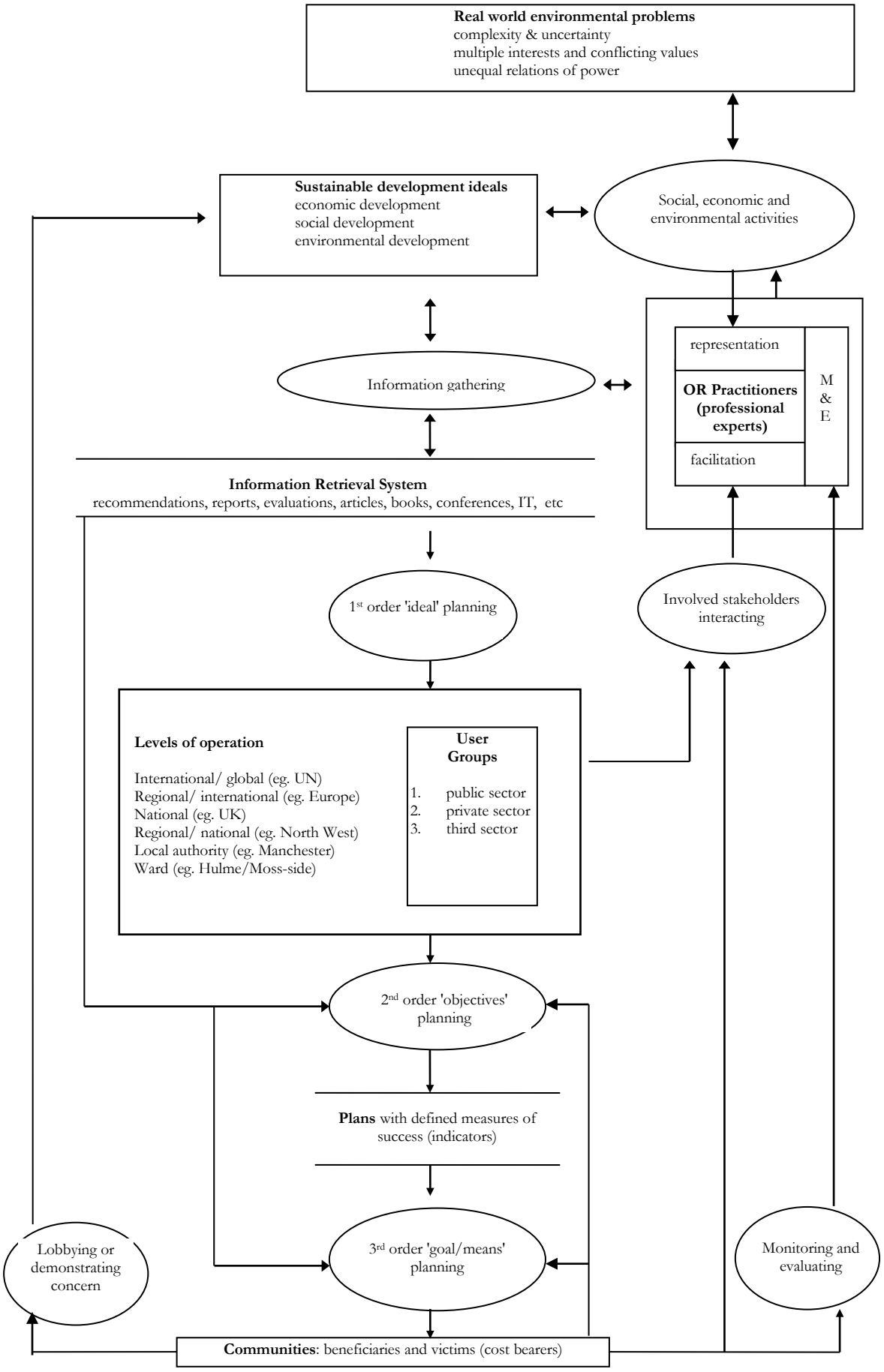
- Plans are represented as dynamic *data stores* rather than as information 'sinks', suggesting that a plan should be conceptualised as a *currency* (used as part of a process) rather than as a *commodity* (an end product).

The diagram provides four loops of feedback from the lived experiences and concerns of those affected by the implementation of plans. This feedback is expressed in terms of both benefits and costs. It is first generated by beneficiaries and victims, and is usually amplified and/or attenuated by organisations whose role is to represent the information in a form that will be received as meaningful. The four loops represent (a) immediate ('incremental') feedback to second and third order planning; (b) information mediated through monitoring and evaluation; (c) feedback mediated through the expert facilitation of community

[9] For readers who are uncomfortable with describing OR practitioners as experts, see Chapter 1, section 1.2, for an argument in favour. Essentially, if we do not acknowledge that the OR practitioner brings special skills into an intervention, we cannot make him or her accountable for the use of those skills.

participation in the planning process; and (d) information passed without expert support through direct action and community lobbying activities.

Figure 3.1: Flow Diagram Relating Stakeholder Groups to Environmental Planning



Below, we present the findings from our interviews of people in the public, business and third sectors. For each sector, we have structured the findings in terms of the 3 categories of generic issues introduced in Chapter 2: (i) complexity and uncertainty (ii) multiple values and (iii) political effects. What emerges are clear patterns of emphasis: the public sector is oriented primarily towards issues of complexity and uncertainty; the private/business sector is primarily concerned with multiple values; and the third sector is mostly concerned with political effects. Of course, each sector is also concerned with the other two generic issues, but mostly *in relation* to their primary orientation.

It is also clear that there is a consistent rationale for the emphasis within each sector, but there are also major disputes between the sectors (and sometimes within them) about the legitimacy of these rationales. Therefore, the picture that emerges is one of considerable conflict over values, policies and actions. In some ways, however, this is unsurprising given that multiple (conflicting) values is one of the generic, recurring themes that has already been identified.

3.3 The Public Sector

3.3.1 Overview

In recent years, environmental issues have provided high profile sources of controversy for the UK government—examples being genetically modified foods, transport policy, proposals for an industrial energy tax, fuel vulnerability, the depletion of fish stocks, water quality, and greenfield site developments. Since the early 1990s there has been a resurgence of interest in development planning in the UK, and there have been international pressures regarding sustainable development. The ensuing emphasis of public sector planning has most notably been to try to identify and work with appropriate *measures* that can encapsulate an expanded notion of sustainability (including economic and social concerns as well as environmental issues). Sustainable development requires environmental assessments of policies proposed in draft plans, as well as monitoring of the implementation of plans using appropriate indicators.

However, in addition to the design of measures and indicators, people in the public sector also have an interest in fostering more meaningful partnerships with stakeholders. This is because they are aware of the existence of multiple values surrounding many environmental issues, and wish to move towards a consensus position which will (amongst other things) legitimate action for environmental change and the use of particular indicators to evaluate the effectiveness of this action. Likewise, ensuring that there is proper accountability for the political effects of the implementation of plans is of concern to the public sector. Again choosing the right indicators, and making information on the effects of implementation publicly available, addresses this concern.

3.3.2 Complexity and Uncertainty: Working towards Transparency

One means of coping with the complex and sometimes uncertain world of sustainable development is to capture and work with disparate variables as *indicators* of performance. For example, since 1990, the United Nations has been producing a Human Development Index (HDI) (46), which involves composite health and education as well as economic indices to counter the dominance of the World Bank's single criterion of economic performance as a measure of national development. Similarly, the Department for International Development (DFID), in producing the Sustainable Livelihoods Approach (89), has focused on monitoring a range of 'capital assets'—social, natural, physical, financial and human—as a means of measuring international poverty elimination programmes. Likewise, the Department of Environment, Transport and Regions, in designing its strategy for sustainable development (DETR, 1999), has proposed 14 'headline indicators' to measure quality of life (these

indicators are sometimes called QoLs or "qualies"!) (47). At local and regional levels, the QoLs are being adapted for use as 'Best Value' indicators and Local (Authority) Agenda 21 (LA21) indicators for sustainable development (6, 53).

A positive attribute of the use of indicators is that they can help to surface and make transparent variables that might otherwise be hidden or ignored. Another plus is that they can provide a useful focus in highly complex situations. There are downsides to indicators too, however. One is a tendency for people to treat the use of indicators as a convenient substitute for looking at the real world: the indicators pre-define what is relevant, and the significance of new, previously unanticipated variables may be missed. Another potential problem is that an over-dependence on indicators can lead to people ignoring important factors that are not easily quantified (Stirling, 1999).

On a global scale, whilst relatively efficient markets in the North might be able to satisfy demands for reasonably accurate projections of economic growth, fuel prices and technological costs (as required in the 'emissions trading' and 'flexibility' mechanisms of the Kyoto Protocol), less developed countries clearly have problems in making such economic projections (40). Instead, there remains a greater reliance on what one OR consultant referred to as "the sometimes dubious use of External Cost Estimates". These, it was further argued, might lead to the perpetuation of existing trade disparities (see glossary items 36-39 for examples of External Cost Estimates, and Chapter 2 for a further discussion of the pros and cons of their use).

At present, in the UK, although considerable energy is being put into developing indicators that take account of environmental issues, there remains scepticism in some circles regarding the value of looking beyond economics. As one central government official candidly suggested, "by 'best' in Best Value, government officials more often mean 'cheapest'". The government's strategy for sustainable development (DETR, 1999) sets out the challenge that faces the public sector: to design indices representing non-economic variables *and* persuade people of their importance.

Even *within* economic indices, there would appear to be a need for designing appropriate measures for monitoring the *distribution* (as against the 'growth') of wealth. Whilst the Sustainable Livelihoods Approach (SLA) focuses on *local* community assets, an observer from a prominent third sector organisation suggested that it is limited in terms of accounting for relevant assets outside the local community which are significant for actual and potential changes in distribution:

> "SLA is useful for outsiders to get a better picture of complex local situations. There is little evidence of communities being made aware of structural changes that might help in transforming livelihoods".

However, there are proposals for an Index of Sustainable Economic Welfare (ISEW) (52), which will include a distributive element, and this will no doubt be welcomed in many quarters.

There are nevertheless problems associated with using national or international indices for more local decision making. For example, the Human Development Index (HDI) ranks nations according to their level of development, and this is particularly useful for identifying the countries in greatest need of future investment. However, the HDI scores need to be disaggregated in order to identify which *sectors* should be targeted for investment within the country concerned. Specific local geographical/environmental conditions also need to be taken into account in development and investment planning.

According to one local government officer, there is also a problem with the translation of national UK Headline indicators for more local use:

> "Indicators can lack flexibility for local authorities to creatively work with. More often it is suspected that they are used as a benchmark for comparing performance".

Indeed, it seems that the LEAP (Local Environment Agency Plans) indicators are having to be revised because of local preferences (53). Similarly, there are significant issues arising from the Central and Local Information Partnership project (CLIP) (6) which is designing locally appropriate 'best value' and LA21 indicators. One local government officer noted:

> "At workshops it was signalled by many local authority reps that we must avoid using indicators which are easiest to collect… For example, information on local business environmental management systems is notoriously difficult to obtain, yet vital for monitoring an LA21 plan".

Earlier, we suggested that a positive attribute of using indicators is that they provide a useful focus when trying to manage highly complex situations. However, this complexity might itself be compounded by the multitude of different indicators in circulation. Another local government officer, for example, commented:

> "Before, we had a problem [with regards to sustainable development] of swimming against the tide. We now have a problem of keeping up with the tide!"

Aside from the design of indicators, people in the public sector are also seeking to improve performance by providing examples of *best practice* that others can emulate. Several are evident in the North West region of the UK. They include the River Valley Initiatives (RVIs) (86), the Evolve programme (34), and the Manchester City Council LA21 Action Plan based on the implementation of six visible projects by different interest groups.

Within international development, there is a propensity for donor agencies to promote best practice through short-term 'projects' rather than longer-term 'programs'. This is obviously controversial, because it means that good initiatives which are designed to provide longer-term benefits are not always funded. However, this practice was defended by one senior central government official on the grounds that accounting is made easier, and best practice needs to be set up and communicated swiftly: "DFID rural development projects provide us with reality checks".

Although examples of best practice provide models for others to learn from, the risk is that pressures to succeed may lead to cosmetic exercises in public relations which hide problematic aspects. For example, BNFL featured favourably in Evolve in late 1999, about the same time as its management structures were under critical inspection. Similarly, the ICI plant at Runcorn enjoyed considerable success with the Environment Agency shortly before a significant hydrochloric acid spill endangered local residents in early 2000. These are high-profile cases, but they illustrate the dangers inherent in failing to present a balanced picture of the pros and cons of best practice projects: if problems come to light then they can tarnish the reputation of a project—but more worryingly, if they remain hidden, they may be replicated in other projects as people begin to emulate the 'success' they have seen.

In summary, then, the main focus in the public sector for managing complexity and uncertainty is the design and use of indices for monitoring and evaluation (although other methodological approaches, like publicising examples of best practice, are also engaged with). Indices can be very useful for ensuring transparency and a clear focus, but they inevitably have limitations too (not all variables are quantifiable, and indices need to be reviewed regularly if they are to remain responsive to changing circumstances). There are also problems encountered in the translation of national and international indices for use at more local levels of planning.

3.3.3 Multiple Values: Working towards Compromise

UK public sector planners are, of course, aware that they are working in a pluralist society, and that value conflicts are inevitable—especially in environmental planning where economic and environmental values often collide. Conflicts of interests and values are generally addressed through the push towards 'joined-up-government' and "building partnerships for prosperity" (the title of a government white paper published in 1998), as illustrated by the 1999 mission statement of the Government Office for the North West:

> "To work with regional partners and local people to maximise competitiveness and prosperity in the regions, and to support integrated policies for an inclusive society".

The newly created Regional Development Agencies (RDAs) have been charged with the task of facilitating better interaction between stakeholder groups. Incremental approaches (often using pilot studies) to facilitate cross-sectoral dialogue are increasingly used: examples are the Central and Local Government Information Partnership (CLIP) (6), the Riverside Valley Initiatives (RVIs) (86), and the Sustainable Livelihoods Approach (SLA) (89).

In the new 'knowledge economy', partnerships between business and government thrive in what Elkington (1997) refers to as a 'third wave business strategy' (93). Initiatives like The Natural Step (91) and To the Heart of Sustainability (90) enable interaction between the two sectors. Also participatory planning, one of 10 principles in the UK Sustainable Development Strategy, demands community involvement. At present the DETR is very active in drafting a series of papers on the Community Strategy Initiative. The emphasis is on seeking compromises in situations of value conflict so that practical ways forward can be identified that strike an appropriate balance between economic and environmental demands.

Similar thinking has been associated with what major development institutions like the International Monetary Fund, the World Bank and the various United Nations agencies refer to as the "new consensus". In principle the idea is to move away from the failed posturing of both free-market economists and neo-Marxist protagonists of under-development theory, and shift attention towards getting stakeholders involved in dialogue through planning.

However, such endeavours are seen by some people as ignoring the real power struggles that exist between different interest groups. One respondent from the third sector referred to the eventual abandonment of the World Trade Organisation's round of negotiations in Seattle in November 1999:

> "Seattle proved beyond doubt that the cosy consensus talked about in the corridors of power is a consensus between those *with* power".

New Labour's 'Third Way' provides a similar expression of intent to remove, or distance itself from, classical ideological frameworks (Giddens, 1998). The Fabian Society's recent pamphlet on 'environmental modernisation' (Jacobs, 1999) presents a programme explicitly designed to articulate environmental issues within the Third Way frame of thinking (33). The proposal is for the Labour Government to actively disengage with the ideological positioning behind the green movement and thereby phrase issues in ways that make for more ready consumption and debate amongst other stakeholders. While the motivation behind this is the promotion of dialogue to enable environmental issues to be taken seriously by those who are currently ignoring them, it could be said that the proposal disregards very real ideological divides in communities which might provide an obstacle to even minor requests for co-operation. This is exemplified by the experience of one local government official who found it impossible to get hold of information from sister agencies even within the same local authority because of what s/he claimed were ideological differences.

Although the facilitation of meaningful dialogue between stakeholders is useful for improving trust and confidence, there is arguably a risk, as one central government official

candidly put it, that a "false consensus" can be generated that effectively masks key issues of contention. We would argue that this is partly a methodological issue, in that a false consensus is usually produced when one of three scenarios obtains: either (i) dialogue is not sincere, and the dominant party fictitiously presents their own view as the outcome of a debate; (ii) the participants in dialogue are not representative of key stakeholders; or (iii) people feel unable to represent their views effectively because they think there is no point (they feel powerless), or they do not have the social or psychological space (or resources) to create a convincing argument that will match that produced by professional planners. We say that this is partly a methodological issue because, using OR methods, dialogue can be constructed or facilitated to address all these problems. See Ulrich (1983) for a methodology that explicitly deals with these issues.

Importantly, the drive for consensus and compromise that the public sector is currently engaged in to address multiple values actually complements the focus on designing indicators to deal with complexity and uncertainty. This is because indicators are expressions of value commitments (to provide a simple example, measuring levels of pollution in rivers is based on the value attached to unpolluted water). If there are highly public disagreements over basic values, then this can undermine the legitimacy of any indicators that are used. Clearly, the answer to this problem is to try to reach agreements with key stakeholders and establish a consensus or compromise that enables action to be taken and evaluated without major controversy.

3.3.4 Political Effects: Working towards Social Accountability

Establishing appropriate indicators is closely associated with the setting of 'targets'. Ambitious long-term targets are now frequently being set, whether on eradicating poverty or making substantial reductions in carbon dioxide emissions. Clearly there are costs involved in fulfilling such targets, and these can be disproportionately distributed. The forthcoming 'climate levy tax', for example, will affect businesses in general, but more so those small and medium sized enterprises which are employing large numbers of the population. To mitigate against such effects, it is clearly advantageous to involve the potential cost-bearers in the planning process from the outset. However, a disaffected small business manager claimed in relation to the climate levy tax that

> "Small businesses and Unions were consulted only *after* plans had been designed and rubber-stamped with government approval".

Concerns like this, as well as calls for greater public involvement in planning, are not new. In the late 1960s the Skeffington Committee was established to investigate "the best methods… of securing the participation of the public at the formative stage in the making of development plans" (cited in Yewlett, 2001). The assumption is that genuine social and environmental transformation is dependent on a strong civil society, and this assumption also informs much more recent thinking, including Giddens's (1998) 'Third Way'. The United Nations Development Programme (UNDP) concern for 'social capital' and 'capacity building', along with recent UK-based initiatives like regional devolution and the setting up of a Social Exclusion Unit, all focus resources on establishing more vibrant civil society organisations.

The resonance of this way of thinking with the earlier discussion of seeking compromise and consensus on values, and legitimating the use of indicators with reference to the agreements achieved, should be clear. A strong civil society, which sweeps those affected by plans into the planning process, underpins the search for consensus and the legitimation of indicators. Indeed, the information provided by the use of these indicators should feed into mechanisms of citizen participation, making government and other organisations accountable, thus completing a virtuous circle. A strong and consistent philosophy seems to be in place.

However, some of our respondents questioned whether the indicators designed to help the public and business sectors deal with complexity at the *organisational* (rather than societal) level do actually produce information that enables those organisations to be held accountable. A number of environmental management systems (such as BS7750, EMAS, ISO 14001, and SIGMA) (29-32) were held up by several people as examples of indices which purport to make organisations accountable for their activities, but which do not measure much of value despite large investments of time and money. One third sector representative claimed that they simple legitimate "business as usual". Also, the Environmental Agency principle of 'best available technology not entailing excessive cost' (BATNEEC), introduced as part of the Integrated Pollution Control Directive, might, it was suggested by two senior public sector officials, often be used as a misnomer for 'cheapest available technology not entailing prosecution' (CATNEP)!

Essentially, this concern over the utility of organisational accountability systems reflects the fragility of the supposed consensus that such measures are based upon. Clearly, some people do not share the set of values that have informed the construction of these environmental management systems, and view them as essentially "cosmetic" (a word used in relation to ISO 14001 by a senior business manager).

In some ways this should come as little surprise. The UK is a relatively pluralistic society, and in our view it is not realistic to expect people with diverse knowledge, interests and experiences to be fully in accord when it comes to complex environmental issues. Indeed, many cybernetics and systems theories (see Yolles, 1999, for a review) suggest that *maintaining* a variety of viewpoints, but harnessing them constructively into the planning process, is a *positive strength*: it ensures that a wide range of options remain open to society.

3.4 The Business Sector

3.4.1 Overview

Since the 1970s, widespread concern for the natural environment has cast industry as the principal villain, requiring strict control to ensure compliance with national and international regulatory regimes. However, the expanded notion of sustainability introduced in the 1990s (embracing economic and social issues as well as the environment) provides industry with some leverage. At the same time, however, the increased pressure to be environmentally responsive has generated a focus on *minimising environmental risks*—and this demands improved stakeholder interaction so that risks seen by others can be identified and countered. Increasingly, business success is dependent on the types of relationships established and maintained with government, other businesses, academia, non-governmental organisations and local community groups. The principle focus of business is therefore on dealing with multiple values to minimise risks.

Issues of complexity and uncertainty are there too, but these tend to be seen *in relation* to multiple values. Therefore, multiple values mean new regulatory regimes to respond to, and multiple markets to design new products for. Political issues, in contrast, centre around the degree to which open and purposeful debate can be set up to enable trade-offs that establish key accommodations between value positions, thereby minimising risks associated with backlashes from campaign groups, etc.

3.4.2 Complexity and Uncertainty: Sustainable Business

Globalisation of the market and new legislative compliance structures imposed through European and UN treaties have generated a new dimension of complexity and uncertainty

for the private sector. Pressures exist on enterprises to change in a number of ways. Four examples are described below.

First, there is a need to be responsive to a variety of social and environmental issues as well as to think about economic performance. For example, Life-Cycle Assessments (55, 56) demand full product life cycle information. This means that business has to be concerned with both the supply and environmental chains (3-5)—or, to use the language of systems, business has to concern itself with its impacts on the wider systems in which it is embedded. This wider set of concerns is expressed in the new consolidation of 'health and safety' with 'environmental' responsibilities through the establishment of composite Safety, Health and Environment (SHE) posts, sections and departments in industrial organisations.

A second change that is required is a greater focus on longer-term strategic planning, with associated pressures to be more diverse and flexible in product-output, more adaptive, and more pro-learning. The Mersey Basin Campaign (MBC), for example, began in 1985 as a 25 year programme centred on cleaning up what was one of the most polluted river catchment areas in Europe. Although initiated as a government programme, the MBC, as one prominent business manager in the region suggested, has since been instrumental in promoting long-term planning amongst the many corporate and smaller businesses that have played a leading role in the Campaign's success:

> "The success of many businesses here in the North West is due partly to improved forecasting of market demands, but also the willingness of enterprises to look at future scenarios".

In 1991, a Business Leadership Team (BLT) was established in the North West. A close associate of the Team summarised what it does:

> "It acts as a kind of 'think tank', geared originally, it has to be said, towards making a successful bid for hosting the 2000 Olympic Games!"

Notwithstanding its failure to win the Olympic bid, the BLT has continued being active and influential in promoting long-term strategic planning in the region, and currently has a strong association with the North West Regional Development Agency.

Of course, the long-term sustainability of enterprises can be compromised by short-term opportunism driven by the desire for economic gain, or simply company survival. On the charitable side, as one respondent from the third sector put it, "businesses are realists"—meaning that a short-term, 'opportunistic' approach to planning ensures flexibility in rapidly changing market places. However, as suggested by another respondent representing a transnational business enterprise, this might be a feature of the British cultural environment:

> "Sadly, the UK culture is more focused on the business ethic of achieving short-term returns than any long term ethos of conservation".[10]

He was not of the opinion that short-termism is universal in the business world. However, examples like the MBC (mentioned above) indicate that, at least in some areas of the UK, people are thinking again.

A third new requirement is to be more proactive and creative in *steering* environmental change, not just learning about it and adapting to it.[11] This is embodied in the idea of 'new

[10] Arguably, this is borne out in the different responses by UK-based and France-based airline companies in the immediate response to the Paris Concorde disaster in the year 2000. The French decided to suspend all flights with immediate effect (exercising, in effect, the precautionary principle), while the British embarked on normal scheduling until an international report confirmed safety hazards in the wheel/tyre design.

conservation', as opposed to 'fortress conservation' (73). In 'new conservation' businesses associated with natural resource management are encouraged to work with local communities and government authorities to *develop* the resource base for the benefit of wider stakeholders, rather than simply *conserving* it. The same concern has also been expressed as part of an academic argument for reconceptualising conservation:

> "…there appears to be no such concept as that of *environmental development*; indeed, the concept of environmental conservation is often seen in terms of opposition to the activities of 'the developers'" (Friend, 1998 p.21).

An example of 'new conservation' can be found in the development of leading-edge technologies for waste processing—creating wealth from waste, or "modernising muck" (Murray, 1999). Another angle on businesses steering change for improved practice in environmental management was proposed by a respondent from the retail trade:

> "…retailers, traditionally seen as being 'reactive' to changing customers whims, are really very (and sometimes perniciously) proactive in shaping/cultivating opinions. Why not tap into this skill?"

The leading role of business during late 1999 in shaping opinions on organic foods amidst the controversy over the use of genetically modified organisms provides a good example. Some of the major retail chains picked up on public anxiety over GM foods, sought to distance themselves from the bio-technology industries, and created a profitable alternative by actively promoting organic produce.

The fourth and final change required of business is to demonstrate transparency through social, environmental and financial auditing (32). Financial auditing has long been practised, with companies expected to produce publicly available annual reports. However, social and environmental auditing are relatively new innovations, and the motivation for them is expressed in the following quotation:

> "…we believe that, in years to come, the only truly successful businesses will be those that achieve a sustainable balance between their own interests, and those of society and the natural world" (Cooperative Bank, 2000).

There is nevertheless some cynicism surrounding the value of the audit systems currently in existence. This has already been mentioned in connection with the public sector (section 3.3.4), but we heard similar attitudes expressed in relation to business too. A senior business manager asked whether accreditation by the Eco-Management and Audit Scheme (EMAS), or successor schemes like ISO 14001, are much more than cosmetic. He observed that "ISO 14001 monitors *if* checks are being done rather than *what* checks are being done!"

Two managers in multi-national companies suggested to us that high profile social and environmental auditing exercises provide more in terms of improving 'brand image' than meaningful critical reflection on business practice:

> "Most social auditing, it has to be said, serves more to promote visibility of product rather than transparency of process".

On a different but related note, several business representatives observed that failure to engage with prescribed audit schemes such as EMAS (30) or ISO 14001 (31) is due to the costs involved, particularly in the later stages of audit development. Apart from the financial

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[11] Here we are reminded of the "evolutionary complex systems" (10) referred to by Allen (1998). In our view, it is no accident that ideas about complex systems are finding favour in some sections of the business community. These ideas offer a rational explanation for many of the complexities encountered by management (see also Stacey, 1999).

costs, these schemes are also time consuming. With reference to dental practices, for example, an official from a public regulatory agency noted that

> "people would rather take the mercury wastes home for disposal than fill in endless forms!"

Some businesses (especially corporate industries) take 'mitigating action' when they know they are having a negative environmental effect (for example, planting 6 trees for every 1 tree uprooted in a development initiative). However, these gestures can receive a cynical reaction too, particularly from the third sector:

> "Such endeavours merely patch up the *symptoms* of 'development'… they do nothing other than distract from wider root *causes* of overall environmental degradation".

It would appear that there are very real pressures on businesses to change in response to the complexities and uncertainties of environmental issues. There are new requirements for, amongst other things, (i) the integration of environmental thinking into core organisational functions, (ii) long-term strategic planning, (iii) proactive environmental management, and (iv) social and environmental auditing. While many businesses have responded positively to the changes, seeing opportunities to develop new and profitable markets (e.g., organic food), there is nevertheless some scepticism about the value of auditing and the willingness of businesses (especially in the UK) to pass over short-term opportunities in the interests of long-term sustainability.

3.4.3 Multiple Values: Averting Risks

In our pluralistic society, characterised by multiple (often conflicting) values, public relations and the development of brand images are becoming increasingly important to businesses—especially in relation to environmental issues, where conflicts can be both acute and high-profile. All the respondents we interviewed from the business sector stressed the importance of fostering good working relationships with interest groups. The primary imperative is to offset risks by involving stakeholder groups in the development and evaluation of products and manufacturing processes: entrepreneurial ventures are more likely to succeed if possible objections to business activity can be anticipated in advance and addressed. Relevant stakeholder groups include government agencies, other businesses, academia, pressure groups and local communities.

Risk management was a common theme for many of our interviewees. Indeed, one respondent, claiming to speak on behalf of the business sector more generally, talked about a sense of "palpable relief" when the fashion for business deregulation promoted by the UK government in the 1980s came to an end:

> "Industry often actively seeks frameworks of environmental guidelines to provide security of planning… to offset risks and uncertainties".

This is particularly the case during the development phase of product/plant initiatives prone to high risks and uncertainties.

From the government perspective, there is a pragmatic reason for preferring to encourage *self*-regulation within industrial sectors (as opposed to centrally imposed regulations), requiring a high level of co-operation:

> "If you can get businesses to tell businesses what to do, they'll listen… If you get bureaucrats to tell businesses what to do, they'll tell you to p*** off!"

Indeed, as part of the process of globalisation, businesses are increasingly involving themselves in co-operative networks of organisations (Contractor and Lorange, 1988; Nohria and Eccles, 1992; Alter and Hage, 1993), partly to stabilise relationships with suppliers and customers, and partly to offset risks by involving key stakeholders in decision making. Business organisations have also sought to have a voice in international negotiations on regulative frameworks. For example, the Business Council for Sustainable Development was established to engage with the 1992 UN Conference on Environment and Development in Rio (the 'Earth Summit'). Other similar partnerships include the Transatlantic Business Dialogue and the Global Climate Coalition.

At the local level, in the North West, business partnerships have thrived through initiatives generated by the Business Leadership Team set up in 1991. Examples are the 1994 North West Partnership (the precursor to what is now the Regional Development Agency) and Sustainability North West (SNW). SNW began in 1996 and is considered the first regional partnership grouping of business interests in Europe (comprising of 160 regions). Attempts are being made in the region to emulate Scandinavian 'industrial symbiosis' programmes where businesses seek to establish whole 'ecosystems' where the waste from one industry becomes the raw material for another. If sufficient businesses can be involved, then the overall production of waste can be much reduced. Indeed, similar initiatives are happening world-wide, as exemplified by the work of the ZERI Foundation[12] and the international Zero Waste campaign which has been launched by Future 500 (a large international business network headed up by Mitsubishi).[13]

Business links with academic departments are also becoming more evident. These range from one-off sponsorships of research initiatives, such as Unilever's involvement with the Science and Technology Policy Research Unit (SPRU) at Sussex University (see Chapter 4, section 4.3), to more permanent arrangements—e.g., between The Co-operative Bank and Salford University's National Centre for Business Sustainability. Other noteworthy involvements of academic institutions with the business sector include the Edinburgh Sustainable Architecture Unit and 'Third Wave' (93) at Edinburgh University, which have created useful tools for "greening the market" (7), and the Centre for Urban Rural Ecology at the University of Manchester where ISCAM (the Integrated Sustainable Cities Assessment Method)[14] was first devised (51). Initiatives like To the Heart of Sustainability (94) and The Natural Step (95) were also originally associated with academic pursuits in university departments, although have since become independent.

Business links with established environmental pressure groups are likewise becoming more evident. As one corporate business representative acknowledged, organisations like Greenpeace and Friends of the Earth carry considerable public credibility: "we ignore them at our peril!"

Initiatives like the BioThinking International,[15] based in Sweden, Forum for the Future (in England) and the Centre for Human Ecology[16] (in Scotland) take the relationship one step further by offering consultative services to businesses.

Finally, initiatives like Groundwork in the UK foster local-scale working relationships between small and medium sized enterprises (SMEs) and community groups. Engagement in these sorts of initiatives is based on the belief that active working relationships between industry and the local communities in which they operate provide for better understandings

[12] http://www.zeri.org/faq.htm
[13] http://www.globalff.org/Future_500/F500main.htm
[14] See Chapter 4, section 4.2, for details.
[15] A non-profit organisation that, like Forum for the Future's adoption of The Natural Step, promotes the idea that sustainability can be achieved by modelling industrial systems on nature (http://www.biothinking.com).
[16] The last two organisations promote The Natural Step and To the Heart of Sustainability respectively.

of relevant issues (and ultimately, according to many of our respondents, the minimisation of risks). In international development this principle of co-operation between businesses and communities is also becoming increasingly evident, with proposals for improving community-based natural resource management under the banner of 'new conservation' (in contrast to the traditional 'fortress conservation' which operates with an ethos of accusation and blame) (73). Refer back to section 3.4.2 for further details.

Of course, the question remains as to whether these co-operative relationships represent a genuine change in business orientation towards environmental sustainability, or whether they are simply cosmetic public relations exercises, legitimating business as usual in a marketplace where companies have to at least be *seen* to be responding to environmental issues. The latter interpretation is supported by a quotation adapted from a statement made by the US public relations firm, Mongoven, Biscoe and Duchin:

> "Opponents can be co-opted if 'opportunists'. If 'idealists', they need to be cultivated and educated to become 'realists' and then co-opted to agree with what industry has already decided. The trick is to leave the radicals isolated" (cited in Lohmann, 1998).

