

Planning for the Strategic Management of South  
Africa's West Coast Rock Lobster Fishery:  
An Integrated Approach to Group Decision Support

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“They employ violence,  
so that bloodshed follows bloodshed.  
Therefore the land mourns,...  
And also the fish of the sea disappear.”

Hosea 4, verses 2-3<sup>1</sup>

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<sup>1</sup> From the New American Standard Version of the Bible.

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# Synopsis

*“Strategic planning is a leadership and management innovation that is likely to persist because, unlike many other recent innovations, it accepts and builds on the nature of political decision making. The raising and resolving of important issues is at the heart of political decision making, just as it is at the heart of strategic planning.” [Bryson (1995) p.20]*

As Bryson (1995) points out, strategic planning is particularly useful for assisting organisations and communities to deal with change. This study was carried out at a time of great change in South Africa, when a new fisheries policy was being formulated and negotiated. The research describes an intervention with a group of fisheries managers, scientists, fishing company directors and other key stakeholders, in planning for the future management of the West Coast Rock Lobster fishery.

The primary objective of the study was to consider an integrated approach to group decision support, incorporating a particular soft-OR approach, SODA<sup>1</sup>, together with multi-criteria decision analysis (MCDA). An integration of these two approaches has recently been suggested by researchers, for several reasons. Firstly, different phases of an intervention usually involve different tasks. Secondly, mixing methodologies will enable different aspects of the problem to be modelled and analysed.

SODA was used at the outset, for divergent exploration and structuring of the problems surrounding the development of an operational management procedure (OMP) for the fishery, including more subjective and qualitative information. Several stakeholder groups opposed the idea of an OMP in the form in which it was proposed. The emphasis at the early stages of the intervention was on engendering a strategic thought process. During this process, the broader aspects of the fishery, and problem issues impacting on management decisions, were considered. A few areas of concern which arose, and were explored, are:

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<sup>1</sup> Strategic Options Development and Analysis

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1. the poaching problem,
  2. allocation of access rights to previously disadvantaged communities (under the government's Reconstruction and Development Programme (RDP)),
  3. the need to include qualitative information in decisions.

Our intention was to use the SODA model as input into a 'decision conference', where MCDA could provide further structuring of values and preferences, as well as assisting with the evaluation and negotiation of alternative OMP's. In this way, the judgements between conflicting objectives could be made explicit.

## **Key issues in fisheries management**

Fisheries management is, at the best of times, a complex task. Managers continually wrestle with uncertainty and multiple conflicting objectives. Whilst ensuring the continued preservation of fish stocks and their environment, fisheries managers need to embrace the economic and social implications of their decisions. Fisheries management in the past has generally been preoccupied with biological objectives, with little explicit regard for economic and social factors, or input from other disciplines. Several researchers have proposed MCDA as a means to dealing with the conflicting objectives in fisheries management decisions. Their proposals have generally been met with criticism, mainly on the grounds of the complex dynamics of the decision process, requiring negotiation and bargaining.

Past research in decision analysis has often assumed as it's starting point a semi- or well-structured problem. In practice however, organisational decision makers frequently disagree on the formulation of problems, and consequently also on appropriate solutions, or the methodologies to be used in developing solutions. Soft-OR methods, like SODA, were developed by OR consultants for this very reason; to help clients to make more sense of the ill-structured, and often subjective, decision problems encountered.

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## The SODA approach

Ten participants were interviewed using the cognitive mapping technique, to articulate and structure problem issues which they were concerned about. In phase two, a strategic workshop was held, in which the merged SODA model was explored and updated through negotiation.

The underlying philosophy of SODA is that in ill-structured problems, each person has an idiosyncratic perspective of the problem, and that by bringing together different perspectives, a richer problem definition is formed. Sharing of information is often neglected in organisational decision-making. Competing proposals are frequently put forward without much explanation of the thought processes by which they were arrived at. By incorporating multiple perspectives in the problem definition, individuals often shift their views towards a broader, shared understanding as they 're-interpret their world'. Inclusion of all perspectives also encourages creativity and innovation, and challenges decision makers to think beyond the repetitive thought patterns associated with heuristics and biases.

The primary emphasis in SODA is on facilitating consensus through negotiation. SODA concentrates not only on the problem issues themselves, but also on facilitating a negotiation *process*. For this reason, the SODA approach was developed through careful consideration of the organisational politics and psychological factors which influence not only each individual's perspective, but also how they communicate their perspectives to the rest of the group.

## Integrating SODA and MCDA

Translating the SODA map into an MCDA model was no simple task. Value Focused Thinking (VFT) eased the transition and assisted in interpreting the SODA model within an MCDA framework. In particular, VFT proved invaluable for bounding the decision context. The exploratory nature of the SODA process had led to an extremely broad formulation of the conundrum. Using concepts from Keeney's (1992) VFT, the problem was reformulated in terms of the effective operation of the West Coast Rock Lobster Working Group

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(WCRLWG), the working group responsible for scientific advice relating to the fishery. A set of fundamental objectives was identified as a guiding principle for future WCRLWG decisions. Surprisingly, there was significant consensus on this set of objectives. This offers potential for future work; in particular, to consider ways of improving decision-making in the WCRLWG, by generating alternatives and decision opportunities using VFT.

The fact that VFT proved useful in the intervention is not surprising, given the significant contribution it has made to problem structuring in MCDA. However, several similarities between SODA and VFT were identified, which give some clues as to why VFT was useful in translating the SODA model.

Due to the tight deadline for the implementation of the OMP, we were unable to carry out a decision conference. However, a paper exercise was conducted to simulate a decision conference. This exercise showed how the problem structuring phase prior to that point could inform the construction of an operational MCDA model. The eventual MCDA model covered a small section of the original problem explored in SODA. It's focus was on the evaluation of various OMP alternatives. However, it is clear that insights in the SODA model should provide a back-drop, and be borne in mind in evaluating alternatives in a decision conference.

## **Conclusions and recommendations**

Many researchers have emphasised the need for negotiation and bargaining in fisheries management. We found that SODA and MCDA provided an effective framework for structured negotiation. The intervention facilitated an intensive exchange of information; often a prerequisite for successful negotiations. A great deal of qualitative information was brought to bear on the OMP decision in a structured and meaningful way. In practice, negotiators often conceal their thoughts and strategies, for tactical reasons. It was our experience, that SODA brought the issues into the open, and by so doing, encouraged a learning process.

Even though consensus on many issues was not attainable, an important benefit was that the intervention engendered participation and transparency. Participants appreciated the fact that

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their views were considered and incorporated in the analysis. As a result, SODA was particularly effective in securing participation and commitment to the intervention process.

There is much scope for future research on the integration of soft-OR and MCDA methods. SODA and MCDA stem from significantly different philosophies of providing help in management science consulting. Future research needs to consider the effect of employing two quite different philosophies of decision support within a single intervention, as well as the practical compatibility of the two. In considering both of these questions, it will also be important to consider consultant style.

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## List of Abbreviations

1. **AHP** - Analytic Hierarchy Process
2. **BATNA** - Best alternative to a negotiated agreement
3. **CPUE** - Catch per unit effort
4. **DA** - Decision analysis
5. **EIS** - Executive information system
6. **GDSS** - Group decision support system
7. **MCDA** - Multi-criteria decision analysis
8. **MEY** - Maximum economic yield
9. **MS** - Management science
10. **MSY** - Maximum sustainable yield
11. **NSS** - Negotiation support system
12. **OMP** - Operational management procedure
13. **OR** - Operational research
14. **OY** - Optimum yield
15. **PCT** - Personal Construct Theory
16. **SFAC** - Sea Fisheries Advisory Council
17. **SFRI** - Sea Fisheries Research Institute
18. **SODA** - Strategic Options Development and Analysis
19. **TAC** - Total allowable catch
20. **VFT** - Value Focused Thinking
21. **VISA** - Visual Interactive Sensitivity Analysis
22. **WCRLWG** - West Coast Rock Lobster Working Group

## Chapter 1

# Introduction

## 1.1. Background to the study

Until recent years, the task of structuring complex and messy problems in management science was considered more an art than a science, and left largely up to the skill and experience of the analyst. Much of the research in decision analysis, for example, assumed as its starting point a semi- or well-structured problem. However, in practice, due to different views and perspectives, organisational decision-makers frequently disagree on the formulation of problems, objectives, constraints, and consequently appropriate solutions. Increasingly, management scientists recognised the need for the development of group decision support approaches for assisting with management decision-making.

Several 'soft-OR' approaches were designed by OR consultants to engender strategic thought, and help their clients to better manage the subjective, and often politically charged, problems encountered in organisational decision-making. More recently, a few researchers within the MCDA community have suggested an integrated, "more mature" approach to group decision support, incorporating both soft-OR and multi-criteria decision analysis (MCDA) methods. If successful, the integration of soft-OR and MCDA will assist facilitators to effectively manage both the group decision *process*, as well as the *content* of complex decision situations. Furthermore, by combining both approaches, the management scientist will have the tools necessary for modelling qualitative information, in addition to the more traditional quantitative analyses.

This research centres around an intervention with a group of fisheries managers, scientists and key stakeholders, conducted over a period of approximately fifteen months (between March 1996 and July 1997). The particular focus was on the development of an operational

management procedure (OMP<sup>1</sup>) for South Africa's west coast rock lobster fishery. It was carried out at a time of great change and transition, when a new fisheries policy for the country was being formulated and negotiated. As consultants, our task was to structure the messy problems facing the scientific working group upon whose recommendations management decisions are taken. Fishing company directors, government officials, scientists, labour union representatives and informal fishermen were all included in a strategic planning process. Both soft-OR and MCDA approaches were used to provide group decision support to this diverse range of interest groups.

The arena of fisheries management is renowned for conflict and complexity, and did not fail to provide several challenges to us as consultants. Although several researchers have vehemently forwarded the potential use of MCDA in fisheries management decisions, very few cases of successful application thereof have actually been reported. Working with a group consisting of representatives from diverse organisations and interest groups, proved particularly challenging.

## 1.2. Objectives of the study

The primary objectives of the research were to consider:

- i) the use of group decision support systems (GDSS's) in a fisheries management context, and
- ii) ways of combining a particular soft-OR approach (SODA) together with MCDA, in an integrated approach to management science consulting.

The initial focus was on structuring the problem issues surrounding the development of an OMP for the west coast rock lobster fishery. Our intention was to get representatives from the various interest groups around the table together; to engender a participatory process, and consider a broad spectrum of views in constructing a 'rich', negotiated model of the problem environment. The SODA approach, and its associated software GraphicsCOPE, were used for this purpose. A strategic workshop was held with the aim of facilitating a learning process,

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<sup>1</sup> An OMP is defined in the government white paper 'A Marine Fisheries Policy for South Africa' (May 1997) as: *a scientifically evaluated process which defines the manner in which the available data on a resource are used to determine the level of a control measure such as a TAC (i.e. the total allowable catch for a given fishing season), thereby incorporating a harvesting strategy.*

whereby participants could view diverse perspectives of the problem situation, and negotiate around key issues. The SODA model could then serve as an executive information system (EIS).

It was envisaged that the SODA model would serve as input to an MCDA exercise, to further structure the problem by considering decision-makers' values and preferences in the evaluation of alternatives. A decision conferencing approach was to be used, to encourage further negotiation of the problem, and foster an explicit consideration of trade-off judgements.

### **1.3. Statement of the problem**

#### **1.3.1. Issues facing the west coast rock lobster fishery**

As in most fisheries world-wide, the South African rock lobster fishery is fraught with complexities and conflict. In addition to ensuring the sustainability of fishing resources, decision-makers are increasingly required to weigh up the political, economic and social aspects of fisheries in a transparent and participative way. This is a difficult task in light of the great uncertainties inherent in biomass estimates and projections of future resource productivity. Management decisions typically impact upon numerous stakeholder groups, and there is a powerful lobby for less bureaucracy, and more stakeholder participation, in management.

Although the west coast rock lobster fishery is relatively small in monetary terms, lobsters are a high value resource, with most of the catch being exported. In recent years, scientists were dumbfounded by strangely low somatic growth rates measured in lobsters. The low growth rates ("believed to be a result of an unknown environmental anomaly") placed considerable pressure on the resource and fishing industry, with total allowable catches (TAC's) declining significantly over the past decade. As a result, the industry were forced to scale down their operations, and lay off employees. Poaching also presents a major problem at present, with illegal and recreational catches growing at a considerable rate. It is estimated

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<sup>1</sup> From the government white paper "A Marine Fisheries Policy for South Africa" (5 May 1997)

that they together account for approximately 50% of the current annual catch. The poaching problem is exacerbated by a lack of effective policing, due to funding shortages. To make matters even worse, hundreds of tons of lobster were lost in the 'walk outs' of 1997, caused by low oxygen levels in the water.

In October 1994, the then Minister of Environmental Affairs and Tourism appointed the Fisheries Policy Development Committee (FPDC) to draft a new fisheries policy for South Africa. This committee included representatives from all the various stakeholder and interest groups. After almost two years, a draft policy was submitted to the minister, articulating the main policy objectives and principles. The new policy guidelines did not go untouched by the government's Reconstruction and Development Programme (RDP), aimed at rectifying the wrongs of the apartheid past.

Based upon the FPDC document, a government white paper<sup>1</sup> was published in May 1997. Two strategies which clearly emerge from the white paper are i) the need to redistribute access rights to previously deprived communities and ii) the need to develop OMP's for managing the various fisheries. As shall be discussed in Chapter 6, one of the primary objectives of developing an OMP for the west coast rock lobster fishery, was to set in motion a systematic and long-term stock-rebuilding strategy. The white paper stresses that long-term management plans, including OMP's, are to "be developed through a co-operative process involving all interested parties", and consider socio-economic issues.

The issues facing the South African fisheries are in many respects similar to those experienced in the US and Canada. With the passing of the *Magnuson Fisheries Conservation and Management Act* (MFCMA) in the US, and publication of the *Policy for Canada's Commercial Fisheries* in 1976, fisheries managers were officially required to consider a broader set of social and economic objectives, in addition to conservation. The MFCMA also led to the decentralisation of decision-making structures, in order to accommodate social and economic objectives on a more regionalized basis. More recently, the Aboriginal Fishing Strategy in Canada (linked to land claims negotiations) was developed to ensure greater participation of First Nations people in fisheries, and the management thereof. However, in past years, confusion arose as to the precise meaning of the various

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<sup>1</sup> "A Marine Fisheries Policy for South Africa" (5 May 1997)

policy objectives, and how they should be achieved in practice, both in the US and Canada. Particular difficulties arose in deciding how to make trade-offs between the multiple and conflicting objectives.

*"Fisheries management has been more preoccupied with tactics than with strategic planning. Objectives have been broad, ill-defined, and in many cases not operationally feasible. Strategies, where they have existed, have been cast aside or ignored in times of crisis or dispute" [Stephenson & Lane (1995)].*

### 1.3.2. Decision making structures

The management of marine resources in South Africa is the responsibility of the Chief Directorate of Sea Fisheries (SF), a subsidiary of the Department of Environmental Affairs and Tourism.

Several boards and committees are involved in various aspects of the decision-making process. Scientific advice is provided through the Sea Fisheries Research Institute (SFRI). The SFRI frequently consult the expertise of scientists in academia to assist in formulating total allowable catch (TAC) recommendations. The Sea Fisheries Advisory Council (SFAC) then consider socio-economic information, together with the purely scientific recommendations of the SFRI, before submitting their recommendation to the Minister of Environmental Affairs and Tourism. Once he/she has decided on the TAC for the following season, the Quota Board is responsible for deciding on how to distribute the TAC between stakeholders.

Our involvement was primarily with the scientific working group responsible for advising on the west coast rock lobster fishery in the SFRI, called the West Coast Rock Lobster Working Group (WCRLWG). This group consists of scientists from SFRI and academia, as well as independent scientists hired by the fishing industry. In order to structure the problems surrounding the development of an OMP, representatives from various sectors of the fishing industry and other users, as well as the director of SFRI were also involved in this research.

## 1.4. Plan of the thesis

A review of relevant literature is contained in Chapters 2 to 5. Chapters 6 and 7 discuss our intervention 'in the field'. Finally, conclusions and recommendations are documented in Chapter 8.

Chapter 2 considers past and present paradigms in fisheries management, as well as some of the problems facing fisheries management in practice. It also reviews proposals for using MCDA in supporting fisheries management decisions, and criticisms thereof. This leads into Chapter 3, which addresses the need for problem structuring and effective management of group process in management science. Past and current trends in management science (and MCDA in particular) are discussed.

Chapter 4 takes a deeper look at the context within which strategic decision-making takes place. This context is considered from three perspectives: i) how individuals construe problems and behave in organisations, ii) the need for groups, how they function, and different types of groups, and iii) the role of the consultant, including issues of personal style and philosophy. This provides an introduction to Chapter 5, which looks at past research on problem structuring in management science. The SODA approach is discussed here.

Chapter 6 discusses the first part of the intervention, where SODA interviews and workshop were held to structure the problem in a strategic and participative manner. Chapter 7 looks at the latter part of the fieldwork process; our attempt to interpret the SODA model within an MCDA framework. Some of the problems encountered are raised, as well as solutions found for dealing with them.