Also, one of our own respondents was quite clear that his company's engagements with the public are not genuinely consultative:

> "We quickly learnt to steer clear of holding open public deliberations or public hearings. Management officials found they can lose control very quickly… Instead we now organise public *exhibitions* to disseminate information. They are by far the easier to manage".

But this attitude was not the norm amongst the business people we interviewed. Their commitment to dialogue and change appeared to us to be sincere, although obviously not devoid of self-interest: as we have already outlined, co-operation with others over environmental issues helps to minimise the risk of costly future conflicts.

Having said this, however, we should acknowledge that there could be a methodological bias in our sampling of business people: when we approached companies for interviews, we were mostly put in touch with people with specific responsibility for environmental planning and management. These are more likely to have a heightened awareness of the need to deal with environmental issues in a positive manner. There is still an open question, beyond the remit of this research, about how far this awareness has penetrated the thinking of managers who do not necessarily have to consider environmental issues on a day-to-day basis.

This is not to say that our respondents felt that maintaining an 'appropriate' balance between economic and environmental imperatives is unproblematic. On the contrary, global economic conditions, and the policies of some overseas governments, were cited as particular difficulties that have to be grappled with. Systems are in place for the UK government to provide some guarantees against risk in global business practice: for overseas investments, these are provided in the form of licences issued through the Export Credit Guarantee Department (ECGD) at the Department of Trade and Industry. The support offered to industry by the ECGD was acknowledged by several respondents in multi-national enterprises. However, concern was expressed about the effect of low-tax deregulatory regimes in other countries (to attract foreign investment, thereby improving the competitiveness of their domestic industries) on maintaining the integrity of business commitments to sustainable development. Industries based in countries with low taxes and few (or lax) regulations can undercut their UK and European competitors, forcing the latter to cut costs—including costs associated with environmental management.

The overall picture, then, is of business organisations striving to minimise risks in a sometimes hostile economic environment by building working relationships with their

stakeholders—including government agencies, other businesses, academia, pressure groups and local communities. These kinds of relationships can allow a company to deal with environmental issues before they become openly conflictual, thereby ensuring that the risk of public relations damage is minimised. Of course, different interpretations can be put forward of this kind of activity: while we have no reason to doubt the sincerity of our business sector respondents, there is still an open question (outside the remit of this research) about how far their 'enlightened self-interest' has penetrated the thinking of others in their companies.

3.4.4 Political Effects: Debating Trade-Offs

Before starting this third section on the business sector, we need to make a methodological note. When it came to analysing the interview transcripts, it transpired that there were a number of criticisms of the ways in which businesses engage other stakeholders in debates over 'trade-offs'. Other political effects of business activities were highlighted too. However, no business representatives had chosen to discuss these problems, preferring instead to concentrate on the positive value of dialogue (partly to minimise the risk of costly backlashes against business ventures, as we saw in the last section). Therefore, this section might appear rather 'one-sided'. Arguably, this is a result of our methodological decision to conduct individual interviews: had we had some interaction between stakeholders in workshops during the data collection phase of the research, the business representatives might have put some opposing views. However, because of the time constraints of interviewees, we ruled out this option at an early stage. Also, because the whole project had to be finished within a year, it was not possible to do a further iteration of interviews to get more feedback.

Partnerships in the business sector tend to be based on the idea of establishing 'trade-offs', and moving towards acceptable compromises. Deliberative and Inclusionary Processes (DIPs) is the umbrella term given to some of the techniques used to work out compromises (20). Ideally, bargaining takes place in an open forum where all interests and opinions can be expressed and debated, and basic rights are not compromised. Arguably though, many actual discussions fall short of this ideal because they take existing market forces and trade relations for granted: there are therefore limits to the range of environmentalist views that businesses can take seriously, and 'rights-based' (or 'deontological') views, in which there are environmental values which are not open to negotiation and compromise, are likely to be excluded (Spash, 1997a).

In the UK, for example, the parameters of the debate over GM crops were arguably determined principally by a coalition between the UK Agricultural Supply Trade Association and the government. As one prominent third sector activist argued, the idea of setting up 3-year trials of genetically modified crops has centred debate on the *effects* of the technology rather than the *need* for the technology:

> "No one is asking 'who is benefiting from promoting GM organisms?'… There is only a dubious assumption that the poor in the Third World will somehow prosper. Lessons from the 'green revolution' in India, which resulted in massive peasant displacements, are ignored".

Another third sector representative argued that it is the powerful corporate coalitions like the International Chamber of Commerce, Transatlantic Business Dialogue, the Business Council for Sustainable Development, and the Global Climate Coalition which ultimately determine the parameters for negotiating trade-offs because of their influence in the global economy. The question is, how inclusive of both stakeholders and issues are the affairs of these organisations? Certainly, several affected groups can be identified with little bargaining power, including SMEs, trade unions, and representatives of national and local community interests. Of course, it is an open question whether these organisations are indeed as influential as the interviewee claims, or whether (as Luhmann's, 1986, systems theory would

have it) local debates are circumscribed by systemic forces that no-one has any real control over.

Of course, even if we accept that international business organisations are not able to exert as much control over market forces as some people believe, it is still undoubtedly the case that large multi-national firms have resources available to hire environmental auditors, conduct research, lobby governments, etc., that are unavailable to many other stakeholders. This can make a significant difference to their relative abilities to produce persuasive arguments, or to have their views listened to by significant others.

One third sector representative discussed his role in some high-profile negotiations between a multi-national company and a charitable organisation following an industrial accident. The issue was the best method for cleaning up the resulting pollution: "our real mistake was that we got bounced into discussing the technical details…". The company simply had far more resources at its disposal to back up its claim that its own preferred method (the cheapest option) was best, and (according to the respondent) managed to discredit the charity on the grounds that it had a poor grasp of the scientific realities.

Indeed, disparities in the resources available to different stakeholders is not just a feature of capitalist economies. Midgley *et al* (2000) discuss the evaluation in China of proposals to build the Three Gorge Dam. Those in favour of building the dam had extensive scientific resources to draw upon, and the ear of government, while those arguing against had few of these advantages. Even though the OR team conducting the evaluation, when weighing up the pros and cons, eventually supported the 'anti' camp and recommended that the dam should not be built, the government ignored their recommendations. The dam has now been constructed, and many of the negative social and environmental consequences that were predicted by the evaluation have come to pass (see Zich, 1997, for a discussion of the dam's social and ecological effects).

Not only is it the case that large business organisations have more resources than others to support their arguments when entering debates, but also some third sector groups are becoming dependent on the business sector for an income. Several prominent non-governmental organisations that were originally set up to represent the interests of those affected by, but not involved in, business and government deliberations have recently established their own companies to offer consultancy services to the business sector. It is therefore open to question whether these third sector organisations are still able to speak quite as openly as they once did. This is potentially a weakening of third sector representation, but certainly not a silencing of it, as there are still many other non-governmental organisations which have maintained their independence.

So far in this section on political effects, we have tackled a variety of issues surrounding who participates in debates with industry, what implicit parameters have to be accepted, and how resources get used to build arguments and influence opinion. However, a couple of interviewees in our study also raised concerns about *social* issues that they claim are now receiving less attention than they once did because of the focus on environmental issues.

One such issue is unionisation. It was pointed out by a third sector representative that a lot of SMEs have non-unionised workforces, yet this is not considered by many people at the turn of the Century as an issue of much concern. As this respondent said, given that front-line workers have a legitimate perspective to contribute to the discussion of how their company handles environmental issues, this must raise the question of whether they really have a voice (even if they are 'officially' allowed to speak).

This person also pointed out that organisations like Groundwork UK do commendable work for SMEs, and support New Deal participants (those not having worked much before), but offer little help for working people forced to leave relatively high paid specialist jobs because of management failure to comply with environmental regulations. In other words

there are people who, through no fault of their own, are becoming 'victims' of environmental regulation, yet this is not being recognised.
On a similar note, one business sector representative said that, given the high public profile of environmental issues, companies, whether small or large, have become less interested in issues of workforce health and safety:

> "We seem concerned more these days on what is going on outside than inside the factory".

This might be compounded in some cases by the remote siting of certain industries. When talking about the siting of a potentially hazardous plant in a relatively remote area, one business representative commented:

> "People in ******* do not complain about work practices… the alternative is sheep rearing!"

The bargaining position of sheep farmers in this remote region might be compared with the bargaining position of larger communities, even whole countries, in a global economy with extreme disparities of wealth and power. It has been argued, for example, that the contents of Agenda 21, the principal document coming from the Rio Earth Summit, was largely influenced by the Business Council for Sustainable Development (Hildyard, 1993). Significantly, Agenda 21 chose not to address issues of ownership, particularly non-documented ownership of communal land in the less developed world, and assumed instead that key natural resources could be given a price that would then be subject to negotiation in the market place. Enclosure of the commons was effectively granted. According to Hilyard (1993), on the basis of Agenda 21, there can be no automatic protection of 'rights' of access to communal property. It is therefore arguably the case that a key international agreement for environmental protection has been founded on a principle, the private ownership of land, that is taken for granted by most of the industrialised North (and certainly the Business Council for Sustainable Development), but is alien to many cultures in the South.

To summarise the political effects relating to environmental planning and management in the business sector, as surfaced in our interviews and our readings of the literature, there are various ways in which deliberations between stakeholders on trade-offs between environmental, economic and other values fall short of the ideal of free and fair debate. There are implicit exclusions based on the assumption that businesses have to take market forces as given, and some people argue that there are powerful players with global influence who have the ability to determine the parameters of debates. Furthermore, multi-national enterprises have more resources available to construct persuasive arguments than other stakeholders. Arguments have also been advanced that an 'over-concentration' on environmental issues has marginalised concern over social problems that used to be high on the political agenda. Finally, it has been argued that important political treaties that purport to regulate business conduct in the interests of sustainable development are phrased in the language of the Northern, industrialised business culture, and thereby marginalise many Southern interests.

3.5 The Third Sector

3.5.1 Overview

Having played a significant part in putting 'the environment' and 'sustainable development' on the agendas of government and business, the emphasis amongst environmental pressure groups is now more often on improving meaningful participation in the planning process and thereby dealing with the *political effects* of that planning.

Traditionally, of course, the third (or voluntary) sector is concerned with promoting the interests of those (including non-human nature) who are affected by the public and private sectors. These interests are diverse, and it is this diversity that provides the prime focus of attention when third sector representatives talk about complexity and uncertainty. Similarly, it is the prioritisation of interests, and the representation of these to people in other sectors with different concerns, that is the main challenge in relation to the theme of multiple values. 'Complexity and uncertainty' and 'multiple values' are therefore subordinate themes for the third sector, of meaning *in relation* to dealing with political effects through effective participation.

3.5.2 Complexity and Uncertainty: Valuing Diversity

Preserving diversity to enable adaptation to a complex, uncertain and constantly changing world constitutes a significant mantra for third sector groups dealing with environmental issues. Diversity is valued so greatly because recent biological theories of evolution suggest that the more genetic variety ('biodiversity') there is within an ecosystem, the more adaptable it is to changing external conditions. Therefore, in a very real sense, the maintenance of life-supporting environments in the face of external threats could be dependent on retaining as great a diversity of species as possible—and of course the fate of humanity is caught up in this too. See Leakey and Lewin (1996) for a discussion of the value of biodiversity. For the first time, this brings together the interests of two previously separate environmental movements: the green movement which is interested in harmonising the activities of human beings with their natural environments, and the conservationist movement which is interested in the preservation of endangered species.

Concern for retaining biodiversity is also mirrored by a more general concern for retaining and celebrating *social* diversity, both within and between cultures. The values of multiculturalism, freedom of sexuality, lifestyle choice, etc., bring together a powerful alliance of left and right wing libertarians who, in other areas of political life, have strongly divergent views. If we put together this social movement with the environmental movement campaigning for biological diversity, then it becomes clear why *diversity in general* is valued so highly by third sector groups—especially as the expanded understanding of sustainable development, now taken for granted by most stakeholders, represents a complex fusion of the environmental and social.

Third sector environmental groups have sought out strategies for action that respect the diversity of the complex social and natural worlds. Through our own analysis of the literature and interview transcripts, we have identified four such strategies:

- Adding third sector representatives to existing relevant committees;
- Practising the "small is beautiful" ethos by working in small groups, or within local communities, on clearly definable and demarcated issues;[17]
- Practising bottom-up 'process', as against top-down 'blueprint', approaches to planning; and
- Maintaining distance from mainstream planning and engaging in critique.

Below, we give more detail about each of these before moving on to discuss criticisms that have been raised against each of the strategies. Finally, we step sideways to highlight another angle on complexity raised by several of our third sector respondents: the operational complexity that keeps people from having sufficient time available to reflect on issues.

[17] "Small is Beautiful" is a term derived from the influential book of the same name by Schumacher (1973).

Adding in Third Sector Representation. Having a voice on planning committees ensures that a diversity of interests are being represented and not disregarded or over-simplified. As one respondent from the third sector pointed out, "it is often quite satisfying putting the spanner in the works!" Most multisectoral committees have at least one non-governmental representative who, at minimum, fulfils the role of flagging up issues and countering possible complacency amongst the other sectoral representatives. Of course, both the public sector strategy to seek consensus and the business sector strategy to negotiate trade-offs with third sector groups are dependent on significant numbers of third sector groups wanting to engage with planning committees.

Small is Beautiful. Many non-governmental organisations, particularly those operating in less-developed countries, work on the assumption that change needs to be planned and executed *by* local communities *for the benefit* of those communities. Planning methods like Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA) (79, 85) have been developed to support these activities. The techniques of RRA and PRA have roots in some considerable disenchantment with the large-scale surveys used to support mainstream development initiatives which were, as Chambers (1992, p.7) succinctly puts it:

> "…long-drawn-out, tedious, a headache to administer, a nightmare to process and write up, inaccurate and unreliable in data obtained, leading to reports, if any, which were long, late, boring, misleading, difficult to use, and anyway ignored".

Within the industrialised countries, a similar kind of disenchantment prompted the development of various 'Deliberative and Inclusionary Procedures' (DIPs) such as Consensus Conferences, Planning Cells, Citizens' Juries, Citizens' Panels, Focus Groups, and Deliberative Polls (20). The use of these has certainly spread far beyond 'small is beautiful' movements, and they have particular appeal to agencies and individuals, such as those in the retail trade, wanting a cost-effective, manageable and comprehensible picture of local issues generated from the 'grass roots'. This was confirmed by one of the business representatives interviewed in our study:

> "We find the use of focus groups much more effective in gaining an insight to public attitudes regarding retail products. Opinion polls and census data is expensive and only provides you with information that you want to hear".

Process (Bottom-Up) Planning. Process approaches to planning (including a number of OR problem structuring methodologies) also have wide-spread currency, particularly amongst non-governmental organisations in the UK, as one experienced activist from the third sector noted:

> "…participants… engage in making progress through a number of negotiated/ deliverable steps as opportunities and resources arise. The Mersey Basin Campaign and much Groundwork activity are excellent examples. A vision is developed and a catalysing unit established to persuade partners to move towards it incrementally".

Another example in the North West of the UK is the establishment of the Manchester Environmental Resource Centre Initiative (MERCI), a non-governmental organisation consisting of a collective engaged with the local community in building a multi-purpose resource centre. This is not only being *physically* built by the collective, but they are also actively engaging with 'green ethics' and constructing a network of institutional links:

> "We would like to become a linking agency for processing dialogue between the big environmental NGOs and the local communities".

Critique from a Distance. The final strategy worthy of note is to maintain some distance from public and business sector organisations and engage in principled critiques which are

then used to influence others. There are various ways of doing this. Lobbying, including the submission of briefing papers and letters, is the most common, though often the most demanding, quiet and often uncelebrated (not to mention unremunerated) expression of critique. Institutions with research capacity (such as Amnesty International, the Institute for Public Policy Research, The Cornerhouse, the Socialist Environment Resources Association, the Town & Country Planning Association, Friends of the Earth and Greenpeace) are a few of the many agencies in the third sector with a wealth of lobbying experience.

Arguably, the practice of non-violent direct action is another means of turning critique into action to influence others. The non-violent direct action of agencies like EarthFirst has roots in disenchantment with established non-governmental organisations which, after the Rio Earth Summit, were seen as being co-opted. Arguably, the anti-road protests at Twyford Down in the 1990s established non-violent direct action as a strategy which was capable of significant public influence in the UK. The protesters constructed and lived in precarious underground tunnels and 'lock-ins', thereby creating human barriers which the road builders found difficult to remove without threatening the lives of those inside. Such strategies have been described in terms of "manufactured vulnerability", with the principal aim of exposing or making visible relations of power which otherwise remain hidden (Doherty, 1996) (21).

Criticisms of the Four Strategies. Endeavours to address issues of complexity in any of these four ways have their drawbacks. For example, whilst many multisectoral committees actively seek out representatives from pressure groups, there can sometimes be a sense of tokenism. As one of our third sector interviewees said:

> "I sometimes feel that, being the odd-ball in the team, my presence is often tolerated rather than valued".

The 'small is beautiful' ethos helps to focus on local environmental issues relating to the poorest sectors of society, but many people following this strategy do not engage with the dominant forces and ideologies that they claim are producing poverty and environmental degradation. It is all very well establishing alternative modes of working, but does this account for the fact that, for many people, *big* is beautiful? The problem is that, without engaging with others with different values, demonstration projects are not likely to be learned from and replicated. It is also easy for powerful organisations to dismiss the arguments of campaigners if the latter are not willing to extend the same courtesy they expect from those with power: to listen to other points of view (Gregory, 1992).

Some of the *methods* associated with the 'small is beautiful' movement have been subject to criticism too. Rapid Rural Appraisals and Participatory Rural Appraisals inevitably produce only a partial picture of the circumstances affecting rural communities: they tend to focus on local issues but often fail to analyse the wider national and international politics which may impact on local circumstances (Reynolds, 1998). As an OR practitioner pointed out in one of our interviews:

> "Small scale participatory approaches to livelihood appraisal provide a comforting riposte to the sheer magnitude and scale of the problem of rural poverty".

The question is, is a "comforting riposte" enough? Indeed, one third sector worker we interviewed argued that these approaches might even perpetuate inequalities (see also Mosse, 1994):

> "PRA is a time consuming public event which, like other public events, effectively excludes many women, some ethnic groups, and the poor who are preoccupied looking after 'the lands' and cattle posts".

Earlier we pointed out that many of the techniques used by the 'small is beautiful' movement have also been adopted by others who do not share the original ethos. Most notable are

Focus Groups, which are widely used now by business and public sector organisations. One local activist talked about his experience of the Focus Group method used by a government department:

> "First they elicit discussion to identify chief trouble-makers, and then divide us into small 'round tables' making sure that the chief protagonists are evenly spread. Then each table's discussion is carefully steered by an appointed official 'facilitator' constantly dropping subtle hints regarding the (his) best ways forward".

The interviewee saw this as manipulation.

Next there is the process (bottom-up) strategy, which includes the use of some OR problem structuring methods. Process approaches to planning are invaluable in facilitating flexibility and appropriate changes in direction, and looking at the wider system in which activities are embedded, but a frustrated third sector activist said:

> "What's the point of wasting time discussing matters which we have no control over anyway? Let's just deal with the matters at hand".

Another interviewee from the third sector talked about an "indulgence in relativism". Process approaches tend to assume that learning comes about through sweeping in diverse perspectives (in this sense, these approaches fit very well with the value placed on diversity in the third sector). However, when the tolerance or celebration of diverse perspectives distracts from focusing upon key realities that need to be changed, these approaches can be problematic. This criticism has been surfaced in the OR literature too (see, for example, Jackson, 1982).

Critique from a distance has a problematic side as well. Critique means showing the weaknesses of current thinking and proposing better alternatives, but it is often misinterpreted as purely negative thinking and can therefore come to be ignored. Worse than this, however (according to one of our interviewees from a third sector group), is when the critics themselves are content with highlighting problems without considering possible solutions. Hence, some environmental activists call for explicitly proactive arguments:

> "Bearing witness to bad behaviour is not enough… All environmental groups must also now be seen to offer alternatives".

Finally, keeping one's distance from existing institutions can be problematic. While this enables the critic to remain true to his or her principles, it may make implementation of the ideas less likely (Midgley and Ochoa-Arias, 1999, 2001).

Operational Complexity. Having explored the four strategies for dealing with complex and uncertain environmental issues, and having discussed criticisms of these, we can now take a step sideways and look at another angle on complexity raised by several of our third sector respondents: the operational complexity that keeps people from having sufficient time for reflection. One person commented:

> "There is very little opportunity for us as an organisation, and voluntary organisations in general, to step back and reflect on our practices… We are too busy with the day-to-day operations and demands".

Closer association with academic institutions provides one such means for facilitating reflection. For example, Forum for the Future (who use the Natural Step methodology) have a long-standing relationship with the Centre for Human Ecology in Edinburgh:

> "There's a lot of mythology about the Natural Step work in Sweden… We need time to reflect on these issues… research students provide a critical core for such reflection".

However, another respondent said, "we are lacking academic links… particularly on the scientific side". In our own experience, many third sector organisations are in the same position. So, apart from anything else, there is an opportunity here for OR academics.

3.5.3 Multiple Values: Representing Who or What?

In the majority of cases, the basic remit of third sector organisations is to represent people or issues persistently and persuasively to generate change in the desired direction.[18] Therefore, they deal with multiple values by communicating their own value position and (in the case of those groups who are prepared to engage closely with other sectors) seeking to reach accommodations for environmental improvement.

Perhaps the most effective way of conveying values to the wider community is through campaigning. Campaigns can range from local issues (such as the removal of a mobile phone mast from a school roof, which was the concern of one of our interviewees) to national and international issues such as campaigns against nuclear power, fuel taxes, perceived inadequacies in public transport, and Third World debt. A strong campaign requires people to gather the necessary supporting information and mobilise resources in order to communicate with, and gain support from, different community interests. A campaign can demand considerable feats of imagination to capture the public's attention: for example, Greenpeace drew attention to McVities use of fish oil in biscuit manufacture by picketing their factory in penguin suits, which gained national media attention. Increasingly, campaigns are made easier through the networking activities of environmental pressure groups (which may share some values but differ in others).[19] Networking through the internet has been found particularly useful for mobilising support for campaigns on global issues, and the internet facilitates the national and international co-ordination of a wide variety of organisations, from green pressure groups to trade unions—as witnessed in Seattle, for instance.

Conferencing is also useful for raising the visibility of issues and maintaining liaison with academic and government agencies, as well as generating income for third sector organisations. There are also increasing opportunities (as noted in previous sections) for non-governmental organisations to have representation on multisectoral committees. LA21 and Regional Development Agency committees provide typically widespread on-going examples. LA21 committees have mostly been initiated by local councils (following directives from the DETR), and have elicited participation from the business, academic and voluntary sectors. However, some LA21 committees have been initiated by local voluntary groups themselves, and remain under their leadership.

Bilateral arrangements with organisations in other sectors also exist, though usually on a more transient basis, focusing on particular issues. For example, opportunities are provided for representatives from the third sector to attend local government planning meetings, and they are frequently invited to submit evidence to public hearings. Another special kind of bilateral relationship can be found between third sector organisations and local government in the UK (and some other European countries) too: since the early 1980s, voluntary organisations have been encouraged to bid for funding from local government to provide

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[18] We say "in the majority of cases" because some third sector organisations provide services (sub-contracted from the public sector) or engage in limited business activities. Certainly, the distinctions between the sectors are more blurred now than they were twenty or so years ago, but the majority of third sector organisations dealing with environmental issues still do have a campaigning role.

[19] A useful starting point to explore the plethora of such networks is the EnviroLink library: http://www.library.envirolink.org/search

services. When this system of sub-contracting was introduced, the rationale was two-fold: to introduce competition into the public sector, and to give resources to the voluntary sector (which was said to have the most progressive ideas). However, many third sector organisations have reservations about sub-contracting. They complain that becoming dependent on public money compromises their campaigning role.[20] Also, the remit of service provision is still largely specified by the public sector organisations who advertise contracts, and measurement of success tends to be relatively simplistic and narrow, frustrating some of the more progressive ideas of people in the third sector (Taylor, 2000).

Some non-governmental organisations provide services (e.g., research and consultancy) to the business community as a means to promote certain values, as well as to ensure economic survival. Also, businesses sometimes consult pressure groups on their views regarding specific development initiatives. This is usually done to elicit some idea of the practical problems to expect from the implementation of plans, and to see if compromises can be achieved (refer back to section 3.4.3). Sometimes, as with the controversial developments associated with Manchester Airport, the value of such dialogue is only seen in retrospect:

> "Public hearings on the proposed new runway were very uncomfortable at times, but in hindsight extremely useful in preparing us for what was to come…".

Others, like Land Rover Vehicles for example, have invited non-governmental agencies to discuss controversial issues such as waste management and the potential impact of expanding the rail link to their Solihull plant. The media also increasingly liase with the larger third sector environmental organisations to elicit opinions on controversial issues. All these invitations provide opportunities to influence people's values.

People in third sector organisations obviously expect to encounter differences in values when they work with other sectors. However, there are also divisions *within* the third sector. These reflect the fact that there is no single dominant 'environmental philosophy', but rather competing visions of what a sustainable society should look like (Dobson, 1995). One key division is between what might be termed 'anthropocentric' (human-oriented) and more 'ecocentric' (nature-oriented) values: those in the former camp tend to be most concerned about poverty, and environmental issues are relevant because they impact on the lives of the poor, while those in the 'ecocentric' camp are primarily concerned with sustainability, and poverty only becomes an issue because poor people often have no option but to exploit their environments to survive.

However, some protagonists from the third sector prefer to play down these differences:

> "Voluntary organisations are not as diverse as they sometimes try to make out… often a poor excuse for not taking a stand on various issues… The voluntary sector has not got to grips with the concept of representation… Diversity is not an excuse for turning your back on representation".

One respondent pointed to an essential dilemma of representation with reference to the more severe environmental problems associated with metropolitan councils (as against county councils) and ethnic minority groups (as against white middle-class groups): "those who shout loudest usually have the least problems". These tensions are similar to those mentioned in relation to negotiating on values in the business sector (section 3.4.3). While people often aspire to an ideal of free and fair debate, this is rarely realised in practice, with some players gaining advantages through the use of resources and influence that others don't have.

[20] One of the authors, Gerald Midgley, has been involved in a wide variety of Community Operational Research projects with third sector organisations. In nearly every one, the issue of a conflict of interests between campaigning and service provision has been raised.

One final issue of representation, pointed out to us by an OR practitioner working with third sector organisations, is the need to be constantly aware that representation of all relevant people and issues is rarely possible—especially when dealing with highly complex global problems. Therefore, there is a need to regularly revisit the boundaries of inclusion and exclusion to ensure as systemic an understanding as practically possible (in the knowledge that true comprehensiveness is always elusive).[21]

3.5.4 Political Effects: Opting In and Opting Out

Almost by definition, environmental pressure groups engage in political activity.[22] Ideally, it can be argued that the remit of agencies in the third sector is to represent the interests of those vulnerable groups who are not normally involved in, but who are affected by, planning. Vulnerable groups can be defined in terms of having little 'bargaining power', through circumstances of (i) poverty, (ii) discrimination, (iii) difficulties of direct representation (e.g., when tribal people speak a different language to business negotiators), (iv) absence (e.g., of future generations), or (v) non-communicative nature (e.g., the non-human world cannot represent itself).

To represent vulnerable groups, third sector organisations can either promote wider participation in mainstream government and business planning processes or, alternatively, they can remain outside mainstream planning to act in a more independent lobbying, advocacy or militant role. In the latter case, in systems terms, by remaining in the *environment* of planners and decision makers, they are not subject to their control. However, they can have relatively little influence over the ways in which their campaigning is perceived: planners may or may not take their views into account. By actually involving themselves in mainstream government and business planning, they may increase their influence—but the downside is that they may have to make significant compromises. This is an issue of *co-option*.

Remaining engaged with the planning process crucially allows third sector organisations to have an input to the agenda. For example, on the issue of GM crop trials, one third sector respondent reflected:

> "Very often the questions to be addressed are quite simply wrong. Rather than addressing issues of what impacts a technology might have we should be asking, who needs the technology?"

Although it's certainly difficult to influence an agenda that is already dominated by one set of questions (as we saw in section 3.4.4, the parameters of the GM crop debate were initially established by a coalition of powerful stakeholders), remaining engaged at least leaves this open as a possibility.

It becomes a problem, however, when 'success' comes to be measured purely in terms of representation or participation, not in terms of changes in practice. From the point of view of an environmental pressure group, getting someone onto a committee, or participating in a multi-agency planning exercise, is not enough on its own: these positions need to be used as catalysts to promote desired action.

One third sector representative involved in tackling environmental problems in less-developed countries commented that Participatory Rural Appraisals (PRAs) (Chambers, 1992) can sometimes fall into this trap, as can LA21 committees. S/he pointed out that, in

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[21] Interestingly, this observation resonates strongly with the idea of boundary critique in Critical Systems Thinking (Churchman, 1970; Ulrich, 1983, 1993, 1994, 1996; Midgley, 1992, 1994, 2000; Midgley *et al*, 1998; Cordoba *et al*, 2000; Yolles, 2001).

[22] By this, we do not mean Party politics. Many third sector organisations can get charitable status because they don't engage in Party politics, but this makes them no less political in the wider sense of the term.

using PRA, the attitude is usually "if less than 5% of the village attend we will not have a viable action plan".

A similar difficulty is believing that just because the village has co-operated in planning and has produced an output (i.e., a 'village' or 'community' action plan), this by itself is a success. The question is, what is the *quality* of the plan in relation to the social and environmental issues faced by the village, and will it be implemented? The problem arises when the substantive quality of deliberations or plans are effectively side-lined in preference to seeing the *process* as an end-product. The process of a PRA *is* important, but it is not enough on its own.

The same argument can be levelled against having a single 'public interest' representative on government or business committees. The question has to be asked, does the presence of a token 'public interest' representative merely provide a false sense of legitimacy? Indeed, one local activist who had worked in partnership with government, businesses and non-governmental organisations to secure European funding for sustainable development projects went even further:

> "I sometimes feel that there is an unspoken pact between government and businesses to effectively retain levels of environmental degradation and social deprivation in order to sustain the business activities of NGOs!"

Of course she was speaking tongue-in-cheek: this was an expression of the fact that sometimes getting money for projects can become an end in itself.

One local activist, when discussing the issue of co-option, also said that *concepts* as well as people can get co-opted. She commented that, on local authority committees, she often hears phrases like

> "Civil society organisations must be a key focus for future developments in poverty eradication and environmental development".

The concept of 'civil society', to her, was vitally important, but it was effectively neutered by being used as part of what appeared to her as empty rhetoric.

Terms like 'social justice' are similarly vulnerable to woolly or rhetorical use. The Natural Step (95) has social justice as its 'fourth commitment', but a representative from a multi-national business who had worked with the methodology was concerned that it had been added as an afterthought:

> "My impression of The Natural Step is that it works OK for the first three system conditions but then gets unstuck with the fourth… No one seems sure what to do with it!"

With all the problems associated with co-option, it is unsurprising that several people we interviewed from third sector organisations told us about times when they had turned down opportunities to participate in public or private sector initiatives on political grounds. For example, one prominent non-governmental organisation representative declined an invitation to join the Manchester City Council LA21 Partnership Committee, stating that "the Manchester LA21 is just greenwash".

Opting out of participation, and opting into an alternative strategy like non-violent direct action, can sometimes be used as a last resort when all other means appear to have been exhausted. For example, at a local action group meeting concerned with the siting of a mobile phone mast on top of a primary school, one participant summed up the state of play after over a year of participating in local government planning meetings:

> "As I see it we have no option other than making the mast inoperable. The local councillors feel unable to 'break the contract' and [the company] are not going to voluntarily remove the mast unless they have a guaranteed alternative site of comparable value in the locality".

One of the strategies used in non-violent direct action is to remain organisationally obscure, fragmented, and thereby difficult for authorities to pin down, whilst at the same time being able to seek out important information. One representative of a non-violent direct action group said

> "We've got contacts in places that you would not believe… We've got a lot of useful knowledge about what's going on".

Of course the down side of 'opting out' is the risk of further marginalisation.

So, in summary, political effects are central to the activities of third sector groups: their whole reason for being is to identify and deal with these (that is, if we understand 'politics' as wider than just Party politics which charities, by law, cannot engage in). However, in the process of identifying and dealing with political effects, they need to tread a fine line between engaging with public and business sector organisations (where the risk is co-option leading to a watering down of principles) and distancing themselves from these organisations to preserve their purity (in this case the risk is marginalisation). The comments of our third sector respondents suggest that it is not easy for them to get the balance right.

3.6 Summary and Conclusions

Table 3.1 (on the next page) summarises the issues (under the generic headings of complexity and uncertainty, multiple values and political effects) encountered by each of the three sectors (public, business and third sector). The issues for each category are presented as opposing viewpoints in order to clarify the dilemmas/problems facing different stakeholders.

Some key substantive features can also be outlined as follows:

- The questions presented in each box signal a potential conflict between two alternative interpretations that the stakeholder arguably needs to address.

- Each stakeholder group can be shown to have concerns in each of the three issue categories. Nevertheless, each group has a *primary* interest, as follows:

- Issues of complexity and uncertainty dominate the public sector with attention focused on developing appropriate indicators for evaluation.

- Multiple (competing) values are the main concern in the business sector, with attention being paid to minimising risks through improving stakeholder interactions.

- Political issues dominate the third sector with concerns about widening the net of meaningful participation in planning processes.

- For each stakeholder group the two *secondary* issue categories tend to cluster around the primary issue category.

Table 3.1: Environmental Management Issues and Interest Groups

	ISSUES		
	Complexity & uncertainty	**Multiple Interests**	**Politics**
Public Sector	***Indicators***	*Partnerships*	*Responsibility*
	Providing transparency of relevant information or Promoting illusory technical/analytical fix?	Leading to compromise without compromising integrity or Contriving a smokescreen of false 'consensus'?	Based on discomforting, though vibrant, social accountability or An in-house, self-referential (comfortable) systems accountability?
Business Sector	*Sustainability*	***Risk aversion***	*Trade-offs*
	Creating a learning culture adaptive to social & environmental needs or Sustaining an opportunist culture based on short-term economic growth?	Based on nurturing co-operative enterprises in the spirit of sustainable development or Based on superficial and deceptive 'public relations' exercises?	Agreed between stakeholders in free and fair debates or Compromised through inherently biased market-oriented discourse?
Third Sector	*Diversity*	*Representation*	***Exclusion***
	Respected and guided through 'process approaches' to planning allowing for free debate or Preserved and maintained through resort to relativism?	Of the most important interests for a sustainable future (e.g., the poor, future generations and non-human nature) or Of interests close to the heart of those who are themselves relatively advantaged?	Addressed by both encouraging purposeful participation and acknowledging the value of opting-out or Addressed through measures of co-option?

The recurring, generic issues of complexity and uncertainty, multiple values and political effects are inevitably rather abstract. Substantive issues relating, for example, to transport, energy, waste disposal, pollution and greenbelt development—or even wider concerns relating to sustainable development, global warming, world trade and poverty elimination—

can, it might be argued, be more specifically examined using the same parameters. That is, any environmental issue being addressed could potentially involve each of the three stakeholder groups (from the public, business and third sectors), as well as some form of 'expert' support, such as OR. Also, any substantive issue might be analysed in terms of all three generic issue types as discussed above. For instance, in relation to the recent 'fuel crisis' in the UK, it might be a useful exercise to map out the concerns expressed by people in each of the three different sectors regarding the issue of fuel prices, categorised in terms of complexity and uncertainty, multiple values and political effects. It would then be possible to explore how OR support might be provided to improve the situation.

Finally, a note of caution. The framework adopted in this analysis is *systemic* in terms of addressing both the so-called 'soft' issues of values and ethics (multiple values and political effects) in addition to the more usual 'hard' issues of complexity and uncertainty commonly associated with the remit of OR. In our "notes on reading this chapter", before we presented our analysis, we made clear why the approach we took might give the *erroneous* impression that we want to privilege the views of the third sector: essentially, because most of the critical interpretations of people's actions (in all three sectors) were provided by the third sector representatives. Now, having concluded our analysis, we need to warn against another potential misunderstanding:

It might be interpreted that we are privileging 'soft' over 'hard' approaches to OR, simply because two of the generic themes we have explored are commonly labeled 'soft'. This is not our intention. Although it might superficially appear that 'hard' (largely quantitative) techniques are most appropriate to address issues of complexity, and 'soft' (largely qualitative) techniques are best for the other two issue categories, we do not agree that such a simple categorisation has any validity. Quantitative OR techniques have provided invaluable sources of support across the *range* of issue categories (think about how MCDA techniques handle value conflicts, for example), as have problem structuring approaches (Soft Systems Methodology, for instance, is an invaluable aid to learning in complex situations). Our own view, as we explained in Chapter 2, is that different OR methods are useful for different purposes—but purposes do not divide nice and simply along the lines of the three issue categories (complexity and uncertainty, multiple values and political effects). Exploring and deciding on purposes, and selecting and/or designing methods to address these purposes, is a far more complex business (Midgley, 2000). Essentially, this misunderstanding stems from the loose use of the words 'hard' and 'soft': they are actually used *differently* when applied to issues and methods, and therefore have the potential to cause significant confusion.

In the next chapter, our aim is to deepen the reader's understanding of the strengths and weaknesses of some of the best of current OR practice. Three examples of good OR practice are presented: one in the public sector (but including other stakeholders), dealing primarily with issues of complexity and uncertainty; one in business (but again including other stakeholders), addressing value conflicts; and one in the third sector (once again sweeping in others), geared to identifying and dealing with political effects. In addition to explaining why the three methods employed were particularly appropriate for the circumstances being addressed, we will also highlight limitations of these applications that point to the need for further research.

Chapter 4:
Case Studies of Operational Research Support

4.1 Introduction

In Chapter 2, we identified three generic issues that recur in the environmental management literature, which we argued that Operational Research (OR) practitioners must come to grips with if they are to enhance their contribution to environmental planning:

- Complexity and uncertainty;
- Multiple (often conflicting) values; and
- Political effects.

A substantial amount of OR work has already been conducted on each of these issues in relation to environmental planning and management, but the major challenge is to create methodologies and methods that can deal with all three simultaneously.

In Chapter 3, we discussed how the three identified 'user' groups for OR—the public, business and third sectors—have different *primary* interests in dealing with complexity and uncertainty, multiple values and political effects respectively. Each also needs to address the other issues, but in relation to their primary interests.

In this chapter, we present three case studies of the successful application of OR methods. The Integrated Sustainable Cities Assessment Method (ISCAM) mainly addresses issues of complexity and uncertainty, and is principally seen to serve the public sector. Multiple-Criteria Mapping (MCM) addresses multiple values, providing a tool that appears particularly useful for the business sector. Finally, Reciprocal Outreach (incorporating Participatory Rural Appraisal and Strategic Choice) addresses issues of political environmental effects commonly of interest to third sector groups in less-developed countries.

For each of the three case studies we present the historical context; an outline of the OR approach; and a critical evaluation of how complexity and uncertainty, multiple values and political effects were addressed. The detailed outputs from each application are not the focus of attention in this analysis (details of these can be found in the references provided).

Finally, before embarking on our description of the first case study, we should note that we have made the judgement that these were 'successful' OR applications on the basis of write-ups in the literature. We have had no first-hand involvements in any of the applications reviewed.

4.2 The Integrated Sustainable Cities Assessment Method (ISCAM) Applied to Long-Term Planning for Greater Manchester

4.2.1 Historical Background

ISCAM came to public prominence with the publication of *City Region 2020* (Ravetz, 2000).[23] The book uses Greater Manchester as a detailed case study to explore the possibilities of the integrated strategic management of cities and regions, and was written in collaboration with

[23] Ravetz is a former builder, community architect, development agency manager, and presently Senior Research Fellow and Programme Director at the Centre for Urban & Regional Ecology at the School of Planning and Landscape, Manchester University. He is also the UK coordinator of ENSURE - UK (European Network for Sustainable Urban & Regional Development).

the Sustainable City-Region Working Group set up in 1994 by the Town and Country Planning Association (TCPA).

The book builds on the research work of the TCPA Sustainable Development Group and their report, *Planning for a Sustainable Environment*, which was published in 1993. This earlier work set out an agenda for change based around the concept of 'social city-regions' in which a balanced portfolio of policies could be applied to help promote sustainable development: that is, policies to avoid environmental damage, social distress and economic decline. From this earlier study, the TCPA selected Greater Manchester as a test-bed for demonstrating the ideas and models that were to be advanced. A research partnership and working group was formed between TCPA, the Centre for Employment Research at Manchester Metropolitan University, and the ten local authorities of Greater Manchester (who were tasked with implementation). The full working group included many leading academics in the field of urban planning from around the UK, along with non-academic consultants, and experienced local authority planners. Funding was gained in the aftermath of the 1992 Rio Earth Summit from the European Regional Development Fund in conjunction with the Global Forum 94 event (hosted in Manchester) and a number of corporate sponsors. As stated by Peter Roberts in the Preface, the publication of *City Region 2020* marks the centenary of the establishment of the TCPA, and provides a worthy successor to the TCPA's founding text, Ebenezer Howard's 1898 publication, *Garden Cities of Tomorrow: a Peaceful Path to Real Reform*.

The ambition of the book is to propose a more holistic view of, and longer term approach to, urban and regional planning than is currently practised in the majority of localities. The Integrated Sustainable Cities Assessment Method (ISCAM) provides the central core modelling framework for meeting this remit. The book draws on a wide source of OR, cybernetics and systems writers including Ashby (1956), Holling (1980), Odum (1983), Alexander (1986), Friend and Hickling (1987), Checkland and Scholes (1990) and Bossel (1996).

4.2.2 The ISCAM Approach

ISCAM is a modelling approach with a heuristic purpose (orientated to learning rather than problem-solving) described by Ravetz as a "powerful tool… for exploring the sustainability theme" (ibid. p.19). Cities are seen as complex systems, prompting the need to examine how they can evolve, organise and regenerate. The systems view being advanced hinges on the concept of 'metabolisms' as found in the natural world. A metabolism is a transformation process that can be modelled showing causal chains involving materials (resource use to resource disposal); energy (low entropy sources to high entropy sinks); economic activity (human needs to production and consumption of goods), etc.

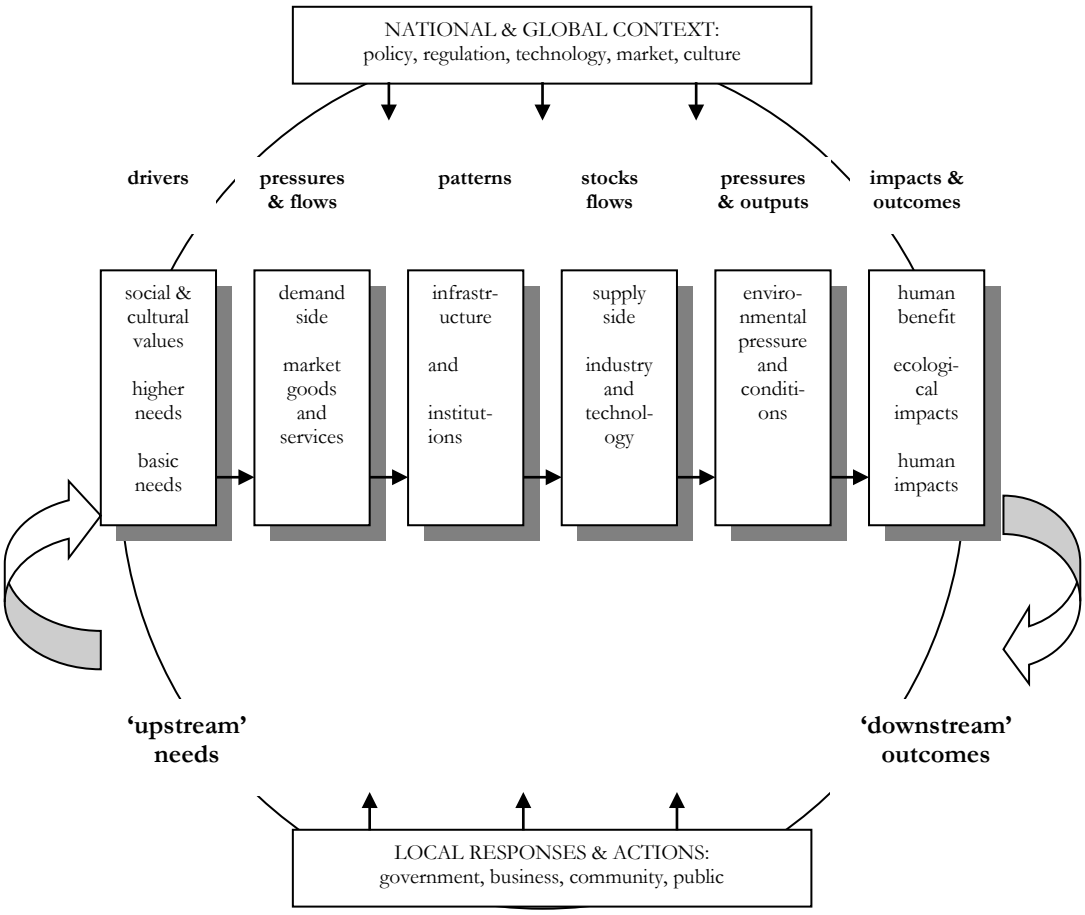
Drawing on the ideas of Howard Odum, a system is seen as having

> "…to deal with diverse conditions, respond to short term changes, and adapt to long term changes. Most importantly it has to co-exist with other systems, both larger and smaller, by containing its external impacts which could affect its resource base. To fulfil these functions there are key qualities which reflect the system's capacity for survival, resilience and integrity:
>
> - Cybernetic feedback and communication—ability to respond to pressure or change.
> - Self-organization—capacity to innovate and generate diversity.
> - Emergence—capacity to evolve to higher levels of self-organization"
>
> (ibid. pp.17-18).

Another key aspect of ISCAM is Ravetz's 'integrated assessment' tool which provides a means of capturing the sustainability theme by combining the economic, social and environmental in terms of cause and effect. Total metabolism is conceptually mapped as

'informational metabolism', where environmental problems are typically seen as caused by economic activity, and economic activity is caused by social needs and demands. Extending the Organization for Economic Cooperation and Development (OECD) 'pressure-state-response' framework, Ravetz puts together an approximate chain of cause and effect from *upstream* needs (socio-cultural values translated in terms of economic 'supply and demand' pressures and flows) to *downstream* outcomes (environmental pressures and human impacts), within a *context* of assumptions about national and global policies, regulations, markets and technologies, and local *responses* which may alter links in the system (see Figure 4.1).

Figure 4.1: Integrated Assessment
(Ravetz, 2000 p.19)



Ravetz suggests that mapping the chains of cause and effect (where known) can help planners in their task of identifying positive changes required at each step. For example, in the transport sector, the human 'need' to travel, and the desire to provide equal access to transport, give rise to many proximate chains of cause and effect, making it possible to identify strategies to avoid the 'outcomes' of congestion and climate change. The mapping should involve many dimensions including socio-cultural, economic and environmental, arranged in a rough order from upstream (needs and desires) to downstream (outcomes) and looping back.

The production of a systems map for a particular issue or sector provides the first step or "platform" for ISCAM. Two other components of the approach then follow: scenario

accounting and sustainability appraisal.[24] The process of 'scenario accounting' involves identifying chains of indicators and targets and exploring alternative scenarios. Choosing indicators that are both relevant and measurable is problematic enough, but *linking* the sets of targets so that they represent an acceptable balance of social values, economic resources and political constraints provides an extra level of challenge. ISCAM attempts to do this through the software package *Atlas NW Futurequest*, adapted from the Canadian 'QUEST' software.[25] The software selects features regarding the metabolism illustrated in Figure 4.1: drivers, pressures, stocks, patterns, flows and impacts. These are arranged as a set of three scenarios:

- Current values (and historic values where available);
- Business-as-usual (BAU) trends; and
- Sustainable development (SD) targets.

The distance between BAU trends and SD targets can be shown as a 'trend-target index' (see Box 4.1 as an example). The core indicators and trend-target index can then be used to inform the design of strategies as co-ordinated sets of actions involving different agents (see Box 4.2).

The software programme is designed to be interactive: it explores and illuminates choices and trajectories for different user groups. The business of designing possible strategies and learning about their potential effects is arranged in three steps:

(i) *Inventing a future*, using worldviews, values and priorities, etc;
(ii) *Choosing policies*, with detailed possibilities for each sector; and
(iii) *Viewing consequences*, in terms of results, maps, stories, charts, etc.

Box 4.1 (Ravetz, 2000 p.129)

Waste & Pollution Trends & Targets

		1995	BAU 2020	SD 2020	Trend target index %
Material throughput/GDP factor	kg/£GDP	3.6	2.8	1.8	50
total waste recycled	Mt/Y	1.4	2.6	3.3	60
Compost/digestion/spread	Mt/Y	0.1	0.7	1.5	40
total waste arising	Mt/Y	11.4	7.8	5.3	60
Estuary water nitrate loading	mgN/l	14	23	10	-100
Nox total emissions	kt/Y	107	108	39	0
CO total emissions	kt/Y	330	270	110	30
PM total emissions	kt/Y	24	22	12	20

Summary 'core indicators' with trends & targets from ISCAM scenario accounts for Greater Manchester 1995-2020

BAU = business as usual projection from trend
SD = sustainable development scenario

[24] This is not made very clear in the original text. Within a few pages (pp.20-21) Ravetz oscillates between describing the method in terms of (i) a platform linking 5 applications (mapping, accounting, strategies, agencies, and appraisal); (ii) 3 different modes (deliberative, analysis, and action); and three stages (scoping the problem, exploring alternative scenarios, and exploring the implications). For simplicity and conformity the last two divisions can be considered as complementary, whilst the third and fourth 'applications' in the first typology can be aggregated with systems accounting, leaving three complementary sets of 'applications' (mapping, accounting and appraisal).
[25] http://www.art.man.ac.uk/planning/cure

Box 4.2 (Ravetz, 2000 p.129)

Waste & Pollution Goals & Strategies	**GOV**	**LAP**	**BUS**	**COM**	**PUB**
ENVIRONMENTAL STRATEGY: Integrated city-region strategy for material flows, capacities, thresholds, with fatality risk levels at 1 per million	o	**+**	+		
AIR QUALITY: Common pollutant emissions reduced by half or more to bring air quality to best practice guideline levels	+	+	o		
WATER QUALITY: All river quality to 'good' or 'fair' standard: sewage & effluent strategy to minimise toxins: demand management & lead-free drinking water throughout	o	o	+	o	
GROUND & SOIL: Strategic programme for areas of search on contaminated & unstable land: reduce derelict/ contaminated land by 2/3 to 2% of urban area	o	+	+	o	
WASTE: Reduce waste arisings by 1-2% per year: 'Best practical environmental option' for waste disposal with city-region material management system. Zero waste economic development with consortia markets for recycling and use.	o	+	+	o	+

KEY:

GOV - government and EU; LAP - local authorities & partnerships; BUS - business & finance; COM - community and third sector; PUB - public

o indirect or minor responsibility
+ direct or major responsibility

The chapters in Parts I and II of Ravetz (2000) are framed in accordance with scenario accounting. Part I looks at future trends and prospects for Greater Manchester, providing a scenario for 2020. Part II examines all the environmental sectors in detail, providing a trend-target index for each one. Part III examines how to put the various sector-based strategies together.

The third stage of ISCAM explores the implications of selected scenarios. This is what Ravetz calls the '"appraisal' of the sustainability of systems, projects or programmes" (ibid. p.20). The trend-target index for each indicator can be used as the starting platform for an appraisal, highlighting the difference between 'where we are heading' and 'where we want to be'. 'Sustainability appraisal' is, again, ideally a multi-sectoral *process* of investigation, with explicit reference being made to the particular interests being served. 'Sustainability appraisal' should not be considered as the simple provision of a *fixed* answer.

4.2.3 Evaluation of ISCAM

Having presented a brief outline of the methodology and methods of ISCAM, we now conduct an evaluation of it, structured around the three recurring, generic themes first identified in Chapter 2: complexity and uncertainty, multiple values and political effects.

Complexity and uncertainty. As implied by Michael Meacher, the UK Minister for the Environment, in the Foreword to Ravetz (2000), ISCAM provides a useful analytical tool for helping with the government's own national sustainable development strategy. The achievement of ISCAM resides principally in the ambitious scope of the modelling process. The modelling is designed to help people see where 'social improvements' might be made. It is not just another attempt at representing complex realities: "…If this project has succeeded at all, it will show that more sustainable, and enjoyable, futures are there to be invented" (ibid. p.280).

ISCAM provides a multi-method platform: indicators providing a quantitative 'accounting system' are complemented by the more qualitative integrated systems mapping methods. The platform invites contributions from different areas of related practice, including the design for gaming tools, simulation, GIS explorer, accounting tools, decision support tools, etc. Boundaries are extended on both temporal (25 year scenarios) and spatial (economic, social and environmental) dimensions. Whilst being extended, care is taken to make the boundaries manageable. A 25 year scenario represents a single generation. While this does not engage with the uncertainties of much longer term forecasting, which is undoubtedly needed for effective sustainable development planning, it does improve upon the traditional 5 year planning scenarios commonly produced by governments. Also, chapters of the book provide advice for short, medium and long term strategies. Similarly, while the links between different sectors in the global economy are undoubtedly significant, though more or less infinitely complex, the 'city-region' context is chosen as a manageable arena to work with. Given the prospective future dominance of regional assemblies and regional development agencies, both in the UK and in Europe more widely, the city-region provides a politically viable working frame of reference for future public land-use planning.

Central to the modelling process is the identification and use of 'core indicators' throughout the report.[26] The indicators are selected as those most sensitive to the environmental performance of the city-region system, and to economic and social policy opportunities. Each indicator is given a value and an average rate of change over 25 years. The modelling approach and subsequent indicators chosen aim to satisfy an approximate representation of flows of resources and services. 'Proximate' modelling takes account of the prevalence of uncertainties and the limitations of 'direct representation'. The model is generated explicitly as a heuristic device to prompt external feedback and interaction with users. What is important is that the indicators provided have maximum transparency with regards to their strengths and limitations, and are essentially flexible with regard to the environment of uncertainties associated with different user groups with different values.

Nevertheless, despite its modelling strengths in relation to dealing with complexity, ISCAM is less clear about how major uncertainties should be handled.[27] Also, an inevitable weakness is that the 'accounting' dimension of modelling remains dependent on indicators being chosen that are "relevant but measurable" (ibid. p.20). Whilst acknowledging that some sustainability factors are impossible to measure, Ravetz does not discuss the significance of leaving these out.

[26] These are usefully summarised by Ravetz (2000) in an appendix on pages 284-285.
[27] This is partly illustrated by the fact that citation of Friend & Hickling's (1987) Strategic Choice omits the underlying principle of 'managing uncertainties' discussed by the original authors.

Multiple values. The integrated system mapping component of ISCAM requires intersectoral co-ordination. Each chapter in the book provides summary boxes (e.g., Box 4.2) showing the relevant roles and responsibilities of government, local authorities, businesses, community groups, and the public. The ISCAM software, Atlas NW, also attempts to bring into relief the different value systems underpinning models for sustainable development. The software, it is claimed, provides a heuristic device for exploring and illuminating choices and trajectories for different classes of users.[28] The model is designed around user dialogue. Modelling becomes a bottom-up approach to chain building by users of the software who are prompted to invent a future, choose policies and view consequences.

The modelling focuses on 'win-win' rather than 'win-lose' scenarios, which is important in fostering co-operative working relationships. Nevertheless the question remains, which stakeholders are going to have access to the computer-generated model and will therefore be able to articulate their preferences? At issue here is the risk of using the software interface as a substitute for, rather than as an aid to, deeper and more inclusive political and economic debates. For example, if the users are predominantly unelected officers working in the newly formed regional development agencies, and they make assumptions about what other agencies ought to be doing, questions may arise with regard to the use of such methods in helping to fabricate a false consensus on particular issues. Implementation is also likely to be put at risk, as multi-agency partnerships are usually voluntary and therefore require genuine participation to work effectively. While Ravetz is explicit that modelling should be 'bottom-up', it would arguably help if more methodological guidance for enabling participation could be provided.[29]

Political effects. Political effects are addressed by the 'sustainability appraisal' component of ISCAM. In the modelling software, the implications of selected scenarios for different actors are highlighted and explored. Refreshingly, appraisal is not seen in terms of whether, for example, housing (or the housing industry) is objectively sustainable, but rather is dependent on the context: "…it depends on what or whom we want to sustain" (ibid. p.21). The study is also refreshingly reflective on the issue of potentially unforeseen consequences:

> "…following the instructions in this book, for instance, could help to raise the quality of life to such levels that local property markets escalate, the inner cities are re-colonised by wealthy enclaves, others are pressed into compact 'sustainable neighbourhoods', and the excluded and marginalised practice their own colonisation, in a new geography of wild zones" (ibid. p.276).

Whilst being alert to such effects, and offering tools that can build these considerations into planning, ISCAM does not pretend to be able to resolve such issues.

4.3 Addressing Conflicts over Genetically Modified Foods using Multi-Criteria Mapping (MCM)

4.3.1 Historical Background

The 1990s witnessed a number of controversial issues in the public domain regarding the risk assessment of industrial products. The BSE crisis, Brent Spar and the furore over genetically modified (GM) crops served to highlight the weaknesses of purely analytical, optimisation approaches to risk assessment. Probabilistic Risk Assessment and Cost-Benefit Analysis, for example, are closed to possibilities for exploring divergent values. Participatory and 'deliberative' approaches (e.g., problem structuring methods), on the other hand, address

[28]Unpublished draft discussion notes on model concept design and algorithms (Ravetz, 31/01/00).
[29] This raises the possibility of future research to bring insights from Critical Systems Thinking, particularly about managing the boundaries of participation (Churchman, 1970; Ulrich, 1983, 1993, 1994, 1996; Midgley, 1992, 1994, 2000; Midgley *et al*, 1998; Cordoba *et al*, 2000; Yolles, 2001), into ISCAM.

divergent values, but are open to challenge regarding verifiability, as well as (in some instances) the transparency of starting assumptions. There are also logistical concerns regarding the time it takes to undertake participatory planning. *Both* sets of approaches also raise issues of manipulation and control, and feasibility and accountability can be called into question (Romm, 2001).

Between June 1998 and May 1999, research began on piloting Multi-Criteria Mapping (MCM) in the contentious arena of GM foods. This resulted in the publication of *Rethinking Risk: A Pilot Multi-Criteria Mapping of a Genetically Modified Crop in Agricultural Systems in the UK* (Stirling and Mayer, 1999). The project was co-ordinated by the pressure group GeneWatch, but was funded by Unilever. The report's authors were Andy Stirling, a Senior Research Fellow in the Science and Technology Policy Research Unit (SPRU) at the University of Sussex, and Sue Mayor, Director of GeneWatch. The work carried forward suggestions from a 1997 seminar, *Confronting Risk*, organised by Unilever, Sainsbury's and the Consumers' Association. The seminar identified a

> "need to establish a wider knowledge base to decisions and to institutionalise reflection and feedback so that decisions can be continually reviewed in the light of changing circumstances" (ibid. p.14).

It also explicitly addressed two recommendations regarding public involvement suggested in a 1997 report from the Centre for the Study of Environmental Change at Lancaster University (Grove-White *et al*, 1997):

- To develop more socially resilient, shared understandings of the conditions of acceptability (or otherwise) of GM foods; and

- To improve the 'social intelligence' of industry and government *vis a vis* relevant public understandings.

The basic impetus then was to address public anxieties in what is seen as the "general corrosive attitude of fatalism, disillusion and distrust" surrounding the development of GM foods. The approach builds on well-established OR techniques of Multi-Criteria Decision Analysis to 'map' debates surrounding the contentious issues. Stirling and Mayer (1999) argue that such mapping can help decision makers in both government and industry find better routes to negotiation between polarised positions. For government, it can help in the design of appropriate regulatory processes. Perhaps more significantly though, for industry, it can help inform future research and development, and ultimately product promotion.

The choice of genetically modified, herbicide-tolerant oilseed rape was incidental to the main purpose of the pilot study. That is, there was no intention to make specific pronouncements on the safety and general desirability of this particular GM crop, but rather to explore and evaluate its relative performance from different perspectives.

4.3.2 The MCM Approach

The MCM approach consists of 8 stages as outlined in Figure 4.2 (on the next page).

Twelve participants agreed to take part anonymously: two academic scientists; two government safety advisors; four representatives from different religious and public interest groups; and four representatives from the agricultural and food industries. Individuals were chosen because they represented divergent perspectives ranging from being strongly in favour of GM foods to being strongly opposed to them. They were also chosen on the basis of their established positions as leading protagonists in the UK debate.

Six basic policy options were identified and defined in advance by the researchers. Unlike conventional regulatory risk assessments which tend to focus on only one option, and deal with questions of whether the course of action is 'safe', 'unsafe' or 'safe enough', the MCM approach provided options which included both GM and non-GM strategies. It was therefore possible to direct attention to the consequences (positive and/or negative) of *not* pursuing the GM options.

Figure 4.2: Outline of MCM Techniques Applied in the Pilot Study
(Stirling and Mayer, 1999, p.15)

Decide Subject Area
- genetically modified, herbicide-tolerant, oilseed rape

Define Basic Policy Options
- No GM crop, organic agricultural system
- No GM crop, integrated pest management system
- No GM crop, conventional agricultural system
- GM crops with segregation and labelling
- GM crops with post-release monitoring
- GM crops with voluntary controls on areas of cultivation
- Up to six more to be chosen by the participants (these could include combinations of the above)

Select Participants (according to…)
- sector of debate
- relevance of expertise
- spread of opinion

Individual Interviews (2-3 hour sessions)
- select additional options
- define criteria by which to evaluate
- score options for each criterion, specifying uncertainty when relevant
- decide relative weighting of criteria

Analysis (qualitative and quantitative)
- group criteria
- identify areas of agreement/disagreement
- examine uncertainty patterns
- conduct sensitivity analysis
- investigate diversity

Feedback on Preliminary Results
- participants reassess or confirm initial input
- results and analysis adjusted where necessary

Deliberation
- discussions between participants on the basis of adjusted results

Final Analysis and Report

During interviews, participants were first allowed the freedom to specify up to six alternative options that they thought might be worth exploring in addition to those defined by the researchers.[30] Second, participants were asked to define a maximum of twelve independent criteria for evaluating the production of GM herbicide-tolerant oilseed rape. More precise definitions of the criteria were elicited when general suggestions such as 'sustainability', 'precaution' or 'efficiency' were offered. Third, participants were asked to score each policy option using each criterion. They could use either established units appropriate for each criterion (e.g., numbers of species affected or monetary value) or an arbitrary cardinal scoring scale (such as 1-10 or 1-100), with high numerical values corresponding with high performance. The scoring process demanded systematic and iterative deliberation bringing in to discussion a wide variety of conditioning assumptions and countervailing factors.

Participants were also asked to provide 'optimistic' (high) and 'pessimistic' (low) scores for each option using each criterion. This enabled judgements regarding the importance of technical uncertainties to be expressed. Where uncertainties were not judged to be important, the two scores would be identical. Participants were also asked to describe the 'framing assumptions' being applied, such as confidence in good practice and/or regulatory regimes, or assumptions concerning dynamic changes over time.

Finally, participants were asked to assign numerical weightings to reflect the importance of each of their appraisal criteria. Whereas 'scoring' addressed 'technical' and 'scientific' considerations, weightings expressed value judgements reflecting how much participants cared about each criterion in relation to the others. Starting from the default position where equal weighting was assigned to each criterion, participants went through a strongly iterative process of assigning relative values according to perceived importance. A computer spreadsheet programme was designed to perform "a straightforward 'linear additive weighting' multi-criteria procedure" (p.19). This involved taking the performance scores, normalising the scoring scales (putting them all on the same scale), and multiplying them by importance weightings to express the relative priorities attached to the different criteria. This resulted in a 'ranking' of each option. Participants were allowed to feed in weighting scores to the programme and to see and examine in real time the resultant rankings of options displayed as bar charts. The bar charts showed the rankings of options using both 'optimistic' and 'pessimistic' performance scores.

Preliminary analysis began with an exercise in *grouping* the criteria. The 117 individual criteria suggested were categorised into six groupings: 'environment', 'agriculture', 'health', social', 'economic' and 'other' issues. Where there was a degree of overlap between the six groupings (7 out of the 117 criteria were judged as being in more than one group), that aspect (grouping) which was more strongly emphasised during the interview was taken as the basis for categorising the criterion.

The second stage involved a *sensitivity analysis*. This was a further iteration of experimentation with changes in the weighting values assigned to the different criteria. Post-interview analysis explored what the final rankings would have looked like for each participant if the weightings on each of the six groupings had been different by a factor of three either up or down. No weighting changes were suggested by any participant as a result of this further iteration.

Finally, a *diversity analysis* was undertaken to assess the value of the deliberate pursuit of a *number* of the better-performing options. This would satisfy, for example, one element in a 'precautionary' strategy where benefits of diversity might be seen as an acknowledgement of political pluralism, serious uncertainty, or contextual variability. A numerical index of

[30] Nine of the twelve participants added a total of seventeen to the list of core options. Adding or combining controls, and/or making them compulsory, were the most common types of additional options (7 of 17), and using GM crops inside integrated pest management or organic systems were the next most common (5 of 17). Others included GM crops evaluated with needs assessment; GM crops assessed against criteria of quality; complete public control over choice; GM crops only to be grown in the USA; and no GM commodity crops (see Stirling and Mayer, 1999, p.24, for a full breakdown).

diversity (the Shannon-Wiener function), derived from work conducted in the energy sector and in the field of evolutionary economics, was employed to allow for diversity to be considered as an additional 'criterion' in the appraisal. The index was used to explore what would happen if progressively greater weighting was placed on diversity compared with the other criteria.

All participants received a copy of their own results as well as those of others in the group. Participants were also asked to critically comment on the difficulty and utility of the MCM process as a whole and its individual parts. A final meeting was held with participants to give them an opportunity to provide further feedback and discuss the implications of the study.

4.3.3 Evaluation of MCM

Again, our evaluation is structured using the three headings of complexity and uncertainty, multiple values and political effects. The evaluative findings offered by Stirling and Mayer (1999) are integrated with our own observations.