# Literature Review

*“science has a mature methodology for testing causal hypotheses, but a very immature methodology for formulating proper hypotheses” [Ackoff (1962)]*

On reviewing past research in fisheries science and management science a striking parallel emerges. Traditionally, both fields have adopted mathematically intensive approaches to decision support. These mathematical approaches have dominated, with relatively little attention given to the more qualitative issues, such as the human behavioural, social and organisational aspects of decision-making [Bouyssou et al (1993), Lockett et al (1997), Bryson (1995), Hilborn (1992), Stephenson & Lane (1995)]. The management science literature has, until recent years, paid relatively little attention to the decision-making process and context [Drucker (1974), Eden (1990a), Ostanello (1997)], or to *how* the techniques have been (and could be) used in different decision contexts [Cropper (1990)].

As a result, these quantitative methods in fisheries science and management science have often failed to completely and adequately model the decision environment, and critical issues which could otherwise have influenced management decisions, have been neglected or ignored [Rosenhead (1989), Drucker (1974), Stephenson & Lane (1995)]. Fisheries science has traditionally concentrated on the biological aspects (population dynamics) of the fish stocks concerned [Hilborn & Walters (1992), King (1995)]. Economic, social and other aspects of the fisheries have, on the other hand, been dealt with in a rather ad-hoc manner. As a result, several researchers have stressed the need for, and importance of, negotiation and bargaining in fisheries management decisions [Leschine (1988), Marasco & Miller (1988)].

Both fisheries management practice and traditional OR/MS methodologies have been criticised as being conceptually naive and neglecting the ‘messy’ realities of fisheries and management issues [Ackoff (1981), Leschine (1988)]. There have been numerous calls, even pleas, for conceptual change in both fisheries management paradigms [Stephenson & Lane (1995)] and OR/MS practice [Woolley & Pidd (1981), Ackoff (1981)].

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Most research in MCDA has in the past assumed as its starting point, a well-structured or 'tidy' problem to be solved [Belton et al (1997)]. Relatively little was said about the decision *context* or *process* [Ostanello (1997)]. Hence, the above criticisms which have been levelled at management science practice are, to a greater or lesser degree, aimed at the problem structuring process (or lack thereof) in decision analysis.

Bouyssou et al (1993), in their "Manifesto for the new MCDA era" point out that an MCDA approach to decision aid is "yet to be conceived as such", stressing the need for future MCDA research to draw on the knowledge already established in cognitive psychology, organisational decision making, and other related fields. Ostanello (1997) calls for a "more mature and integrated approach" to decision aid, suggesting that MCD-analysts consider using the "new tools" and methodologies developed by the English school of Soft OR and the European school of MCDA.

Under the name of soft OR, much work has been done in the past few decades on structuring "ill-structured" problems [Simon (1973)]. SODA [Eden (1989)], Strategic Choice and SSM [Checkland (1989)] have been developed in order to provide strategic planners and management consultants with a conceptual framework for assisting their clients with strategic problems. The methodologies focus not only on the problem issues themselves, but also on the decision-making process; attention is given to the psychological, political and organisational aspects of the decision environment. Although the methods were not specifically intended to be used for MCDA analyses, Eden et al (1989) do suggest that SODA could complement more traditional OR analyses.

Interestingly enough, the above-mentioned criticism of the strongly quantitative scientific approach has also applied to a large body of psychology research. As Bannister & Fransella (1986) put it : "A variety of vanities have caused psychologists to turn their backs on the complete and purposeful person. A craving to be seen, above all, as scientists has led them to favour the clockwork doll, the chemical interaction or the environmentally imprisoned rat as their models of humanity." It is not surprising that SODA, in an attempt to understand the *person* in decision making, in order to offer effective decision support, looked to a more dynamic theory of psychology (*viz.* Personal Construct Theory) for its philosophical foundation [Eden (1988)].

It is only very recently that an integrated approach to decision support, employing soft-OR methodologies in conjunction with traditional MCDA approaches, has appeared in the OR/MS literature. [Stewart (1997), Ostanello (1997), Belton et al (1997), Bana e Costa (1997), Daellenbach (1997)].

In the problem concerning the future management of the West Coast rock lobster resource, we employed the SODA method at the outset, in order to structure the problem issues, before considering an MCDA analysis. Using SODA in a strategic planning exercise was an attempt to take a broad-based and new approach, not only to MCD-support, but also to fisheries management. By so doing, it was felt that it may be possible to allay some of the main criticisms which have been levelled at the more traditional paradigms of management science and fisheries management.

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## Chapter 2

# Paradigms in Fisheries Management : Past and Present

## 2.1. The decision-making environment

*“Fisheries are characterised by conflict. From angry fishermen picketing fisheries offices to the burning of fisheries patrol boats, conflict often runs rampant. These are examples of conflict directed at the management agency and its representatives. But conflict in the fishery runs deeper. Group is often pitted against group in the struggle for the ‘rightful’ share of the resource. Values and beliefs on how the resource should be managed and shared frequently clash.” [Parsons (1993) p.441]*

### 2.1.1. Conflict and stakeholders

Fisheries management is a task fraught with complexity and conflict. Decisions are taken in the face of great uncertainty with respect to i) the present state of the fish stocks, ii) future variability thereof and iii) the impact that future environmental changes and exploitation might have on the resource.

Parsons (1993) notes that one of the main problems plaguing the management of marine fisheries is the conflicting nature of management objectives. Fisheries managers are increasingly required to consider a broader suite of objectives: economic, social, political and conservation. Clearly, there are many trade-offs to be made between economic issues and conservation, short-term and long-term goals, etc. However, up until now management

approaches have generally been unsuccessful in “addressing and incorporating the range of criteria required to manage multiple objectives” [Stephenson & Lane (1995)].

Management decisions affect multiple stakeholders with often conflicting interests and agendas. Parsons (1993) explains that the “common-property” nature of fisheries resources led to overcapacity, with “recurrent conflict among competing users”. King (1995) notes that conflict is often compounded when a fishery incorporates both commercial and artisanal (or recreational) fishing sectors. As a result, Hilborn (1992) stresses that fisheries management is not merely about managing fish stocks, but rather about managing people. Marasco and Miller (1988) also emphasise the need for negotiation and bargaining as the basis for fisheries management decisions. They state that “fisheries management will never be easy. The best that might ever be expected is a mediation exercise among respected counterparts.”

Hilborn (1992) further suggests that understanding fishermen’s behaviour is a key to successful management, and suggests the need for fisheries agency staff to ‘go fishing’ with commercial fishermen to get a feel for how fishing behaviour changes from year to year. He predicts that the trend in future will be towards greater involvement of the users of the resource in data collection and decision-making. Such an arrangement, involving both the industry and regulatory bodies together in management decisions, is known as co-management. Stephenson & Lane (1995) however state that the lack of effective involvement of stakeholders in decision-making is “seen as a primary factor in the failure of modern fisheries management.”

### 2.1.2. Decision making structures

Gale (1992) notes that there are three different arenas within which fisheries management decisions might take place:

1. The one extreme is where decisions are made by ‘agency professionals’, based upon professional expertise and data. The decision-making process is generally closed to the public in this so-called *professional* arena.

2. The other extreme is the *public* decision-making arena. Under this arrangement, the agency operates in an open manner, with constituencies providing input and data into “open, often formal, deliberative bodies”.
3. A third arena is the *political* arena, where both professionals and the general public might be excluded from the decision-making process. Parsons (1993) [p.60] notes that in reality, decisions are often taken by politicians rather than by biologists or economists, since they are the ones who ultimately need to decide between conflicting interests in the fishery.

King (1995) points out that biologists and economists responsible for fisheries assessment are usually also involved in the management of the resource. He states that it should be recognised that this is not ideal, since fisheries managers require “a much wider range of political, legal, sociological and conflict resolution skills, rather than the rather specialised skill of the assessors.” These skills are required since, in most cases, it is desirable to include stakeholders in the development and implementation of management plans [King (1995)].

### 2.1.3. Objectives in fisheries management

*“The FAO Working Party on the Scientific Basis of Determining Management Measures emphasised the complexities of the fisheries system but concluded that fisheries management structurally is the same as any other form of management....Defining objectives is the first step. Then data are collected and analysed...Managers use this information to examine options, and make and implement decisions. Results of these decisions are monitored and evaluated in the context of the original objectives.” [Parsons (1993) p.57]*

Prior to World War II, the emphasis was on the commercial development of fisheries. Improvements in technology and rising levels of fishing led, in many cases, to dwindling fish stocks. Fishing restrictions had to be imposed. Consequently, the emphasis in modern fisheries management is on “managing the twin problems of overfishing (conservation) and overcapacity (economic viability)” [Stephenson & Lane (1995)].

Fish stocks are generally regarded as a common property resource. Unlike farmers who benefit from prudent management of their own private stock, fishermen will not necessarily share in the future benefits of for instance, not catching small fish, in order to allow them to reach a more marketable size. “There is no incentive in open access fisheries for individual

fishers to restrict their effort as long as costs remain less than revenue. Each individual in the fishery is motivated to compete for a maximum share of the resource, and has little incentive to practice conservation.” [King (1995)]

Due to persistent overfishing and declining fish stocks, controls in the form of total catch quotas, called total allowable catches (TAC's), were instituted in the late 1960's to curb the depletion of stocks [Lane (1989), Parsons (1993) p.65]. Under this arrangement, fisheries managers are responsible for:

- i) setting the size of this 'global quota' (TAC) for each fishing season, and
- ii) deciding how to allocate the TAC between the different fishing fleets who have a stake in the fishery.

Stephenson & Lane (1995) note that since then, conservation objectives have been given precedence in decision-making. Generally, the TAC (step i) above) is based on biological reference points, with social and economic factors only considered thereafter - in deciding on the allocation of the TAC (in step ii) ) [Healey (1984)]. This approach “avoids political influence on scientific evaluation of stock status, but leaves a rift between the assessment and management functions” [Stephenson & Lane (1995)]. Hilborn and Walters (1992) concur with this, noting that if analysts do not know the objectives or values of the decision makers they are advising, they are likely to not present all the information they should.

According to Hilborn and Walters (1992), management objectives have been almost totally ignored in practice. The economic and social dynamics of fisheries have been particularly neglected in formal analysis [Hilborn (1992), Parsons (1993)]. Alverson and Paulik (1973) also stress that fisheries management agencies must “be realistic about the potential conflicts in human values” and “broaden the scope of their objectives or at least clearly recognise the impact of decisions on other national or international goals.”

More recently, several authors have considered the objectives which are important for fisheries management. Hilborn and Walters (1992) enumerate various biological, economic, recreational and social objectives, as well as criteria (or 'indicators') for measuring performance under each. King (1995) however, notes that objectives are specific to particular fisheries and their circumstances, and depend on the political agenda of the government. In a commercial fishery, the primary objective might be to maximise profits through a small and

highly efficient fishing fleet. On the other hand, in an artisanal fishery where the emphasis is on food production and employment, the primary objective might be to provide access to as many people as possible [King (1995)]. Parsons (1993) also gives a thorough and lengthy review of management objectives and their application (or non-application) in practice.

## 2.2. Plea for conceptual change

Stephenson and Lane (1995), in their paper "Fisheries Management Science: a plea for conceptual change" propose the integration of management science and fisheries science into a new paradigm of fisheries management practice. Their 'plea' is based on the observation of significant problems with current stock assessment methods, and past failures in fisheries management which led to "catastrophic collapses" of fish stocks. They enumerate the following problems of current management approaches:

- i) There is generally no explicit and comprehensive treatment of objectives in practice. Managers generally do not plan strategically or define longer term goals and strategies for achieving biological, economic and social targets. Preoccupation with politics and tactics has led to objectives often being vague and non-operational.
- ii) Advice to management has been predominantly biological, with a lack of consideration of economic, social and operational issues.
- iii) On the whole, there is a lack of effective involvement of stakeholders in the decision process. As was discussed previously, current thinking is that harvesters should have more say in participatory co-management schemes.
- iv) There is a tendency amongst managers to depend heavily on scientific data, only implementing actions when scientific evidence is complete and unequivocal.
- v) Management is characterised by an inability to effectively deal with the inherent variability in fisheries. Stephenson & Lane (1995) note that biologists are only now starting to properly consider the possible impacts of variability, and erroneous stock estimates. Consequently, there has been very little communication of the uncertainties underlying stock estimates in the past.
- vi) Management approaches are often inflexible to changes in fishing behaviour and market conditions.

Stephenson & Lane (1995) stress that incorporating management science methods in fisheries management will enable the consideration of all objectives together, rather than decomposing the problem into sub-components. Before considering further the use of management science in fisheries management, the next section considers past and present paradigms in management practice.

## 2.3. Past paradigms in fisheries management

*“Since so much of the study of the problems of fisheries management has been done by biologists a feeling has developed that it is chiefly or wholly a biological problem, and that the main, or even the only, objective of management should be the protection or conservation of the fish stock or the harvesting of the maximum sustained yield measured in physical terms.”*

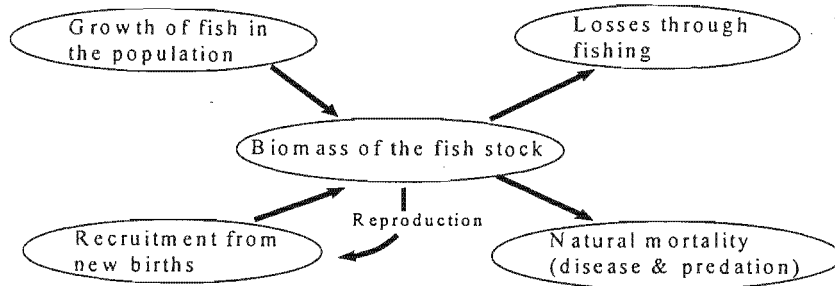
[Gulland (1974)]

It is necessary to look at past paradigms in fisheries management since present management practice has evolved from, and is heavily influenced by, historic developments. Decisions have traditionally been dominated by biological considerations [Stephenson & Lane (1995), King (1995)]. Economic and social factors, on the other hand, were usually considered in an ad hoc manner.

### 2.3.1. The concept of MSY

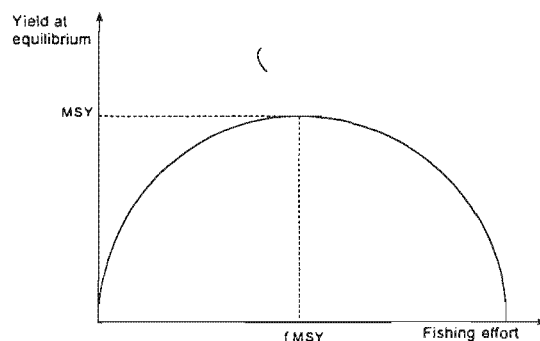
The guiding principle in early fisheries management was the maximum sustainable yield (MSY). The MSY concept developed through the desire to consider the long-term yields of fisheries resources [Allen & McGlade (1987)]. Based upon biological models of fish stocks (Figure 2.1), MSY represents the long-term maximum average catch which can be sustained by the resource [King (1995), Payne et al (1993)].

According to population dynamics models, initial fishing of a pristine stock leads to reduced competition for food and space amongst the particular species. This often has a positive effect on the productivity of the resource in that the number of recruits increases.



**Figure 2.1. Population dynamics of a fish resource**

Larger, slower-growing fish are removed by fishing, leaving more food and other resources (e.g. space) for smaller, faster-growing fish. Therefore, the surplus production of the resource can increase under exploitation. If the fishing yield is less than the surplus production, the biomass (i.e. “stock abundance in terms of mass” [Payne et al (1993)]) will increase (provided the stock size is not at or near the carrying capacity of the environment). However, if the yield is greater than the surplus production, the size of the stock will reduce, since “reproduction is unable to replace the numbers lost” [King (1995)]. Therefore, it was proposed that the optimal fishing policy would be to “adjust fishing in such a way that the abundance of fish would move towards, and then be held at, the level that would provide the maximum equilibrium yield” [Payne et al (1993)]. This relationship is shown in Figure 2.2. below.



**Figure 2.2. Yields for varying levels of fishing effort**

The MSY concept assumes that the system in Figure 2.1. is static rather than dynamic, with  $f_{MSY}$  being the level of fishing at which it is expected that the optimal solution (i.e. MSY) will result under equilibrium [Allen & McGlade (1987)].

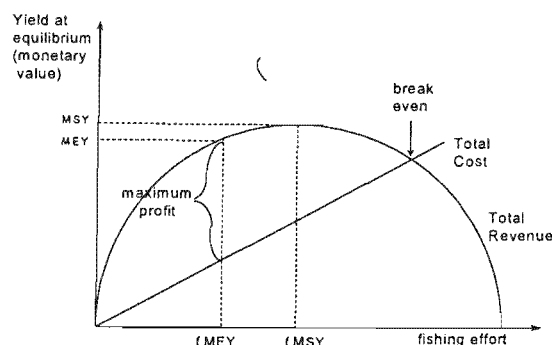
### **Problems with MSY**

MSY as a guiding principle for the management of fisheries has been criticised on both biological and economic grounds. The assumption of the static nature of the resource is unrealistic. Fish stocks by nature are inherently variable. Several researchers have shown that exploitation at or near MSY could actually lead to the collapse of the stocks, particularly under adverse environmental conditions [Parsons (1993), Allen & McGlade (1987)]. Furthermore, the above models consider the simplified case of one species in isolation, with no account of species interactions [Hilborn (1992)].