Complexity and uncertainty. MCM draws on three relatively separate traditions in risk assessment: Multi-Criteria Decision Analysis (MCDA), which comprises a set of well established and powerful analytical techniques derived from twenty years of research and development; Personal Construct Theory (initiated by Kelly, 1955, and refined by a variety of researchers since then); and participatory, deliberative, problem structuring approaches (see, for example, Rosenhead, 1989b). Whilst the 'scoring' exercises draw principally on MCDA, the assignment of subjective 'weightings' reflects the influence of Personal Construct Theory. The iterative process and sharing of results reflect the participatory, deliberative style of problem structuring methods.

Despite purposely drawing in a diversity of actors with contrasting perspectives, for logistical reasons this pilot study was limited to intensive work with only twelve representatives who were all specialists in their fields. The method does not claim to be able to represent all the views in the population, although the breadth of options and criteria captured by just these twelve people indicate that representativeness might not be a serious problem (at least in this case). There is no reason to suspect the robustness of the results, which Stirling and Mayer (1999) claim provide a reliable indicator of the broader dimensions of the contemporary controversial debate on GM foods. In this sense, MCM appears well able to capture the complexity of the issues.

Interestingly, in the GM foods case, the option of supporting diversity—not putting all one's eggs in one basket—was generally supported by a wide range of participants, suggesting that options which compromise an ability to pursue other strategies in the future might be regarded unfavourably when using MCM. Therefore, MCM can be said to deal with complexity by keeping a variety of options open.

Optimistic and pessimistic ratings associated with the ranking of options give expression to the degree of *uncertainty* about the present state of knowledge. Also, the research frame itself generates considerable explicit candour about uncertainties. Interestingly, the results in the GM foods case illustrate how uncertainty is much more important to some people than others. Like ISCAM, there is considerable transparency in the approach. It is claimed that people can go back through the numbers to see how particular outcomes were reached, and they can also amend their inputs as they learn about the issues.

However, the perceived difficulty of the exercise, and the time consumed in interviewing and analysis, prohibits its use as an everyday tool:

> "…it can only make sense, for instance as part of a wider deliberative process of appraisal—a process within which it might be hoped that MCM may help contribute the key properties of systematic discipline, transparency and verifiability" (ibid. p.53).

Multiple values. Stirling and Mayer (1999) provide a short quotation from *The Economist*:

> "After BSE, simply quoting scientific authority is no answer to the conundrum of public trust. What impresses the public in these matters is transparent and impartial decision-making based on wide consultation" (*The Economist*, 29 May 1999, p.37).

Arguably the greatest strength of MCM lies in its aid to deliberation and reasoned judgement, taking account of a plurality of interests and values. The pilot study reported above illustrates its utility in securing engagement from disparate parties in a very hotly disputed controversy. Crucially, the framing of the inquiry was determined by the initial choice of options and criteria suggested by the participants (only 6 of the 23 options being provided by the researchers). Many of the criteria chosen were found to lie outside the scope of traditional risk assessments. The spreadsheet programme allows for simultaneous analysis of several alternative policy options, which is a vital aid to decision making. Importantly, MCM also acknowledges the pivotal role of subjective judgements, particularly in the 'weightings' input, reinforced by subsequent iterations of sensitivity analysis.

We can, however, identify two sources of bias: one actual and one potential. First, whilst MCM benefits from the transparency of quantitative analysis, there remain significant points of view—for example, the belief expressed by some people that non-human nature should be seen as having inviolable 'rights'—that remain difficult to quantify. As Spash (1997a) points out, people who take a 'rights-based' (or 'deontological') approach also resist weighing this against benefits that might be gained from other ways of thinking. In other words, MCM embodies a rationality of liberal choice, and therefore has limitations when being used with people who don't share this rationality. This is particularly significant when dealing with environmental issues (as opposed to some other business and social problems), because there is a whole constituency of stakeholders (those who might be termed 'deep ecologists') who embrace a deontological philosophy and could therefore find the use of MCM problematic.

The second source of *potential* bias can be found in the fact that, in the GM foods pilot study at least, participation was restricted to specialists. 'Ordinary citizens' were not involved. Also, because MCM requires detailed individual inputs, interaction tended to be one-to-one with the researchers rather than between participants with different views. Further research is needed to test whether the method will still work if (i) there is more participant-to-participant interaction; and (ii) 'ordinary citizens' are involved (Stirling and Mayer, 1999, p.54). Indeed, it will be interesting to compare the outputs of the specialists and citizens.[31] Stirling and Mayer (1999) recommend introducing a dimension of public participation by establishing a citizen's panel (or panels) to select additional options and assign weightings (indeed, the panel may also hire in specialists to help with the scoring).

While it is clear from the results of Stirling and Mayer's (1999) work that the participants gained a great deal from the use of MCM, both in terms of personal value clarification and learning about the assumptions of others, there is nevertheless a logistical issue which might affect how the method is used in future. Even with their limited sample of specialists, Stirling and Mayer found that only seven out of the twelve participants responded further once the preliminary results had been produced, and at the final meeting only six were able to attend

[31] Intuitively one might expect the outputs from specialists to be more complex, with a greater number of policy options being explored. However, research by one of the authors of this report (Gerald Midgley) indicates that 'ordinary citizens' are capable of producing highly sophisticated results (at least as competent as those generated by specialists) when they are supported by a facilitator using Ulrich's (1983) Critical Systems Heuristics (Cohen and Midgley, 1994; Midgley *et al*, 1997; Boyd *et al*, 1999; Midgley, 2000).

despite efforts to schedule it for maximum convenience. This suggests that the participants really have to be committed enough to *want* to spend the time engaging with MCM before its use is contemplated, and resources might be needed to 'buy' people's time. Certainly, in dealing with major controversies (such as GM foods, nuclear power, the use of non-renewable fuels, etc.), there are significant numbers of people who will want to learn from the MCM process, and organisations with the resources to pay for their involvement.

Political effects. In being open to wider perspectives, MCM may be said to be better than traditional procedures of risk assessment which are (wittingly or unwittingly) framed to marginalise certain ideas: for example, traditional methods tend to focus on the safety of just one option, thereby ignoring other possibilities. The approach here serves to highlight otherwise hidden concerns, both by exploring multiple options and (crucially) allowing the range of options to be determined by participants. It also might serve to highlight unanticipated areas of agreement as well as disagreement.[32] MCM is iterative and potentially open-ended, allowing for continual reappraisal and review.

The only caveat we would place on this observation of inclusiveness is the marginalisation of 'rights-based' or 'deontological' perspectives (already mentioned under the heading of 'multiple values'). MCM would therefore tend to favour businesses and liberal environmentalists over deep ecologists and fundamentalists.

Finally we should say that, like ISCAM, the approach does not attempt to usurp the role of the democratic political process as the ultimate arbiter of techno-scientific controversy. By representing a broad range of views and values, MCM can, and does, claim greater potential for informing democratic decision-making than scientific methods alone.

4.4 Reciprocal Outreach (with Participatory Rural Appraisal and Strategic Choice) Applied to Complex, Diverse and Risk-Prone Natural Environments

4.4.1 Historical Background

Since the early 1990s, participatory approaches (primarily problem structuring methods) for designing and implementing projects and programmes have been prominent as a means of facilitating initiatives in less-developed countries (e.g., in South Asia and Sub-Saharan Africa). They have been particularly useful in promoting natural resource management in what have been described as 'complex, diverse and risk-prone' (CDR) natural environments (e.g., ecosystems with poor and variable soil structure, subject to periodic drought).[33] At the forefront of these techniques is the internationally renowned set of tools known as *Participatory Rural Appraisal* (PRA), associated with the work of Robert Chambers (1992). PRA is an approach to information gathering and dissemination that comprises a set of primarily visual techniques (not dependent on literacy) designed to be user friendly for resource-poor communities in less developed countries. An underlying imperative, promoted particularly by Chambers, is that the techniques offer a source of 'empowerment' for the users.

Notwithstanding the widespread use of PRA and other problem structuring methods by non-governmental organisations (and even major development agencies like the World Bank and the UK government's own Department for International Development), there have been strong reservations expressed regarding their effects. They have been said to entrench existing power relations, both within local communities and, sometimes more significantly,

[32] For example, one of the results of Stirling and Mayer's (1999) research was the finding that, across a broad range of perspectives, the organic option performs very well.

[33] CDR agriculture is sometimes referred to as 'third' agriculture associated with poor quality land in less developed countries. 'First' agriculture refers to industrial farming in the North and plantations in the South. 'Second' agriculture refers to 'green revolution' agriculture in the relatively fertile lands of the South (using irrigation techniques and specially produced high yielding varieties of seed).

between communities and agencies working in the development 'industry' (see Reynolds, 1998, for references and a more detailed discussion).

These critiques were of particular concern when, in August 1997, an inaugural conference established the Centre for Applied Development Studies (CADS) under the directorship of John Friend at the University of Lincolnshire and Humberside. During the proceedings, a review was undertaken of the World Bank's 1996 guidance on participatory methods, and some effort was put into conceptualising how OR might provide assistance in addressing some of the weaknesses of participatory environmental development projects.

Reciprocal Outreach began to be developed (Friend, 1998), drawing not only on Friend's knowledge of development, but also on his experiences of working with local authority planners and community groups in Europe. A statement of intent regarding Reciprocal Outreach is worth quoting verbatim:

> "The introduction of interactive methods from the management sciences offers the potential to add significant value to the range of participatory development methods already used in managing international development projects. This potential lies primarily in the use of visual methods for modelling patterns of relationships among decisions, uncertainties and systemic interactions. Such methods can provide people in host communities with means to reach out towards empowerment through fuller appreciation of, and influence over, the various external forces that combine to exercise most influence over their future lives" (ibid. p.14).

The underlying idea is to offer those involved with participatory projects, and in particular those representing the resource-poor intended beneficiaries, supplementary tools for gaining an appreciation of the wider structural forces which can impact both positively and negatively on the participatory projects being undertaken. While participatory tools can help development agencies appreciate the complexities of rural livelihoods, it was suggested that similar tools should be available for rural communities and front-line project managers so that they can gain insights into the external factors that might help or hinder development.

Unlike ISCAM and MCM (discussed earlier), Reciprocal Outreach remains largely a methodological idea and has not been codified into a set of specific methods. It has mostly been applied retrospectively to understand past experiences, and has not yet been widely tested in the field. Nevertheless, workshops have been facilitated in less-developed countries to explore the potential of the approach. At the CADS inaugural conference, representatives from Kenya, Congo, Tanzania, Zambia and South Africa formed an action plan for continental collaboration to introduce flexible OR methods into participatory development. Visits to Africa by representatives from CADS in 1998 and 1999 consolidated these efforts: firstly by providing assistance to the Siyabuswa Educational Improvement and Development Trust in South Africa;[34] and secondly by supporting HIV/AIDS organisations in Kenya who wanted to strengthen their networks and contribute to the work of the international non-governmental organisation, ActionAid, in their efforts to provide programmes of support to other non-governmental organisations throughout Africa.[35] In both cases, Reciprocal Outreach succeeded in strengthening civic organisations so that they could more effectively monitor and influence public policy and practice. The potential for initiating similar developments in civic organisations concerned with community natural resource management is, we believe, highly significant. Hence, we are presenting Reciprocal Outreach as our third example of good OR practice despite the fact that it has not yet been applied in environmental planning and management.

Because it is a methodological idea, not a set of methods, Reciprocal Outreach requires the OR practitioner to use methods from other methodological sources in support of it. Below,

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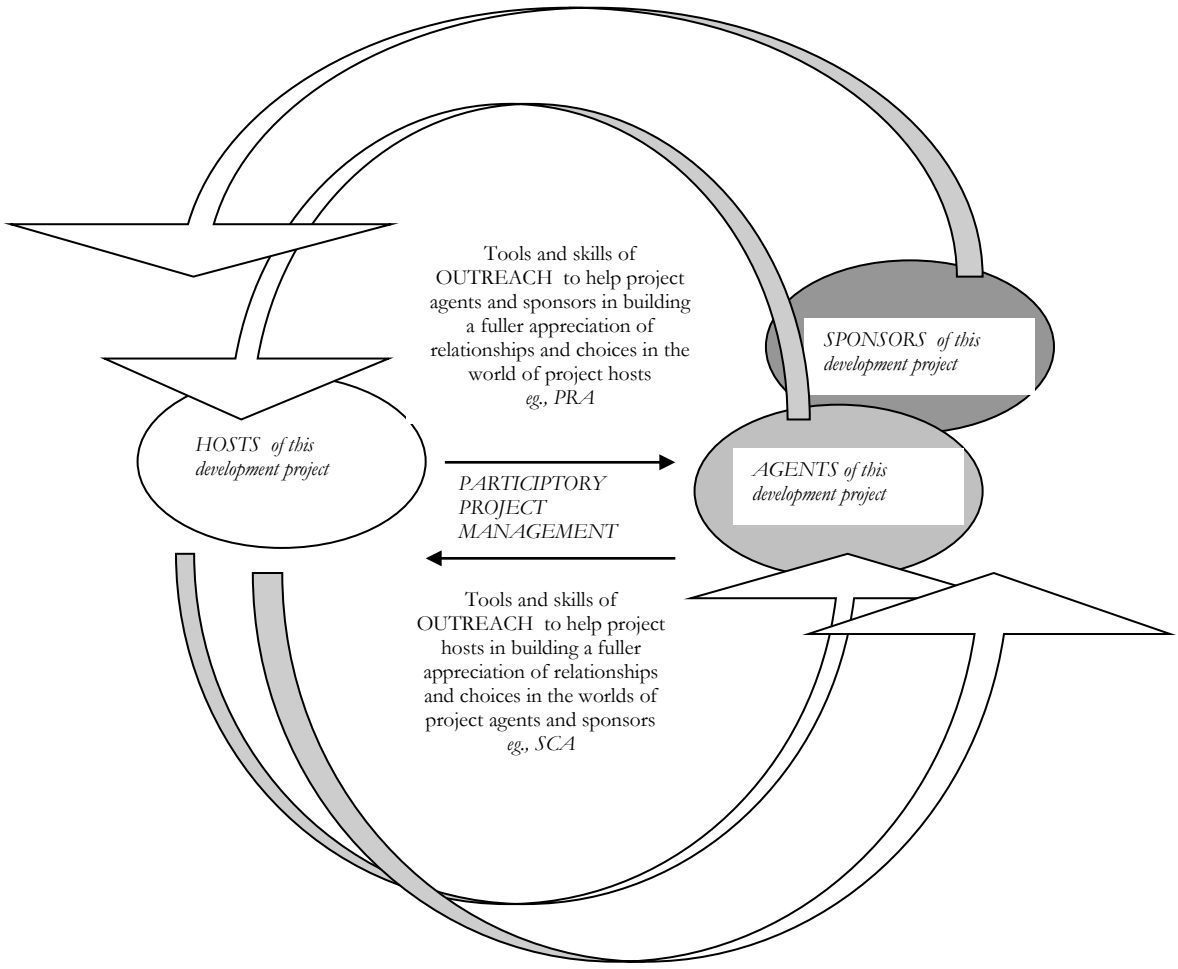
[34] *Global Lincs: The Newsletter of the Centre for Applied Development Studies*, Issue 2, February 1999.
[35] *Global Lincs: The Newsletter of the Centre for Applied Development Studies*, Issue 3, September 2000.

when we present Reciprocal Outreach, we will describe it in relation to two other approaches, each of which embodies a set of methods: Participatory Rural Appraisal (PRA) (Chambers, 1992) and Strategic Choice (Friend & Hickling, 1997). [36]

4.4.2 Reciprocal Outreach (with PRA and Strategic Choice)

Reciprocal Outreach offers a systemic approach to the management of international development projects and programmes. A model is used to illustrate three sets of stakeholders who need to be considered when identifying problems and appropriate courses of action: *hosts* (usually a region or regions in a less developed country), *agents* and *sponsors*. See Figure 4.3 for details.

Figure 4.3: Reciprocal Outreach
(*Global Lincs: the Newsletter of the Centre for Applied Development Studies* Issue 2, February 1999)



[36] Actually, Strategic Choice is also a pluralistic methodology, in the sense that it allows one to draw upon any methods that might be helpful in a local situation. However, Friend and Hickling (1987) do present a set of methods that they have found useful, even though Strategic Choice is not limited to these.

Reciprocal Outreach distinguishes between *programmes* of development, with clearly defined ownership and a degree of stability over time, and finite development *projects*, which are negotiated among parties with differing programmatic interests. Also, drawing on earlier work with colleagues from the Tavistock Institute, Friend *et al* (1998) further distinguish between influences of *institutional* programmes (which are focused on particular organisations or parts of organisations, contributing towards their adaptability in changing environments); *disciplinary* programmes (relating to the development of professional or scientific disciplines and related codes of practice); and *personal* programmes (relating to the career paths and aspirations of individuals, subject to change over time). The influences of these programmes intertwine within and between host, sponsor and agent domains (ibid. p.23, Attachment 3). The model prompts questions regarding the peculiar influences of different programme strands on the viability and effectiveness of the 'negotiated' development project.

Although it is now widely accepted that development projects are more likely to succeed if sponsors and agents have tools to gain a greater understanding of their local hosts, Reciprocal Outreach also recognises the importance of the hosts themselves developing and/or using tools to appreciate the complex worlds of the external sponsors and agents. Below, PRA and Strategic Choice are given as examples of tools that can be used for this purpose.

Participatory Rural Appraisal (PRA). PRA itself, with its constituent tools of village and institutional mapping, debating and participative design (Table 4.1), closely resembles Soft Systems Methodology (Checkland, 1981). Indeed the precursor to PRA, Rapid Rural Appraisal (RRA), has a strong tradition of links with soft systems thinking and systems practice—in particular, through the qualitative techniques of 'farming systems research' in America, and Agroecosystems Analysis in the UK (Kaen, 1987).

The PRA methods consist of a range of relatively simple analytical tools used for exploring the complexity of rural livelihoods. We have presented Chambers's (1997) categorisation of the visual tools in Table 4.2.

Table 4.1: Methods used in Participatory Rural Appraisal
(Cornwall *et al*, cited in Scoones and Thompson, 1994, p.109)

Visualised Analyses	**Interviewing**	**Group and Team Dynamics**
• Participatory mapping and modelling • Aerial photograph analyses • Seasonal calendars • Daily activity profiles • Historical profiles and trend analyses • Timelines and chronologies • Matrix scoring • Preference ranking • Venn and network diagramming • Systems and flow diagrams • Pie diagrams	• Semi-structured interviewing • Transect and group walks • Wealth ranking • Focus group interviews • Ethnohistories • Futures possible	• Team Contracts • Buzz sessions and reviews • Rapid report writing • Do-it-yourself (taking part in local activities) • Villager and shared presentations • Self-corrected notes and diaries

Table 4.2: Categories of Visual Tools Associated with PRA
(Chambers, 1997)

Spatial:	mapping and modelling (maps on ground, paper, chalk, pens, symbols)
Nominal:	collecting, naming, listing (collections, symbols, lists)
Temporal:	sequencing (ground, paper, cards, symbols)
Ordinal:	sorting, comparing, ranking (cards, symbols, matrices)
Numerical:	counting, estimating comparing, scoring (seeds, stones, matrices)
Relational:	linking, relating (Venn diagrams, cards, symbols)

A PRA event usually lasts between 7 to 10 days.[37] Typically, a daily format consists of:

(i) Early morning sessions where facilitators instruct participants on the use of particular tools being employed for the day;

(ii) Engagement of the participants with the tools;

(iii) Recording of outputs by the facilitators;

(iv) Afternoon evaluation sessions based on a dialogue between the facilitators and participants; and

(v) 'Recap' sessions at the outset of the following day where facilitators re-present participants' outputs before providing instruction on the use of further tools.

The last few days of a PRA event is focused on collectively:

(i) Synthesising data using the recap outputs from previous sessions (e.g., by highlighting 'problems' and 'causes' or making 'problem trees' on large charts, etc.);

(ii) Ranking problems and opportunities (e.g., using 'pairwise' or 'preference' ranking, etc.); and

(iii) The preparation of a community (or village) action plan. This will have more precise details regarding how each item is to be implemented, with some indication of the timescale; who might be best positioned to carry out each of the tasks prioritised in the ranking of opportunities; and what resources might be accessed in order to carry out the different activities.

It should be clear from this description of the PRA methods and process that a PRA event (especially in the latter stages) can easily be focused on helping members of the community to appreciate the complex realities of donors and development agencies (required by Reciprocal Outreach) as well as the complexities of their own lives.

Strategic Choice. While PRA focuses attention on complexities in the local context, and in relationships with others, in order to formulate an action plan, Strategic Choice is more explicitly concerned with *uncertainties* in decision making, and it asks people to explore the consequences of making different choices in relation to such uncertainties. Three kinds of

[37] The notes that follow come from the experiences of one of the authors (Martin Reynolds) when observing a PRA exercise in Lentsweletau, Botswana in 1997-1998.

uncertainty are identified, relating to the working environment[38] (UE), values (UV) and related agendas (UR) (Friend and Hickling, 1997):

- **UE:** uncertainties regarding the working environment call for investment in further investigations (e.g., through surveys, experiments, analyses, costings, technical studies, etc.);

- **UV:** uncertainties regarding competing values call for investment in consultations and/or negotiations with powerful policy-makers, representatives of important interests, and (ideally) marginalised stakeholders; and

- **UR:** uncertainties regarding other issues in 'related' agendas (to be decided elsewhere at some point in the future) call for investment in dialogue, co-ordination or joint planning with other parties (with anticipated different organisational or political allegiances).

There are four iterative modes of activity associated with Strategic Choice which take place in action-orientated workshops. Each mode takes account of the three levels of uncertainty:

1 The *shaping* mode for formulating the problem situation. The techniques used here include formulating: (i) *decision areas* with sets of questions needing to be addressed; (ii) *decision links* between areas (these can be subjective and often tenuous); and finally (iii) *decision graphs*, which are essentially conceptual models (maps) of the decision areas and the links between them;

2 The *designing* mode for exploring possible courses of action. The technique used here is known as Analysis of Interconnected Decision Areas (AIDA), which leads to the provision of a set of mutually exclusive options in the form of 'decision trees' (derived from classical Decision Analysis);

3 The *comparing* mode for exploring the possible consequences of choice. The technique here surfaces the three sets of uncertainties mentioned above, and makes a shortlist of comparison areas; and

4 The *choosing* mode, which asks people to keep an eye on the future when exercising choice.

In managing development programmes and projects, some of the most significant areas of uncertainty and choice may relate to organisations and things that lie outside the immediate domain of the host (Figure 4.3), making Strategic Choice an appropriate vehicle for operationalising Reciprocal Outreach. The efforts of community members might be channelled into further investigations of environmental uncertainties (UE); negotiations with other significant decision-makers (e.g., donors and development agencies) when there are uncertainties surrounding values (UV); and/or co-ordination of activities and the mobilisation of political influence through formal and informal channels to deal with uncertainties surrounding related agendas (UR).

4.4.3 Evaluation of Reciprocal Outreach

Using the three categories of complexity and uncertainty, multiple values and political effects, we evaluate Reciprocal Outreach as follows:

[38] The term 'environment' is used by Friend and Hickling (1987) in the systems theory sense, meaning whatever lies outside the system of concern that the system interacts with. It is not used to refer to a purely 'natural' environment, although elements of the natural environment are obviously going to be part of the working environment of the system of concern.

Complexity and uncertainty. Reciprocal Outreach provides a useful systemic approach to the management of complex international development initiatives, including those dealing with ecological and sustainability questions. The three domains of *host, sponsor* and *agent* are inevitably an over-simplification, particularly in the context of 'participatory' projects where considerable overlap exists. Nevertheless, there remains significant conceptual currency in prompting questions regarding the relationships between different 'host' stakeholders; the types of expertise being drawn upon by 'agents'; and the control being exercised over resources by 'sponsors'. Surfacing such issues, along with 'programmatic' influences on project management, enables increased understandings to be generated of complex relationships, and helps make everyone mutually accountable for their actions.

In addition, PRA and Strategic Choice, as leading candidates to provide methods to operationalise Reciprocal Outreach, share four positive features relevant to dealing with issues of complexity and uncertainty in environmental management:

- Both PRA and Strategic Choice explicitly address complexity: the former in the immediate host domain, and the latter in the host, agent and sponsor domains. Whereas PRA strives to disentangle the complexities of specifically located rural livelihoods in relation to boundaries of the natural environment, Strategic Choice is concerned with identifying and addressing uncertainties associated with decision making;

- Both approaches are founded upon principles of participation. The involvement of stakeholders in PRA events and Strategic Choice workshops improves understanding and appreciation of both complexities and uncertainties, as insights can be shared between people with different knowledge and experience;

- Both approaches depend strongly on *visual* means of conveying information, whether in the form of village maps drawn in the sand or decision graphs produced in workshops. In other words, attention is paid to both the non-linear capture of information (addressing complexity) and improving the transparency of the presentation of information (thereby alleviating the uncertainty that can be associated with information presented in a form that is alien to participants in planning); and

- Both approaches are founded on the principle of 'incrementalism': that is, they seek to offer practical ways of taking small (incremental) steps towards improvement. They are not rooted in the academic world of social theory, but have emerged from long periods of practical engagement and observation.

Some possible shortcomings can be highlighted, however. First, questions might be raised regarding the capacity of Reciprocal Outreach to fully address the complexity of issues *within* the host domain when PRA methods are used. Although PRA events support people in viewing their livelihoods in relation to boundaries of the natural environment, there is usually an imperative to produce an action plan within a limited period of time. Therefore, many important issues can be brushed aside in order to meet deadlines. Although the speed with which a PRA event produces results is one of the attractive aspects of the methodology (in the eyes of many commissioners), it must be asked whether on-going learning is being sacrificed in the process. A useful comparison can be made here with Checkland and Scholes's (1990) Soft Systems Methodology (SSM): Checkland and Scholes view the ideal application of SSM as one where the problem structuring language becomes an integral part of people's debates—there does not have to be a defined end point to an SSM intervention. Checkland and Scholes (1990) emphasise the particular value of on-going learning for dealing with complexity. Of course, the answer to this criticism is for practitioners of Reciprocal Outreach to cast their net a little wider and draw in ideas from other methodologies (like SSM, for instance) to complement those from PRA.

Another issue is that, although visual methods provide 'transparency', there is a risk of accepting people's representations at face value rather than using them as the basis for further interrogation. The time constraints inherent in PRA make this a particularly acute concern. In contrast with PRA, there is nothing in Reciprocal Outreach or Strategic Choice to *prevent* deeper analysis, but neither is there a *requirement* to probe further (as there is in MCM, for example).

Multiple values. There are some important distinctions in Reciprocal Outreach that enable people to differentiate a variety of potential stakeholder agendas, and therefore potential value conflicts: there are distinctions between 'hosts', 'agents' and 'sponsors'; 'project' and 'programme' imperatives; and 'institutional', 'discipline' and 'personal' programmes. This kind of language enables a subtle differentiation of interests and values that takes people beyond superficial analyses which ascribe homogeneous values and/or motives to whole communities and/or organisations.

Importantly, Reciprocal Outreach is also founded on the idea of the *mutual appreciation* of the complex realities and values of others, and the fostering of dialogue and purposeful interaction between stakeholders—which requires the empowerment of those traditionally on the receiving end of the actions of others. Problem structuring methods and some simple quantitative techniques are the means for this empowerment. This is an advance on some other problem structuring methodologies which tend to be oriented towards consensus and/or accommodation (Jackson, 1982) rather than mutual understanding and purposeful interaction.[39]

However, there is a risk inherent in the incrementalist philosophy of Reciprocal Outreach. This risk is *relativism*—tolerance of questionable values simply because to challenge them appears to be a radical imposition on a local culture (i.e., a successful challenge would represent non-incremental change). A good example is when the norm in a local context is the exclusion of women from participation in planning. We would argue that, in this case, if incrementalism means accepting the value of discrimination against women, then it contradicts the principle of participation and should be open to question.

Political effects. Reciprocal Outreach is explicitly designed to redress a political imbalance commonly perceived in international development interventions. The intention of development is generally to benefit local host communities, especially the poor, whilst at the same time taking account of future generations and non-human nature. However, all too often it is perceived that those who primarily benefit are the development planners, managers and workers. Of course this is a sweeping generalisation, but it is nevertheless the case that a paradigm shift has taken place in the last fifteen years, with the emphasis moving from interventions planned outside local communities and imposed on them, to interventions planned in consultation with local people. The work of Chambers (1992) has been influential in this paradigm shift, and we see Reciprocal Outreach as a step further along the same road: it is designed to empower local communities to take account of, and actively engage with, agencies and donor organisations instead of taking their agendas for granted.

Power imbalances are explicitly recognised in Reciprocal Outreach as being particularly problematic in the world of international sustainable development initiatives. There are two significant points to be made here. First, in common with some other methodological approaches,[40] there is a recognition that forces of coercion *do* exist. Reciprocal Outreach

[39] Here there is a similarity between Reciprocal Outreach and Critical Systems Thinking (CST)—particularly the works of Gregory (1992) and Flood and Romm (1996b) which also promote mutual understanding and purposeful interaction. In our view, there is substantial scope for learning between methodologists operating from these two perspectives.

[40] See, for example, Ulrich (1983), Flood and Jackson (1991a), Jackson (1991), Mansell (1991), Flood and Romm (1996b) and Midgley (1997).

does not promote the rhetoric of 'partnerships' and 'new consensus' associated with leading development agencies like the World Bank: in our view, this rhetoric tends to hide coercion and thereby it becomes more difficult to address. Secondly, the OR methods offered to local people "can serve as an operational means by which questions about hidden power structures can be brought to a project agenda" (Friend, 1998, p.15).

Nevertheless, in terms of addressing political effects, the 'incrementalism' of Reciprocal Outreach could be problematic. We have already seen that incrementalism can be associated with relativism (see the earlier section on multiple values). However, it might also encourage people to make small adjustments when quite substantial changes are actually needed to make a meaningful difference. We are reminded of Freire's (1972) observation that even the words used in less-developed rural communities to describe people's everyday realities tend to support existing relations of power. In Freire's view, it is the task of a development methodology to support people in questioning the meanings they live with on a day-to-day basis. The idea is not to replace these with another set of pre-defined meanings (e.g., originating from Marxist ideology), but to empower local communities to define meanings *for themselves*. This is certainly in line with the general spirit of Reciprocal Outreach, but may be impeded by an over-concentration on incremental change to the exclusion of deeper analyses leading to more far-reaching transformations.

4.5 Conclusions

Each of the three case studies presented in this chapter share five common features:

1 They each address issues of environmental concern, but significantly they define the issues broadly to encompass social and economic aspects;

2 They are all explicitly examples of OR;

3 They each draw upon multiple methods, either used side by side as part of a wider methodological practice (ISCAM and Reciprocal Outreach) or synthesised into a new method (MCM);

4 The application of each approach, though exciting, remains limited in practice. An important aspect of an agenda for developing OR must be to promote the potential of such initiatives to a wider audience; and

5. Each application involved public, business and third sector representatives and/or organisations.

There is, however, a clear orientation towards particular sectors within each case-study. ISCAM provides a framework particularly suited for public-led, intersectoral urban development where issues of complexity are at the fore. MCM provides a useful means for the business sector to not only make transparent conflicting values surrounding technological innovations with potential environmental effects (so they can make more responsive decisions), but to work towards compromises in future strategic developments. Finally, Reciprocal outreach specifically addresses the concerns of those normally affected by plans and designs (but who are not normally involved in planning as equal partners) by providing means for making visible the wider structural constraints and opportunities for meaningful engagement.

Whilst each approach offers exciting potential for future use, there are questions concerning their development and visibility. As a minimum, it seems to us that an agenda for developing OR must:

(i) Identify ways to make good OR practice more visible to environmental planners, thereby raising its profile;

(ii) Specify further research to minimise the current shortcomings of OR methodology and practice; and

(iii) Identify what other disciplines and sectors OR practitioners can usefully learn from.

In the next chapter we present the results from the workshops and mini-conference held with OR practitioners to engage them in developing the agenda. They not only addressed the three points above, but much more besides.

Chapter 5:
Developing the Agenda for Operational Research

Notes on Supplementary Material

- The methods used in the regional workshops and final mini-conference are detailed in Chapter 1 (sections 1.7 and 1.8). An evaluation of these events can also be found in Chapter 1 (section 1.10). This chapter presents some very brief details of our process of application of the methods, but the main focus is on the *outputs* from the workshops and mini-conference.
- Section 5.2 (below) is a revised version of a section presented originally in our Workshops Report.
- Appendix 4 presents the Critical Systems Heuristics (Ulrich, 1983) questions used during the regional workshops.
- Appendix 6 summarises the outputs from the two regional workshops used as a launch for the mini-conference.

5.1 Overview

The regional workshops and final mini-conference were designed to address aims 3-5 of the project (see Chapter 1, section 1.2, for all the aims):

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.

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

5. 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.

As discussed in Chapter 1 (section 1.4), we drew upon aspects of three problem structuring methods in our design of the workshops and mini-conference: Critical Systems Heuristics (Ulrich, 1983), Interactive Planning (Ackoff, 1981) and Soft Systems Methodology (Checkland, 1981). These were synergised using 'creative design' principles from Critical Systems Thinking (Midgley, 2000).