Despite these shortcomings in modelling the biological aspects of a fishery, the main criticism was levelled by economists. As they pointed out, "MSY is a purely physical concept which considers only one output, the magnitude of the catch" [Parsons (1993) p.59]. MSY takes no account of economic supply and demand influencing the value of the catch, or of how costs are incurred with varying levels of fishing. MSY is also too simple in its consideration of short-term and long-term trade-offs [Parsons (1993)]. In an attempt to address some of these issues, the concept of maximum economic yield (MEY) was proposed.

#### **2.3.2. The concept of MEY**

The concept of MEY arose from an economic interpretation of Figure 2.2. above. Fisheries economists proposed that, instead of measuring yield in terms of the physical amount of fish caught, it should rather be measured in terms of monetary revenue, as shown in Figure 2.3. The relationship between monetary yield and fishing effort (Figure 2.3.) is similar to that between physical yield and effort in Figure 2.2. This is based on the simplifying assumption that the long-term value of the catch is proportional to its volume. In addition, costs are incorporated into the model. In this case a simple linear relationship is assumed between fishing effort and total fishing costs.



**Figure 2.3. An economic model of a fishery**

Using the MEY model, economists suggested that profit should be maximised in the fishery, with fishing effort correspondingly restricted to  $f_{MEY}$ .  $f_{MEY}$  is the level of fishing in Figure 2.3. at which the difference between revenue and costs is maximised. The new MEY paradigm was appealing in the context of the ‘overfishing problem’ [Parsons (1993)], since MEY suggests a lower level of exploitation than MSY. Economists had also shown that the overfishing problem was caused essentially by the economic organisation of the fishing industry [Parsons (1993)].

In an unregulated or ‘free-entry’ fishery, the level of fishing effort will increase, with more and more fishermen entering, until the break-even point is reached i.e. as long as revenue exceeds costs. However, as Parsons (1993) points out, the proposal of MEY as the optimal harvesting policy is based on the “economic implications of fish as a *common property resource*” [p.52]. He further notes that the concept of a fishery as a “common property” has “developed in the intervening years as a new and broader groundwork for regulating fisheries” [cf. Healey (1984)].

### Problems with MEY

As with MSY, the main problem with MEY as a guiding principle in management, is that the model is static. In reality however, it might be several years before the impact of increased fishing effort is seen on a fish population [Parsons (1993)]. This is particularly true for long-living species such as lobster, where the effect of lower stock levels on future reproduction will only be known several years ahead.

Another problem with MEY is that it focuses solely on economics. As Parsons (1993) emphasises, *“few fisheries are valued solely in economic terms. Different countries view their fisheries from considerably different perspectives. Some are concerned with employment, others with food supply and still others are occupied with fisheries as a source of foreign exchange. Other factors, such as minimizing conflict between groups of fishermen or maintaining coastal communities, might be as important as minimizing the economic input for a particular country.”* [p.60]

### 2.3.3. ‘Optimum Yield’ as guiding principle

With the passing of the Magnuson Fishery Conservation Management Act (MFCMA), and publication of the *Policy for Canada’s Commercial Fisheries* in 1976, the concept of optimum yield (OY) replaced MSY as the official guideline for fisheries management in the US and Canada [Healey (1984)].

In the MFCMA, OY is defined as the catch:

- “a) which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and
- b) which is prescribed as such on the basis of the maximum sustainable yield from such fishery, as modified by any economic, social or economic factor.”

Whereas both MSY and MEY proposed a one-dimensional objective as the guiding principle for decision-making, OY recognises that fisheries are complicated due to multiple and conflicting objectives, and requires a more thorough consideration of economic and social goals in addition to conservation. This “new, broader objective” [Parsons (1993)] provides much more scope for managers to interpret OY in a subjective manner, in order to take social and economic considerations into account.

The MFCMA also brought about significant restructuring of decision-making structures. The primary responsibility for decision-making shifted from federal government to Regional Fishery Management Councils (RFMC’s) [Leschine (1988)]. Linked to this decentralisation

of the decision-making process, the OY concept encourages flexibility in the weights given to economic, social and biological factors depending on regional circumstances in the fishery [Healey (1984)]. As such, OY's great strength lies in its flexibility.

However, although OY is intellectually appealing, there appears to be confusion over how to implement it in practice [Healey (1984), Leschine (1988), Stephenson & Lane (1995)]. OY significantly enlarged the set of objectives to be considered, but gives little guidance as to how they should be implemented. Leschine (1988) suggests that it is ironic that "while more attention is officially accorded to the question of what the objectives of management should properly be", no analytic mechanisms exist for implementing OY in practice. As a result, the attempt to replace MSY by OY has had limited impact [King (1995)]. King (1995) stresses that "although not many present-day fisheries managers are content with MSY as a sole objective, its estimation may be regarded as important as an upper limit to the catch that can be taken from a stock."

Allen & McGlade (1987) suggest that the Canadian policy document and concept of OY serve to show how unclear management objectives really are. Phrases such as "best use of the resource", "optimal socio-economic benefits" and "maximum continuing economic and social benefits" are extremely vague, and mean different things to different people. As a result, OY has been criticised as being too vague and open to political manipulation and abuse [Parsons (1993), Healey (1984)].

Leschine (1988) points out that in addition to the introduction of OY, the restructuring of the decision making framework further complicated matters, with each council finding itself "populated with strategic actors". He therefore suggests the potential for decision support systems (DSS's) to assist in fisheries management decisions.

## 2.4. Incorporating objectives in management decisions

*"Fishery management at present is based on a mixture of theoretical concepts and practical considerations which in fact do not result in a clear basis for policy, nor in any self-evident criteria for management decisions." [Allen & McGlade (1987)]*

The RFMCs experienced considerable difficulties in translating OY into clear management objectives in a way which was acceptable to bureaucratic and scientific, not to mention industry and public, communities [Marasco & Miller (1988)]. Marasco & Miller (1988) suggest that RFMCs cannot, and should not, be expected to articulate clear statements of objectives, since true objectives are political [Huppert (1988)], and only really emerge through the process of developing fisheries management plans. Therefore, they argue that statements of objectives offer little or no impetus to the management process, and rather stress the importance of negotiation in decision-making.

They suggested therefore that the "classical view of technical decision-making, which makes a clear statement of objectives the first order of business, is not applicable to the decision environment of Fishery Management Councils" [Huppert (1988)]. In particular, they noted that decision makers tend to deal with ill-structured problems by 'muddling through', initially considering familiar solutions and then examining others only if the obvious ones are not acceptable. Keeney (1992) refers to this style of problem solving as 'alternative focused thinking'. As shall be discussed in later chapters, this approach to problem solving is contrary to contemporary thinking in strategic planning and management science, where the explication and exploration of higher objectives is considered essential for making sense of situations, guiding the search for alternatives, and providing a basis for conflict resolution and negotiation support [Keeney (1992), Bryson (1995), Kersten (1997)].

Parsons (1993) notes that the "FAO identified the inadequate formulation of objectives as one of the most general weaknesses of fisheries policy ... The reconciliation of conflicting interests and the articulation of a set of generally acceptable objectives pose a major challenge for fisheries managers. Making trade-offs is a formidable but essential task." Cunningham (1980) also discusses the difficulties experienced in the EEC in establishing

policy objectives for managing fisheries. As he pointed out, “unless objectives are made explicit they cannot be discussed; unless they are discussed they cannot be agreed on; and unless they are agreed on fisheries management appears doomed to failure.”

Huppert (1988), in response to Marasco & Miller (1988), stresses the importance of objectives for providing accepted professional values and ethics (e.g. for biologists and economists). He argues that experts’ values inherently *do* come into the process, and that their role cannot be considered as that of “detached specialists”.

From the above discussion, it is clear that objectives are extremely important for guiding management decisions. Generic objectives relating to the conservation of stocks and their environment, maximising economic returns from the fishery, and providing for the needs of society provide useful guidelines [King (1995)]. However, it is also evident that objectives need to be flexible; customised to the particular and regional circumstances of an individual fishery. This, in essence, is the spirit of OY. Also implicit in this flexible approach, is the need for management objectives to be continually open to review, in order for management to adapt to the changes arising due to variability in fish stocks and economic markets.

However, as has been stated above, with this greater flexibility, decisions are more susceptible to political manipulation and abuse. Therefore, it is all the more necessary to engender a more transparent and participative management process. This presents the problem of how to manage an effective and inclusive decision process within the conflictual context of fisheries. Group decision support is clearly necessary.

A problem which appears to have received more attention in the research than the issue of managing the group process, is that of using analytical methods for incorporating the multiple and conflicting objectives in decisions. As Stephenson & Lane (1995) and Healey (1984) stress, fisheries managers have in practice had no mechanism in place to effectively deal with multiple objectives. For this reason they, and others, have suggested decision analysis as the solution. However, decision analysis has generally been received with widespread opposition from other researchers, mainly due to issues relating to the decision-making process. Several researchers [e.g. Marasco & Miller (1988), Leschine (1988)] emphasised the need for a democratic process in which both the users and regulating agency could engage in negotiations around key issues. They felt that the traditional decision

analysis paradigm was inadequate for facilitating such a process, and questioned its effectiveness for dealing with a group with conflicting constructions of the problem environment [Leschine (1988)]. Leschine (1988) further pointed out that fisheries managers do not act in the utility-maximising fashion assumed by normative decision analysis models.

## 2.5. Using DA/MCDA in fisheries management

This section takes a closer look at past attempts to employ management science (in particular, decision analysis) in the arena of fisheries management.

*“All fisheries management must at some point decide which of several alternative management decisions will cause the most desirable outcome. There are two stages to such decisions. First, for each possible action, possible outcomes and their probabilities must be assessed. This is the traditional realm of stock assessment and modelling. We estimate that 99.9% of effort by fisheries management staff is devoted to such evaluation activities.*

*The second stage is to decide which of the possible actions is best, in recognition of the outcomes that it may produce. Usually, a decision maker is presented with possible actions and outcomes and asked to exercise his craft without any precise guidance about what criteria to use in weighing the alternatives.” [Hilborn & Walters (1992)]*

Hilborn & Walters (1992) note that if an analyst providing scientific advice is ignorant of decision makers' objectives, they are not likely to present either the full information, or range of options required, for a wise decision. The analyst might not even consider management options that could otherwise have been very useful [cf. Keeney (1992)]. Therefore, management science clearly has potential for clarifying strategic objectives and, by so doing, assisting decision makers and their scientific advisors to work together in a closer partnership. Healey (1988) also stresses that in decisions “as value laden as fisheries management”, a comprehensive evaluation of alternatives offers great benefit for managers. Parsons (1993) [p.76] notes that although fisheries managers “abhor the thought of value judgements”, they implicitly make such judgements all the time.

For this reason, many have purported the usefulness of MCDA in fisheries management. However, as has been noted above, the trend is towards more participatory management of

fish resources, with negotiation an important part of the process. It is therefore essential to consider how MCDA can be useful for assisting with this negotiation process.

### 2.5.1. Review of past research

Keeney (1977) and Hilborn & Walters (1977) employed a multi-attribute utility model to structure the conflicting objectives and preferences of the stakeholders involved in the Skeena River Salmon fishery. Ten participants were selected from several management agencies and stakeholder groups. Utility functions were constructed depicting the assumed preferences of several stakeholder groups, before integrating them into an overall utility function. Keeney (1977) argues that, in this way, the model allowed an explicit consideration of value trade-offs and the question of equity in considering the implications for the different interest groups. He points out that the model aided communication between the participants and identified differences in judgement which could then be discussed. Hilborn & Walters (1977) note that most participants felt the method was good for promoting discussion, but considerable disagreement arose on how appropriate the method was for determining interest group preferences. Participants generally felt the method should not be used with public groups "due to unreliability of responses."

Healey (1984) proposed the use of MCDA for implementing OY in practice, suggesting that it provided the analytical framework for modelling trade-offs between conflicting objectives, and hence OY. Leschine (1988), however, suggested that in the context of fisheries management, the then emerging idea of decision support systems was "much more in tune with the needs of OY-oriented fisheries managers than present decision theory-based paradigms." In response to Leschine's (1988) criticisms of MCDA, Healey (1988) states that he does not agree with Keeney's (1977) approach of incorporating conflicting interests into a single utility function, and confirms the importance of the negotiation process. He stresses that decision analysis can provide essential structure to this bargaining process, helping interest groups to communicate their views, and identify areas of disagreement to be negotiated. Healey therefore points out that the model will evolve throughout the process, and in fact adds structure to the policy evolution process, as it is continually updated with new information coming to light. He further states, as do Hilborn & Walters (1992), that current management practice is particularly weak in its analysis of alternative management

options, and suggests that it is in this area of decision making that “the greatest short term gains are to be made.”

DiNardo et al (1989) showed how AHP could be used in fisheries management decisions. In their exercise, they showed how the Expert Choice software could be used to structure biological, political, economic and social objectives for Maryland’s River Herring fishery. They assumed a centralised decision process, with different stakeholders’ interests and influences represented within the different objectives hierarchies. For instance, their political ‘decision factor’ consisted of the following criteria:

1. Impact on decision-maker’s political future,
2. Influence of primary fishermen,
3. Influence of secondary fishermen,
4. Influence of environmentally conscious groups/individuals
5. Influence of those in related occupations.

The three authors then made ‘pairwise comparisons’ to choose between three policy alternatives: open access, restricted access or close the fishery.

More recently, a Value Focused Thinking (VFT) exercise was conducted by McDaniels et al (1994) to explore strategies for co-management initiatives in British Columbia. As they point out, although the need for greater involvement of so-called First Nations in co-management is generally acknowledged, how it should be done and in what form, remained “wide open questions” at the time.

Four individuals were selected who could “speak about the views of particular stakeholder groups”, and “were knowledgeable about co-operative management”. One was a Canadian Department of Fisheries and Oceans (DFO) representative; another a “Chief of the Chilliwack Band” and lawyer, deeply involved in fisheries issues. The other two were a fisheries specialist and co-management specialist. In-depth interviews were carried out with each individual, and a set of fundamental objectives constructed. In addition to eliciting objectives from the participants, scenarios depicting potential future successes and failures were determined. These future good versus bad scenarios were useful in developing each persons’ set of objectives. These were then merged into a combined set of fundamental objectives.

McDaniels et al (1994) further identified possible strategies for achieving the fundamental objectives, and discuss organisational and political factors which had delayed the implementation of co-management strategies in practice. These strategic alternatives were submitted to DFO managers in 1992 for consideration during the development of the Aboriginal Fishing Strategy. McDaniels et al note that although they do not know to what extent their findings were drawn upon by the DFO managers, it no doubt did provide some useful input into the negotiations.

Stephenson & Lane (1995) urge that case studies be conducted in different fisheries, incorporating management science with fisheries science to provide management advice. They suggest that such empirical research “will bring about the evolution required for successful management of fisheries systems, rather than of fish, and will promote the framework and tools required to develop effective fisheries co-management.” This essentially is what this research set out to do.

## Chapter 3

# The Need for Problem Structuring in Management Science

*“To be successful, operational research must be problem-oriented, not technique-oriented”*  
*[Ackoff (1962)]*

## 3.1. Management science in consulting practice

Around the globe, organisations and governments are daily challenged by new and unprecedented problems. In order to survive, today’s organisations need to keep abreast of rapid changes taking place in the arena of politics, technology and economic markets (locally and globally). Organisations constantly need to be on the lookout for better, more efficient ways of operating, and for new opportunities.

These organisations, on occasion, seek the help of management science consultants to assist in finding the ‘most effective’ way out of difficult predicaments. This generally only occurs when the conundrums confronting them are difficult and messy [Von Winterfeldt & Edwards (1986)]. Often, what the organisation requires is the counsel of someone who can view the problem from the outside with a fresh and unbiased perspective, and bring a creative and strategic approach to the problem. The decision owners, in the very midst of a difficult problem situation often feel overwhelmed and anxious about the problem, and are ‘too busy’ to really sit down and think about what the real problem is, or to plan strategically [Eden et al (1983) p. 15].

### 3.1.1. The origins of OR

OR / Management science methods began to be developed around the time of the Second World War, born out of the desire to apply scientific methods to management-type problems

in business, defence and government [Markland (1989)]. Operational researchers have traditionally adopted a 'systems' approach to viewing management problems [Ackoff (1981), Woolley & Pidd (1981)]. For instance, an organisation can be seen as a complex system of interacting and inter-related parts, people and processes. An action taken in one part of the organisation is likely to produce knock-on effects elsewhere in the 'system'.

The distinctive characteristic of the OR methodology has been the development of formal 'scientific' models of the systems under consideration with which to evaluate and compare alternative decision choices. The model building activity is considered to be scientific in the sense that the emphasis has been on 'objective' observation and collection of quantitative data for modelling.

### 3.1.2. A shift in emphasis ...

The past few decades has seen a shift in the emphasis of operational researchers/management scientists from well-defined and largely quantitative "operational problems, such as production scheduling and inventory control" to more qualitative and ill-structured "managerial planning and decision making" [Stewart (1992)]. Today's management scientist is not restricted to the role of quantitative analyst and modeller; his task often involves facilitating group deliberations, especially when conflicting views and objectives are held by the participants. As facilitator, he may even be called upon to act as mediator or arbitrator between various parties (decision-makers or stakeholders) in order to 'solve' the problem at hand [Friend (1990) p.19].

Despite numerous successful applications of decision analysis in practical decision situations, management science methods have in the past often not been that well received by decision-makers [Kersten (1997), Ackoff (1962), Evans (1989), Rosenhead (1989), Leschine (1988)] - they certainly haven't revolutionised management practice [Drucker (1974) p.508], and are not as widely used as they potentially could be. Various reasons have been put forward for this situation, one of which has been that management scientists, on the whole, have not taken the time to fully appreciate the messy and ill-structured nature of the problems dealt with by managers in practice.

Lockett et al (1997) point out that although there have been several good examples of successful practice in MCDA, most of the literature has focused on theoretical approaches, avoiding the issues “surrounding the wider organisational environment.” The emphasis has been on the mathematical and technical details of the methods and models [Drucker (1974), Rosenhead (1989), Lockett et al (1997)]. However, before any problem can be analysed, it must first be properly defined [Kepner & Tregoe (1981)].

Evans (1989) stresses that creativity is the most important ingredient for successful management and, as a result, management scientists need to focus more on the creative ‘art’ of problem structuring. Management scientists should learn from research which has been done in the field of creative problem solving in order to encourage and inspire their clients to more creative and effective decision-making.

### 3.1.3. Working with groups

Critics have suggested that decision analysis paradigms are particularly vulnerable when it comes to group decision-making [Leschine (1988), Lockett et al (1997)]. Lootsma (1996) also points out that, even though there are several schools of thought in MCDA, most models and techniques are aimed at the single decision-maker. Descriptive MCDA models for group decision support entail the creation of a “supra decision maker” [Kersten (1997)], whose preferences are portrayed in an aggregate utility function, being an aggregation of each individual’s utility function. In these models, the difficulty comes in determining the weights to ascribe to each individual’s preferences, in order to find a compromise [Kersten (1997), Lockett et al (1997)].

Both decision-makers and social scientists have criticised MCDA methodologies for attempting to make over-simplified and superficial mathematical assumptions, ‘aggregating’ the views and values of the different parties in an attempt to produce a compromise solution [Kersten (1997)]. They argue that this is not how decisions are made in practice, where discussion, bargaining and negotiation are often vital to finding a ‘solution’. Critics have even gone so far as to compare decision analysis methods with “Soviet-style state planning”, where “a single agency could ... deploy a unitary set of agreed objectives... for a holistic planning which would override more pluralistic arrangements” [Rosenhead (1989)]. It is true

that stakeholder participation is often imperative in public and inter-organisational decisions. In this context, issues are debated, coalitions formed, compromises negotiated and consensuses built. It is also true that complex analytical and purely mathematical approaches can, and do, tend to exclude lay participation, and rule out these more social aspects of decision-making [Rosenhead (1989)].

However, one must differentiate between descriptive and prescriptive MCDA models. Although these criticisms are a caveat to poor MCDA practice, they do not do justice to the field of *prescriptive* MCDA practice. It should be remembered that MCDA is in fact intended to assist decision makers in a participative process [Kersten (1997), Stewart & Scott (1995)]. What is important, is not so much the mathematical basis of the models, but *how* they are used as tools in providing decision support [Phillips (1982)]. It is for this reason that several management scientists today are increasingly concerned with organisational and group processes, and in particular, using soft-OR (and other structuring methods) to manage decision processes. As such, prescriptive MCDA, although having mathematical undertones, does not fall into the same category as the more traditional 'hard' operational research methods. In fact, MCDA could be considered to be a 'soft' method if used in this manner. Under this approach, the emphasis is on using MCDA as a framework for negotiation around the structuring of the problem. This obviously requires of facilitators a high level of skill in managing group processes.

As Phillips (1982) explains, analysts employing decision analysis in practice "soon discover the difficulty in constructing an optimal model of the decision process, for the very act of modelling often changes the client's understanding of the problem." For this reason, many management scientists today do realise the importance of effective management of group process, making provision for bargaining and negotiation, and considering the organisational, political and social aspects of the decision environment.

The above criticisms of decision analysis are perhaps not totally unfounded in light of the strong mathematical approach and attitude with which researchers have approached decision problems in the past, often neglecting the more qualitative 'art' of problem structuring [Evans (1989), Keller & Ho (1988)]. The dearth of research on (and methods for) problem structuring in past times has, no doubt, been the downfall of many apprentice analysts who, not fully understanding the complexity and dynamics of the decision environment, have been

tempted to rush into quantitative analysis. The result is that the 'wrong' problem is considered and modelled [Von Winterfeldt & Edwards (1986), Woolley & Pidd (1981)]. As Daellenbach (1997) also stresses, failure to recognise and deal with conflicting perspectives of the problem, is likely to cause problems later on in the analysis.

## 3.2. Dealing with strategic problems

Many management and planning methods have failed in practice because they try to impose some formal rationality on the decision-making process, ignoring or attempting to counter the political dynamics of group decision-making [Bryson (1995)]. Bryson (1995) suggests that, although they may appear scientifically 'irrational', decision-makers in public organisations are usually *politically rational*.

Leschine (1988) also emphasises that decision-makers, and fisheries managers in particular, often do not behave in the 'rational', utility maximising fashion assumed by traditional (descriptive) decision analysis, and suggests that DDSs are potentially a better alternative to assisting fisheries managers in their decisions.

Kersten (1997) confirms that axiomatic rationality rarely holds due to the influence of complex social, organisational and political factors, which normally cannot be "formally represented". Roy & Vanderpooten (1996) too, warn against the potential danger in "seeking among axioms the foundation for a form of rationality".

Many management scientists today realise that there are serious 'limits to objectivity' in real-life decisions, and that MCDA should not be used rigidly, but rather in a flexible manner, with the prime objective to assist decision makers to together explore their preferences and alternatives.

Operational researchers have on numerous occasions also found the traditional, quantitative OR methods inadequate for dealing with complex, organisational problems in consulting work [Eden (1988)]. As a result, 'hard' operations' research methods have largely been relegated to solving problems at the lower organisational levels, once the more strategic decisions have been taken at the higher organisational levels [Rosenhead (1989) p.5].

Eden and Radford (1990) note that it has become “accepted wisdom” that strategic issues cannot be dealt with by some routine form of analysis, but rather, that a “strategic thinking process” be designed. Group decision support should carefully consider and explicitly take account of the politics, personal agendas and power dynamics in group interactions, in addition to analysing the problem issues themselves. As such, facilitators should combine the skills of the behavioural scientist together with those of the management scientist in order to provide effective decision aid [Ackoff (1981), Eden (1990)]. In order to facilitate this, problem structuring techniques need to incorporate not only the quantitative information known about the problem (content), but also the qualitative (subjective / political) information, so enabling the consultant to manage the decision-making process.

*“Those OR groups which flourish and continue to operate at strategic levels have found ways of avoiding the conceptual straightjacket. They do so through a network of organisational contacts, and through the maintenance of an internal culture which recognises that problems are broader than the technical-fix orientation of traditional OR methods. But the general OR culture, and its proven techniques, offer them precious little help.” [Rosenhead (1989) p.6]*

### 3.3. The nature of decision problems

Before discussing the issue of problem structuring, it is necessary to first consider the concept of what a problem is.

Problems in the field of management are normally detected as a “sign of dissatisfaction, a judgement on something to be modified and a stake in which the actor feels involved” [Roy (1993) cf. Daellenbach (1997)]. As such, problems are not pre-existing entities in themselves, but rather, subjective and idiosyncratic constructions of reality. [e.g. Smith (1989), MacCrimmon & Taylor (1976)]. Of course there will be *objective* evidence and facts relating to the issue at hand, but with messy, real-life conundrums, the ‘problem’ is ultimately *subjective*, based upon the individual’s personal perspective and world-view [e.g. Daellenbach (1997), Eden et al (1983), Von Winterfeldt (1980)].

Personal views reflect individual preferences, values, beliefs and objectives [Eden et al (1983)]. All decisions are taken in the pursuit of goals, or of opportunities for achieving those goals [Keeney (1992), Henig & Buchanan (1996), Newell & Simon (1972), Smith (1989)]. As a result, Keeney (1992) stresses the importance of focusing on goals and values when considering how to solve a problem, rather than merely choosing between the alternative courses of action before one. He goes still one step further, encouraging decision makers to *seek* 'decision opportunities' in order to pursue values and objectives.

#### What is the *real* problem?

*"When a management situation occurs, the available information is usually a confusion of the relevant and the irrelevant, the important and the inconsequential."* [Kepner & Tregoe (1981) p.25]

Correctly identifying messy or ill-structured problems when they arise is no trivial task, even though the symptoms may often be quite obvious. Consultants are usually called in when the managers or directors of an organisation feel they are needed to help with the problem - in such cases, the organisation itself usually does not know what the problem really is. For example, a particular department in a company might have an unhealthily high staff turnover. There are numerous possible reasons for this problem, such as uncomfortable working conditions, poor management, etc. A manager will often just have a vague feeling or hunch that things are not as they should be, or that certain things could be done better. However, the difficulty lies in diagnosing precisely what the cause of the problem is, and in prescribing how best to deal with the situation [Kepner & Tregoe (1981)].

The management scientist has the important task of determining what the 'real' conundrum is before they can be of any real assistance to their client. A dynamic and creative approach is essential for effectively defining and structuring the problem before more detailed analysis and modelling can take place. Von Winterfeldt & Edwards (1986) refer to this as 'identifying the unscratched itch'. As the well known idiom goes: If you know what the problem is, you are half way to solving it [cf. Simon (1973) p.187].

The way in which one construes the issue at hand has a fundamental impact on the solutions which will be advocated [e.g. Roy (1993), Volkema (1993)]. Ackoff (1962) cites the rather

amusing, but very apt example of the building manager who received numerous complaints about the inefficiency of the lifts in his building.

*“He employed a group of consultants who specialised in the design and operation of lift systems. They found that, indeed, the service was bad and they formulated and evaluated three possible solutions. (1) Adding lifts. This turned out to be too expensive. (2) Replacing old lifts with new and faster ones. This also turned out to be too expensive. (3) Controlling the lifts from a central panel. This did not yield enough improvement. When confronted with these unsatisfactory choices the manager turned to his staff for advice. A young psychologist in the personnel department made a suggestion which the manager grasped eagerly. A few days later, after a very small expenditure, the problem was solved. The psychologist had suggested placing large mirrors on all the walls in the lift lobbies. The mirrors occupied the women in self-appraisal and it kept the men busy appraising the women without appearing to do so.”*

One needed to look at the problem through the eyes of a psychologist (a very creative psychologist) in order to arrive at this effective solution.

An interesting comparison is that of the Japanese, versus the western philosophy of decision-making. In general, western education equips one to solve well-formulated problems for which there is usually one, and only one correct answer. “Problems that are set are *singular* and *abstract* rather than *pluralist* and *social* in their content; they rarely, if ever, involve the elements of negotiation, emotion or interpersonal tensions that typify real life” [Eden (1988)]. Unlike in most western cultures, the Japanese do not focus on “*what is the answer?*” in decision-making, but rather, on what the *question* or *problem* is. To them, the essence of a decision is defining what the conundrum is; all members of the organisation, at all levels, are involved in the search for a consensual view of the issue at hand [Drucker (1974)].

In the example of the department with high staff turnover, one employee may see uncomfortable working conditions as the real problem issue. Another might view the situation in a totally different light - feeling that the management style is particularly ineffective and inappropriate for the department, and as such, the main contributing factor to people leaving. In the example of the lifts which were slow and inefficient, the psychologist, rather than seeing the problem as “how to improve lift efficiency”, reformulated the problem

as “how to reduce peoples’ frustration caused by waiting for the lifts”, and explored the idea of how to occupy people whilst they are waiting for the lift.

### 3.4. Problem structuring in planning and decision making

Decision-making and planning consists of the following generic phases: First the problem is *detected*. If it is decided that an asserted planning effort is required, decision makers and planners then *formulate* the problem, and *generate alternative solutions*. The next step is to *evaluate* each of the proposed alternatives, and to *select* the ‘best’ one. The solution is then *implemented*, and should be *monitored*. (Figure 3.1.)

[Evans (1989), Keeney (1992), Massey & Wallace (1996), Rosenhead (1989), Smith (1989), Volkema (1983), Smit & de J. Cronje (1992)]

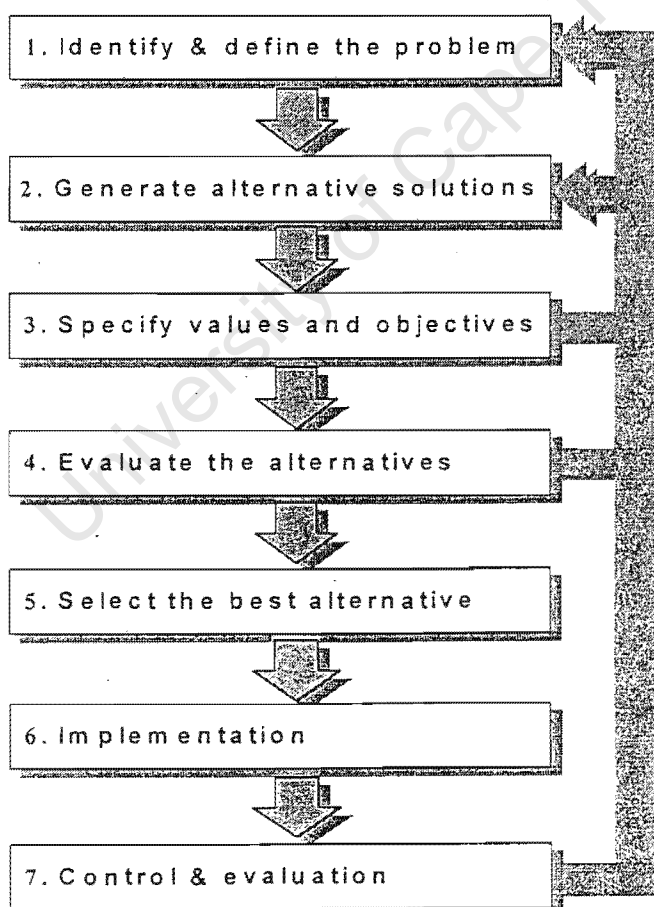


Figure 3.1. The decision-making process (rational planning model)

It is important to note that, although these steps are sequential (for example, identifying and defining the problem in step 1 is a necessary precursor to solving the problem in steps 2 - 6, and so on...), the process is not rigid, but iterative [Keeney & Raiffa (1993), Watson & Buede (1987), Volkema (1983), Von Winterfeldt (1980)]. In practice, it is common that the evaluation of alternatives in step 4 might lead to significant changes in the formulation of the problem. Formal evaluation (step 4) might also bring to light creative and novel ideas for new alternative solutions to the problem, necessitating that the decision-makers go back through steps 2 to 4 [Belton, et al (1997), Keeney (1992), Keller & Ho (1988), Stewart & Scott (1995)]. Similarly, careful consideration and articulation of one's personal values and objectives in step 3, and how best to achieve them, is likely to inspire the decision-maker (s) to come up with other alternatives not previously considered in step 2 [Keeney (1992), Gregory & Keeney (1994)].

Problem structuring (denoted by the first three steps in Figure 3.1.) is particularly important, since it occurs early on in the planning process; all further analysis is based upon this phase [Volkema (1983)]. Furthermore, with management science practice being directed more towards ill-defined, strategic problems, structuring is crucial for effective decision support.

It is perhaps surprising therefore that, until recent years, relatively little attention was given to developing pragmatic prescriptions for problem structuring in the management science literature [Bouyssou et al (1993), Rosenhead (1989), Ostanello (1997), Evans (1989), Von Winterfeldt (1980)]. The focus of most research has been on the process of evaluation and choice (steps 4 & 5) [Keller & Ho (1988), Belton *et al* (1997), Henig & Buchanan (1996)-p.4]. Problem formulation, on the other hand, was considered more an art than a science, and left up to the creativity, skill and experience of the analyst. [Evans (1989), Buede (1986), Keeney (1988), Von Winterfeldt (1980)].

In an attempt to rectify this situation, several researchers [Ackoff (1962), Woolley & Pidd (1981) and others] have in previous years pointed contemptuously to the great lack of problem structuring skills amongst the OR community. Many an OR society presidents' inaugural speech has called for more solid research in the field of problem structuring [Woolley & Pidd (1981)].

### 3.5. The MCDA approach to decision support

Complex conundrums typically require trade-offs between multiple, conflicting objectives i.e. when a particular alternative is considered beneficial for fulfilling a particular objective, but less effective, or even counter-productive, when considered against some other criterion [Bouyssou et al (1993), Henig & Buchanan (1996)]. MCDA was designed for facilitating greater understanding, and informing choice, in such decisions. Using MCDA, decision-makers' values and preferences are articulated and explored. Trade-offs are made explicit in the evaluation of different decision options.

Contemporary MCDA is not intended to be some sort of black-box procedure, which automatically produces an 'optimal' solution to problems. Rather, the emphasis is on encouraging and assisting decision-makers to consider their problem situation in greater detail and with greater precision, to identify what the problem issues really are, and to process the information they have in a structured way [e.g. Belton et al (1997), Keeney (1982), Healey (1984)].

Under the MCDA methodology, problems are structured in terms of:

1. alternatives, which are generated initially and throughout the problem solving process,
2. objectives/criteria, representing the core issues which are important to the decision-maker (s) in the particular decision, and
3. causal (means-ends) relationships, used for evaluating the consequences of the various alternatives (as measured against the criteria) [e.g. Keller & Ho (1988)].