Some time was set aside at the beginning of the two regional workshops to discuss the findings presented in the interim report (a revised version of which now constitutes Chapter 3 of this document). Discussion points are recorded in section 5.2 (below).

The two regional workshops, kick-started by these discussions of the interim report, provided spaces in which people could explore and better define 'the problem situation' regarding OR support for environmental planning and management (section 5.3).

In these workshops, people also began to define the agendas for development that would be needed (at this stage, in very broad, ideal terms). The outputs from the two regional workshops were then assimilated at the beginning of the final mini-conference into three coherent sub-agendas (section 5.4).

These were then conceptually modelled as a way of identifying activities needed to fulfil the objectives defined in each agenda (sections 5.5 to 5.7). A 'whole system model' was also

designed to illustrate the relationships between the three sub-agendas, thus enabling us to gain a picture of the total agenda for developing OR and its interactions with other stakeholders (section 5.8).

5.2 Matters Arising from the Interim Report

5.2.1 Experts and Expertise

Amongst the interest groups identified in the interim report, professional experts were deliberately separated from the other stakeholder groups (the public, business and third sectors), despite clear overlaps in the real world (see Figure 3.1 in Chapter 3). We argued in that report that this conceptual separation was fundamental in marking the boundaries of OR support, and it would allow us to move forward to identify attributes of a purposeful OR agenda.

However, people at both regional workshops registered some degree of discomfort with the term 'expert'. Although they acknowledged the need to separate out such an interest group, they felt it was also important to define what constitutes an 'expert' more precisely to avoid it being seen either as a catch-all term (who is not an expert in some way?) or being laden with pejorative connotations. 'Specialist' was offered as a possible alternative to the connotations of arrogance associated with the term 'expert'. However, we felt it was important to retain 'expert' since it raises useful and necessary (albeit awkward) questions. When one person has knowledge or skills that others need, power issues can arise which we believe should not be hidden—if these *are* hidden, the risk is that the OR professional will not be held accountable for his or her actions.[41]

It seems appropriate to define expertise not just in disciplinary terms, but also using interdisciplinary and transdisciplinary criteria. In reinforcing this point, it was helpfully suggested that a feedback loop from professional expertise to environmental problems be included on the original information flow diagram (Figure 3.1)! Distinguishing 'expertise' from 'experts' was considered to be a useful way to defuse (by depersonification) the pejorative connotations of the term 'expert'.

5.2.2 Levels of Planning

Whilst acknowledging the usefulness of having 3 levels of planning (ideal, objectives and goal/means planning) proposed in the report (see Chapter 3, Figure 3.1), a fourth level—*incremental planning*—was suggested as being relevant by one workshop participant, particularly in relation to the activities of non-governmental organisations in the UK. Incremental planning is when progress is made through small, achievable steps without necessarily being informed by a grand ideal. It was argued that third sector organisations often take the role of "animateur" or "broker", and act as a "catalyst" for change. These were all words that this person viewed as important, but which did not appear in the interim report. We felt it important to acknowledge this 'bottom-up' principle in terms of there (hopefully) being continued *iteration* and revision of ideals, objectives and goals/means during implementation, as people need to respond to unexpected obstacles and opportunities. However, we were uncomfortable (and the participant agreed) about any suggestion that incremental planning should *take the place* of the other sorts of planning: this would basically reduce planning to mere opportunism, leaving no space for reflection on ethics or the reasons why people might want to do what they are doing.

[41] We found it necessary to adjust the Critical Systems Heuristics (CSH) questions between the London and Sheffield workshops, partly to make clearer the understanding of 'experts' that we were working with.

5.2.3 Issue Categories

As we have seen (Chapters 2 and 3), three recurring, generic environmental issues were identified: (i) complexity and uncertainty; (ii) multiple values; and (iii) political effects. In the interim report we argued (as we did in Chapter 3 of this document) that each stakeholder group can be shown to have concerns in each of these three issue categories.

It was suggested at the workshops that the three issue categories were not only relevant to environmental planning and management, but could also be useful in understanding any other major sphere of application where there are multiple, interacting stakeholders (e.g., health or education). It was also usefully suggested that a defining feature of environmental management—different from education, health, etc.—is that 'lay knowledge' regarding environmental issues is of great importance. The idea is that the 'true' expertise lies with ordinary people in the campaigning organisations, not with (for example) academics who have studied global weather patterns but do not appreciate the systemic connections with other issues.

However, two objections were raised against this. First, some people argued that it is *exactly the same* in health, education, etc.: there are continuing arguments about what constitutes expertise, with patients and pupils claiming to have unique knowledge that should not be ignored. The only difference, arguably, is that the practice of consultation and participation is further advanced in environmental planning and management than in these other areas, making 'lay expertise' more visible.

The second objection to simply taking the label 'expert' from one person (in our research, the OR practitioner) and giving it to another (the lay participant in a third sector group) is that this hides the fact that the OR practitioner *does* use knowledge and skills for which s/he should be made accountable. It might be argued that the third sector should also be made accountable, but our feeling is that treating the term 'expert' as a badge that can be pinned first to one shirt then another is really confusing 'expertise' with 'legitimation'. We agree that lay participants in the third sector have a *legitimate* role to play in environmental planning and management, but knowledge of OR techniques should still be recognised as *expertise* that can be used or abused.

5.2.4 Issue Prioritisation

In the interim report (also see Chapter 3 of this document) we argued that each stakeholder group can be shown to have concerns in each of the three issue categories. Nevertheless, each group has a *primary* interest. Issues of complexity and uncertainty dominate the public sector with attention focused on developing appropriate indicators for evaluation. Multiple (competing) values are the main concern in the business sector, with attention being paid to minimising risks through improving stakeholder interactions. Political issues dominate the third sector with concerns about widening the net of meaningful participation in planning processes. For each stakeholder group the two *secondary* issue categories tend to cluster around the primary issue category.

In discussions, several workshop participants highlighted the risk of aligning particular generic issues with particular stakeholder groups, thereby over-simplifying the 'real world' complexity of group/issue interaction. We accepted that there is indeed a risk that our analysis could be interpreted simplistically, and said that in the final report (Chapter 3) we would stress that all three stakeholder groups have to deal with all three issues—it's just that a different issue tends to dominate for each of the groups.

We were also questioned about which of the generic issues was dominant for OR practitioners as a separate stakeholder category. Thinking on the hoof, we suggested that, as

evidenced from the workshop discussions, the 'role of the expert' might be regarded as the primary issue category for many OR practitioners—not one of the three generic issues derived from our review of the literature on environmental planning and management. In retrospect, however, we are not sure whether the 'role of the expert' became such a strong theme in the workshops because this really *is* the primary issue for OR practitioners working in environmental management, or whether it came to prominence simply because our interim report highlighted the issue in a controversial manner.

5.2.5 The Range of Conflicting Interpretations

We pointed out in the interim report (and in Chapter 3) that the range of conflicting viewpoints regarding any particular issue can be mapped on a continuum between two opposing positions or extreme alternative interpretations (see Chapter 3, Table 3.1). These alternatives represent dilemmas that stakeholders might need to be aware of.

Some people registered surprise in the workshops at the depth and scope of conflicting values emerging from this analysis. Others suggested that there are actually *more* conflicts than those we highlighted, such as conflicts between macro and micro concerns, that our analytical framework did not reveal. On a similar note it was suggested that a key factor missing in the analytical framework concerned the 'victims' of planning: those vulnerable groups who are not represented despite the efforts of the third sector, but nevertheless bear the costs of planning. We actually felt that we had addressed this issue, but others obviously thought it had not been given a high enough profile. It was agreed that this was a concern needing constant reflection whenever OR support (or any other kind of expert support for that matter) is offered.

5.2.6 Application of the Framework to Substantive Issues

We suggested in the interim report (also see Chapter 3, section 3.6) that the framework of analysis, in which the stakeholder groups were cross-referenced with the generic issues, could be applied to help understand any substantive, complex environmental issue (pollution, energy, greenbelt development, global warming, waste disposal, transport, etc.). Whichever one is focused upon, the three generic issues are likely to be relevant, as are interpretations from the different stakeholders.

However, questions were raised in one of the workshops regarding the relevance of the analytical framework to different geographical contexts, especially developing countries, and different points of time in history. We had certainly not intended to suggest that the framework is universally applicable (in our view, no OR theory or method ever is), and we accept the point that in other geographical and temporal contexts the categorisation might not appear so relevant. Nevertheless, most of the workshop participants said that they saw it as a useful framework for understanding environmental problems from our own cultural perspective. This suggests the need for further research to test its utility in supporting the analysis of substantive environmental issues, and to explore the limits of its applicability.

5.2.7 Operational research

When talking about the interim report in the workshops, we were aware that there were a couple of participants who were relatively new to OR (having come to it recently from other disciplinary backgrounds, or in the case of one person simply through practical involvements in a series of OR projects). We therefore attempted to present an (inevitably incomplete) potted history of the last 50 years or so of OR practice. In bringing this up to the present day, we painted a picture of the OR community characterised by considerable heterogeneity in disciplinary roots, methodological approaches, values and application areas. However, we

stressed that the community does share a common concern for bridging the gap between *conceptualising* problem situations and *applying* models to structure and/or resolve those situations. Essentially, the common focus is on *intervention*.

Despite agreeing that intervention is a common focus, one workshop participant pointed out that, whether a problem structuring method or a quantitative technique is being used, OR is still a relatively *structured* form of intervention compared with, say, some variants of action research. There was general agreement that it is this structuring that differentiates OR from many other intervention practices.

Several people said that they acknowledged the variety and richness of what OR has to offer, but commented that this should simply be accepted, and should not lead us to get embroiled in, and distracted by, internal dilemmas regarding a perceived 'identity crisis' in OR. Rather, the focus should be on what is needed for environmental management, and what the implications of this are for our practice. This was certainly our own intended focus, which is why we had conducted the series of interviews with stakeholders and had written the interim report.

With regard to the variety of OR methods and practice, several readers of the interim report commented on the usefulness of the attached glossary of terms (Appendix 1 in this document) and suggested that this could be further developed in the future.

5.3 Workshop Deliberations

A large number of possible 'mission statements' were generated by individuals as a starting point for clarifying the ideal purposes that should be used as driving forces for an agenda. These were then grouped into themes, and new mission statements were generated to express each theme. The London group produced 5 mission statements this way, and the Sheffield group produced 3. See Table 5.1 for details.

Table 5.1: Workshop Mission Statements

Missions from London	Missions from Sheffield
1. Promote over-arching goal of sustainable development 2. Promote interaction between OR and environmental planning 3. Promote OR as a driving force for environmental management 4. Provide methodologies for conflict management and pluralism 5. Develop OR	1. Promote the better application of OR 2. Identify weaknesses and develop a more accessible OR 3. Promote public participation

In London, missions 2, 3 and 5 (all concerned with developing OR and its relationship with environmental management) were synthesised into a single mission statement. In Sheffield, missions 2 and 3 (concerned with the interface between OR and other people and disciplines) were selected for concurrent exploration (see Table 5.2). The other mission statements were dropped due to (i) time constraints, and (ii) they were judged by the participants to be either too general or too specific.

Table 5.2: Mission Statements Used for Further Exploration or Dropped

<table>
<tr><th>London mission explored:</th><th>Sheffield missions explored:</th></tr>
<tr><td rowspan="2">Missions 2 + 5 (+3) Develop OR (as a driving force?) and facilitate interaction between OR and environmental planning.</td><td>Mission 2: Identify weaknesses and develop a more accessible OR</td></tr>
<tr><td>Mission 3: Promote public participation</td></tr>
<tr><th>London missions left out:</th><th>Sheffield mission left out:</th></tr>
<tr><td>Mission 1: Promote over-arching sustainable development goals</td><td rowspan="2">Mission 1: Promote better application of OR</td></tr>
<tr><td>Mission 2: Provide methodologies for conflict management and pluralism</td></tr>
</table>

Each of the three mission statements were then explored using Ulrich's (1983) 12 Critical Systems Heuristics (CSH) questions (reproduced in Appendix 4). We worked solely in what Ulrich calls the "ought mode": what *should* be the parameters for an agenda. At this point we also introduced Ackoff's (1981) concept of *ideal planning*: while people's suggestions had to be technologically feasible, financially viable in the longer term, and adaptable (not creating a super-bureaucracy), no other constraints should be accepted. The responses to the questions are documented in Appendix 6.

The points below flag particular issues of concern or disagreement emerging from the workshops that people felt needed to be addressed during the final mini-conference to be held in Hull.[42] Our notes are organised with respect to the four themes that CSH addresses: purposes, control, expertise and legitimacy. This text has been adapted from our Workshops Report circulated prior to the mini-conference. Because by this time we knew that we were going to use aspects of Soft Systems Methodology (SSM) (Checkland and Scholes, 1990) in the mini-conference, we began to introduce some of the SSM terms (underlined below) to facilitate some synchronisation of terminology. Of course, it was not *just* these points of concern and disagreement that were taken forward to the mini-conference: the vast majority of ideas generated in the workshops (Appendix 6) had everybody's wholehearted support, and these were also brought forward as a basis upon which to plan in more detail.

5.3.1 Purposes

- Do the 3 mission statements explored in the workshops—(i) develop OR (as a driving force?) and facilitate interaction between OR and environmental planning, (ii) identify weaknesses and develop a more accessible OR, and (iii) promote public participation—encapsulate the ideals of a future agenda on which people want to work?

- Is talking about OR as a "driving force" for environmental management too imperialistic? Some people thought that this would be off-putting to those in

[42] All of these were brought forward to the mini-conference, but not all were explicitly addressed because other priorities emerged.

other disciplines whom we might wish to co-operate with. However, another group argued that to aspire to produce excellent practice that people would want to emulate is perfectly legitimate. It could also be that the other 2 mission statements (concerned with accessibility and public participation) would serve to temper any possible inclinations towards imperialism.

- In SSM, purposes are expressed as transformation processes.

5.3.2 Control

- There was some conceptual confusion amongst the participants in the workshops about the difference between the terms 'decision maker' and 'planner' as used in CSH, and we found we had to adjust our own use of language in between the London and Sheffield workshops to clarify matters.[43] For the purposes of the mini-conference, it was proposed that 'decision makers' should be the label given to those in *control* of resources (possibly including human resources like 'planners') deemed indispensable for implementing the agenda. Decision makers are therefore like Checkland's 'owners': if they choose to withdraw support, implementation cannot go ahead. Planners, on the other hand, are those who work out what needs to be done to get activities going. Of course, if planners withdraw support then this might well affect implementation too, but not necessarily in the same fundamental way as if the decision makers (owners) pull out. 'Planners' have the particular (professional and/or non-professional) expertise necessary to offer leadership in implementation. In SSM terminology, they are a sub-group of the actors (although, in a co-operative enterprise, it's possible for all the actors to participate in planning).

5.3.3 Expertise

- In our interim report we differentiated between three types of expertise: *technical/disciplinary* (knowledge of substantive subject areas), *facilitative* (tacit and explicit knowledge about fostering communication/interaction between different people and/or sectors) and *critical* (the ability to think about issues and values in different ways to support reflective practice). The participants at one of the workshops felt that these would be useful categories of OR support to relate to environmental management.

5.3.4 Legitimacy

- An imperative was identified in the workshops to distinguish clearly between those who should be 'involved' in pursuing an agenda and those who would be 'affected' by the activities of an agenda, but not be involved. It was suggested that the group could establish a shared worldview to underpin the agenda, but could also possibly explore alternative worldviews which might be in conflict with the one chosen. This way, the legitimacy of the chosen worldview could be tested.

5.4 Mini-Conference Deliberations

[43] One of the authors (Gerald Midgley) has used CSH in a variety of previous projects and has found that this is a very common area of confusion. Perhaps some new terminology is needed here.

The wealth of ideas generated at the workshops were not considered to be exhaustive, but they did provide a firm base on which to build further iterations of planning. They also provided some initial answers that addressed important 'real world' questions regarding how the ideals might be realised.

When it came to the mini-conference in Hull, we realised that there was considerable overlap between the mission statements explored in London and Sheffield. It would be important, when starting the mini-conference, to use the outputs from the workshops to create *discrete* purposes for the agenda.

Before the mini-conference, we put together a proposal for reframing the mission statements as three quasi-separate agendas which, taken together, would form the total agenda for promoting a more purposeful interaction between OR and environmental planning and management:

- **Agenda 1:** *Develop OR* (with a focus on methodological issues);
- **Agenda 2:** *Promote interaction* (with a focus on issues of inter-disciplinarity, intersectoral co-operation and pluralism); and
- **Agenda 3:** *Promote public participation* (with a focus on issues of accountability to the public).

We suggested that these three agendas should not be viewed as mutually exclusive, and can be thought of as a nested hierarchy: public participation is a special case of interaction, and the demands of interaction should have an impact on how OR is developed. Indeed, all three will influence each other if the agendas are pursued effectively: for example, not only will promoting interaction (including public participation) affect the development of OR, but the ways in which OR is developed may frame the forms of interaction and participation that are pursued.[44]

The conference participants were happy with this realignment, which they felt captured the essential aspects of the outputs from both previous workshops. Having secured an agreement, we passed around pre-prepared handouts documenting the outputs from the workshops (the answers to the CSH questions), realigned with each of the 3 new suggested agendas (Appendix 6). This handout not only differed from the original Workshops Report in terms of this realignment, but we also added in two of our own contributions:

- Two of the CSH questions (on expertise and values) were not addressed in the regional workshops due to time constraints. We provided our own answers to these, anticipating what the workshop participants might have said (although we made it clear that the participants were at liberty to dispense with our answers if they wished).
- The outputs from two of the 'expertise' questions were rephrased slightly to include references to the three types of expertise mentioned earlier (technical/disciplinary, facilitative and critical). It was suggested that this would be useful by the participants at one of the regional workshops (see section 5.3.3).

This information was used as the basis for starting to use some of the SSM methods. In our discussion of our methodology (Chapter 1, section 1.4), we explained the use of the CATWOE mnemonic, which was modified to BATWOVE ('customers' became 'beneficiaries', and 'victims' were added) to make it more relevant to environmental planning and management (see Chapter 1, section 1.8). To help the participants in constructing their

[44] It was further noted that the 3 realigned agendas might also incorporate mission statements previously left out of the original exploratory exercises undertaken in the 2 regional workshops.

BATWOVEs, we gave out copies of the Workshops Report with the relevant aspects highlighted for ease of reference. This meant that the participants were not having to elaborate the agendas from scratch once again, but could make relatively straight-forward connections with their Critical Systems Heuristics answers from the regional workshops. The only drawback to having pre-prepared this material was that we had not anticipated the move from CATWOE to BATWOVE, so the participants had to take the 'customers' information and differentiate it into points relevant to 'beneficiaries' and 'victims'.

Two separate groups worked on BATWOVEs for agendas 2 and 3 (promoting interaction and public participation). The groups then presented their ideas in plenary sessions, and their BATWOVEs were modified in the light of open discussion. The BATWOVE for agenda 1 (developing OR) was undertaken by the group as a whole after the other 2 agendas were agreed.

Participants then went back into their two smaller groups to produce conceptual models for agendas 2 and 3 (promoting interaction and public participation). These were again discussed and modified in plenary sessions. As with the BATWOVE for agenda 1, the agenda 1 conceptual model (developing OR) was produced by the whole group working together. See Chapter 1, section 1.8, for details of the method of conceptual modelling. It was suggested that participants should (i) concentrate only on the 'operating system' and save discussion of the 'monitoring and control' sub-system for a future meeting (because of time constraints), and (ii) identify at least one linking activity with each of the other 2 agendas.

The next three sections present the BATWOVEs and associated conceptual models. In addition, we have provided a very short narrative summary of the activities represented in the conceptual models, and have highlighted issues of feasibility regarding each of the three agendas that were discussed by the participants. Activities highlighted in bold in the conceptual models are those that the participants considered worth opening up at a higher level of resolution in order to map out further key activities. However, this was not done in the mini-conference due to time constraints.

After the three BATWOVEs and conceptual models, you will find a 'whole system model' (Gregory and Midgley, 2000) which shows how the three agendas relate to one another. This demonstrates that they fit together to produce a coherent whole. Ideally, the whole system model should have been produced by the participants at the mini-conference, but a shortage of time resulted in us designing it ourselves after the event. Nevertheless, the participants were able to provide feedback by mail, and there was no disagreement with it.

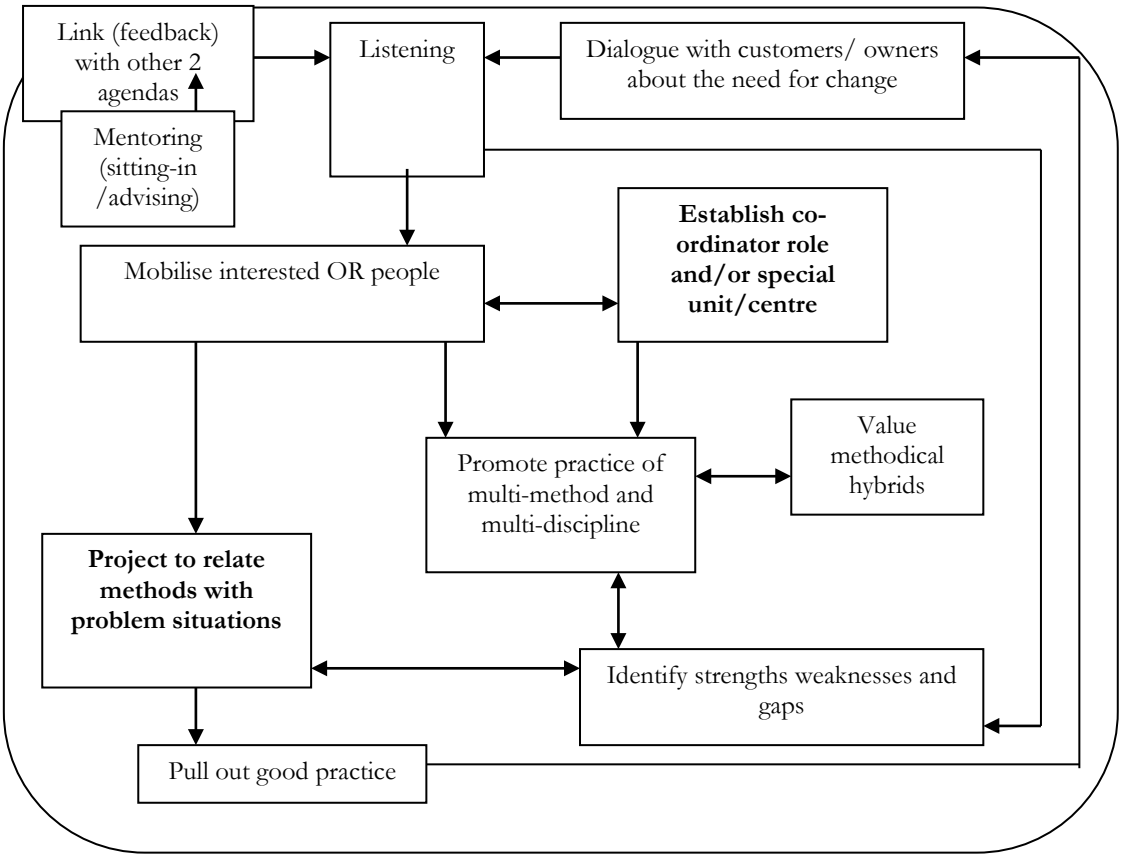
5.5 Agenda 1: Develop OR

For agenda 1 (*Develop OR*), the activities centre on establishing an on-going research project to relate methods with problem situations relevant to environmental management. The need for extensive testing of OR methods in case studies was stressed, as was the need to communicate the results of these tests to enhance the OR knowledge base for environmental management. Importantly, however, the idea of relating methods to problem contexts was not conceived as the production of a mechanical rule book for OR practice. Rather, it was seen as involving the *reconceptualisation* of OR as a reflective practice; questioning purposes (not taking purposes presented by clients as given); focusing on the big picture; involving multi-sectoral thinking; involving multiple agents in defining problems; drawing upon and mixing multiple methods; and embracing environmental issues alongside social ones.

The BATWOVE for this agenda is on the next page, and the conceptual model follows it (Figure 5.1).

Beneficiaries	*Ultimate Beneficiaries*: planet/everyone/future generations; people who are current victims of OR; people looking for a career that accords with their values. *Immediate Beneficiaries*: future OR practitioners; people currently marginalised from decision-making; environmental planners; other disciplines (including interdisciplinary and systems efforts).
Actors	OR practitioners/educators; front-line people aware of the issues; OR Society environmental study group, community OR, development OR, as a unified group with critical mass of activists; new research unit; interested people in other disciplines/practices.
Transformation	Small picture to big picture; unreflective to reflective practice; not questioning purposes to questioning purposes; geared to corporate thinking to geared to multi- sector thinking; problems defined by unitary clients to problems defined by multiple beneficiaries/agents; problems defined without environmental concern to problems defined with environmental concern; single method focus to multi-method focus.
World view	It's good to talk; need to develop OR contribution to a sustainable world; no easy solution to complex problems; the future maters; OR is useful in relation to a variety of world views.
Owner(s)	'Beneficiaries' and 'actors'; OR Society; Research Councils and other funders.
Victims	Entrenched/isolated experts/academics; unknown/unknowable victims (including other species); opportunity costs could produce victims (i.e. time/resources not spent on doing other things).
Environmental constraints	Funding bodies' priorities; entrenched/isolated experts/academics including other disciplines; entrenched sectoral divides.

Figure 5.1: Conceptual Model of 'Develop OR'



5.5.1 Problems of Feasibility

The following feasibility issues were discussed in relation to the agenda for developing OR:

- *Mobilise interested OR people*: two major constraints are (i) the lack of a critical mass of activists in the OR Society Environmental Study Group, and (ii) enormous time pressures on those people who *are* willing to get active in implementing this agenda. The group discussed the possibility of addressing these problems by amalgamating several currently dormant study groups with a focus on OR for social and environmental benefit to generate a critical mass. There was strong support for this, and since the mini-conference we have had conversations with the co-ordinators (or other prominent members) of five study groups who are in favour of taking this forward. Hiring a Co-ordinator and/or setting up a Research Unit will also give leadership to the work, which will be important in terms of motivating people to get involved and then stay active.

- *Dialogue with customers/owners about the need for change*: many businesses in particular are only likely to be motivated to deal with environmental issues if there are obvious economic benefits or regulative pressures from government. The question remains as to how, within a market economy in which shareholders expect short-term financial returns, businesses can maintain a focus on longer-term sustainability. There is clearly a need to demonstrate possibilities for financial returns on investments in environmental development.[45]

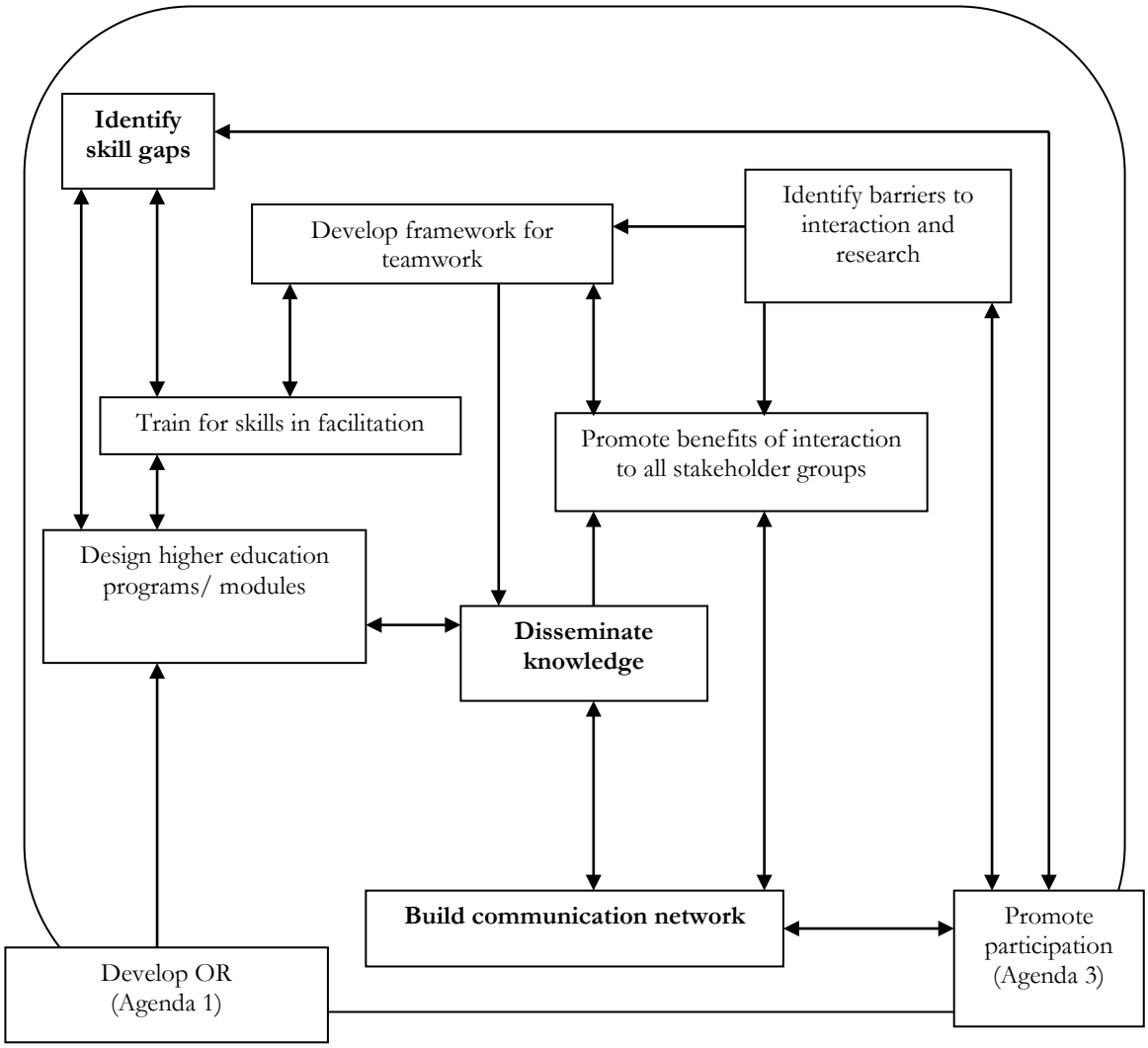
5.6 Agenda 2: Promote Interaction

In agenda 2 (*Promote Interaction*), the activities centre on developing 'skills', 'knowledge' and 'communication channels' (see Figure 5.2). Whilst the focus is mainly on important issues of interdisciplinarity, the agenda is also concerned with promoting intersectoral relationships. The transformation is seen to require OR to move from being a primarily 'backroom', problem-solving form of expertise to being a more pro-active discipline where raising awareness of issues amongst stakeholders and problem structuring are key activities. Also, it will require OR practitioners to be more outward looking and facilitative than is currently the norm.

[45] Certainly, Weizsäcker *et al* (1998) do us a great service here by providing many practical examples of how businesses can halve resource use and double wealth at the same time. However, even these authors admit that ultimately sustainability depends on a change in attitudes away from rampant consumerism.

Beneficiaries	*Ultimate:* inheritors of the environment. *Immediate:* inhabitants of the environment; experts.
Actors	OR practitioners; planners (authorities); public communities
Transformation	Backroom expertise to pro-active awareness generating problem structuring; inward looking to outward looking; technical orientation to interactive (facilitating) orientation
World view	Improved cohesion between expertise (including tacit knowledge) is required to enhance accountability and for ensuring better environmental transformations
Owner(s)	Funders; 'institutions'; planning fraternity; Operational Research Society; International Federation of OR Societies (IFORS)
Victims	Entrenched/isolated experts
Environmental constraints	Academia, especially disciplines; project pressures

Figure 5.2: Conceptual Model of 'Promote Interaction'



5.6.1 Problems of Feasibility

The following feasibility issues were discussed in relation to the agenda for promoting interaction:

- The activities are in part dependent on the success of agenda 1 (*Develop OR*), in that successful dialogues with other disciplines and sectors will require a much more outward looking and facilitative sort of OR.

- *Identify barriers to interaction and research* and *identify skill gaps* are time consuming activities, and therefore require considerable funding support.

- The funding schedule of the Operational Research Society (and possibly those of other organisations) means that much of the work is unlikely to start until the second half of 2001. It is important to keep the momentum going in the absence of any immediate financial input.