This MCDA structure does not readily emerge, especially when the decision-maker (s) have no real idea of what the problem is, which, as has been stated above, is often the case in ill-structured problems. As a result, management scientists have sought out various approaches and methods which have proven useful for assisting with structuring messy situations. Various of these methods and approaches are discussed later on in this chapter, and further in Chapter 5.

What makes the implementation of MCDA in practice even more difficult, is that MCDA methodologies are concerned not only with single decision-makers weighing up various

conflicting objectives, but more usually with groups of several decision-makers, particularly when group members have conflicting views, values and preferences [e.g. Daellenbach (1997), Stewart & Scott (1995)]. In organisational decision-making, there is often disagreement on objectives, constraints, and the formulation of the problem. Consequently; in complex decisions, players often also disagree on alternative solutions or on the appropriate methodology to be used in solving the problem [Marasco & Miller (1988)]. This is perhaps even more so in public planning, where different individuals and stakeholder groups have very different perspectives and views of what the 'real' problem is.

For this reason, critics of MCDA have again argued that the assumption of a single and concordant formulation of the problem (which has often been assumed as the starting point for MCDA research) is unrealistic. Phillips (1982) however argues that these objections are not 'insurmountable obstacles' to successful decision analyses.

*"Different people have differing views of a problem, and as they discuss it, they change and modify their internal representations of it. In carrying out a decision analysis, one attempts to construct, to generate an explicit representation of the problem. It would be foolish to say that any particular representation is optimal, for there can be no criterion against which to make that judgement. That is why the term 'requisite' model has been introduced..."*

*[Phillips, L. D. (1982)]*

In this regard, MCDA offers a potentially useful framework for negotiation support. In decision conferencing, the emphasis in using MCDA models is to encourage participants to learn about other parties' objectives and aspirations, and the impact thereof on the choice of a decision option. As information is exchanged, the different parties can alter their own aspirations, leading to compromise offers [Kersten (1997) p.340].

However, obtaining consensus on the formulation of the problem, as required by the eventual MCDA model, is no trivial task, and can take a lot of the consultant's time and effort. It is at the initial problem structuring stages of the intervention that soft-OR is useful for facilitating a negotiation process aimed at obtaining an agreed upon, shared perspective of the problem, before further modelling of values and preferences using MCDA. Gregory & Keeney (1994) feel that their key role as analysts (particularly in public decisions) is to "ensure that the decision context is cast broadly enough that all stakeholders can agree on the context". They

further point out that disagreements tend to arise when the initial statement of the problem is too narrow, ruling out objectives, alternatives or other concerns which are important to one or more stakeholders.

In order to provide constructive and effective intervention in group decisions, it is important that the MCD-analyst concentrate not merely on analysing the problem issues faced by his client (s), but also on managing and facilitating the decision-making process [Eden (1989), Ostanello (1997)]. Decision-aiding methodologies (and any corresponding computer software) should encourage effective participation and communication between decision-makers. Just as importantly, structuring tools should assist the consultant to steer the decision process in such a way that secures the decision-makers' participation and commitment to the decision-making process and a consensus formulation of the problem [Ostanello (1997), Massey & Wallace (1996)]. Also, since problem structuring in MCDA is iterative, with the model of the problem being continually debated and reviewed, it is important that any structuring methods provide the support required *throughout* the intervention. [e.g. Daellenbach (1997)].

### 3.5.1. The problem of structuring in management science

Drucker (1974) argues that management scientists were in earlier times often guilty of inadequately defining the context of their problems, being more concerned with the mechanics and technicalities of the methods themselves than with the real complexities of the problem environments [cf. also Ackoff (1962)]. Rosenhead and others support this assertion : "Classical operational research fails to see the world in which decisions get taken or problems get resolved as being peopled by purposeful human beings and by groups of such individuals aggregated by imperfectly shared interests." [Rosenhead (1989),p.9]

Management scientists too, have universally acknowledged problem structuring as the most important and difficult task in consulting practice, and suggested that the most common pitfall of analysis is that of producing a sophisticated solution to the 'wrong problem' [Von Winterfeldt (1980), VonWinterfeldt & Edwards (1986), Woolley & Pidd (1981)]. 'Solving the wrong problem' has been suggested as a primary reason for why many OR solutions are not implemented in practice, or if they are, are often short-lived [Ackoff (1962)].

This applies to MCDA practice, as well as to more quantitative and traditional management science methods. Lootsma (1989) mentions that it is not unusual for decision-makers to feel that the analyst does not fully understand either the decision problem, or the official management structures and processes by which decisions are taken. Conversely, analysts often suspect that “the problem under study is not the real problem. They feel that there are hidden objectives which cannot be discussed, and they are frequently right” [Lootsma (1989) p.85]. All of these comments highlight the need for management science consultants to carefully plan their intervention process in a manner which encourages their client (s) to buy-in to the process and be committed to it.

Despite the unanimous acknowledgement that problem structuring is key to effective decision support, most research has, until recent years, paid little attention to the structuring phase itself, assuming a well-structured problem with unambiguous objectives, a clear and comprehensive set of alternatives, and establishable cause-effect relationships [Rosenhead (1989), Henig & Buchanan (1996)]. Roy (1993) stresses however, that the ‘solutions’ which OR/decision analysis models lead us to are highly dependent on “how the problem is formulated, the means by which uncertainty, imprecision and the ill-determination are taken into account”.

The way in which one sees the role of MCDA in practice has important implications for problem structuring, since structuring is a recursive exercise, occurring continuously throughout the MCDA analysis [Keeney & Raiffa (1993)]. Any quantitative analysis in MCDA should, in fact, bring issues to the surface which assist in better defining and understanding the problem (the so-called ‘constructivist’ approach). Hence, it is necessary to look at current trends in MCDA - how MCDA tools and methods are being used in practice - in considering the role that structuring has to play in decision-aid, and hence, what is required of problem structuring methods.

### 3.6. Past & current trends in MCDA

*“the great strength of management science - whether its methods be those of the physical sciences, of economics, or of the social sciences (and a good management scientist needs to be at home in all three areas) - is its capacity for asking questions. The manager*

*himself will have to give answers. For answers ... are always judgement, always choice between alternatives of different and yet uncertain risks, always a blend of knowledge, experience and hopes."* [Drucker p.514]

With management scientists shifting their emphasis to more ill-structured, non-routine and strategic problems over the past few decades [Stewart (1992), Keeney & Raiffa (1993)], there has been a shift from the view that decision analysis' role is to produce an 'optimal' solution, to one of decision support [Thomas & Samson (1986), Michalowski (1997)]. Keeney (1982) points out that decision analysis is not intended to solve decision problems, but rather, it's "purpose is to produce insight and promote creativity to help decision makers to make better decisions". Hence, MCDA is intended to provide a framework for discussion between the decision-makers about their predicament, and by so doing, to equip participants with a better understanding of the problem issues.

### 3.6.1. Decision science or decision-aid science?

Roy & Vanderpooten (1996) suggest that a major characteristic of the 'European school' of MCDA is the recognition of the 'limits of objectivity' in decision-making and decision-aid [cf. Lootsma (1996)]. They stress that individual decision-makers seldom have well-defined preferences - "among areas of firm convictions lie hazy zones of uncertainty, half-held belief or indeed conflict and contradictions." As a result, the quantitative measures (weightings and relative scores) obtained using MCDA methods are often "imprecise, uncertain or ill-determined". As Roy (1993) mentions, participants are often quite happy to provide quantitative answers to the questions posed by the decision-analyst even when the criteria are imprecise or vaguely defined.

Objectivity is further limited due to decision makers bringing their own subjective views to the decision table. Even if they are not working in a group or team, they invariably are influenced by the views of others around them. Therefore, organisational and cultural aspects further exacerbate this 'lack' of objectivity [Weick (1995)]. It is therefore impossible to take a totally objective approach to decisions and decision-aid. Subjectivity needs to be accepted and accounted for in the modelling process. [Roy & Vanderpooten (1996) p.26].

As a result of these 'limits to objectivity', the European school advocates a '*constructivist*' approach to decision-aid. The constructivist approach accepts, and even encourages, the evolution of decision-maker preferences throughout the intervention process. The role of MCDA is therefore seen as one of assisting decision-makers to learn about, shape and transform their preferences through an interactive process, rather than assuming a pre-existing value function which guides decision-maker preferences.

Barzilai and Lootsma (1997) further point out that MCDA has received much resistance due to the widespread belief that "a volatile concept like preference" cannot properly be captured in a mathematical model. Kersten (1997) however points out that the main contribution MCDA can make to negotiation support is that it is concerned not only with the negotiation outcome (as in game theory), but also with the negotiation *process*. This is achieved firstly, through the use of criteria, which are more meaningful to decision-makers than utilities (as used in multi-attribute utility theory (MAUT) [cf. Keeney & Raiffa (1993)]). Secondly, the interactive nature of MCDA methods allows decision-makers to participate in the decision process.

Roy and Vanderpooten (1996) [see also Roy (1993)] suggest that there is a significant difference between the American and European schools of MCDA in their general approach and attitude to decision-aid. The American school ascribes to a *prescriptive* approach which assumes that some 'optimal' solution exists ("taking into account certain characteristics of the individual or group"), and that it is only a lack of means or resources which prevents one from arriving at this optimal solution. The prescriptive approaches' primary aim then is to approximate as closely as possible, given these constraints, the 'ideal' solution.

However, the 'limits of objectivity' in organisational decisions are widely recognised by other management scientists too, who also adopt a 'constructivist' approach to MCDA [e.g. Stewart (1992), Belton et al (1997)]. Lootsma (1996), for example, suggests that there is no great difference between the so-called European school of thought, and other management scientists' views world-wide.

### 3.6.2. Visual interactive computer software

Phillips (1982) notes that decision analysis texts in the past often neglected the issue of how a single, concordant problem structure can emerge, and in particular, how sensitivity analysis can be used “as a method for dealing with differences of opinion.”

The VISA (Visual Interactive Sensitivity Analysis) software package [Visual Thinking International (1995)] makes effective use of computer graphics to provide decision-makers with a clear and easy medium for analysing and evaluating alternatives, under a flexible set of assumptions. Participants are free to alter and adjust the weights and performance scores used in the MCDA model in order to see the impact of those adjustments on the final outcome and choice. This sensitivity analysis allows decision-makers to consider under what conditions (with respect to preferences and uncertainty) a particular option is preferred. In this way, uncertainty (with respect to preferences, and the impacts or outcomes of the different alternatives) can effectively be taken into account in the decision.

VISA’s primary aim is to stimulate discussion, equipping participants with a better understanding of the problem, their own preferences and values, and the views of other participants. In this context MCDA is seen, and used, as a decision support tool, as a ‘sounding board’ for showing participants the effect of slight (or great) changes in the weights they ascribe to their stated values and their relative scorings of alternatives. In the sense that discussion and interaction are encouraged, iterative and interactive MCDA methods are themselves a form of problem structuring [Belton et al (1997)]; perceptions of the problem can change throughout the analytical evaluation and subsequent discussion sessions. Even at the conclusion of the analysis, the aim is not to prescribe a particular solution; the decision still lies with the decision-makers at the end of the day. However, the analyst can hopefully say that the MCDA process led participants to a better understanding of their preferences and the options open to them.

Interactive MCDA methods confront decision-makers [Stewart (1996)], forcing them to explore and negotiate their problem, with the outcome being an MCDA formulation of the problem. They are challenged to carefully consider their views and objectives, as well as the consequences of their choices, as measured against those objectives. The evaluation of

alternatives is *not* the final step in the analysis, but rather a stepping stone to further discussion and deeper understanding of the problem. The *iterative* evaluation and sensitivity analysis often prompt the identification of new criteria and/or alternatives. It is important to note that the extent to which MCDA methods will spur on discussion and encourage better understanding is dependent on how well the results of the analyses are fed back. VISA is particularly effective in providing clear, graphic and easy-to-understand output of the results of the MCDA models, together with information on the sensitivity and robustness of these results.

The way in which VISA is intended to be used is very much in the spirit of the European schools' constructivist approach, where preferences are formed throughout the process. As Roy (1993) points out, even though it has been observed that the Von Neumann-Morgenstern axioms are often contravened by decision-makers in practice, "neither the concept of utility function nor the procedure for calculating expected value loses all its interest or viability as keys which can develop convictions and cause them to evolve, as well as communicate with respect to the foundations of these convictions". Although MCDA adopts a more pragmatic approach than descriptive decision analysis models, MCDA still alludes to the set of axioms assumed by them [Henig & Buchanan (1996) p.4]. However, the more flexible approach of MCDA allows decision-makers to interact and propose compromises, so terminating the process and "selecting an inefficient compromise" [Kersten (1997)]

Despite this modern, interactive and constructivist style of decision-aid, MCDA still requires, at the outset, a preliminary problem structuring phase, where the problem is first explored and defined. Particular emphasis should be given to different perspectives in group decisions. This might be achieved through using nominal group techniques [e.g. Stewart & Scott (1995)] or Soft OR, for example. In this stage, the initial objectives and alternatives are identified before further MCDA analysis and problem bounding/structuring can take place. This initial definition of the conundrum should represent a consensus view, in order to ensure the success of subsequent analysis, participants' buying in to the process, and being committed to it. It is no use doing further analysis using a particular problem definition if all the parties do not agree on what the problem really is.

As has already been mentioned, real-life problems do not normally come nicely pre-packaged. An investigation often begins with only a rudimentary statement of what the

problem issue is, such as: *What policies should be adopted to reduce poaching of the West Coast Rock Lobster resource?* or *How should the fishing industry and other stakeholders be involved in management decisions?* [Rosenhead (1989), Belton et al (1997)]. What actions are, or are not possible often only becomes obvious during the investigation [Roy & Vanderpooten (1996)]. Hence, there is a great need for techniques, such as those of soft-OR, to structure these messy problems prior to more quantitative analyses. Belton et al (1997) emphasise that MCDA analysis using VISA is “embedded in a wider process of problem construction”. [p.4]

### 3.6.3. An integrated approach to MCDA

*“The upgrading effort [of MCDA methods] has to include support in the development and analysis of cognitive maps, different and evolving rationalities, causality, process attributes, use of multiple problem representation and solution methods and transformations from qualitative to quantitative structures.” [Kersten & Noronha (1996)]*

There is broad consensus amongst the MCDA community that there is the need for the development of a broader approach to MCDA in future research and practice [Kersten & Noronha (1996)]. In particular, special attention should be given to determining the needs of managers and decision-makers in practice. It is apparent that MCDA practitioners need to adopt an integrated, “meta-approach” to decision support, incorporating ideas and techniques which have been developed in other fields such as cognitive psychology and organisational behaviour, in order to establish, and empirically validate, an MCDA approach [Kersten & Noronha (1996), Bouyssou et al (1993), Michalowski (1997)]. The MCDA methodology needs to focus not just on the solution of decision models, but also on the “creation of decision problem representations” [Michalowski (1997)]. This MCDA methodology should incorporate:

- i) methods and guidelines for problem structuring [Roy & Vanderpooten (1996) p.29],
- ii) techniques and skills for effectively managing group decision processes - focusing on the activities of the analyst and facilitator, as well as
- iii) the analytical methods themselves.

Several researchers have advocated the integration of MCDA methods together with methodologies developed by the English school of Soft OR, and the European school of MCDA [Stewart (1997), Ostanello (1997)]. Soft-OR is particularly suitable for structuring messy and ill-defined problems which are usually formulated in qualitative, rather than quantitative terms in organisational decision-making. Consultants in practice are finding it increasingly important to model qualitative knowledge and information in addition to performing quantitative analyses [Eden et al (1983), Ackermann & Belton (1994)]. Soft-OR has also proved extremely effective for managing the group process within the highly political arena of organisational decision-making, as well as securing client commitment to the intervention process.

The potential benefits of integrating Soft-OR methods (like SODA) within an MCDA approach are numerous and far-reaching:

1. Soft-OR can provide a better appreciation of the problem (through divergent exploration of different perspectives), before trying to nail down the key issues and evaluate alternative solutions (convergent modelling),
2. They can assist in encouraging participation, and managing the group decision process,
3. Soft-OR structuring methods foster creative thought. By considering others' perspectives, a broader range of ideas can emerge. Furthermore, they help decision-makers to talk about their problem, order their thoughts into a meaningful structure, and by so doing, make more sense of the situation,
4. All of the above three assist in getting participants to buy in to the process,
5. Different phases of an intervention often involve different tasks, and
6. Different methods tend to focus on different aspects of the problem [Mingers et al (1997)].

Belton et al (1997) emphasise that research in this area should adopt an empirical approach, to explore and validate integrated approaches in real-life interventions. A few trial investigations have been conducted using SODA [Eden (1989)] and VISA in a combined decision support effort [Ackermann & Belton (1994), Belton et al (1997), Bana e Costa (1997)].

Daellenbach (1997) also recommends that another soft-OR methodology, SSM [Checkland (1989)], be used within the broader MCDA approach, stressing that SSM strives to bring about a “climate of appreciation and understanding of ... conflicting world views”.

### 3.7. Past paradigms of problem structuring in MCDA

Various advice has been given to MCD-analysts to help with problem formulation. In particular, the analyst should become educated about the problem environment [Von Winterfeldt & Edwards (1986)]; this might entail examining background literature [Keeney & Raiffa (1993), Buede (1986)], observing how decision-makers currently make and rationalise their decisions (“casual empiricism”), interviews, or surveys to determine public values [Buede (1986)].