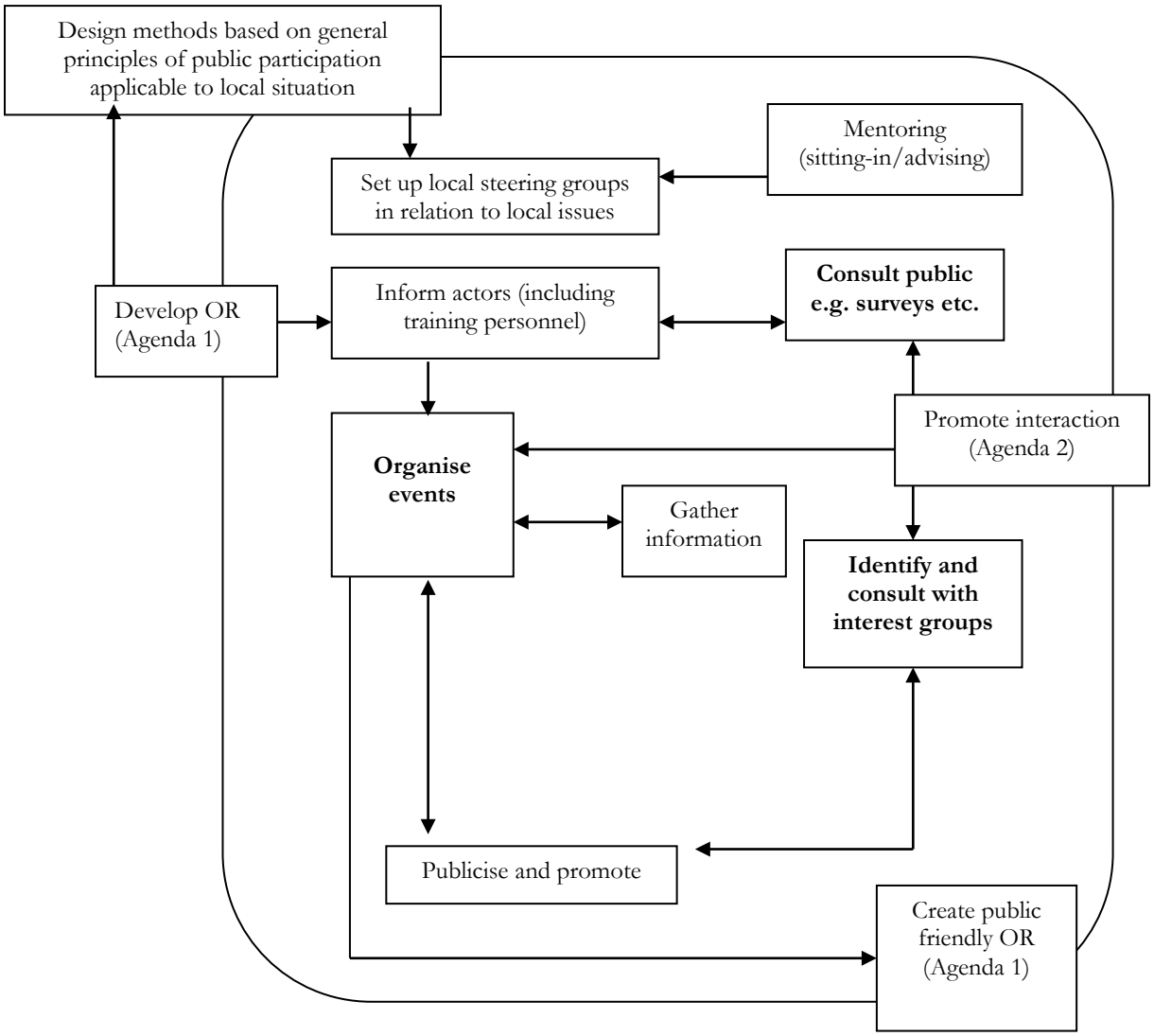
- More concrete evidence of the benefits of OR to environmental planning and management is needed in order to convince funding agencies of the case for support. This can be dealt with partly through the on-going research project (proposed as part of agenda 1), and partly by taking the work in Chapter 4 of this document one stage further and assembling more case studies. Papers can be written in plain English, for publication in environmental management journals, arguing the case for OR.

5.7 Agenda 3: Promote Public Participation

Agenda 3 (*Promote Public Participation*) recognises the difficulties of having a catch-all public participation remit: it is not realistic to try to engage 'the public' in improving OR in general. Rather, the emphasis needs to be on local participation in projects, taking care to differentiate between general public expressions of concern and special interest group involvements. The BATWOVE for this agenda is below, and the conceptual model is over the page (Figure 5.3).

Beneficiaries	The universe from this day on!
Actors	People involved in projects; OR practitioners; environmental planning community
Transformation	Current state of poor public involvement to level of participation which ensures justice, communication and information
World view	Greater participation promotes accountability and empowerment 'involving' stakeholders, and brings in more experience, expertise
Owner(s)	Beneficiaries ('the universe from this day on!')
Victims	(Potentially) the universe; jobs that might have been done (opportunity costs); people threatened by participation; accountants!
Environmental constraints	Destructive anti-democratic forces; willingness of public to engage (public deference to professional expert knowledge)

Figure 5.3: Conceptual Model of 'Promote Public Participation'



5.7.1 Problems of Feasibility

- One assumption that the group made is that it is not possible to conceive of a generic model for public participation that can be implemented without unanticipated local side effects. It is more realistic, and more in line with bottom-up/grassroots thinking, to think in terms of *methodological principles and guidelines* for participation that can be translated into methods in many different ways depending on the local circumstances.

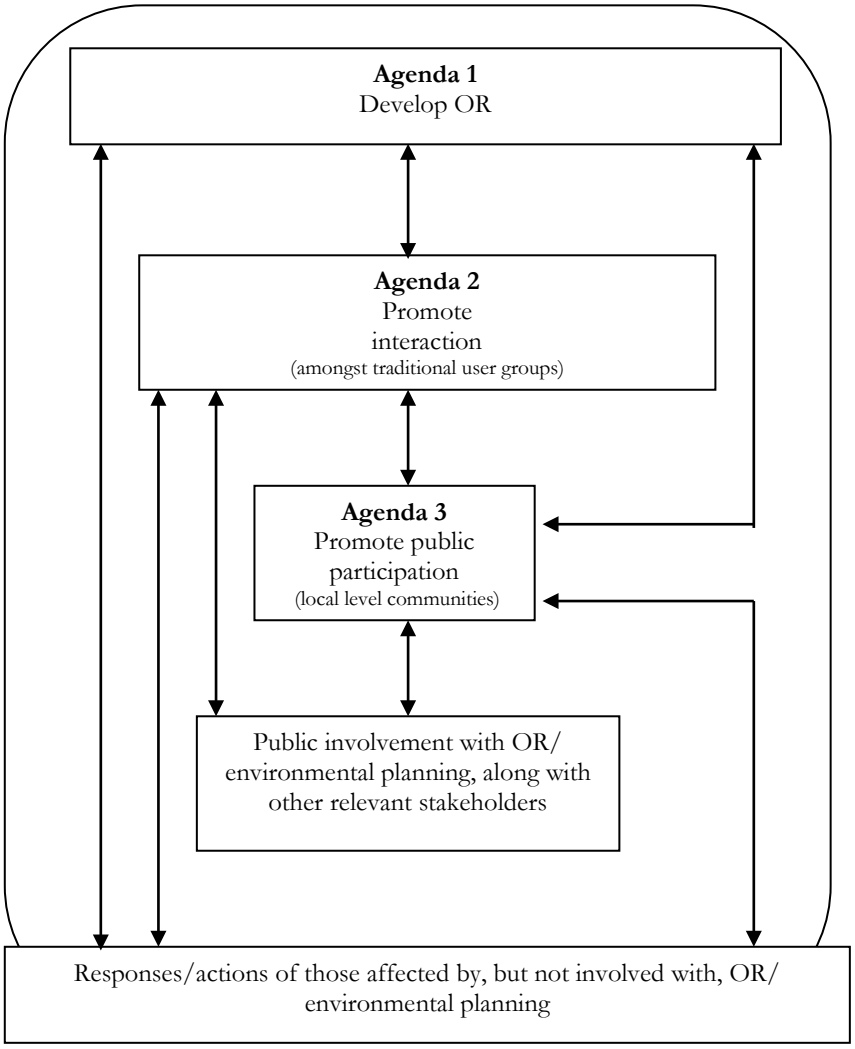
- Immediate benefits need to be apparent from the participation of the public in local projects, otherwise there is a danger of public scepticism and/or apathy regarding 'participatory' projects.

- Facilitative skills are needed to engage/promote public participation, suggesting that this agenda is in part dependent on the success of agenda 1 (*Develop OR*).

5.8 The Whole System Model

The three agendas are, of course, constituent parts of an overall strategy to improve future interaction between OR and environmental planning and management. This overall strategy is represented in the 'whole system model' below (Figure 5.4).

Figure 5.4: Whole System Model



Two important features of this whole system model can be highlighted:

- *Interconnectedness*. Each of the three agendas are mutually dependent (see also section 5.4). Methodological development, for example, needs to take place in the context of interactions with other disciplines and sectors, and should take account of the need for public participation. Similarly, public participation at the local level, and interactions with other disciplines and stakeholders, should benefit from methodological developments that increase the facilitative expertise of OR practitioners.

- *Boundary critique*. It is important to keep alive the idea that whatever planning is undertaken (in this case, planning an agenda for enhancing interactions between

OR and environmental management), there are always going to be people and issues outside the boundaries. Some people may *choose* to occupy a marginal position (perhaps because they are afraid of compromising their integrity), while others may be pushed into the margins against their will through unanticipated and/or unwanted side-effects of implementation. Therefore, monitoring of implementation is vital. As an aid to this, those who take the agenda forward may want to design the 'monitoring sub-systems' omitted from the conceptual models due to time constraints in the mini-conference.

5.9 Summary

In this chapter we have reported on the deliberations from two regional workshops and a mini-conference, all of which involved OR practitioners (based in public, private, third sector and academic organisations) in developing an agenda for enhancing interactions between OR and environmental planning and management. The regional workshops were designed to explore the parameters of a future agenda. Using methods drawn from Critical Systems Heuristics and Interactive Planning, a number of purposes in the form of 'mission statements' were defined.

The outputs from the regional workshops provided the basis for further explorations in the mini-conference. Three coherent sub-agendas were identified for further detailed work. Each of these sub-agendas—*Develop OR*, *Promote Interaction* and *Promote Public Participation*—were conceptually modelled using methods adapted from Soft Systems Methodology. This resulted in the identification of the key activities needed to fulfil the purposes defined for each sub-agenda, and the feasibility of these activities was explored.

In the next and final chapter we provide specific recommendations for action that were identified by participants in the mini-conference from reflections on the conceptual models and the discussions of feasibility. These recommendations have also been further elaborated following (i) feedback from participants on our Mini-Conference Report, and (ii) discussions with people active in some of the Operational Research Society study groups.

Chapter 6:
Conclusion and Recommendations

6.1 Introduction

In the final session of the mini-conference, participants engaged with the task of formulating recommendations. These were derived from reflections on the conceptual models and the discussions of feasibility reviewed in Chapter 5. Since the mini-conference, we have written up the outputs and received feedback from the participants. In addition, one of us (Martin Reynolds) presented the outputs at the Annual Conference of the Operational Research Society. Not only did this enable a wider range of operational research (OR) practitioners to provide feedback, but it also gave us the chance to test out the ideas for short-term action with key players in some of the study groups whose support will be necessary if the plans are to be implemented. As a result, some of the recommendations have been elaborated beyond the original mini-conference discussions.

Some of the recommendations, especially those designed to prepare the ground for future activities, are most relevant to the Operational Research Society, which is the obvious source of short-term charitable funding to take this work forward. However, other recommendations relate to how the ideas might be pursued by OR practitioners more generally once a critical mass of activists has been formed.

6.2 Recommendations to be considered by the OR Society

1 Recruit a short-term worker to kick-start the identified initiatives. A key responsibility of this worker should be to liase with several of the Operational Research Society study group co-ordinators who have expressed a desire to amalgamate their groups. There are a number of study groups with a focus on social improvement and/or sustainable development, but none enjoy a critical mass to sustain sufficient activities to thrive. Groups whose co-ordinators (or other prominent members) have expressed a desire to join a much larger group include Environment, Community OR, Development, Complex Systems, and Agriculture. Amalgamating these groups should bring together a critical mass of activists, making the new study group viable into the future. If it is considered appropriate, the worker might also liase with the Operational Research Society to seek the views of the ordinary membership of these study groups before any action is taken.

2 One of the actions proposed as part of agenda 1 (*Develop OR*) is to establish a longer-term co-ordinating function to give leadership, and to ensure that the agenda is taken forward. Ideally, this was envisaged as a Unit, preferably independent from existing institutions. This independence was seen as important because the Unit should not be viewed as having any vested interests (which it might be if it was attached to a pressure group or a business). Also, it is preferable for the Unit to be based outside the University sector (although academics could work with it), because its role should not be hampered by stereotypes of academia being projected onto it. Establishing this Unit as a viable enterprise will take substantial funding beyond the resources of the Operational Research Society: the lottery is a possible source of funding, but it is most likely that money will have to be brought together from a variety of sources. Therefore, an intensive period of fundraising is needed. The Operational Research Society could usefully support this by providing money for a one year period to cover the salary of a person with experience of applying for charitable funding. This person may eventually become Director of

the Unit, or may hand over the reigns to someone else depending on the circumstances.

3 The literature on the past OR contributions to environmental planning and management is large, but is scattered widely throughout a variety of journals. Also, four out of five applications published in the environmental management literature never mention OR, despite the fact that they are using OR methods. We have attempted to begin consolidating the field by presenting examples of good OR practice in environmental management that illustrate the diversity of relevant methodological approaches (see Chapter 4). Nevertheless, more is needed—especially to reach environmental management audiences who are not currently familiar with OR. As part of its next round of charitable funding, the Operational Research Society could consider providing a sum of money to an experienced academic who is able to present OR in an accessible manner to other disciplinary audiences. The money should be sufficient to buy out his or her teaching and administrative duties for a period of a year, enabling him/her to write a series of articles evaluating the substantial contributions that OR has already made to the field of environmental management. These should be directed, not only to new initiates in the field of OR, but also to readers of environmental planning journals.

6.3 Wider recommendations

4 It should be clear that interactions with people in other disciplines relevant to environmental planning and management, and with people in the three sectors (public, business and the third sector), will need to feed back to transform OR methodology. Therefore, agenda 1 in this report should be viewed as a *provisional* basis for action. It has been formulated by OR practitioners in the light of substantial dialogues between the researchers and user groups in the various sectors, but it should not be set in stone. Agenda 2 asks OR practitioners to engage in *on-going* dialogues with planners and managers as part of the development process, so there will no doubt be considerable scope for further elaborating the activities to be pursued. To enable communication, further action plans will need to be phrased without resorting to OR or other academic jargon. As we see it, however, one emphasis of the dialogues with planners and managers can usefully be on the employment and integration of multiple methods in OR to serve the variety of demands in environmental management.

5 It will be important to identify potential funders for different aspects of the action plans, including academic and non-academic sources. The fundraiser for the Unit may assume a central role here, but some of the activities can usefully be distributed across a collaborative network of activists to avoid over-dependence on one person. Bids can be constructed for different funding agencies taking into account the agenda item for which support is being sought and the interests of potential benefactors.

6 In saying that, in general, OR practice will need to change, we have tried to emphasise the positive attributes that it should embody if it is to become more responsive to the complexities of environmental management. However, there is also value in identifying aspects of existing OR approaches in environmental planning and management that represent a barrier to good practice, and especially to public participation. Therefore, more 'critical' research should be encouraged (critical in the sense of highlighting weaknesses and proposing positive alternatives). Also, it is important not to become complacent and assume that an enhanced OR practice can do everything that is needed. It will

be necessary to explore and document those areas of environmental planning where OR is *not* able to deliver effective support.

7 An important aspect of the strategy for raising awareness of OR is the establishment of local pilot projects for environmental development, each of which should have a steering group bringing together local stakeholders and OR practitioners. Good practice in local projects can then be publicised. A starting set of pilot projects might be identified with the collaboration of the Community OR Network, the regional Groundwork offices, and regional development agencies.

8 It will no doubt be easier to establish pilot projects with the co-operation of the public sector and business organisations simply because many of these organisations have resources to pay for OR support. Therefore, to keep a balance and ensure the involvement of the third sector, it may be necessary for Community OR practitioners to specifically seek out environmentally-orientated community groups and explore the possibilities of OR support with them.

9 While comprehensive plans for enhancing the role of OR in environmental planning and management were generated through the project reported in this document, the issue of monitoring implementation was not explored in any detail. It will be necessary for those taking forward this agenda to consider how implementation should be monitored so that any unanticipated side-effects can be identified and addressed.

10 Finally, we recommend undertaking a comprehensive review of the agenda's successes and shortcomings in three years time, with a view to identifying further possibilities for new directions.

6.4 Summary and Conclusion

Let us now bring this report to an end by summarising our findings and presenting a final call for action.

The traditions of OR and environmental management share some common concerns. First, both have wide boundaries in terms of clientele, range of methodological approaches used, and attention to multiple and often conflicting values. Second, both traditions have an interest in fostering purposeful interdisciplinarity. Third, both OR and environmental management are concerned with the *implementation* of, as well as the *design* of, planning strategies.

Three generic issues were found to recur in both the environmental management literature and the interview data generated in our study:

1 *Complexity and uncertainty* (regarding the unpredictability of natural and social phenomena);

2 *Multiple and often conflicting values* (of those involved in environmental planning); and

3 *Political effects* (on those not involved in planning processes, including non-human nature).

An examination of how these generic issues are perceived in the different sectors (public, business and third sector) revealed clear patterns. Issues of complexity and uncertainty

dominate the public sector, with attention primarily focused on developing appropriate 'indicators'. Competing values are the main concern of business organisations, with attention being paid to minimising risks by improving stakeholder interaction. Political issues dominate the third sector, with concerns about representing marginalised interests and widening the net of meaningful participation in planning. However, each sector also has concerns relating to the other issue categories too. Also, for each sector there are conflicting interpretations of how people are handling the generic issues. These conflicts highlight dilemmas for practice that organisations arguably need to address.

Clearly, in the increasingly complex, interdisciplinary and politicised world of environmental planning, if we want to enhance OR support, it will be vital to do more than just deal with the technical difficulties associated with modelling the natural world. This is not to say that the technical issues are trivial or unimportant (far from it), but it will also be necessary to address the more messy social worlds of values and ethics in which both OR support and environmental issues are embedded. A major challenge for OR practitioners will be to develop methodologies and methods that are capable of dealing with *all three* of the generic themes identified in this research (complexity and uncertainty, multiple values and political effects).

However, developing OR in isolation is still not enough. As part of our research, a group of OR practitioners working in public, business, third sector and academic organisations came together in two workshops and a mini-conference to collaborate on producing an agenda for change. They identified *three* sets of strongly interrelated activities that need to be undertaken if OR is to enhance its contribution to environmental planning and management, and make it more visible:

- *Develop OR*, with a focus on methodological issues;
- *Promote interaction*, with a focus on issues of inter-disciplinarity, intersectoral co-operation and pluralism; and
- *Promote public participation*, with a focus on issues of accountability.

To kick-start these activities, the mini-conference participants produced 11 recommendations (detailed earlier in sections 6.2 and 6.3). In our view, these provide a sound basis to mobilise the enthusiasm and commitment of practitioners so that OR can finally realise its potential as a key contributory discipline to environmental planning and management.

In conclusion, it seems to us that there are two scenarios for the future of engagements between OR and environmental planning and management. First, there is a 'business as usual' scenario: allowing the OR frog to hop anonymously from one lilypad to another while pike-like environmental planning communities attempt to consume (or perhaps a better word is 'absorb') OR practice. An alternative scenario is for OR to become more purposeful and visible as a discipline: celebrating past achievements and heralding future prospects—though crucially always remaining aware of our weaknesses, and striving to overcome them. In authoring this report, we unequivocally advocate the second scenario as being in the interests of both operational research and environmental planning and management. It is a scenario that remains true to Ackoff's (1974) plea—echoed by Mike Pidd's Presidential Address to the OR Society at its Annual Conference in Swansea (12 September, 2000)—for OR to do more than attempt to *predict* the future. Rather, we should be trying to *design* it.

Appendix I:
Glossary

Selected Terms in Operational Research and Environmental Management

	Methodologies/ approaches/ methods/techniques	Description
1	AI (artificial intelligence)	Study of intelligent performance, brain functioning and how we think, in order to define analogies suitable for intelligent computer application.
2	AI (artificial intelligence): Distributed (DAI) (Gasser, 1991 cited in Khakee *et al*, 2000)	"Socialising AI"; collections of interacting and co-ordinated knowledge-based processes using concepts such as 'commitment', conflict resolution, negotiation, agreement… ; useful for interactive and communicative planning.
3	Chain modelling (environmental) (Daniel *et al*, 1997; Bloemhof-Ruwaard *et al*, 1995)	Integrating OR into environmental management; monitoring and impact assessment followed by resource management and global analysis: 'nature' orientated (resources); ecocentric cyclical systems:
4	Chain modelling (supply) (Daniel *et al*, 1997; Bloemhof-Ruwaard *et al*, 1995)	Greening OR; life cycle analysis and risk assessment followed by risk & product management and location analysis: 'human'/ business oriented (manpower and technology); linear human system (extraction.. use...disposal):
5	Chain modelling (sustainable development) (Ravetz, 2000)	Environmental problems (downstream outcomes) typically caused by economic activity (supply and demand functions) driven by social needs (upstream drivers); basis of ISCAM
6	CLIP (central & local government information partnership)	Pilot project initiative (jointly run by the New Economics Foundation, Improvement Development Agency and the Local Government Association) focusing on 30 local authorities to compile local indicators from set of national headline indicators published in DETR QoL sustainable development strategy; to be used in designing LA21 strategies and (possibly) as a basis for 'best value' indicators.
7	Community Learning Toolkit (Talbot, 1997, *Melbourne conference on environmental justice*)	Pilot project involving Edinburgh, West Indies and USA testing tools for developing sustainable (systems-oriented) communities (lifeworld oriented); tools include: bioregional mapping, ecological viability for transport, energy, eco-efficiency, capacity building, employment skilling, business management, socio-economic viability, + tools for realising sustainability
8	Community Operational Research (Rosenhead, 1989b; Ritchie, 1994; Ritchie *et al*, 1994; Midgley and Ochoa-Arias, 1999; Midgley, 2000)	Use of operational research techniques from the 1980s to facilitate debates between agencies involved with planning starting from the needs of clients rather than an objective (typically mathematical) modelling of real world; questioning of boundary judgements (Rosenhead = voluntary sector only; Midgley = public and voluntary sector involvement)
9	Complex systems 1: theory/ modelling (incorporating 'chaos theory') (reviewed in Murray, 1998)	Started with 1963 weather modelling by Edward Lorenz; based on 3 dimensions of analysis - speed of air, temperature difference (both individually comprehensible and predictable in terms of cause and effect), and 3rd uncertain dimension which is unpredictable; translated in terms of butterfly metaphor by Morgan, 1997 - flap of wings in Amazon causing temperature changes and effecting possible hurricanes or fine weather in Caribbean; translated to organisational behaviour in terms of 3 characteristics of complex systems - emergence, recursion (or lack of it), and process based approaches; akin to Senge's 5th Discipline - system dynamics influence, need for a shared vision, use of metaphors, apolitical (failing to come to terms with divergent voices of organisational success)
10	Complex systems 2: evolutionary (Allen, 1998)	Pinnacle of nested 4 system hierarchy ranging from simple systems with many assumptions to complex systems based on fewer assumptions: (i)

		equilibrium models assuming the achievement of a single stationary state, underlying much policy/ planning; (ii) system dynamics characterised by nonlinearity with a range of different equilibria dependent on assumptions from start (iii) self-organising systems with collective adaptive capacity; and (iv) evolutionary complex systems (not necessarily progressive) rooted in diversity, cultural richness, openness and willingness to take risks; driven by creativity
11	Critical Operational Research: Urban Solid Waste Management (Sudhir *et al*, 1996)	Based on Habermasian principles of truth (objective reality), truthfulness (subjective reality), and rightness (social reality) facilitating 'free discussion'; need to integrate hard (formal/municipal/private waste converters/ legal) and soft (waste pickers/ small scrap dealers/ informal) approaches
12	Cross-impact matrix (1960s Futures research and Schlange, 1995)	Pair-wise analysis to illustrate complexities of interrelatedness between relevant variables; use of fuzzy thinking/ logic in more recent techniques
13	CSH (critical systems heuristics) (Ulrich, 1983)	Based on Churchman's framework for a 'very' rich picture of social systems and the necessity for subjecting systems rationale to social rationale (i.e., 'enemies of the systems approach'); delineates 12 categories derived from 4 sources of influence on a system; motivation, control, expertise and legitimacy; each category prompted with questions of 'is' and 'ought'; criticised for its practical use being dependent on open debate
14	CST (critical systems thinking) (Flood & Jackson, 1991a; Flood & Romm, 1996a; Midgley, 1996, 2000)	Approach to research and intervention based originally on the Frankfurt school of critical social theory though widened to include Foucauldian principles of reflexivity; Midgley suggests 3 themes associated with CST; improvement (emancipation), critical awareness (theoretical and practical) in terms of boundary critique, and methodological pluralism
15	DEA (data envelopment analysis) for evaluating environmental impact (Linton, 2000, drawing on management evaluation of Charnes *et al*, 1978, 1981)	Claims to be "non-controversial option to compare controversial environmental metrics"; pollutants considered as 'inputs' to a system rather than as measures of performance (i.e., 'outputs') thus avoiding problems re. disputed evaluations of environmental costs; outputs are chosen with respect to being less controversial with regard to their measurement, e.g., power generation, regarded then as a measure of performance of 'decision making units' (DMUs) e.g., US states, which can then be relatively compared; methods reveal evidence of 'best practice'; pollutants are inputs to reducing the planet's carrying capacity for accepting additional units of pollutants.
16	Decision support	Traditional remit of operational research in support for decision making; makes available choices; visible product oriented (cp. systems support which is more process oriented)
17	Decision support system (strategic) : Graph model for conflict resolution (GMCR II) (Hipel *et al*, 1997)	Forecasts compromise solutions in international strategic systems that are viable (socially and politically *given*) yet sustainable (environmentally and economically *unchanging*)
18	Decision Support System: computer based	Used to encapsulate knowledge to assist, for example, the medical practitioner in processes of diagnosis & medical decision-making
19	Dialectical Inquiring Systems (Churchman, 1971)	Precursor to soft systems methodology in giving expression to teleological (purposeful) systems as nominal constructs in contrast to objectivist notions of 'systems' existing as real objects; later (1979) made a critical component more explicit - the 'systems enemies' (politics, aesthetics, morality, religion and ethics)
20	DIPs (Deliberative and Inclusionary Processes) (Bhattachary, D. cited in ESRC Global Environmental Change Programme, 1999)	Participatory approaches to decision making to capture values; focused on contentious issues: (i) *focus (and in-depth) groups* - 6-10 people taken through a number of set questions around an issue with the help of a trained facilitator (reveals main concerns); (ii) *citizens' juries (and larger consensus conferences)* - 12-25 representatives from local community have opportunity to interrogate/challenge witnesses (experts, etc.) with the potential of creating new policy options; (iii) *stakeholder decision analysis* - combining quantitative multicriteria and qualitative techniques; and (iv) *deliberative polling* - public are briefed on an issue and then interviewed as part of a survey

21	Direct Action (non violent) (NVDA) (Doherty, 1999)	Anti-roads protests (e.g., Twyford Down) - use of tunnels, lock-ins, tripods - = "manufactured vulnerability" with dual aims of making power visible by prolonging its exposure, and changing government policy directly; Earth First! critique of Greenpeace/Friends of the Earth:
22	Direct Action: "lifeworlds" (McNeish, 1996 cited in Doherty, 1999)	Habermasian view of NVDA as new social movements = resistance to the "System's colonisation of the Lifeworld"; government perception of roads development as technical expert driven encroachment of the 'System' on the "lifeworld"; Reclaim the Streets (1995 Camden); May-day 2000 "guerrilla gardening" reclaiming urban land through de-paving, planting and later harvesting (under banner 'resistance is fertile')
23	EB (Environmental burden approach) (ICI, 1997, http://www.demon.co.uk/ici)	Method for assessing potential harm to people and environment from chemical emissions; 3 steps (a) identifying global recognised impact categories e.g., acidity, warming, health effects, ozone depletion, smog (photochemical ozone) creation, aquatic oxygen demand, exotozicity to aquatic life (b) assigning a factor to each emission reflecting potency of impact (c) apply formula based on weight and potency to calculate EB; does not address local issues such as noise and odour
24	Ecological footprint (Rees & Wackemagel, 1995, cited in Talbot, 1997; Ravetz, 2000)	Accounting tool for measuring and visualising the resources required to sustain a community; embraces 'carrying capacity', resource flows, waste disposal; converts into graphical form for public understanding
25	Ecological Modelling for Management (Shrader-Frechette & McCoy, 1994)	Logic of low-level thesis, case-studies, management-oriented, inductive, bottom-up approach; counters claims that ecology is useless and should be dropped given its inability to generate universal theory and null (falsification) models (e.g., discredited "stability-diversity hypotheses); suggests instead that ecology's case-specificity lends itself as a powerful heuristic tool for management (cp. policy design)
26	Economic input analyses (Barrow, 1997) part of 'chain (supply) Modelling'	Cost-benefit; cost-effective; log. framework; input-output
27	EIA (normative) (Brown & Jacobs, 1996)	Final 'go/no-go' decisionistic; project oriented; expert driven; high administration costs
28	EIA (proactive) (Brown & Jacobs, 1996)	Experimental (cf. trial-design); issue oriented; local review; inter-agency
29	Environment Management Systems: British Standard Environmental Management System BS7750 (British Standards Institute)	First systematic approach to identify those issues which had significant environmental or business impacts for management attention developed in late 1980s
30	Environment Management Systems: Eco-Management and Audit Scheme (EMAS)	European industrial regulation (1993) derived from UK BS7750; further adapted by UK for local government as part of LA21 imperative towards "putting your own house in order"; also used as benchmark by business to help win contracts through compulsory competitive tendering (CCT); 7 stages – *policy* driven, *review* of significant issues, *programme* design (broad objectives), *management* system outlining who will do what, when and how, *audit* of programme and management system, public *statement* of performance, *validation* by external assessors using verifiers accredited by National Accreditation Council for Certification Bodies (NACCB)
31	Environment Management Systems: ISO 14001 (International Standardisation Organisation)	Certification of environmental management system involving identification of issues, sites, significant environmental impacts, methods/strategies of reducing impacts, training of staff; compliance documentation needed; checked by independent audit; criteria limited to basic ecological rather than social impacts; only feasible (given time and resource restraints) for large businesses
32	Environment Management Systems: Sustainability: Integrated Guidelines for Management (SIGMA):	Piloting idea of comprehensive management framework integrating environmental, social and economic aspects of sustainable business; use of ISEA management auditing system AA10000; possibly useful for local authorities 'best value' directive; 1st phase of gap analysis

	initiated in 1999 and being developed by BSI, Forum for the Future (i.e., TNS), Institute of Social and Ethical Accountability, with the support of DTI and DETR	identifying where new research work is required; establishing a consortium of 20 companies to experiment with new tools and standards as they are developed whilst concurrently inviting wide input from all sectors to the project; and 2nd phase of 2 years piloting tools and systems; hoping to follow influence of BS7750 in creating European and international standard.
33	Environmental modernisation (Jacobs, 1999)	Fabian Society (Labour 'think tank') pamphlet outlining how environmental issues might be aligned with New Labour 'Third Way' philosophy; need to remove/distance issues of the environment from ideological commitments (particularly 'green'); similar to 'ecological modernisation' in Europe, where issues are brought in to mainstream debate rather than being marginalised in 'ghetto' of the environmental movement; counter to sustainability emphases on economic and social issues.
34	Evolve (towards sustainability) initiated in 1999 by Sustainability North West.	Programme based on principles of 'best practice' to gauge the social & environmental activities and management within Northwest England's largest companies; teams from each organisation assess performance according to management processes (policy and environment mgt. systems etc.), measurement and reporting of environmental and social performance, promoting awareness of sustainable development, and developing partnerships; very little 3rd party objectivity! (MR)
35	Expert systems (Starfield & Bleloch, 1983; Mercer, 1995)	Branch of artificial intelligence involving acquisition of knowledge from experts and its processing by means of computers; shift from computer based *product* oriented programs (data, algorithms, repetitive and quantitative) to wider *process* oriented strategies (knowledge, heuristics, inferential and qualitative); used for facilitating dialogue by making the biases transparent
36	External Cost Estimates 1 (cited in Mirasgedis & Diakoulaki, 1997)	Monetary and quantitative expressions of costing externalities friendly for market decision makers (cp. MCA used for *influencing* markets); e.g., 1992 European Commission 'ExternE Project'
37	External Cost Estimates 2: Contingent Valuation (Pearce *et al*, 1990; cited critically in Mulberg, 1996)	Internalising externalities; neo-conservative/ orthodox economics environmental economics modelling objective reality in market terms; shadow pricing "externalities"; based on individual *preference* choice; confusing judgements & beliefs with desires and preferences; markets (consumers) rather than forums (citizens) = participatory medium
38	External Cost Estimates 3: Transaction (cited critically in Mulberg, 1996)	Internalising externalities; neo-liberal (Austrian)/ normative ideas based on *subjective* valuations of transactions; environmental externalities caused by limits on property rights; extension of property rights could cause trading to occur
39	External Cost Estimates 4: Debt-for-Nature SWAPS (sell with a purchase) particularly taken up by the Washington based NGO, Conservation International, in the late 1980s	Commercial bank sells debt at reduced rate to independent organisation (WWF, CI, World Bank) which then works with debtor nation, using local currency, to encourage rainforest preservation in exchange for debt forgiveness; alternative to export-producing in quest for foreign exchange; market based incentives reinforce existing market relations of power
40	Flexibility mechanisms of Kyoto Protocol (1997): (i) International Emissions Trading (IMT); (ii) Joint Implementation (JI); and (iii) Clean Development Mechanism (CDM) (critically discussed in Parkinson, 2000)	Kyoto Protocol aims at net reduction of global greenhouse gas emissions. IMT & JI relate to industrialised countries, where targets are set; CDM relates to trading between industrialised and less developed countries: IMT is where fractions of each country's emission's target can be bought and sold to other industrialised countries; JI is where 'donor' countries can fund individual projects which lead to emissions abatement in 'host' countries in return for credits; CDM is the same principle as JI but where host is developing country and projects must contribute towards sustainable development; arguments have been dominated by economic rather than social concerns; safeguards against unethical (e.g., nuclear) projects; can perpetuate existing trade dominance of industrialised countries
41	Futures research (Wissema, 1981 cited in Schlange, 1995)	Similar to OR in offering a wide range of methodologies from different disciplines

42	Fuzzy thinking (Zimmerman, 1991, cited in Schlange, 1995)	Systems modelling allowing iterations and non-expert user-friendliness of language e.g. for cross impact matrix ; logic problem of 'fuzzy in - fuzzy out'!
43	Game analysis 1: *prisoners dilemma*/ 'tragedy of the commons' (Hardin, 1968)	Attempt at modelling human interactions; simplest game modelling based on preference orderings for 'players' ranking outcomes ('best' to 'worst'); in Hardin's interpretation, people having equal access to resources (the 'commons'), will inevitably result in depletion of resources
44	Game analysis 2: metagame analysis (Howard, 1971, cited in Schlange, 1995)	Derived from game theory though advancement on optimization studies associated with 1960s arms control; process rather than product oriented; geared towards implementation rather than planning (i.e., 'systems') imperatives; identify actors and develop scenarios
45	Game analysis 3: hypergame analysis (Bennett *et al*, 1989; in Rosenhead, 1989b)	Shift from simple models in taking account of players' different perceptions, modelling not as a single game but as a collection of subjective games
46	HDI (Human Development Index) (UNDP, 1991)	Counter to World Bank's prioritising of GDP as measure of developing countries' performance; aggregate set of key statistical measures include indicators of education and health as well as income; index revised through annual publication of HD Report; based on Amartya Sen's political economy approach to poverty; brings in dimensions of endowment, entitlement and capabilities on the demand side of resource access, as distinct from neo-classical economic theory concentrating on supply side (e.g., food availability).
47	Headline indicators (DETR, 1999)	Set of 14 indicators (from a total of more than 150) proposed in *A Better Quality of Life: a strategy for sustainable development in the United Kingdom* (published by the UK government on 17 May 1999) to monitor progress of sustainable development in the UK. Indicators include a mixture of economic (x3 e.g., GDP), social (x4 e.g., expected years of healthy life), and environmental (x7 e.g., emissions of greenhouse gases). Other indicators are also proposed which at the time of publication were either difficult conceptually or required new data collection.
48	IAD (institutional analysis and development) framework (Imperial, 1999)	Systems based approach to integrating different interests for environmental management; advocates polycentric institutional arrangements for bridging the gap between planning and implementation
49	Interactive planning (Ackoff, 1981)	Organisational planning based upon principles of participation, continuity and change, and the holistic perspective; 5 phases – formulating the mess, ends planning, means planning, resource planning, and design of implementation and control; potential conflict in means planning averted through deciding from the outset 'the ends' (i.e., if there is no consensus on ends then there is no point of participative planning!)
50	Interpretive systemology (Fuenmayor, 1991a-c)	Investigator examines alternative understandings of a problem situation and attempts to reveal their root underlying interpretations as a basis for further participative interaction; uses unveils the richness of phenomena as manifest in variety of meanings providing the basis towards comprehensive debate; debate produces alternative discourses, transforming existing fixed ideological relationships
51	ISCAM (Integrated Sustainable Cities Assessment Method) (Ravetz, 2000)	'Proximate' modelling approach (cp. 'equilibrium' or 'optimization') of scenario accounting used for exploratory heuristic purposes (cp. predictive/normative tools); aims for an approximate representation of the flows of resources and services, which can be characterised as a 'metabolism' or process of transformation; rather than capturing changes internally (neo-classical 'black box' scenario), the modelling (e.g., Atlas NW Futurequest) puts the question back to the user interface with maximum transparency
52	ISEW (Index of Sustainable Economic Welfare) (Jackson & Marks, 1994)	Counter tool to government's quality of life index of 15 headline indicators where *distribution* of wealth rather than *quantity* of wealth is the key economic determinant; adapted in ISCAM to 'total-economy/ value-metabolism approach' shifting focus from static 'index' to more

		dynamic picture where change is compared between different scenarios
53	LEAPs (local environment agency plans) promoted and published by the Environment Agency since 1995)	3 stages; consultation report, 5 year action plan, and annual reviews; local agendas of integrated action for environmental improvement ; 8 regions/ 26 areas (NW region has 3 areas/ 15 LEAPs); Environment & Society Research Unit at University College London commissioned by EA to explore group multicriteria analysis and group deliberation techniques (in New Forest and inner city brownfield sites) for identifying issues, surfacing / making transparent reasoning and values and coming to compromise using trade-offs; similar to PRAs and village development plans used in less developed countries
54	LEARN (local environmental analysis and assessment of rural needs) (Njiforti *et al*, 1991)	Based on rapid rural appraisal techniques and proposed for landscape and urban planning; in Cameroon used for promoting integrated rural development beginning with small interventions leading iteratively to local resource management; starting with no etic bias (humbleness instead); problem situation driven by rural participants; interdisciplinary teamwork (unmasking disciplinary hobbyism)
55	Life Cycle Assessment 1 (traditional LCA) (Heijungs *et al*, 1992, cited in Andersson *et al*, 1998)	Traditional production analysis in *operational* mode; 4 steps (corresponding to 4 category groups of CSH…MR) - goal & scope definition, inventory analysis, impact assessment, and improvement assessment; quantitative valuation methods include ecoscarcity, effect-category, and environmental priority strategies (EPS-biodiversity, biological production, human health, resources, aesthetic values); tied to economic and political issues
56	Life Cycle Assessment 2 (The Natural Step LCA) (Andersson *et al*, 1998)	4 TNS principles are incorporated in each step of LCA to make system more *strategic* and sustainable over longer periods of time; iterative procedure starting with *qualitative* approach with possible *quantitative* iteration after 3rd step; attempt to make TNS principles more operational through generating quantitative 'sustainable process index' (SPI); tool proposed as part of environmental management system
57	Linear programing (Ellis *et al*, 1996): optimization analyses	Important component for large-scale integrated assessments e.g., as part of management models for acid rain control
58	Linear programming: large scale (Qingzhen *et al*, 1991)	Post-1985 models devised for optimal production of crops and livestock lead to increase in net profit without adverse effects on environment; 1985 qualitative analysis alone resulted in economic loss; competitors have helped to increase regulation
59	Logframe Analysis or 'objectives-oriented planning', particularly championed by the Norweigian Aid Agency, NORAD, since 1996	Project planning now commonly used in development intervention particularly for social planning; makes clear (1) objectives (2) means, and (3) monitoring and evaluation component; criticised for inviting unrealistic and vague objectives without much substance and which can be open to measurements illustrating positive effects rather than more telling negative impacts
60	Modelling: cognitive mapping (Eden, 1988) see SODA	Designed to represent the way in which a person defines an issue; network of ideas linked by arrows indicating the way ideas interlink; map is a network of nodes and links (directed graph); aggregate cognitive maps = strategic map; in SODA cognitive map is a model of the 'system of concepts' representing the clients' meaning in relation to other concepts
61	Modelling: economic (Pearce *et al*, 1990)	Concern over utilitarian world in valuing resources; human stewardship based on efficient optimisation of equilibrating systems for rational individual choice; cost-benefit technocentric perspective
62	Modelling: Institutional (Wood *et al*, 1999…with reference to initiatives in the Mersey Basin Campaign)	2 sets of relationships superimposed on each other – sustainable development (economy., society, environment) and partnerships (public, private, voluntary); systemic institutional design; holistic, cross-sectoral, and co-operative
63	Modelling: Natural Science (cited in Spash, 1997b)	Drawing up, staking out and defending boundaries or constraints e.g., sustainable fishing yields, carrying capacity, pollution thresholds; realist cost-effectiveness ecocentric perspective; humans stewardship of nature or as component with little control
64	Modelling: Political (Spash, 1997b)	Bringing together science and economic modelling recognising the role of both in creating a consensus in developing dynamic approaches to

		environment policy design
65	Multicriteria analysis (Siskos & Hubert, 1983; Mirasgedis & Diakoulaki, 1997)	Method of ranking energy technologies with respect to impacts on environment; avoids problem of monetary valuation of non-tradable externalities (cp. External Cost Estimates) claimed to be useful for influencing markets
66	Multicriteria evaluation: qualitative (Munda *et al*, 1994)	Addresses *conflictual* economic-environmental evaluation and decision problems; models must have a subjective component (e.g., decision maker's and researcher's preferences) = a desirable feature since it is less rigid
67	Multicriteria mapping (Stirling and Mayer, 1999…reference to the GM food debate)	Systematic and transparent tool for examining peoples' different but "equally reasonable" starting assumptions behind GM debate and ideas of risk assessment; mix of quantitative (ranking/weighting/scoring) and qualitative techniques
68	Multicriteria methodology with Analytic Hierarchy Process (Ramanathan, 1998)	Used for assisting negotiation/bargaining on greenhouse gas emissions; acknowledgement that no single 'best' indicator (vulnerability of poor, effects on biodiversity, future generations etc…) will be universally accepted; must incorporate many indicators; weighing indicators according to power structures; flexible with complexities (cp. game theory)
69	Multi-criterion decision techniques (Özelkan and Duckstein, 1996)	Water resource analysis using MCD techniques including preference ranking, geometric analysis for interactive assistance, multi-criterion Q-analysis (measuring concordance), compromise programming, and co-operative game theory (conflict resolution)
70	Multimethodology/ Methodological Pluralism (Mingers & Gill, 1997)	Concern for applying different methodological approaches and different disciplines to problem situations; attempt to address problems associated with the incommensurability of different epistemological paradigms from which approaches are embedded; Total systems intervention (TSI) (Flood & Jackson, 1991b), within the genre of Critical Systems Thinking, provides a noted example.
71	Multi-objective goal planning (Foran & Wardle, 1995)	Use of 'rating and weighting' tools as part of a decision support system for land-use planning; attempt to quantify sociological criteria
72	Natural capitalism (Hawken *et al*, 1999)	Universal "trans-ideological" approach demanding 4 shifts in organisation of business: increase productivity of natural resources; use biological models eliminating concept of waste; use 'solutions' rather than manufacturing based model; and reinvest in natural capital; underpins TNS
73	New conservation (Hulme & Murphree, 1999)	Experimental management systems based upon community based natural resource management and new ecology; as distinct from 'fortress conservation'
74	Null Models (Popper, 1969)	Top-down deductive models following the logic of falsification (cp. ecological 'inductive'models)
75	Planning models: political planning evaluation (Fischer, 1980)	4 levels: technical verification (meeting goals); situational validation (making goals); systemic vindication (for policy makers); and rational social choice (societal value systems)
76	Planning models: social planning (Jantsch, 1975; Churchman, 1979)	3 levels of planning with increasing levels of discretion from the *tactical*, tame problems to the *strategic* wicked, messes: goal; objective; and ideal planning, extended by Ulrich (1987) to include a 4th 'means planning' before goal planning
77	Political sensitivity mapping (Stirling, 1999) for sustainability analysis (cf. multicriteria mapping for risk analysis):	Use of active public participation in appraisal of sustainability; patterns of sensitivities regarding sustainability issues are mapped based on systematic inclusion of all interested and affected parties; divergent assumptions are put up front; alternative to analytical fix of 'indicators'
78	Power dispatch modelling (economic; environmental; and multicriteria) (Petrovic and Kralj, 1993)	Electrical power dispatch modelled first solely on economic lines (minimisation of power production costs) using established OR techniques; emphasis shift to environmental protection generated new problem structure for OR; use of OR revealed complexity of decision problems & division between economic and environmental objectives: (a) non-commensurability (b) conflict and (c) numerically irreconcilable

79	PRA (participatory rural appraisal) (Chambers, 1992; Scoones & Thompson, 1994)	Farmers and other villagers given control over techniques of appraisal, planning and implementation of plans by facilitating experts ("beyond farmer first" paradigm); rural peoples knowledge privileged
80	Preference schedules: means-end methods (critiqued by Hare, 1989, as cited in Paden, 1999)	Engineer dominant; goals (values) stated intransigently from outset; suitable for single-client situations
81	Preference schedules: trial-design methods (Paden, 1999)	Architect dominant; goals (values) iteratively designed; self-reflective; deliberative groups (representing 'affected') cp. focus groups (representing 'involved' clients)
82	Product stewardship, initiated and developed by ICI, 2000 http://www.demon.co.uk/ici	Environmental part of safety, health and environment auditing; attempt to take account of global disparities in production standards between different countries; reflects management shift from mass quantitative production of materials (see EB approach) to speciality quality production
83	Reciprocal outreach (Friend, 1998)	Relating to interface between systems approach and development; based on 3 groups of stakeholders - *hosts* ("clients" in developing countries), *sponsors* and *agents* (those "involved" in advanced countries); information transfer is seen as 2-way - PRA useful for eliciting information regarding the hosts and systems (e.g., SCA) useful for hosts to get information on resources/ structures available to exploit
84	Robustness analysis (Rosenhead, 1989a)	Serves to keep alive the dialectic between long-term rational comprehensive planning (avoiding blueprint/ top-down approaches) and (traditional remit of OR) shorter-term decision-making (avoiding opportunistic 'disjointed incrementalism') in order to maintain flexibility; exploratory process (cp. problem solution) identifying: (i) possible decision packages rated in terms of robustness (score indicator of flexibility) against different futures; (ii) shorter term performance outputs from implementing decisions; (iii) guidelines for actions of other interests which could be more or less beneficial (basis for contingency plans); and (iv) assessment of vulnerability to different future scenarios (revealing opportunities for lobbying efforts to change future scenarios. Brings 'commitments' up-front
85	RRA (rapid rural appraisal) (Chambers *et al*, 1989)	Farmers perspective given priority by multidisciplinary expert team ("farmer first" paradigm); indigenous technical knowledge privileged; cost effective (4-10 days); environmental focus (e.g., agroecosystem analysis); systems perspective given broader remit; ongoing internal evaluation; distinction made between emic (insiders) and etic (outsiders) perspectives
86	RVIs (riverside valley initiatives) (Mersey Basin Campaign newsletter, 1999)	Represents the heart of the MBC (25 year programme initiated in 1985 to improve water quality so that all rivers streams and canals are clean enough to support fish by 2010); RVIs started in 1993 target local waterway sections with which communities identify; RVI model focuses attention on (i) mobilising resources (particularly local) for clearly defined area of intervention (ii) promoting wide ranging partnerships between different sectoral interests, and (iii) making an impact on economic, social and environmental development
87	SAST (strategic assumption surfacing and testing) (Mason & Mitroff, 1981)	Promoting dialectical debate between clearly opposed positions, consisting of 4 stages, group formation (involved and affected in mutual interest groups), assumption surfacing (unveiling preferred strategy and assumptions), dialectical debate (presenting the case for each group), and synthesis (achieving accommodation)
88	SCA (strategic choice approach) (Friend & Hickling, 1987)	Derived from collaborative work between operational researchers and social scientists at the Tavistock Institute; management of uncertainties - environment (UE)..*risk analysis* (deeper investigation), values (UV)...*interactive working* (clearer policies) and related decision fields (UR)..*interorganisational structure* (broader perspectives); techniques offered in 4 iterative modes (Ravetz terminology in parenthesis) - shaping (deliberative mode), designing, comparing (together = analysis), and choosing (action)

89	SLA (sustainable livelihoods approach) (Chambers & Conway, 1992; Scoones, 1998; Carney, 1998)	Initiated in the 1980s and core of late 1990s Renewable Natural Resources Knowledge Strategy adopted by the Department for International Development to address DFID's aim towards poverty elimination; modelling five assets of poor people (financial, social, human, physical and natural) in relation to the context of vulnerability, transforming structures and processes, strategies and outcomes; attempts to identify research priorities and sectoral/ institutional responsibilities; complexity distracts from overall research strategy and determining appropriate performance indicators
90	SODA (strategic options development and analysis) (Eden, 1989; in Rosenhead, 1989b)	Facilitative devices founded on *subjectivism* with focus on 'the individual' (protecting individuality ensures creativity and consensus); cognitive theory (making sense of the world) informs use of language based conceptual frames for mapping and controlling the world; organisations are changing sets of coalitions between individuals being constantly negotiated; facilitating role of expert both in interviews and workshops; use of COPE software enabling storage of cognitive maps:
91	SSM (soft systems methodology) (Checkland, 1981; Checkland & Scholes, 1990)	7 stage iterative process for "human activity systems" and "holonic" thinking – problem identification, problem representation (rich picture), root definition of problem (using CATWOE mnemonic), conceptual Modelling, comparing models with 'real world', feasible and desirable assessments, and action; distinction between "logic" and "cultural" based analyses emphasises iterative non-linear nature of interaction
92	System dynamics (Forrester, 1961, 1971; Meadows *et al*, 1972)	Computer-aided approach based on information feedback and mutual or recursive causality to understand dynamics of complex physical, biological and social systems; attempts to be systematic and comprehensive in provision of systems' inputs; 'Club of Rome' model of global system with fixed capacity (criticised by Science Policy Research Unit at Sussex); defended by Lane (2000) in terms of not being critically understood by outsiders or theoretically articulated by insiders; basis of *The Fifth Discipline* (Senge) of systemic thinking
93	Third wave business strategy (Elkington, 1997)	Systems based approach to business activity; 1st wave = compliance; 2nd wave = environmentalism, 3rd wave = sustainability (corporate social responsibility); stress need for sustainable risk assessments, cooperation, holistic risk management (i.e., avoiding end-of-pipe *transfer* of risks to more vulnerable); 'Thirdwave' also name of Edinburgh based consultancy group directed by Roger Talbot
94	THS (to the heart of sustainability), Centre for Human Ecology, Edinburgh/WWF	Facilitating support for businesses and other interested agencies; derived from deep ecology principles from North West Earth Institute in Seattle; uses SSM ideas of generating a shared vision of sustainability; compared with more structured TNS, focus is more on personal rather than professional development and is less constrained by any initial commitments.
95	TNS (The Natural Step) developed first in 1989 in Sweden (Roberts et.al., 1994), adopted later by Forum for the Future in UK	Cyclic socio-ecological systems thinking based on scientific principles of thermodynamics (matter and energy) generating 4 system conditions: earth's crust cannot be depleted (ecol); production of synthetics must not exceed destruction (socio); harvesting must be matched by renewal (ecol); and resource efficiency must be matched by resource distribution (socio); apolitical, consensus and learning-oriented
96	Visualization Techniques 1: Computerised Simulations (Orland, 1992; Lange, 1994)	Communication medium to elicit participation of those affected by environmental plans (cf. PRA); offsets incomprehensibility (weight and scope) of EIAs; descriptive tool only; must be used from the outset of planning rather than as a public relations post-planning marketing tool; need to assimilate with quantitative modelling tools
97	Visualization Techniques 2: Geographic Information Systems (GIS) or "Geo-informatics" (Gumbricht, 1996)	Shift from inventory needs to analytical and forecasting tool; Brundtland Commission imperative to integrate data, models and knowledge; associated with digital information systems (artificial intelligence, expert support, decision support, remote sensing) and fuzzy set, multi-criteria methods and dynamic modelling; ambitions as a tool for bridging different disciplines (e.g., natural resource management)

Appendix II:
Interviews and Meetings

Part 1: Interview Dates, Meetings and Workshops Attended

Agency	Date Y2
Manchester Airport PLC	13/1
Manchester City Council	18/1
Bury MBC	18/1
Sustainability North West	20/1
Environment Agency (North West)	24/1
Oldham MBC	24/1
The Natural Step; Forum for the Future	25/1
Manchester Chamber of Commerce and Industry	26/1
Mersey Basin Campaign	26/1
Friends of the Earth Manchester	1/2
H.Marcel Guest Ltd Coating Manufacturers	2/2
Cooperative Bank	3/2
Manchester City Council	9/2
Government Office North West Environment Team & Planners	10/2
Environment & Development Dept. at Manchester City Council	12/2
Groundwork North West	22/2
Sheffield Management School	23/2
Manchester Environmental Resource Centre Initiative	25/2
Centre for Urban & Regional Ecology (Manchester)	28/2
Greater Manchester Centre for Voluntary Organisations	1/3
Greenpeace UK	3/3
Unilever: Arkody Craigmillar	23/2
DETR: Regeneration	9/3
Town & Country Planning Association	10/3
Friends of the Earth: Sustainable Development Research Unit	13/3
Greater Manchester Waste Ltd.	16/3
Science & Technology Policy Division, DETR	17/3
Edinburgh Sustainable Architecture Unit, University of Edinburgh	20/3
Centre for Study of Environmental Change and Sustainability, University of Edinburgh	20/3
Centre for Human Ecology, Edinburgh	20/3
Sustainable Development Unit, DETR	22/3
Planning Division, DETR	23/3
Science Team, British Council	24/3
Institute of Food Health Quality, Hull University	28/3
Complex Systems Management Centre, Cranfield School of Management	28/3
Environment and Society Research Unit, UCL	30/3
Science Policy Research Unit, Sussex University	31/3
Centre for Applied Development Studies, Lincoln School of Management	6/4
OPERA: Orchard Estate Trust	11/4
Department for International Development	13/4
Department for International Development	13/4
Oldham Metropolitan Borough Council	18/4
Quest International (ICI)	20/4
ABL (Aluminium Components) Ltd.	19/5
British Nuclear Fuels Ltd.	13/6
ASDA retail stores	21/6
Land Rover Vehicles	26/6

Event	Agency	Theme	Date
Workshop at Manchester University	Institute for Development Policy and Management/ Natural Resources International PLC	Food & Fisheries, Trees & Cows: roles of DFID RNR programmes in poverty eradication	25/11 26/11 (Y1)
Earth First! Meeting	Hulme Manchester	"Manchester Response to Seattle"	1/2
Sustainable Business Committee Meeting	Manchester Chamber of Commerce and Industry	Presentation of project objectives	2/2
Workshop at Lancaster University	Centre for the Study of Environmental Change	Workshop series: Environmental Knowledge: w/shop 3: "Social Intelligence"	7/2 8/2
Local Community Campaign Meeting	St Margaret' Primary School and Manchester City Council Cllrs	"Removal of mobile phone mast from school roof"	14/2
Workshop at Lancaster University	Centre for the Study of Environmental Change	Workshop series: Environmental Knowledge: w/shop 4: "Ethical Expertise"	3/4 4/4
Workshop/ Conference London, Westminster Hall	Socialist Environment and Resources Association	"New Deal for the Environment - Working for a Better Future"	8/4

Part 2: Workshops Convened

Workshops	Participants
	Martin Reynolds (Centre for Systems Studies, University of Hull) Gerald Midgley (Centre for Systems Studies, University of Hull)
London: **3 July 2000** London School of Economics, Room S53 St. Clements Building	Katie Gibbs (Department of Environment Transport & Regions: OR Division) Amanda Shakir (Defence Evaluation and Research Agency) Stephanie Stray (OR & Systems Group, Warwick Business School) Sandra Weddell (OR Society) Gautam Appa (LSE) John Friend (Lincoln University) John Thompson (Environment Agency North West) Nick Green (Town & Country Planning Association) Nick Mayfield (Unilever)
Sheffield: **10 July 2000** Sheffield Hallam University, Room 7327, Stoddart Building	Seonaidh McDonald (Sheffield University; ORS Environment Study Group) Judy Clark (University College London) Stan Frost (Salford University) David Wood (Department of Social Security, Analytical Services Division) Wolf White (Human Scale Development Initiative) Rebecca Herron (Community OR Unit, Uni. of Lincolnshire & Humberside) Dennis Finlayson (Centre for Applied Development Studies, University of Lincolnshire & Humberside)

Conference	Participants
	Martin Reynolds (Centre for Systems Studies, University of Hull) Gerald Midgley (Centre for Systems Studies, University of Hull)
Hull: **27/8 July 2000** Dennison Centre, University of Hull	Katie Gibbs (Department of Environment Transport & Regions: OR Division) Stan Frost (Salford University) Wolf White (Human Scale Development Initiative) Sandra Weddell (OR Society) Rebecca Herron (Community OR Unit, Uni. of Lincolnshire & Humberside) John Friend (Centre for Applied Development Studies, University of Lincolnshire & Humberside) Michael Wood (Portsmouth Universtity) Andrew Palfreman (Institute for Food Quality, University of Hull)

Part 3: Agencies Represented

ABL Aluminium Components
ASDA Retailers
British Nuclear Fuels Ltd.
British Council
Bury Metropolitan Borough Council
Centre for Applied Development Studies, Lincoln School of Management
Centre for Human Ecology, Edinburgh
Centre for Study of Environmental Change and Sustainability, University of Edinburgh
Centre for the Study of Environmental Change, University of Lancaster
Centre for Urban & Regional Ecology, University of Manchester
Complex Systems Management Centre, Cranfield School of Management
Cooperative Bank, Manchester
Department for International Development: Natural Resource Policy Research
Department for International Development: Sustainable Livelihoods Support Office
Department of Environment Transport and the Regions: Planning Division
Department of Environment Transport and the Regions: Regeneration
Department of Environment Transport and the Regions: Science & Technology Policy Division
Department of Environment Transport and the Regions: Sustainable Development Unit
Earth First! Hulme Manchester
Edinburgh Sustainable Architecture Unit, University of Edinburgh
Environment Agency (North West)
Forum for the Future: The Natural Step
Friends of the Earth Manchester
Friends of the Earth: Sustainable Development Research Unit
Government Office North West
Greater Manchester Centre for Voluntary Organisations
Greater Manchester Waste Ltd.
Greenpeace UK
Groundwork North West
H.Marcel Guest Ltd Coating Manufacturers
Institute for Development Policy and Management/ Natural Resources International plc.
Institute of Food Health Quality, Hull University
Land Rover Vehicles
Manchester Airport plc
Manchester Chamber of Commerce and Industry
Manchester City Council: Environment & Development Department/ local Councillor
Manchester City Council: LA21
Manchester Environmental Resource Centre Initiative
Mersey Basin Campaign
Oldham Metropolitan Borough Council
Orchard Park Environment Redevelopment Association
Quest International, ICI
Sheffield Management School
Socialist Environment and Resources Association
St Margaret' Primary School and Manchester City Council Cllrs
Sussex University: Science & Technology Policy Research Unit (SPRU)
Sustainability North West
Town & Country Planning Association
Unilever: Arkody Craigmillar
University College London: Environment and Society Research Unit

APPENDIX III:
INTERVIEW SCHEDULES

PART 1: PUBLIC SECTOR

Discussion invites one general and three more specific **themes** regarding the relationship between professional expert support and environmental planning in the public sector.

1. General context: clarifying issues regarding (a) the predominant client base, (b) level of planning at which agency predominantly operates (e.g., on-site programme administration, project management or policy design/ evaluation), (c) main environmental issues addressed, and (d) type of expert support commonly used.

2. Scope of demand: exploring the boundaries of information and information gathering relevant to environment planning. For example, questions regarding the relative importance of (a) environmental science for specific impact assessments (b) economic-related support for project/programme management, and (c) wider remits of demand associated with policy advice on agriculture, energy, trade, transport, regional and overseas development. Questions invite comment and views on, firstly, the constraints of, and opportunities for, environmental planning as manifest through existing national and international policy commitments, and secondly, the perceived gaps in, or biases towards, existing types of expert support (both in terms of disciplines and approaches).

3. Institutional dynamics: exploring the opportunities for, and constraints of, integrating relevant components of successful environmental planning. For example, issues associated with (a) the division between the process of planning (conventionally inviting expert support) and the process of implementation of plans, and (b) the impact on effective planning of changing relations between different divisions in the Department and changing relations between different government departments. Questions invite comment and views on issues like the 'precautionary principle' and risk assessment, and methods of securing better interdisciplinarity and more purposeful co-ordination between government agencies associated with environmental planning.

4. Role of 'outside' agencies: exploring the changing relationship with stakeholder groups outside the government sector. For example, relationships with private sector businesses and environmental pressure groups (both operating at international, national, and local levels), and academic/ private sector consultancy groups. Questions invite comment and views on, firstly, the perceived need for, and relevance of, transparency and promoting 'public trust', and secondly, the main challenges and obstacles of purposeful planning in relation to addressing particular stakeholder groups' interests.

PART 2: BUSINESS SECTOR

Discussion invites one general and three more specific **themes** regarding the relationship between professional expert support and environmental planning in the business sector.

1. General context: clarifying issues regarding (a) the predominant client base, (b) level of planning at which agency predominantly operates (e.g., on-site programme administration, project management or policy design/ evaluation), (c) main environmental issues addressed, and (d) type of expert support commonly used.

2. Policy environment: exploring the general legislative and management framework relevant to environment planning affecting business operations. For example, questions regarding enabling and constraining features of present government policy, and mission statements relevant to the natural environment and issues regarding their practical implementation. Questions invite comment and views on, for example, perceived conflicts between expert support for guaranteeing (a) economic viability/ performance and (b) environmental protection, the changing range of factors (e.g., the natural environment) that need to be taken into account during business decision making (internalising 'externalities'); and the perceived gaps in, or possible over-use of, existing types of expert support (both in terms of disciplinary input and methodological approaches).

3. Managing change: exploring the range of tools for integrating environmental concerns with management strategies for improved market performance. For example, issues regarding the institutional imperatives towards being continually responsive and adaptive, use of external as distinct from internal expert support, and measures towards adopting a more proactive engagement in generating environmental initiatives and change in the policy decision-making environment. Questions invite comment and views on issues like risk assessment and concepts like the 'precautionary principle', value of 'pricing' environmental factors, and methods of securing better market effectiveness through local, national or international networking of interests.

4. Securing 'outside' trust in managing environmental affairs: exploring the changing relationship with stakeholder groups outside the business sector, particularly those affected by business plans and long-term strategies. For example, the changing relationships with government and environmental pressure groups (both operating at international, national, and local levels), and academic/ private sector consultancy groups. Questions invite comment and views on, firstly, the perceived need for responsiveness to public concern, the relevance of transparency and promotion of 'public trust' with regards to environmental issues, and secondly, the main challenges and obstacles to environmental planning in addressing business interests.

PART 3: THIRD SECTOR

Discussion invites one general and three more specific **themes** regarding the relationship between professional expert support and planning requirements for environmental pressure groups.

1. General context: clarifying issues regarding (a) the predominant client base, (b) level of planning at which agency predominantly operates (e.g., on-site programme administration, project management or policy design/ evaluation), (c) main environmental issues addressed, and (d) type of expert support commonly used.

2. 'Radical' expert support: exploring the boundaries of information and information gathering relevant to NGO activity in the environmental field. For example: firstly, the relative importance of *technical* expert approaches as exemplified with disciplinary based (a) environmental science for specific impact assessments (b) economic/environmentally-related support for specific project management, and (c) wider remits of multidisciplinary demand associated with advocacy work or invited policy advice on agriculture, energy, trade, transport, regional and overseas development; and secondly, the demand for *practical* expertise associated with facilitating interaction. Questions invite comment and views on the perceived gaps in, or biases towards, existing types of expert support (both in terms of disciplines and approaches), and the constraints of, and opportunities for, a persuasive critical input to existing environmental practice.

3. Integrating independence!: exploring the opportunities for integrating environmental issues (and associated stakeholders) which have been traditionally marginalised by mainstream planning. For example, concerns associated with facilitating effective community participation, providing appropriate facilitating support, and engaging with meaningful professional and cross-disciplinary interaction. Questions invite comment and views on methods of securing a more purposeful sense of action research across disciplinary barriers and more informed co-ordination between relevant agencies (e.g., through 'joint ventures') whilst addressing concerns of appearing to be co-opted into mainstream environmental planning.

4. Challenging dominant mindsets: exploring the main obstacles to effecting better representation of key issues and concerns. For example, the problematic relationships with government agencies and private sector businesses (both operating at international, national, and local levels), as well as academic/ private sector consultancy groups. Questions invite comment and views on the identity of particular ideological commitments (e.g., ecocentrism, anthropocentrism, 'third way' politics etc.), and the perceived need for, and relevance of, transparency in relation to addressing particular stakeholder groups' interests.

PART 4: OPERATIONAL RESEARCHERS

Discussion invites one general and three more specific **themes** regarding the relationship between professional expert support and environmental planning.

1. General context: clarifying issues regarding (a) the predominant client base, (b) level of planning at which agency predominantly operates (e.g., on-site programme administration, project management or policy design/ evaluation), and (c) the main environmental issues addressed.

2. Type of support provided: exploring methodological approaches and the range and specificity of expert support employed for environment planning. For example, questions regarding the relative value given to, and perceived importance of, (a) 'hard' scientific approaches to representation of environmental problems as compared with 'soft' approaches in representing environmental viewpoints, and (b) employing single disciplinary as against multidisciplinary sources. Questions invite comment and views on, firstly, the limitations and possibilities of scientific and heuristic tools such as linear (supply chain and environmental chain) modelling, econometric modelling, cyclical modelling, multicriteria analysis etc., and secondly, issues of guaranteeing neutrality and objectivity.