In the MCDA context, *problem structuring* entails both defining the problem and identifying the elements of the model to be used in analysing the various alternative courses of action [Watson & Buede (1987)]. This includes, for example, determining the decision boundaries, and identifying who is (or should be) involved in the decision-making process.

Churchman et al [Woolley & Pidd (1981)] divide problem formulation into the following steps:

- identifying the decision maker(s)
- identifying the decision maker’s objectives
- examining the system and its environment
- considering alternatives and their consequences
- editing and condensing the list of objectives and actions
- defining a measure of effectiveness (objective function).

Von Winterfeldt (1980) defines problem structuring as “an imaginative and creative process of translating an initially ill-defined problem into a set of well-defined elements, relations and operations”. These problem elements include “events, values, actors, and decision alternatives”, and are related to each other by “influence relations, inclusion relations, hierarchical ordering relations, etc.”. This problem structure should capture and represent both the “environmental (*objective*)” facts known about the decision situation and the

*subjective* views, preferences and values of the decision makers [Smith (1989), Von Winterfeldt (1980), Roy (1993), Roy & Vanderpooten (1996)].

Watson & Buede (1987) differentiate between this problem structuring stage, and model structuring. *Model structuring* refers to the building of a model for evaluating alternatives, incorporating information about the probable outcomes of various alternatives (as measured against various criteria) by considering cause-effect relationships.

On the topic of *problem structuring*, MCDA and decision analysis have concentrated on procedures for:

- i) eliciting objectives, representing the decision maker's concerns which he/she considers essential in the decision situation,
- ii) structuring these objectives, usually through constructing and, if necessary, merging value trees (also called objectives hierarchies by some researchers - this thesis will use the two terms interchangeably), and
- iii) generating alternative options.

Two main approaches have been developed for eliciting objectives: the top-down approach and the bottom-up approach [Buede (1986) and VonWinterfeldt & Edwards (1986)].

### 3.7.1. Eliciting and structuring objectives

#### **The top-down approach to constructing a value tree**

The top-down approach is objective-driven. It commences with the identification of overall objectives, representing the general areas of concern in the decision, and further specifies these broad objectives in terms of more detailed sub-objectives.

The overall objectives are broadly defined; classic examples are: economic benefits, environmental impacts and risks, etc... Considering each of these broad objectives in turn, decision-makers are then asked to divide the general objectives into component sub-objectives which further specify and clarify the meaning of the global objectives. These

lower-level objectives should be sub-components of the superordinate objective, rather than merely means to some higher objective.

In this way, the objectives in the hierarchy should all be ends-objectives i.e. important in themselves, rather than deriving their importance from their implications for some more fundamental, superordinate objective. It is important to distinguish between means and ends objectives in this way [Keeney (1988)] in order to focus on the basic, core objectives in the decision situation. The means objectives are not unimportant, but rather are important to the extent that they influence the ends objectives. Buede (1986) recommends that the top-down method be used in strategic planning situations “where the decision maker has begun to concentrate on the problem ... but has not gotten very far in developing alternative courses of action” [p.61].

### **The bottom-up approach**

The bottom-up approach is alternative-driven, and starts with the consideration of alternatives which are already on the table, or have been used in previous similar decision situations. It is often useful to also think about hypothetical (not quite feasible) alternatives.

Participants are asked to identify those characteristics which are either desirable or undesirable in each alternative. This might be done through brainstorming or some other idea generation technique [Belton et al (1997)]. Once this list of attributes is established, subsets of attributes are then grouped and categorised into higher level values.

### **Top-down or bottom-up?**

In eliciting and structuring objectives, the analyst might use either one of the two approaches, or both in combination. Buede (1986) points out that since all analysis should be iterative, *both* approaches are likely to be used at some stage during the intervention.

In public decisions, where there are various stakeholder groups, separate value trees are often constructed, each one representing the concerns of a particular group. These separate trees then need to be aggregated into an overall group hierarchy, combining overlapping categories [Keeney (1988)]. The principle in constructing this overall objectives hierarchy is that the *union* of all stakeholder objectives should be used. The various players generally have no

problem in accepting the aggregated value tree constructed in this manner since, at this stage, no weighting or prioritisation of the different objectives has yet taken place [Gregory & Keeney (1994)]. This overall group hierarchy might, instead of being constructed from individual hierarchies, be developed in a workshop setting, incorporating the ideas generated by the various participants through brainstorming.

### **Checking and pruning trees**

Keeney & Raiffa (1993), Von Winterfeldt & Edwards (1986) and Keeney (1992) have given various guidelines for checking and 'pruning' value trees. Objectives in the hierarchy should, as far as is possible, be:

- complete,
- operational,
- decomposable (i.e. judgementally independent cf. Von Winterfeldt & Edwards p. 42)
- non-redundant
- concise/minimum size.

Refer to the above references for a more detailed explanation of these desirable qualities required in value trees.

Von Winterfeldt & Edwards (1986) stress that the analyst must pay careful attention to the construction of the value tree, since it determines the "level of abstraction" at which formal analysis and evaluation is carried out.

### **3.7.2. Uses of the objectives hierarchy**

The objectives hierarchy is intended to provide the basis and direction for informed decision making. Keeney (1988) points out that objectives hierarchies can be used for the following main purposes:

#### **Facilitating communication**

The objectives hierarchy provides a framework for common understanding of the problem and legitimate involvement of the different stakeholders in the decision. It can furthermore, provide a "basis for compromise, when necessary, and consensus, if possible."

### **Creating alternatives**

Focusing on objectives, and considering means for achieving them, can inspire creative thought with respect to alternatives and decision opportunities [Keeney (1992)].

### **Design**

The hierarchy can provide the basis for the design of alternatives. In our case, it was used to verify the design of an operational management procedure (OMP) for the West Coast rock lobster fishery [cf. Chapter 7].

### **Data collection**

Consideration of the objectives will often identify areas and purposes for which data should be collected.

### **Evaluation of alternatives**

The objectives hierarchy traditionally provides the analytic structure for evaluating alternatives in formal decision analysis.

It is important to note that the objectives hierarchy defines the decision context, providing the boundaries for the decision problem.

### **3.7.3. Problem taxonomies**

Von Winterfeldt (1980) and others have suggested the development of problem taxonomies to categorise and help identify generic classes of problems. These generic classes would then enable the development and use of 'prototype decision analytic structures' for dealing with problems such as ...

- facility siting - deciding on the best site for a power plant, say,
- contingency planning - what to do in the case of natural disasters, such as blowouts from oil platforms,

- regulation - of emissions from oil refineries or factories, for example
- budget allocation to competing programs.

Problem taxonomies and prototypical structures are intended for problems which are recurring and typical, and hence not appropriate for the more perplexing messy and ill-structured problems which require a novel and creative approach. However, some insight might still be obtained from such prototypical structures.

### 3.8. Value Focused Thinking

*"Ultimately strategic planning is about purpose, meaning, values and virtue." [Bryson (1995) p.68]*

Keeney has made an invaluable contribution to the field of problem structuring with his book, Value Focused Thinking (1992).

In decision-making, people typically focus their energy on identifying and generating alternative options and evaluating which alternative is best. They tend to 'anchor' their thought on the most obvious (least creative) alternatives, and haphazardly select criteria (usually proxies for higher objectives) by which to evaluate them. Keeney refers to this as 'alternative focused thinking'. An alternative approach, where the primary focus is not on alternatives, but rather on *values*, is likely to lead to better and more defensible decision-making. Keeney therefore proposes that steps 2 and 3 in Figure 3.1. be switched; that the specification of values and objectives occur *before* any alternatives are identified or generated.

Bryson (1995) mentions that perhaps the most important benefit of clarifying and agreeing on an organisation's mission is "simply that it fosters a habit of focusing discussion on what is truly important" [p.68]. Most organisations today do recognise the need for articulating organisational values and drawing up a mission statement. However, mission statements are often vague and non-operational, providing little practical advice for evaluating important decisions. In fact, it is not uncommon for employees to be unaware of what the organisation's strategic objectives are, or if they do know what they are, find them ambiguous. Keeney feels that the proper articulation of strategic objectives is often neglected

due to alternative focused thinking being widely accepted as the norm. Also, people seldom recognise the importance of time spent on this exercise.

*“Simply listing objectives is shallow. We need greater depth, a clear structure, and a sound conceptual basis for relating objectives to each other in decision contexts”*  
[Keeney (1994)]

VFT provides an effective means for the structuring and appreciation of objectives. The benefits of the VFT approach are numerous. The most obvious advantage is that it focuses the decision makers’ attention on what is really important in the situation, and helps to “uncover hidden objectives” [Keeney (1994)]. In turn, it provides the framework for better communication between decision makers, and facilitates stakeholder involvement in the public context.

Bryson (1995) points to the importance of focusing on the ultimate purpose and strategic objectives of public organisations in public decision-making. He suggests that this focus on ultimate values provides an effective basis for conflict resolution. As he puts it, “focus on the purpose and ultimate meaning of organisational efforts - to the extent that there is agreement on them - therefore can frame most of these conflicts in such a way that they facilitate the purpose and fulfilment of organisational ends” [Bryson p.69], and “Agreement on purpose therefore gets an organisation to pursue the following (often preferable) sequence of conflict resolution activities: agree on purposes, identify problems, and then explore and agree on solutions.” So, by exploring values it is possible to reach consensus at the strategic level and work downwards from there - to more detailed strategies of how to achieve them. Initial agreement on the strategic objectives of the public organisation forms the foundation for further discussion and negotiation.

## Framing the decision context

Value focused thinking (VFT) is particularly useful for framing the decision situation (defining the specific decision context, and setting the boundaries) and focusing attention on those objectives which are fundamental to the decision situation. Keeney differentiates between strategic, fundamental and means objectives.

*Strategic objectives* are the long-term, *raison d'être* objectives, relating to the strategic and overall operations of the organisation, giving guidance for all decision-making. All decisions take place within this broader strategic context. Everyday decisions need to be consistent with the strategic objectives and values of the organisation in order for those long-term objectives to be achieved. Likewise, politicians and government officials should consider and attempt to take stakeholder objectives into account. Hence, it is important that before anything else, the strategic objectives are properly articulated and fully understood. However, the question still remains : "How can these strategic objectives be applied to everyday decisions?"

In VFT, the answer to this question is : *fundamental objectives*. Fundamental objectives are ultimate ends objectives; those concerns which are of fundamental importance to the decision maker (s) in the particular decision context. They define the decision context for a *particular* decision - remember that all decision-making is in the pursuit of objectives. Therefore, deciding which objectives are fundamental to a particular decision context is crucial, since they frame the decision situation, and guide the search for possible solutions or plans of action. Keeney (1992) points out that with alternative focused thinking, neither the fundamental objectives, nor the decision context are usually made explicit [p.44].

Fundamental objectives are identified in two ways:

1. lower-level *means* objectives are "pushed out using a means-ends logic" by asking the question "Why is that important?" - in this way, the decision maker (s) distinguish between those objectives which are fundamental, and those which are merely means to some fundamental objective,
2. working back from the strategic objectives, considering how they are relevant to the particular decision.

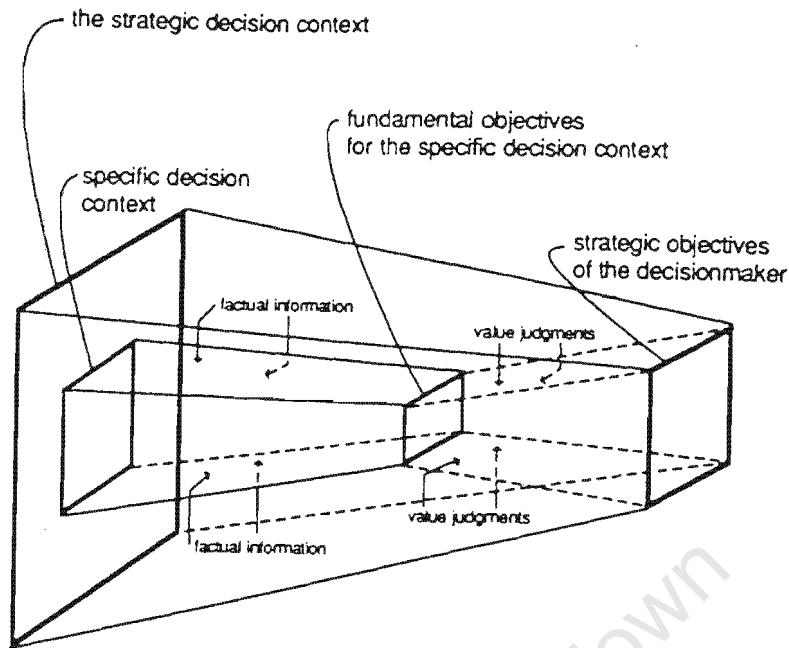


Figure 3.2. The value focused thinking framework (source: Keeney (1992) p.46)

Value focused thinking uses two different structures for structuring objectives: fundamental objectives are structured into a *fundamental objectives hierarchy* (FOH); having the same characteristics and requirements of a value tree, as discussed above. The means objectives, on the other hand, are structured into a *means-ends network* (MEN). The main difference between the FOH and MEN is in the inter-relationships between the objectives in each structure. In the FOH, lower-level objectives *specify* (are a part of) the superordinate objective. Hence, each subordinate objective is linked only to the *one* superordinate objective directly above it. In the MEN however, relationships are *causal* - the lower-level objective is a means to the higher. A means objective might influence (be linked to) several other means objectives, or fundamental objectives.

The aim of VFT is to inspire the decision maker to broaden his vision of the problem by focusing on the fundamental objectives, rather than ‘anchoring’ on already identified alternatives. Furthermore, it enhances the “co-ordination of interconnected decisions” [Keeney(1994)] and provides the basis for everyday decisions to be more consistent with the strategic objectives. In addition, Keeney suggests that decision makers adopt a more proactive approach to decision-making, seeking out *decision opportunities*. Decision opportunities can be created either by broadening the decision context of an existing

problem, or by thinking of creative ideas for achieving one's strategic objectives, without reference to any particular decision context.

### 3.9. Procedures for generating options

Keller & Ho (1988) focus on the task of generating alternative options to be evaluated. The various guidelines and methods they suggest are intended to encourage decision makers to explore less frequently used thought patterns, instead of merely relying on previous or ingrained ways of doing or seeing things; in order to find new and creative ways of thinking about a particular problem issue.

Option-generating procedures can be divided into the following generic categories:

1. objective/criteria -based procedures
2. state (scenario)-based procedures
3. option-based procedures, and
4. creativity techniques.

#### 3.9.1. Focusing on objectives and criteria...

Focusing on objectives for generating alternatives is the pivotal premise of VFT.

In generating alternatives, each objective /criterion should be considered in isolation, and then together with the other objectives - 2 at a time, 3 at a time, etc..., until all are considered together [Keeney (1992)]. The idea is to think of solutions which are effective in achieving each objective within the particular grouping of objectives considered. This method is designed to generate as many alternatives as possible. Considering any particular objective in isolation is likely to produce alternatives which would not have been proposed if only the 'big picture' was considered i.e. all objectives concurrently.

Strategic, fundamental and means objectives are all useful for guiding creative thought and inspiring ideas for options. Particular emphasis should be given to the most important objectives. The aim is to design alternatives which do well on these.

Criteria (or attributes) should also be specified [Keeney (1992)]. Keeney stresses that attributes are important in that they help to clarify the meaning of the fundamental objectives. As an example, when considering one's personal investment portfolio, the following criteria are useful for evaluating *and* generating alternatives:

1. the expected annual rate of return,
2. risk (or volatility),
3. accessibility to the funds (liquidity).

Inventing new criteria can lead to the refinement of existing options, or creation of new ones. For example, introducing the criterion : *minimise tax liability* would lead the decision maker to consider his current tax position and tailor his investments accordingly.

More levels of specification in the value tree might also be useful for generating alternatives. Our investor would be wise to consider risk in terms of the short and long term. He might be happy with a higher risk initially, but require a lower risk after a particular date, such as on, or near to, retirement.

Keller & Ho (1988) further suggest that decision-makers role-play, considering the problem from others' perspectives. In the investment example, it would be useful to consider the Inland Revenue's objectives and plans to predict future changes in the taxation of various investments. For example, how will retirement annuity benefits be taxed in future?

Finally, it is often useful to broaden the decision context in order to come up with better alternative solutions [Volkema (1983)]. This is done by considering higher level objectives.

*"Too often, the objectives used as the fundamental objectives in a decision situation should in fact be means objectives in a more appropriate decision frame involving a broader context" [Keeney (1992) p.208].*

### 3.9.2. Scenario-based procedures

Consideration of future possible scenarios can be used to generate options which will be most effective under each envisaged scenario. Decision makers should focus on those scenarios which are considered most likely to occur in future. For example, before the announcement of who was to host the 2004 Olympic Games, a South African investor might have purchased construction shares in the hope that Cape Town would win the bid, leading to a significant rise in the amount of construction work in the area.

### 3.9.3. Option-based methods

In generating alternatives, decision makers often anchor on the first few alternatives proposed. It has been shown that people tend to focus on a particular local area of the cognitive network, rather than searching globally [Keller & Ho (1988)]. It is therefore useful to rather visualise an 'ideal' option and design options which are as close to this ideal as possible [Keeney (1992)].

Alternative framings of a particular option have also been shown to have a vast impact on its perceived acceptability [Tversky & Kahnemann (1981)]. Keller & Ho (1988) suggest that alternative framings of a particular option might lead to new options being generated.