3. Professional interaction: exploring the opportunities and constraints of integrating other sources of expertise. For example, facilitating and incorporation of lay-public viewpoints and local community perspectives, facilitating meaningful interdisciplinarity, and facilitating greater interaction between planning and intervention. Questions invite comment and views on the possibilities for methodological pluralism, and issues such as expert-driven inquiry, systems approaches, participatory techniques and development, and institutional constraints towards more action-oriented forms of inquiry.

4. Social responsibility: exploring the changing relationship with stakeholder groups not immediately involved with, though possibly to be affected by, the planning process. For example, relationships with government agencies, private sector businesses, environmental pressure groups and media outlets (all operating at international, national, and local levels). Questions invite comment and views on, firstly, the perceived need for, and relevance of, monitoring and evaluation and social auditing to promote transparency and 'public trust', and secondly, the main challenges and obstacles to providing expert support in relation to either maintaining a dispassionate neutral stance or addressing particular stakeholder groups' interests.

PART 5: E-MAIL QUESTIONNAIRE (SAMPLE)

Developing an Agenda for the use of Operational Research in Environmental Planning & Management

The aim of this questionnaire is to help generate a profile of key problems associated with the process of planning in addressing environmental issues (please refer to 'flyer' for outline of project study details).

Contact address

Dr Martin Reynolds	
Centre for Systems Studies Business School University of Hull Hull, HU6 7RX, UK	(residential address) 179 Withington Road Manchester M16 8EF UK
Tel: 0044(0)161 226 6203 E-mail: martin.reynolds@ukonline.co.uk Fax: 0044(0)870 131 6074	

Invited Respondent: …(*withheld*) Institute for Sustainability and Technology Policy (ISTP) re. Land and Water Resources Research and Development Corporation (LWRRDC) projects

Backdrop

1. On what criteria are 'communities' selected for the community-based natural resource management projects being supported through ISTP/ LWRRDC?

2. Which other parties are involved in these projects?

   sponsors?

   other consultants?

   government departments?

   NGOs?

3. What relationship, if any, is there between these projects and the LANDCARE programme or other significant community based natural resource programmes in Australia?

Range of Support Provided

Approaches: In terms of either *technical* extractive research (including use of participatory techniques like PRA which might be used for this purpose, as well as conventional baseline survey approaches etc.) or *facilitating* communication between key stakeholder groups, what do you feel is the main emphasis of support being mediated through ISTP on these projects?

2 Technical support

2.1 What are the strengths in range and quality of disciplinary support provided by ISTP in particular, and expert support in general (economics, sociology, natural sciences, political sciences, management sciences (including planning/systems))?

2.2 What weaknesses, if any, do you think there are in the range and quality of disciplinary support ?

3. Facilitating support In relation to ISTP, comment on the range of support for, and difficulties in, mobilising:

3.1 local community participation?

3.2 intersectoral communication?

3.3 interdisciplinarity?

3.4 interaction between project/programme *planning* (which might be intersectoral and interdisciplinary) and *implementation*?

4. Monitoring and Evaluation What is the range of, and difficulties in, providing or mediating critical feedback to:

4.1 ISTP itself?

4.2 sponsors of ISTP?

4.3 other academic/consultancy groups on similar projects/programmes?

4.4 local communities?

Working Relations

Comment on the state of, and changes in, working relationships between ISTP and the following agencies in promoting community resource management.

1 Local rural communities?

2 Existing local based NGOs?

3 Local government authorities?

4 National government?

5 Other academic institutions/ consultancy groups in Australia (e.g., Hawkesbury) and elsewhere (e.g., IIED in London?

6 National and international NGOs (including, for example, campaigning agencies like Greenpeace, or UN 'family' agencies working with sustainable livelihoods approach)?

7 Private sector agencies

Key Challenges

Using the headings below, briefly state what you feel are the key obstacles towards improving planning associated with natural resource management:

1 Inadequate planning tools and techniques.

2 Limited or inappropriate theorising of natural resource management

3 Institutional and cultural barriers to meaningful communication and interaction between relevant agencies

4 Political impediments (global, national and local policy constraints as well as various material and ideological manifestations of coercion)

5 Other….

Many Thanks!

Appendix IV:
Critical Systems Heuristics Questions Used in Workshops

Part 1: Questions for Further Exploring the Missions

1 Purposes and Beneficiaries

2.1.1 *What purpose(s) should be pursued?* These should already be expressed in the mission, but may need modifying in light of the further explorations conducted in this session.

2.1.2 *Who should benefit?* ('immediate' and 'ultimate' beneficiaries)

2.1.3 *How will you know if the purposes are being realised?* Identify measures of performance, bearing in mind that measures need not be quantitative (they may be the views of key stakeholders, etc.)

2 Inputs Required and Decision Makers

2.1 *What resources are needed in order to pursue the purposes?* Consider the appropriate organisational structures, infrastructure, employment portfolios (voluntary/paid; full-time/ part-time; permanent/ temporary… i.e., do not be concerned about necessary employment skills at this stage), financial support, etc., that will be necessary. Think about where these might come from.

2.2 *Who should take decisions in pursuit of the purposes?* Think of who might be called upon to be the potential benefactors/patrons to support the provision of relevant resources identified above? In other words, who should have the power to change the mission or force abandonment?

2.3 *Are there specific things that those taking the decisions should not have any control over?* Identify relevant resources, activities, etc. that should not be the responsibility of the people with control over the inputs. Also consider whether a 'watchdog' might be necessary that would therefore need to be independent.

3 Expertise

3.1 *What types of expertise will be necessary to pursue the mission?* Think of this in terms of the necessary technical/disciplinary based skills required (in assimilating particular types of information), facilitating skills needed (in fostering communication/interaction between different people/sectors), and critical skills (for reflective practice).

3.2 *Who should constitute the experts?* From which sources might the expertise identified above be sought?

3.3 *By what criteria might the expertise be evaluated?* For example: with technical skills, consider the relative importance of comprehensiveness and/or degree of 'disinterestedness'; with facilitating skills, consider the competence relative to the types of stakeholder interaction being facilitated; and with monitoring skills, consider what agenda items demand particular continuous reflection.

4 Values and Effects

4.1 *Other than those involved and mentioned above, who or what may be affected by pursuit of the mission?* Should they participate, be represented, be consulted, etc.?

4.2 *If it is anticipated that some people or things will be affected, should they be free to remove or counter the effects - and if so, how should this be managed?*

4.3 *What values lie behind pursuit of the mission?*

Part 2: Standardising Outputs from the Workshops

Difference in question categories 2 and 3 between London and Sheffield. Standardising output between the 2 workshops involved making the following shifts from London to Sheffield: 2.1=3.2; 2.2=2.1; 3.1=2.2; 3.2=3.1

London 3rd July	Sheffield 10th July
People involved & inputs required	**Inputs Required and Decision Makers**
2.1 *Who should take decisions in pursuit of the purposes?*	**2.1** *What resources are needed in order to pursue the purposes?* Consider the appropriate organisational structures, infrastructure, employment portfolios (voluntary/paid; full-time/ part-time; permanent/ temporary… i.e., do not be concerned about necessary employment skills at this stage), financial support, etc., that will be necessary. Think about where these might come from.
2.2 *What will those taking the decisions need in order to pursue the purposes?* Consider the appropriate organisational structures, infrastructure, financial support, etc., that will be necessary. Think about where these might come from.	**2.2** *Who should take decisions in pursuit of the purposes?* Think of who might be called upon to be the potential benefactors/patrons to support the provision of relevant resources identified above? In other words, who should have the power to change the mission or force abandonment?
2.3 *Are there specific things that those taking the decisions should not have any control over?* Identify relevant resources, activities, etc. that should <u>not</u> be the responsibility of the people seeking to pursue the purposes. Also consider whether a 'watchdog' might be necessary that would therefore need to be independent.	**2.3** *Are there specific things that those taking the decisions should not have any control over?* Identify relevant resources, activities, etc. that should <u>not</u> be the responsibility of the people with control over the inputs. Also consider whether a 'watchdog' might be necessary that would therefore need to be independent.
Control and Expertise	**Expertise**
3.1 *Who should have the power to change the mission or force abandonment?* Think about what you have already said about a 'watchdog' (if you have decided to have any such checks), and consider what might happen if major unanticipated consequences came about as a result of pursuing the purposes. Who should sort out the situation, especially if there is conflict over whether or not changes should be made?	**3.1** *What types of expertise will be necessary to pursue the mission?* Think of this in terms of the necessary <u>technical/disciplinary</u> based skills required (in assimilating particular types of information), <u>facilitating</u> skills needed (in fostering communication/interaction between different people/sectors), and <u>critical</u> skills (for reflective practice).
3.2 *What skills and/or expertise will be necessary to pursue the purposes?* Think of technical and/or facilitating skills, as well as different disciplinary traditions, if relevant.	**3.2** *Who should constitute the experts?* From which sources might the expertise identified above be sought?
3.3 *What will help to ensure success?* E.g., the competence of OR practitioners, participation by volunteers, etc.	**3.3** *By what criteria might the expertise be evaluated?* For example: with technical skills, consider the relative importance of comprehensiveness and/or degree of 'disinterestedness'; with facilitating skills, consider the competence relative to the types of stakeholder interaction being facilitated; and with monitoring skills, consider what agenda items demand particular continuous reflection.

Appendix V:
Flyers for Workshops and Mini-Conference Announcements

Part 1: Workshops Announcement

London School of Economics on 3rd July or Sheffield Hallam University on 10th July

Developing an Agenda for the use of Operational Research in Environmental Planning and Management

One-year project being undertaken by Gerald Midgley and Martin Reynolds from the Centre for Systems Studies at Hull University.

The workshops are designed to stimulate interaction between the work undertaken in operational research (and associated academic networks) and wider public, private and voluntary sectors associated with environmental planning. More specifically, the workshops will attempt to explore:

1. **the limitations as well as the possibilities of OR related disciplines in addressing issues relating to different interest groups;**
2. **possibly conflicting political agendas within the OR movement;**
3. **better working relations between OR and other disciplines in support of common objectives;**
4. **the implications of support provision with regards to possible adverse effects on particular groups and issues; and**
5. **key areas of activity that might be pursued in formulating an agenda for purposeful engagement of OR related techniques in environmental management; part of a wider objective in seeking more purposeful ways of channeling expert support.**

Detailed maps of the respective campus location will be provided to those confirming attendance. Light refreshments and lunch will be provided on the day and travelling expenses can be claimed. Each workshop is scheduled to start at 10am and finish at 4pm.

Further details of the workshop programme along with a copy of the interim report for initiating the workshops will be sent to everybody who replies. Alternatively, the full interim report can be downloaded from the OR Society Environmental Study Group web pages: http://www.orsoc.org.uk/region/index_f.html

Please confirm your interest as soon as possible by either e-mailing direct or completing the tear-off slip below and sending it to:

Dr Martin Reynolds
179 Withington Road, Manchester, M16 8EF
E-mail: martin.reynolds@ukonline.co.uk
Tel : 0161 226 6203; Fax: 0870 1316074

Name: Organisation:

Address:

e-mail or fax: Telephone:

Please reserve a place and send further programme details and location map for the London/ Sheffield workshop (please delete as appropriate)

Part 2: Mini-Conference Announcement

University of Hull 27th - 28th July

Developing an Agenda for the use of Operational Research in Environmental Planning and Management

One-year project being undertaken by Gerald Midgley and Martin Reynolds from the Centre for Systems Studies at the University of Hull

A two day mini-conference has been scheduled at Hull University to follow up on the outputs generated from two one-day workshops - one at the *London School of Economics on 3rd July* and the other at *Sheffield Hallam University on 10th July* - associated with this study on environmental planning. The aim of these workshop/ conference activities is to explore the possibilities of providing more purposeful expert support for environmental planning using 'operational research' (OR) as a special case.

The London and Sheffield workshops aim to explore answers to questions regarding (i) distinct objectives of a future agenda and associated interests which ought to be privileged (ii) resources that ought to be available in terms of information, structure, and finance for the development and maintenance of a future agenda (iii) stakeholder groups who ought to be involved, and (iv) associated skills needed for mobilising improved OR support. The workshops might also identify which components are best *left out* the remit of any future agenda. In establishing some ideal boundaries, participants will have an opportunity to define and rank relevant activities associated with developing an agenda.

The Hull mini-conference provides further opportunity for participants to consolidate and build on the outputs from the two regional workshops. The aim here is to design a purposeful and more precisely defined set of activities which can be followed up by identified stakeholders. Issues raised during conference deliberations will centre both on the desirability of activities being proposed and on the future practical implementation of such endeavours.

All those invited to the 2 regional workshops are also welcome to attend the mini-conference. In addition, we would particularly welcome activists from OR and environmentalist communities who wish to take a future part in moving the agenda forward. The event is scheduled to begin mid-day on Thursday 27th July and will finish mid-afternoon on Friday 28th July. Board and lodging for the night of 27th will be provided free of charge and travelling expenses to and from Hull can be claimed.

Further details of the programme along with a copy of the interim report for initiating the workshops can be passed on to interested parties. Please confirm your interest as soon as possible to:

Dr Martin Reynolds
179 Withington Road, Manchester, M16 8EF
E-mail: martin.reynolds@ukonline.co.uk
Tel : 0161 226 6203
Fax: 0870 1316074

Appendix VI:
Three Agendas Realigned
(from Regional Workshops Output)

Part 1: Agenda 1: Develop Operational Research (Issues of Methodology)

1.1 Purposes and Beneficiaries

*1.1.1 What purpose(s) should be pursued? ('**transformation**')*

- Recognise OR as a (leading) engine for (critical, review, development, testing) of structured approaches to facilitating decision/ action-oriented communication among parties either engaged in or excluded from debate on issues of (public/emergent) environmental concern
- Promote OR as a major agent for change and development with regards to sustainability
- Define framework of OR to foster sharing of ideas and experiences and promote best practice
- Develop toolkit which transcends disciplinary boundaries; assess influences that benefit/damage environment and the extent to which they do so; propose methods for creating sustainable development (economic, social, environmental) and evaluate impact into the future
- Identify weaknesses in prevailing OR/ environmental planning
- Release creative energy of OR in pursuit of better environment
- Challenge environmental planning community via unique techniques of OR
- Produce scientific facts /figures which may be used as a resource for decision makers who consider environmental issues; encourage consideration of issues
- Target key groups who could take on OR (town planners and environmental planners from all 3 sectors, community groups)
- Make sure OR is 'robust'/ soundly based
- Recognise that recording what you don't do is as important as what you do
- Recognise underlying chaos paradigm
- Recongnise 'chaos' and bring in 'the personal/individual' to merge meaningfully with the 'social/cultural/economic' and the 'environmental' (globalise 'the personal')
- Define a useful methodology for gathering community (?) needs/wishes (consultation/ needs assessment)
- Promote better and more challenging modelling
- Deal with timeframe issues
- Develop processes for achieving collective ambitions - from agreed objectives to idiosyncratic visionary ideals; providing mechanisms to address and incorporate progressive changes

*1.1.2 Who should benefit? ('**clients**')*

'immediate'	'ultimate'
• OR community • OR Society • OR students (especially non-commercially oriented)	• environmental planning community • people impacted ('victims') • people/ interests otherwise excluded (e.g., tribal people) • earth in general • decision makers/takers (where these are different from environmental planners)

1.1.3 How will you know if the purposes are being realised? i.e., *measures of success ('**transformation**')*

• Increased visibility of OR • Study group meetings with environmental managers • Increased take-up of 'our' resources (OR Society or 'movement' or wider resources?) • OR Society memberships/affiliations from environmental management • Developed web-page with appropriate links	• Number of 'hits' on web page • JORS special issues • Environmental Management Journal special issues • Conference streams • University courses • Take up of courses

1.2 Inputs Required and Decision Makers

1.2.1 What resources are needed in order to pursue the purposes?
• People! find out who to involve and where they can make a difference • Environmental managers needed for credibility • A supporting institute (e.g., OR unit for sustainable development); only if there is a proven market for OR in this area • Resources from Europe • Environment Council • Research Councils

*1.2.2 Who should take decisions in pursuit of the purposes?('**owners**')*
• Hierarchy in OR Society (issues of accreditation in being associated with ORS) and influential figures in environmental management • If it's unsuccessful, people will stop using it! i.e., built-in obsolescence.

*1.2.3 Are there specific things that those taking the decisions should not have any control over? ('**environment**')*
• Other disciplines and practices should be enabled to counter as a 'watchdog' to check against any tendencies towards dogma or elitism of OR. • User groups must be allowed to make up their own decisions regarding uptake of OR developments

1.3 Expertise (skills needed)

1.3.1 What types of expertise will be necessary to pursue the mission?		
technical/disciplinary based skills (assimilating information)	facilitating skills (fostering communication/interaction)	critical skills (reflective practice)
• Marketing • Computer skills	• Education/ teaching	• Reflective practice/ evaluation to reduce risk of self-destruction

*1.3.2 Who should constitute the experts? ('**actors**')*
• Focus group associated with OR Society study groups (environment, social…) • Explore synergy between environment, COR, and development 'units' and study groups

1.3.3 By what criteria might the expertise be evaluated?		
technical/disciplinary based skills (assimilating information)	facilitating skills (fostering communication/interaction)	critical skills (reflective practice)
• Competent knowledge of weaknesses in environmental planning • Technical competence in assimilating information	• Wide ranging volunteer participation in OR Society • Enthusiasm/participation of outside user groups	

1.4 Values and effects

1.4.1 Who is affected but not involved?
• Developed OR oriented methodologies may affect other stakeholders not anticipated in early stages • Environmental pressure groups, consumer groups, welfare groups, trades unions…? • Environmental planners not conversant with, or suspicious of, OR methodologies

1.4.2 Should the affected be free to remove or counter the effects—how should this be managed?
• N/A: people are automatically free to decide! (NB. not so sure if 'affected' are defined properly here!) • Need to work together with planning departments etc. • Need pilots to test new methods

1.4.3 Values underlying motivation ('world view')
• The over-arching goals • Working in the public interest • Working in the interest of specific vulnerable groups; nature, future generations, oppressed groups • OR has something to contribute towards, and something to learn from, wider society • OR has significant potential for uncharted territories

Part 2: Agenda 2: Promote Interaction (Issues of Interdisciplinarity and Pluralism)

2.1 Purposes and Beneficiaries

2.1.1 What purpose(s) should be pursued? ('transformation')
• Promote and explore the idea of 'better" environmental decisions! • Promote inclusive participation and serendipity (accidental discoveries!) • Address connections and relationships • Identify potential in other disciplines or working situations which might articulate with OR • Promote better and more challenging modelling for other users • Energise debate (promote a buzz factor) • Define common agenda to get beyond language complexity and draw in others to do this • Nurture a flexible approach • Promote tolerance? openness? listening? (these may not be the right words…) (i) between factions (political, academic/practical, disciplines)(ii) for lots of different voices and (iii) amongst differing epistemological standpoints

2.1.2 Who should benefit? ('clients')	
'immediate'	'ultimate'
• OR community • Environmental planners • Disciplines outside of OR	• Human and non-human • Wider community • "Distributive justice" • Environmentally disadvantaged • Future generations

2.1.3 How will you know if the purposes are being realised? i.e., *measures of success ('transformation')*
• Different methods • Wider boundary of participation • Increase in referrals (formal and informal) • Critical co-option of OR techniques by others • Mutual respect between participants

2.2 Inputs Required and Decision Makers

2.2.1 What resources are needed in order to pursue the purposes?
• Co-ordinator • Outside facilitator • Network of communication • Finance for meetings, 'conferences' (not just academic) • Time!

2.2.2 Who should take decisions in pursuit of the purposes?('owners')
• OR Society • OR community & pro-active interest groups

2.2.3 Are there specific things that those taking the decisions should not have any control over? ('environment')
• Prioritisation of findings • Use of OR • Vehicles of dissemination (choice of journals/ newsletters etc.) - not co-opted by academics

2.3 Expertise (skills needed)

2.3.1 What types of expertise will be necessary to pursue the mission?		
technical/disciplinary based skills (assimilating information)	facilitating skills (fostering communication/interaction)	critical skills (reflective practice)
• Local knowledge is valuable • Talk in terms of 'specialisms'? or expand the meaning of expertise • Making distinction between 'expertise' and 'experts' is important	• Expertise of different kinds feeding into each other • Use virtual technology to keep all groups aware of others	• Make distinction between professional and non-professional

*2.3.2 Who should constitute the experts? ('**actors**')*
• multiple disciplines • Someone who maps expertise • Someone who helps develop shared language

2.3.3 By what criteria might the expertise be evaluated?		
technical/disciplinary skills (comprehensiveness and/or degree of 'disinterestedness')	facilitating skills (types of stakeholder interaction being facilitated)	critical skills (agenda items demanding particular continuous reflection)
• Scope of disciplinary knowledge enlisted • Numbers of participants enlisted • Transparency of limitations/ value-judgements implied	• Accessibility • Range of stakeholder/ interest group involvement • Quality of communication between interest groups	• Monitoring of technical and facilitating skills • Humility and deference to opinions of other involved stakeholder groups

2.4 Values and effects

2.4.1 Who is affected but not involved?
• Public groups not conversant with discourse on environmental management but otherwise affected by plans • Disciplinary purists who envisage contamination/encroachment of traditional robust disciplinary standards

2.4.2 Should the affected be free to remove or counter the effects—how should this be managed?
• Public groups should not feel alienated through hegemony of 'experts' • Purists need encouragement to broaden disciplinary scope

*2.4.3 Values underlying motivation ('**world view**')*
• OR can benefit from, as well as contribute towards, other related purposeful activities in the field of environmental planning

Part 3: Agenda 3: Promote Public Participation (Issues of Accountability)

3.1 Purposes and Beneficiaries

3.1.1 What purpose(s) should be pursued? ('transformation')

- Structuring decision making dialogue with all parties involved (especially voluntary sector and community)
- Promote involvement of individuals but more (?) importantly promote change in individual lifestyles
- Develop processes for achieving collective ambitions - from agreed objectives to idiosyncratic visionary ideals; providing mechanisms to address and incorporate progressive changes
- Deal with issues of accountability in creating the future (public sector and future generations)… Keep an eye on the plot!
- Energise debate (promote a buzz factor)
- Define a useful methodology for gathering community (?) needs/wishes (consultation/ needs assessment)
- Use 'stakeholder' (all) involvement to bring power (political issues) to the forefront of our involvement
- Improve listening abilities
- Involve people in OR activities and be relaxed about how it's done
- Foster a gradual awareness of OR
- Ensure that academic language is not a barrier
- Evaluate knowledge
- Develop humility
- Disseminate 'honest-broker' role to public in non-technical summaries

3.1.2 Who should benefit? ('clients')

'immediate'	'ultimate'
• ordinary people should be able to learn to ask effective questions (including technical questions) • decision makers will learn from participation (e.g., reciprocal outreach)	• Not applicable! (?)… • Non-participants (extreme marginalised groups e.g., severely disabled, 3rd World countries etc.) • Future generations • Nature

3.1.3 How will you know if the purposes are being realised? i.e., *measures of success ('transformation')*

- Community competence
- Getting negative feedback - provoked reaction!
- Discomfort in 'mainstream' OR factions
- Change in boundaries of participation - more and new people
- Referrals - (indicates usefulness)
- Problem ownership in community (but with an open welcoming dimension)

3.2 Inputs Required and Decision Makers

3.2.1 What resources are needed in order to pursue the purposes?

- Removal of long hours work culture to give people more time
- Compensation for time given
- Range of funders with range of interests
- 1 person co-ordinator/ facilitator
- Crèche
- Neutral facilities (not academic… too skewed)

3.2.2 Who should take decisions in pursuit of the purposes?('owners')

- Steering group
- Representatives of agencies
- Local community

3.2.3 Are there specific things that those taking the decisions should not have any control over? ('environment')
• Co-ordinator needs autonomy • Web-site for people to contribute

3.3 Expertise (skills needed)

3.3.1 What types of expertise will be necessary to pursue the mission?		
technical/disciplinary based skills (assimilating information)	facilitating skills (fostering communication/interaction)	critical skills (reflective practice)
• Local knowledge is valuable • Talk in terms of 'specialisms'? or expand the meaning of expertise • Making distinction between 'expertise' and 'experts' is important	• Expertise of different kinds feeding into each other	• Make distinction between professional and non-professional

3.3.2 Who should constitute the experts? ('actors')
• Other disciplines - but important to stick to the issues • Someone who maps expertise • Someone who helps develop shared language

3.3.3 By what criteria might the expertise be evaluated?		
technical/disciplinary skills (comprehensiveness and/or degree of 'disinterestedness')	facilitating skills (types of stakeholder interaction being facilitated)	critical skills (agenda items demanding particular continuous reflection)
• Scope of public interest group engagement • Numbers of participants enlisted • Transparency of interests demonstrated	• Public accessibility • Quality of interest group engagement	• Monitoring of technical and facilitating skills • Humility/ deference to outside opinion

3.4 Values and effects

3.4.1 Who is affected but not involved?
• OR and other related disciplinary experts with a highly developed and complex specialism (e.g., algorithm specialists)… difficulty with dissemination • Marginalised groups not able to give expression (either direct or indirect); e.g., severely disabled or remote dwellers

3.4.2 Should the affected be free to remove or counter the effects—how should this be managed?
• Disciplinary specialists need encouragement and support to translate complexities into understandable language • Specialists need to be responsive to outside social concerns/fears/misapprehensions • Environmental planners (including OR specialists) must seek out affected groups

3.4.3 Values underlying motivation ('world view')
• OR needs general public legitimacy if it is to provide purposeful support to environmental planning

Appendix VII:
Executive Summary of a Study on Sustainable Development Research: Gaps and Opportunities (DETR Commissioned Report)

Department of the Environment, Transport and the Regions
Sustainable Development Research: Gaps and Opportunities

Study Context

The Strategy for Sustainable Development, published by the government, aims to integrate economic, social and environmental policies (the three pillars of sustainable development) to improve the quality of life for everyone, now and in the future. The integration of policies to this end is a formidable task, not least because of major tensions between policy objectives and because of the implied need to consider radically new ways of influencing social and economic behaviour.

The Sustainable Development Unit (SDU) in DETR, is charged with supporting sustainable development (SD) by encouraging public policy makers to make the links between their policies and SD, and to revise policy where it is necessary in order to better contribute to sustainable development. To discharge this responsibility the SDU needs to understand:

i) where and to what extent policies across government relate to SD;
ii) if there is a requirement for additional analyses to improve policy; and
iii) if existing research is sufficient in offering the necessary policy support and insight

This in turn means that the SDU needs to have a continually up to date view (map) of existing and potential SD policy issues, and of relevant research. Relevant research in this context is research that addresses at least two of the three pillars and is therefore potentially supportive of the integration of policy. If the SDU has such a map it is therefore able to identify research gaps and opportunities capable of supporting SD policy making. On the basis of identified gaps, the SDU can make recommendations and proposals to representatives of the policy and research communities, to address the gaps. The SDU itself does not have the resources to undertake the necessary research, but can engage with policy makers and researchers in order that gaps are addressed.

The Purpose of the Study

This Study builds on the current work of the SDU to integrate SD into public policy making, and begins the process of policy and research mapping and engagement that the SDU, with the support of public policy makers and the research community, hopes to foster and continue. The work has been directed to:

* Developing a framework and tools for the SDU to use, to map public policy and related research to identify and communicate research gaps;
* Providing recommendations to the SDU as the basis for mapping of policy and research, and the identification of research gaps and opportunities;
*Defining an initial list of research gaps relating to SD policy;
*Identifying an initial list of research centres actively undertaking research relevant to SD.

The Framework and Tools for Mapping

The framework has essentially two parts: links between the SDU and public policy makers, for policy mapping; and links between the SDU and the research community for research mapping. Policy mapping is concerned with identifying policy questions important to SD which require additional

analyses and insight. The study has identified a number of possible heuristic tools for organising an understanding of the important relationships and questions posed by SD, which then allow policies to be examined for their links to SD.

Research mapping is concerned with identifying the existence of policy relevant research, given the policy questions. In the light of this mapping, gaps and opportunities for further research can be identified. The main tools are better communication methods with the research community to allow the map to emerge from information supplied by the research community (passive mapping); and the use of research syntheses and Concerted Actions to search out the extent of research and information for a given policy question (active mapping). Concerted Actions comprise researchers and policy makers actively working to synthesise the state of the art as a basis for new policy. The recommendations to translate these tools into practice are:

* Policy Mapping

1. Review and test different logical frameworks for mapping policy developments in terms of their importance for SD. Test in relation to different stages in the policy cycle;
2. Continue to establish links between policy objectives/targets of DETR and other government department policy directorates, and SD policy objectives/indicators;
3. Continue to integrate and promote policy appraisal by Departments (using established guidance) against economic, social and environmental criteria. Again test in relation to policy cycle stages. Review appraisal results with individual directorates (perhaps by using the headline indicators);
4. Produce a bi-annual report highlighting policy issues with strong SD links and the risks and benefits from the links and the results of policy appraisals. Specify policy questions for possible inclusion on the policy-research agenda;
5. Hold an annual SD policy forum of policy makers and representatives of the research community (co-ordinated with the Commission for SD) to review, disseminate and update the policy-research agenda.

* Research Mapping

1. Build on the initial list of research centres identified in the study to maintain an up to date catalogue of relevant centres and programmes. To reduce the load on SDU, centres and programme managers should be invited to submit annual updates on research interests and work completed;
2. Complement the catalogue of interests and work completed with an intranet for registered researchers, on which research outcomes would be collected for web publication;
3. Maintain a list of key experts and co-ordinators, based on the previous two recommendations, capable of conducting commissioned syntheses of research areas;
4. Map research using selected syntheses of the state of the art, as a basis for initial policy insight, and as a basis for scoping future research requirements. Set up a synthesis in relation to a preferred topic selected with a chosen policy directorate to test the approach;
5. Institute a research database where details (e.g., research scope and outcomes, quality assessment) of all government contracted research is held and cross-referenced. Given the potential scale of this task it may be helpful to expand the DETR research newsletter through co-ordination with other government departments;
6. Institute a bi-annual meeting of government research programme managers, supported by a Round Table of external experts, to review latest research findings relevant to SD, and of planned research to check whether ToR can be improved from an SD perspective.
7. Initiate a Concerted Action (e.g., in relation to Factor 10 issues) to test the approach and to begin to build closer links between research and policymakers;
8. Identify the methods used by different government departments to set up and define research programmes, and the opportunities for participation in programme design and evaluation. Links to the suggested database should be considered;
9. Review links with NGOs and business research (including research foundations) as a basis for improving the mapping of research directions and outcomes;
10. Examine links and possible initiatives with the Research Councils to address concerns over the limited scope for multi-disciplinary research, and to improve dissemination of completed work. Explore the development of a new portal linking relevant Research Council Programmes and projects.

Research Gaps and Explanations

Existing research gaps and opportunities, capable of improving SD policy making, have been identified from interviews and surveys of research centres interested in SD. Explanations for the research gaps include: (i) the lack of policy questions (e.g., the limited interest in integrating social and environmental policy); (ii) the influence of economics as the predominant discipline for syntheses of the three pillars; (iii) the complexity and uncertainty surrounding SD issues; and (iv) difficulties of establishing and publishing multi-disciplinary research.

The gaps identified are wide ranging, but can be grouped in relation to three important questions raised by SD policy:
* How big is the problem of sustainable development? The main research need relates to a more detailed analysis of the scale of material and energy resource efficiency required to achieve given environmental targets and objectives, following the "Factor 10" debate, and recent work to consider the time required, on current or planned trends, to achieve specified targets. The new work would seek to better understand the requirement for resource efficiencies in terms of the scale and timing of technology changes, and the attendant changes in behaviour. It would also seek to understand the changes in terms of whether incremental or step changes are required and the attendant social and economic impacts.
* Which groups of policies give rise to significant tensions, and hence where are attempts to reconcile and integrate policies most important for SD policy? One gap identified were in the reconciliation of social concerns with environmental resource efficiency, especially in relation to transport, fuel use and fuel poverty. The social consequence of environmental taxes, and the need for additional measures, was highlighted. Another area identified was that between global trade and environmental protection. The conflict between policies for economic growth based on a continued expansion in international trade and international environmental objectives for climate change and biodiversity was also highlighted.
* What institutional change is required for SD policy making, implementation and evaluation? One gap identified was the need to examine the ability of existing institutions to implement measures that represented a significant departure from current activity. The inability of institutions to challenge the status quo represents a potentially important obstacle to step changes in policy. One set of issues relates to the concept of technological "lock-in," where existing institutional structures prevent challenges to prevailing technologies and the development of new ones. Agricultural technologies are cited as a case in point.

Concluding Remark

In the light of the study it is clear that the future role of the SDU in discharging its remit is one of mapping, synthesising and communicating research needs. It is not feasible for the SDU to undertake the research itself or to pay for it. It is only through a process of dialogue, with policy makers and the research community that research gaps can be identified and addressed. The study has identified possible tools and techniques for the necessary policy and research mapping; and has also begun the process of engagement with the research community. The recommendations provide an initial step in building the necessary relationships.

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