### 3.9.4. Creativity techniques

With messy problems in particular, it is useful to examine the problem from different perspectives (different stakeholder groups or experts), or at different levels of the organisation [Keller & Ho (1988)]. This is an extremely effective method for creating options. Brainstorming is often used, particularly in decision-making teams or groups.

Many of these option-generating techniques are employed, either implicitly or explicitly, in the problem structuring approaches and software considered in Chapter 5.

## Chapter 4

# Context for Strategic Decision Making

*“The first task for management science, if it is to be able to contribute, rather than distort and mislead, is to define the specific nature of its subject matter. This might include as a basic definition the insight that the business enterprise [or public organisation] is made up of human beings. The assumptions, opinions, objectives, and even the errors of people (and especially of managers) are thus primary facts for the management scientist.” [Drucker (1974) p.510]*

Management scientists need to pay more attention to problem structuring in order to understand the behavioural, social, organisational and political contexts within which their clients operate [Belton et al (1997)]. Much research has been done on developing methods for group decision support; however, as Cropper (1990) points out, methods and problems have, on the whole, been divorced from their contexts in the research literature. Explicit details of the social context and why, or how, particular methods were used in a given situation is usually neglected [Cropper (1990), Lockett et al (1997)]. Kersten (1997) stresses that if the behavioural and social aspects of group decision making and support are not more carefully considered, and the needs of decision makers in practice not properly accommodated [Michalowski (1997)], research in management science will fail to exert influence either on real-life decision-making, or on research in related fields.

It is crucial that today’s management science consultant strive to appreciate the (often subjective) intricacies of problem environments, understanding the problem as seen through the eyes of their client or client group. Life, it’s complexities and realities generally cannot be modelled by mathematical models; hence, the need for both *qualitative* and *quantitative* modelling of decision contexts [Eden (1989)].

In providing decision support to a group of decision makers, the initial and subsequent structuring of the problem is of utmost importance. The success or failure of a particular structuring method is dependent on its applicability for, or adaptability to, the particular decision *context*. The consultant needs to consider not only which formal method(s) to adopt (e.g. SODA, MCDA or Strategic Choice), but also how they should be used in combination in order to guide the decision *process*. In this way, he needs to decide how to tailor his expertise and knowledge of different methods and methodologies for dealing with a particular decision context. If necessary, he may need to adapt his own personal *style* to deal with particular aspects of the decision making team or environment within or across organisations.

This chapter considers the milieu of strategic decision making from four different perspectives: firstly, the chapter looks briefly at what makes decision making difficult in practice, focusing on the nature of 'problems' themselves. Secondly, decision making is considered from the perspective of the *individual decision maker*. The third aspect of strategic decision contexts to receive attention is *group* decision making (in and across organisations). Finally, attention is given to the *role of the consultant*.

## 4.1. The nature of problems

What makes decision-making difficult?

### Messy problems

Real-life conundrums, especially those which the management scientist gets involved with, are usually 'ill-structured' [Simon (1973)]. The terms 'messy' and 'wicked' are often very descriptive of the complex networks (or 'systems') of inter-connecting issues faced by today's decision makers [Ackoff (1981), Woolley & Pidd (1981), Bennett (1990)]. Drucker (1974) [p.508] points out that complex systems such as "markets, technologies and businesses" often behave "counter intuitively; the plausible tends to be wrong". Rosenhead (1989) notes that a 'wicked' problem is often just the result of, or a symptom, of another wicked problem. Breaking the conundrum down into sub-problems, and optimising over each sub-problem, frequently does not help, since a "system has characteristics that the mere sum

of its parts cannot reproduce” [Volkema (1983) cf. also Ackoff (1981)]. Hence, problems of this nature frequently need to be considered in a more holistic manner than we perhaps are used to doing.

Managing the west coast rock lobster fishery is a good example of such a problem, where several problem areas are dynamically inter-related. Redistribution of fishing rights to previously disadvantaged communities, poaching and policing of the fish stocks, the economics of the fishery, socio-economic conditions of fishermen, the biology (population dynamics) of the fish stock, and the decision-making ‘process’ are but some of the issues making up the complex ‘mess’ to be considered by decision makers. Non-routine decision situations of this nature require novel and innovative approaches to effectively deal with them.

### **Uncertainty**

Ill-structured problem situations are characteristically fraught with *uncertainty*, conflict and complexity [MacCrimmon & Taylor (1976)]. When confronted by such situations, the decision-maker’s first task is to apply his mind to what the problem really is, before he can start to decide what course of action to follow. Initially, he may not even know what options are open to him. Furthermore, when comparing options, an individual decision maker’s preferences are seldom well, or clearly, defined - “among areas of firm conviction lie hazy zones of uncertainty, half-held belief or indeed conflicts and contradictions” [Roy and Vanderpooten (1996)]. When there are multiple stakeholders, the situation is even more complex.

### **Conflicting objectives**

Decisions often involve *multiple* and *conflicting objectives* - requiring trade-offs. For example, fisheries managers world-wide are frequently required to make trade-offs between economic and conservation objectives in a particular fishery. In the South African fisheries at present, politicians are faced with making trade-offs between the interests of the established fishing industry, and those of fishing communities which were previously disadvantaged and denied fishing rights under apartheid.

### **Conflicting views**

The management scientist is normally involved in situations involving *multiple decision-makers* and/or stakeholders. These situations are complicated not only at the level of individual idiosyncrasies and preferences, but also at the communal (i.e. social) and organisational level. The complexity of human cognition, behaviour and socio-political interaction (fashioned by different personalities, cultures, personal preferences and goals, political agendas and tactics, etc. ) all have a fundamental impact on group dynamics and decision-making.

### **Cognitive limitations**

What makes strategic and everyday decision making even more perplexing is our limitation as decision-makers (in terms of cognitive capacity, time constraints, inability to withstand and deal with stress, etc.). Empirical studies have shown that peoples' ability to understand and make sense of complex decision situations is very limited [Keller & Ho (1988), Tversky & Kahneman (1981), Kahneman et al (1982), Harrison & Bazerman (1995)].

Looking at these characteristics of the decision making environment, it is clear that decision analysts, strategic planners, and the like, have an important role to play, to prompt a structured and creative approach to tackling complex conundrums. The management scientists' role is particularly necessary in this day and age, when decisions often need to be defensible and, at least perceived to be, 'democratic' (particularly in the realm of public policy making), incorporating the views and perspectives of different parties and interest groups.

Hence, it is crucial in today's world of decision aid that the management scientist possess dynamic skills and tools for effectively structuring, understanding and modelling the decision environment as seen by the various actors. After all, the management scientist's role is legitimate only to the extent that he can solve, or help the decision-makers themselves to solve their problems more effectively than had the intervention not occurred [Ackoff (1962)].

## 4.2. The individual in decision making

### 4.2.1. Individual perspectives

*“When it comes to people, different is normal” [Simons, G. & Zuckermann A.J. (1994)]*

Humans are complex in their individuality. As a result of the diversity and individuality of personality, the processes of human thought, decision-making and social interaction are complex. Our thoughts and beliefs are fashioned by our culture, upbringing, education, and the social fibre of the community and world we live in.

Eden et al (1983) cite the example with which most of us can vividly identify: on ‘comparing notes’ after a meeting, one is often surprised by how different one’s colleagues’ impressions of the meeting and the implications of the issues covered, are to one’s own. Similarly, consider how much you remember of an academic paper or text recently read. Are there sections which you remember better than others, or which were overlooked totally? A person will take special note of those issues which they consider most significant to themselves, either in their present situation or for some time in future, while paying little or no attention to issues ‘less important’ to themselves. The different emphases we place on issues is determined by, amongst other things, our role or stake in the situation, personal world-view and temperament. Furthermore, people continually make judgements and interact with their environment [Roy (1993)]. Views change as we synthesise and re-synthesise information, observe the actions of others, or communicate with our peers.

“How and what you remember is determined by who you are and what you already know” [Zimbardo (1992) p. 366]. Not only are we different as a result of our experiences and environment (the behaviouristic approach to psychology), but also due to nature’s design (the cognitive approach). Cognitive psychologists suggest that the way in which people perceive, interpret and experience the world around them is fundamentally determined by their inner thoughts and processing of incoming sensory information. When thinking about the milieu of a problem, people match and compare information with their internal mental representations. Comprehension of new information occurs through integration with existing knowledge.

*“An individual responds to reality not as it is in the objective world of matter, but as it is in the subjective reality of the individual's inner world of thoughts and imaginations”*

*[Zimbardo (1992) p.17]*

The way in which we perceive and interpret situations is strongly influenced by our past experiences [Volkema (1983)]. What information we use, and how we use it, differs from person to person [Kepner & Tregoe (1981)]. A problem is detected when we feel dissatisfied about a particular situation, or see room for improvement [Daellenbach (1997)]. In this way, ‘problems’ are idiosyncratic, subjective conceptualisations of the decision environment, rather than realities in themselves [Smith (1989), Woolley & Pidd (1981), MacCrimmon & Taylor (1976)].

Decision making can be seen as the pursuit of values and objectives (either personal or communal), and the seeking of opportunities for achieving those objectives [Newell & Simon (1972), Smith (1989), Eden et al (1983), Keeney (1992)]. With messy problems, although we know something is not quite as we would like it to be, we often don’t know where to start to alleviate the problem [Eden et al (1983)]. If someone were to ask: “What is the problem?”, we might struggle to give an answer. If the person asking is our boss, we might present a particular label, but give another label to a friend we trusted [Eden et al (1983)].

So, our mental picture of the problem evolves out of and is built, not only of *objective* facts known about the particular situation, but also our personal and *subjective* views of the situation. Recognising the subjectivity of problems, Von Winterfeldt (1980) emphasises that problem structuring should seek to “formally represent the environmental (objective) parts of the decision problem *and* the decision makers’ or experts’ (subjective) views, opinions, and values.”

Eden et al (1983) point out that, although the idiosyncratic and subjective nature of problems is generally accepted as common sense, it is often difficult to bear in mind and take into account in practical decision making and decision support.

### 4.2.2. The psychology of personal constructs

*“whatever nature may be, or howsoever the quest for truth will turn out in the end, the events we face today are subject to as great a variety of constructions as our wits will enable us to contrive.” [Kelly (1970)]*

Kelly's (1970) *Personal Construct Theory* (PCT) is founded on the premise that people are continually striving to make sense of their world, “interpreting and re-interpreting themselves and their situation” [Bannister & Fransella (1986) p.63, cf. Eden (1988)]. Although the situations and events we have experienced do not change, the way in which we view the situations *can* change as we actively consider alternative interpretations of the events. As Kelly puts it: “our present perceptions are open to question and reconsideration ... even the most obvious occurrences of everyday life might appear utterly transformed if we were inventive enough to construe them differently” [Kelly (1970)].

The internal constructions and theories of the world around us are built using our personal constructs as building blocks. Kelly suggested that personal constructs can be defined by one's belief about how two objects or events are similar, and how that similarity sets them apart from a third object or event. In this way, each construct is viewed as having an opposite pole [cf. Bannister & Fransella (1986) p. 156]. Meaning is implied through contrast and relativism; we make sense of our experiences by considering similarities and differences [Eden (1988)]. Some of our personal constructs are common and used universally by others, whilst other constructs are unique to us as individuals. Taken together, our personal constructs form a belief system which influences the way we view and respond to situations, and how we form impressions of others [Zimbardo (1992)]. So, different perspectives of the same situation arise as a result of people viewing the situation from their own frame of reference (with reference to *their* personal construct system).

Individuals usually spend a great deal of time pondering on their relationships and interactions with those around them, hypothesising about “what makes others tick” [Eden et al (1983)]. PCT's “sociality corollary” emphasises that the way in which a person relates to and interacts with another is determined primarily by their understanding of the other person. The key to a team of decision makers working effectively together is that they understand the

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internal perspectives of others as they relate to the problem situation. Consensus is reached if a common, shared perspective of future events, or the situation at hand, can be agreed upon (“commonality corollary”) [Thompson et al (1995), Massey & Wallace (1996)].

The SODA approach to group decision support [Eden (1989)] is founded on the principles of PCT. By considering other team members’ perspectives (represented in cognitive maps), individual participants get to see a broader, richer formulation of the problem. Considering others’ perspectives encourages one to re-interpret the situation, and by so doing, to form a shared or joint perspective of the problem. Lockett et al (1997) showed how individual perspectives can be significantly swayed by other group members. In their study, they used psychological profiles to focus on the role of temperament in influencing the group process, and the results on ‘group cognition’ [Thompson et al. (1995), Massey & Wallace (1996)].

Because our views are constantly being reviewed and ‘open to question’, Eden (1990c) questioned whether SODA and MCDA are compatible. SODA strives essentially to achieve *consensus* [Eden (1989)] through group cognition and group problem formulation, whilst the underlying philosophy of MCDA is *compromise* (between conflicting goals or perspectives) [e.g. Kersten (1997), Lockett et al (1997)]. However, even after a SODA intervention, differences in participants’ underlying values may preclude consensus. If a consensus solution is not found through the SODA process, because of conflicts between stakeholders’ underlying values, MCDA might be useful for guiding the negotiation process towards a compromise agreement. After all, consensus in most cases, results from some form of compromise. Knowing one’s own preferences (perhaps even making them explicit quantitatively, as suggested by Keeney (1992)), as well as the values and priorities of other parties, is essential for developing one’s bargaining position, facilitating negotiation and compromise offers [Daellenbach (1997), Kersten (1997), Thompson et al (1995)].

Furthermore, and more importantly, MCDA used in conjunction with soft OR can provide crucial insights which may have been missed by the “softer” approaches. MCDA is also more convergent in its approach to formulating the problem, so helping decision makers to focus on what is important in the problem. Another clear opportunity for making use of MCDA models is when there are many criteria to be taken into account in selecting the ‘best’ alternative. Even after a problem structuring exercise aimed at generating creative and innovative ideas, it is still necessary to make a choice between alternatives. This choice is

seldom obvious or trivial. A problem involving many diverse objectives and criteria often presents problems for decision makers who find it impossible to mentally synthesise the effect of an alternative on each and every criterion at once. It is not unusual to find ten to twenty criteria to be weighed up in scoring possible alternatives.

The second scenario in which MCDA could be particularly useful, after employing some problem structuring methodology such as SODA or SSM, is if a large number of alternatives have been identified for consideration, and the selection process lends itself to quantification [Daellenbach (1997)]. This however, is likely to occur only after the higher-level, strategic decisions have been taken, and the strategic framework is in place [Rosenhead (1989), Eden (1990a)]. In fact, several authors have questioned the usefulness of traditional quantitative OR methods for dealing with strategic issues [Eden & Radford (1990), Rosenhead (1989), Leschine (1988)].

When considering operations at the strategic level, 'top managers' are not so much concerned with optimisation, as with generating creative & innovative ideas [Eden (1990a) p.52]. The basic currency in strategic decisions at the highest organisational levels tends to be concepts (words expressing ideas and beliefs), rather than quantitative data [Eden (1988) p. 11, Eden (1989) p.27, Eden (1990a) p. 130,52]. For this reason, Eden (1988 & 1990a) predicts that the role of computers in assisting with high-level, strategic problems will move towards that of handling concepts and judgements, free from 'hard' numerical information. In particular, computers hold promise for identifying and highlighting the dynamic, and often subtle, inter-relationships between the various components of 'messy' and complex systems of problems. Despite this predicted move towards more qualitative data analysis, relevant and appropriate numerical information and hard structures should always play some role in strategic decisions and will always be important to some degree.

### 4.2.3. Insights from cognitive psychology

Over the past few decades, the cognitive approach has become the dominant approach to modern psychology [Zimbardo (1992)]. For the management scientist, whose craft requires that they effectively understand and structure their clients' problems, it is useful that they have a knowledge of cognitive psychology for several reasons:

1. Their task is, first and foremostly, to assist *people* in their decision making, and to facilitate group decision processes. Cognitive psychology explains the complexities of human cognition, and the resulting differences in views and perspectives. As Smith (1989) points out, “cognitive analysis paves the way for prescriptive theorizing” [p.972].
2. Recent and past studies in negotiation theory emphasise that *information* is the basic requirement for effective negotiation. It is not surprising therefore that researchers have focused on cognitive and information processing theories for developing theories on negotiation and conflict resolution [Thompson et al (1995)].
3. Information processing theory provides an understanding of the cognitive processes driving everyday decisions, explaining the frequent lack of creativity, and hence the need for decision support. Furthermore, it sheds light on why people find difficulty in dealing with, and making sense of, complex and messy decision situations which are non-routine and provide new and unique challenges. The drawing up of a new fisheries policy for the South African fisheries is a good example of such a conundrum. Other examples of ‘non-programmed’ problems include the designing of a new high-rise building, or the search for a cure for aids.
4. Cognitive science gives guidelines for decision support. By considering the common mental traps people fall into, and biases which can result from using heuristics in decision making, the theory gives clues as to how the consultant can help decision makers to avoid these traps.
5. The theory of how information is stored and retrieved from memory is closely linked to the idea of a cognitive map - used extensively in the SODA approach to group decision support. Cognitive maps will be dealt with in more detail in Chapter 6.
6. Massey and Wallace (1996) stress that group decision support systems should accurately represent and support the cognitive processes of decision makers, helping them to effectively articulate and communicate their thoughts in group settings.

## Mental structures for thinking

*“Thinking is a complex mental process of forming a new representation by transforming available information. That transformation involves the interaction of many mental attributes, such as inferring, abstracting, reasoning, imagining, judging, problem solving, and, at times, creativity.” [Zimbardo (1992) p.391]*

Thinking is about learning concepts (concept formation) and classifying these concepts into categories. We are daily faced with countless individual experiences and events from which we extract information and order that information into smaller, simpler and easier to manage subsets, or categories, in order to make sense of it [Zimbardo (1992)]. In this way, past experiences stored in memory serve as prototypes, guiding one’s thought about the current situation. When faced by a problem, a person searches their memory, recalling similar ‘prototype’ instances previously encountered, reflecting on the similarities and differences between these prototype cases and the present situation [Keller & Ho (1988)]. So, in searching for the ‘right’ course of action, decision makers tend to focus on how previous situations were dealt with, and how effective (or ineffective) different courses of action turned out to be. In this way, our search for potential solutions is often restricted to those options which were employed or considered at some time in the past, rather than thinking creatively about innovative and new solutions [Keeney (1992)]. Furthermore, when faced by non-routine, ill-structured decisions, people often find it difficult to synthesise the many dimensions, issues and inter-relationships of the predicament [Ackoff (1981), Keller & Ho (1988)]. In such cases, the decision maker’s previous experience offers relatively little assistance.

Cognitive science tells us that thought is representational [Smith (1989)]. Psychologists explain that information is stored in memory as a cognitive network. This network consists of concepts or ‘nodes’ which are clustered into groups, and linked to other concepts (or clusters of concepts) via connecting arcs [Keller & Ho (1988), Massey & Wallace (1996)]. The mind operates by the principle of *cognitive economy* - individual instances or experiences are categorised together around some ideal or most representative *prototype* e.g. a rose might be a prototype for the concept of flower, or a robin a prototype for bird [Kahnemann et al (1982), Zimbardo (1992)]. In this way, the amount of time and effort required to process information is minimised.

Information is generally not stored as individual items in memory, but rather as integrated packages or clusters of knowledge (known as schemas), where individual items derive their meaning from their context within the schema [Smith (1989)]. Schemas “exert powerful influences on the way we *predict* what objects are *likely* to be present in a given context. We then use both these expectations and sensory and perceptual information to recognise objects” [Zimbardo (1992) p.294]. New information is often incomplete or ambiguous. Schemas help us to fill in the gaps and make inferences about the missing information, enabling us to make more sense of the situation. Consider the following example [from Zimbardo (1992)]:

1. The notes were sour because the seam was split, and
2. The haystack was important because the cloth ripped.

These two sentences make no sense as they stand. However, if the words bagpipe and parachute are added, suddenly both make sense. These sentences make sense only when integrated with our existing knowledge i.e. when viewed within the appropriate schema. Our cognitive processes constantly employ such schemas to make more sense of the events we experience. MacCrimmon & Taylor (1976) point out that people are ‘active information handlers’, who use their understanding of information to reduce the load on memory. The classic example is that of chess masters who more easily recall board positions which have been encountered in famous games than if the pieces are randomly positioned on the board. If they do make errors in recalling the positions, they often place entire groups of pieces in the wrong position, as opposed to individual pieces being out of place [Simon (1973)].

Keller & Ho (1988) focus on how to stimulate creative thought in order to generate innovative and creative solutions to problems. They quote the example of someone contemplating a new fast food business. “Different kinds of take-out ethnic foods will be closely clustered near the state of nature of *being hungry and not wanting to cook*, and a number of possible new business ventures will be clustered near the attributes of *business success*.” People tend to constrain their search for options to local regions within the cognitive network. As a result, the solutions they come up with are ‘locally optimal’. By thinking more globally and laterally - considering other areas of the cognitive network - one is likely to generate better, more innovative solutions; the global optimum. This more global

search might yield an idea such as starting a “hire a formally dressed chef for the day” business, as a creative alternative to the more usual pizza or Chinese take-aways. Decision aid should encourage creativity by stimulating the activation of lesser used pathways in the cognitive network.

### Visual imagery and cognitive maps

*“Albert Einstein claimed to have thought entirely in terms of visual images, translating his findings into mathematical symbols and words only after the work of visually based discovery was finished.” [Zimbardo (1992) p.397]*

People frequently think in terms of visual images or spatial relationships, particularly in the absence of sensory information. A common example is the ability to find one’s way around the house in the dark. These visual images reflect our internal, mental representations of situations. When thinking about the milieu of a conundrum we tend to think about it in terms of i) those issues which we consider to be relevant in the situation, and ii) the inter-relationships between various issues [Massey & Wallace (1996)]. Cognitive maps are particularly useful for helping decision makers to identify inter-dependencies of different aspects of ‘messy’ and complex systems.

### Human problem solving - the information processing way

*“Although it is clear that animals receive and store information, there is little evidence to suggest that they can use it in the same way as humans. Humans ... are able to use information to reason and solve problems, and indeed to do these activities when the information is partial or unavailable. ... we can think about things of which we have no experience, and solve problems which we have never seen before.” [Dix et al (1993)]*

Behaviourist psychologists purported that problem solving is *reproductive*; that people learn to solve problems through experience or ‘conditioning’, and by trial-and-error. Wolfgang Köhler and other Gestalt psychologists however suggested that problem solving is not only reproductive (recalling past experiences), but also *productive*, involving insight and innovation, where known facts are put together in new ways [Zimbardo (1992)]. Existing

knowledge can be transformed and used to provide innovative solutions to new problems through *productive restructuring* of the problem [Dix et al (1993)].

*“Much problem solving involves “breaking set” - temporarily giving up reliance on past learning and mental habits for fullest participation in the stimulus array of the present moment in order to view options from a new perspective.” [Zimbardo (1992) p. 404-405]*

Think of many of the inventions of past centuries such as electricity or Orville & Wilbur Wright’s first powered flight. These inventors employed their creative problem solving abilities, experimenting with *new* ideas. Though they often faced great opposition from their peers, they persevered until they succeeded - experiencing something previously considered impossible.

Modern psychology views human problem solving through the framework of *information processing theory*. Problems often reflect a discrepancy between what you know, and what knowledge is required to solve the problem. The conundrum is solved when the ‘missing’ information is obtained, so reducing the ‘gap’ in information [Zimbardo (1992)]. Newell & Simon’s (1972) *Problem Space Theory* suggests that problem solving involves the definition of a ‘problem space’. This mental construction of the problem consists of:

1. an *initial state* (representing the current - unsatisfactory, undesirable or unsolved - situation),
2. a *goal state*, and
3. a *set of operations* or procedures required to move from the initial to the goal state.

During problem solving, the initial state is cognitively formulated and compared with the desired, or goal state. This is referred to as ‘gap specification’. Thought is directed towards finding ways of transforming the initial state into the goal state by, for example, considering means-ends relationships. The definition of the initial and goal states is of course subjective, based on the individual decision maker’s views - some may be quite happy with the current situation, while others may see a significant gap between initial and goal states [MacCrimmon & Taylor (1976)]. A decision maker must first become aware of the gap (identify that something is amiss) before anything can be done about the problem. In our intervention with the WCRL working group, different views arose amongst fishing industry

participants and fisheries managers about the current state of the west coast rock lobster resource. Fishermen were observing what appeared to be improving catch rates and believed that recent improvements in lobster growth, and resource biomass were 'evident'. Scientists, on the other hand, saw no corresponding improvement (statistically significant improvement, that is) in the indices of resource abundance, and felt that stocks were still in an unhealthy state.

Defining the problem space is no easy task when working on an ill-structured (messy) problem; all three steps above are likely to be unclear. In such cases, the decision maker's first task is to try to make sense of the situation, forming an internal representation of the problem space, and articulating various possible options for achieving the goal state. Simply specifying goals in a useful and unambiguous manner might form a significant portion of the solution process [Dix et al (1993)].

Once the initial and goal states have been clearly defined, the problem solver goes about searching the problem space for solutions. One search strategy is to use an *algorithm*, which methodically compares all possible options. However, the problem space can be massive. In such cases, our search is often limited by our information processing capacity and speed of retrieval [Newall & Simon (1972)]. Short term memory is unable to store the vast amounts of information and algorithms required to solve complex problems, and only those strategies which are used routinely, or have been used recently, are likely to be accessible from long term memory [Volkema (1983)]. As a result, we rely on *heuristics* (such as means-ends analysis, for example), in order to progress from the initial to the goal state [Dix et al (1993), MacCrimmon & Taylor (1976)].

### **Heuristics and biases**

Empirical studies have shown that peoples' ability to understand and make sense of complex problem situations is extremely limited due to limited information-processing capacity [Tversky & Kahnemann (1981), Keller & Ho (1989), Volkema (1983), Keeney (1992), Harrison & Bazerman (1995)]. As a result, decision makers often rely on 'gut-feel' and intuition, or employ various heuristics in decision making. Numerous studies have been

conducted in the study of such heuristics, and the biases which often result from using them in practice.

*Representativeness* : When recalling previous events, people tend to recall the most **typical** prototypes of past experiences. Kahnemann et al (1982) have shown that people often recall a more typical example, even though it may not be the most frequently occurring, or likely, in the particular situation. For example, if you were asked to think of a bird, you are more likely to think of a *typical* bird such as a robin or sparrow as opposed to a chicken say, even though the latter may be more common in a statistical sense. Similarly, if asked to build a cage for a bird, the cage you build is likely to be too small to contain an ostrich, even though an ostrich is clearly also a bird according to the dictionary definition of the word. Researchers have done experiments showing for example, that the response time required to identify a robin as a bird is less than that for an ostrich [Zimbardo (1992)]. Similarly, when considering the likelihood of possible outcomes or scenarios, the representativeness heuristic can lead to 'biased' estimates of probability or likelihood.

When categorising an existing problem according to previous instances, 'anchoring' on the most representative previous case may preclude the decision maker from fully appreciating the uniqueness of certain aspects of the issue at hand. Many of the problems encountered in today's society are not well-structured or routine in nature. In such cases, past experiences and problem situations offer little insight or assistance into the current predicament. The result is that few, if any, options are often forthcoming.

*Availability* : refers to how accessible certain cases or instances are i.e. how easily they are recalled. Often the most unusual instances (unlike with representativeness) are remembered - such as the big successes or major failures. More recent episodes also tend to take precedence in one's mind, due to the limited capacity of long-term memory.

*Confirmation bias* : When learning about a new situation, we combine new facts and information with what we already know. In practice, people often try to fit new information into old categories and misconstrue or neglect new information thinking that they already know it, i.e. placing the information into an existing category into which it does not actually fit. This is known as the confirmation bias [Simons & Zuckermann (1994)].

Table 6.1. Output from brainstorming - using "post-its"

OMP - improved decision making? - incorporating best available knowledge?	Efficiency of OMP	Flexibility & Ability to monitor OMP's effectiveness	Exceptional circumstances
Have simple OMP's worked in the past?	Time wasting in TAC assessment	What length of future period should be considered in evaluation?	How do you define "exceptional circumstances"? - by definition they are not anticipatable.
Structure of decision making process - wide scene - not purely scientific ⇒ Inclusion of qualitative factors is a criterion!	Will OMP clearly produce greater benefits than current practice?	Unambiguous specification of past & future (data) inputs to the OMP	'exceptional circumstances' properly debated and spelt out?
Should qualitative factors be included in an OMP?	Should OMP be fixed for a few years OR annual bun-fight?	Significant scientific paradigm shifts need to be able to influence management thinking timeously & alter the OMP	We must be able to depart from the OMP if we are clearly heading for trouble.
Should industry be allowed to choose between scenarios?	Past performance of OMP's should be objectively assessed at the end of each cycle	Significant improvements in the performance of an OMP procedure should be valid grounds for shifting to a new OMP at any time	
OMP's should not be used to mask a large shift in risk-benefit trade-offs cf. past practice		Which primary indicators of stock status should be used in an OMP?	
How different will OMP recommendation be from present system?		What should be the target recovery level over the selected period?	
Why did the Anchovy / Pilchard OMP not work?		How do you evaluate if OMP's work?	
Why did the Flake OMP work?		Need indices for evaluating the OMP	
How should socio-economics be included in an OMP?			

Clear overall policy	Rights & Obligations	Transparency & Accountability	Co-management
Planning - short term vs long term	Constitution	Transparency of decision making process	How will co-management be developed?
Security of tenure vs access rights	Historic events	Consensus	
De-politize WCRL Industry ⇒ put on firm economic base e.g. NZ model - ITQ's	Can the coast be zoned to allocate rights?	Effective participation & accountability in decision making - all role players: - Formal & Informal industry - Recreational sector of industry	
Current surplus capacity - repurchase by govt.		The procedure (timing & methods) whereby the OMP is to be discussed & agreed must itself be properly discussed & agreed by all role players	
We lack a plan of how to implement policy dreams		Consultation	
Decision Implementation?		Has consultation considered the views of key role players?	
National interest		How will a heterogeneous industry be incorporated in decision making process?	
		Submissions - Democratic research	
		Code of conduct	
		Should industry be allowed to choose between scenarios?	

Economic Yield / Sustainability	Conservation	Operational research	Socio-Economic
Effective economic utilization of resource e.g. input/output ratio (Limit uncontrolled access)	Risk assessment	Risk/Return - goes back to security of tenure	Is there any need to link socio-economic reasons to the rate at which TAC might increase?
Research the whole fishery to assess increased economic yield - hopefully to "expand cake" in WCRL industry	What should be the target recovery level over the period selected?	What is the maximum level of downward change in TAC that the industry can reasonably accommodate?	
Maximize economic yield for benefit of the entire community $\Rightarrow$ contribution from formal & informal sectors	Don't allow harvest proportion above 30% of site stock	What is the relative economic importance of increasing catch rates?	
Maximum sustainable economic yield - within acceptable biological risk	Probability of reducing spawning biomass below level at which recruitment may be impaired.	What is the current processing capacity of the industry?	
Don't drive the resource below Bmsy. If it is there now, don't drop CPUE further.	Protect female population		
	Avoid high discard mortality		
	Preserve spatial distribution of the resource		
	Has adequate brainstorming about various eventualities been carried out?		

Management structure	Policing & Control
Adequate management structure e.g. Working groups, SFAC, etc	How can effective policing & control of the resource be implemented?
Restructuring	<ul style="list-style-type: none"> <li>- State resources</li> <li>- Law enforcement</li> <li>- Judicial system / penalties</li> </ul>
Future development	Surveillance
	Funding
	Available manpower

## Chapter 7

# Interpreting the SODA model in an MCDA framework

## 7.1. The potential for using MCDA

Several conflicting objectives had become clear during the interviews and workshop. It was evident that not only did participants have differing perspectives of the problem issues, but perhaps more importantly, very different objectives and agendas. The problem clearly displayed potential for an MCDA approach in order to structure and model the different parties' values and preferences. This would provide further insight into the problem and, it was hoped, direct the decision-makers closer towards a policy decision. Furthermore, using a decision conferencing approach [Phillips (1990)], a requisite decision model could help to break the stalemate, by reducing the vagueness and complexity of the problem, and focusing on those areas of disagreement which really matter to the outcome of the decision.

However, due to the workshop being limited to one day, and the COPE map being of great magnitude and complexity, much of the workshop was spent exploring the COPE model. It was only in the afternoon session that we attempted to pull together the thoughts in the SODA map and the conclusions from the morning discussion into some sort of MCDA model. As a result there was no opportunity for a decision conferencing exercise. Construction of an MCDA model from the SODA maps would have to be done in the 'back-room', with regular consultation with the participants, and a decision conferencing workshop planned for a later date.

The MCDA model was the mechanism by which we hoped to assist decision makers to take a more focused and convergent look at the problem, after having considered in a rather divergent fashion, and in some depth, the relevant issues, inter-relationships and intricacies in the SODA model. Also, MCDA could provide negotiation support through the identification of trade-offs,

whereby participants could develop their negotiating positions and compromise offers [Kersten (1997)].

So, after the workshop, it was again time for back-room work. Our primary aim at this point was to interpret the SODA map within an MCDA framework. The goals and strategies which had been identified in the strategic map (see the list in Appendix B, pp. 221 & 222), together with the ideas and objectives raised in the brainstorming session (cf. Table 6.1) were combined to construct a value tree. The resulting tree is shown in Figure 7.1 overleaf. Constructing the value tree from the SODA map in this manner proved to be a relatively simple task. As Belton et al (1997) point out, the top-down and bottom-up approaches normally used to construct value trees (cf. Chapter 3) are quite similar to the cognitive mapping procedure for identifying higher goals. For this reason it was anticipated that the hierarchical nature of the SODA map would lend itself naturally to a relatively straightforward transition to the value tree structure, and that this stage of the analysis (i.e. structuring the value tree) would “integrate naturally with the use of COPE”. We found this to be the case.

The participants were then asked to comment on the value tree and its usefulness for guiding future management decisions. Apart from a few minor changes, most people were happy with the tree and felt that it covered all the important issues (i.e. was complete).

## 7.2. Constructing Policy Scenarios

The next step in building an initial model for an MCDA exercise, was to construct ‘policy scenarios’. A policy scenario is a set consisting of several actions or alternatives (called policy elements) which together form a particular policy or plan of action. For example, in Stewart & Scott (1995), various policy scenarios used in water resource planning included different levels of the following policy elements:

1. Percentage change in the maximum level of afforestation allowed (ranging from -2.5% to +5%)
2. Percentage cut in the amount of water abstraction allowed for irrigation (between 0 and 60%)

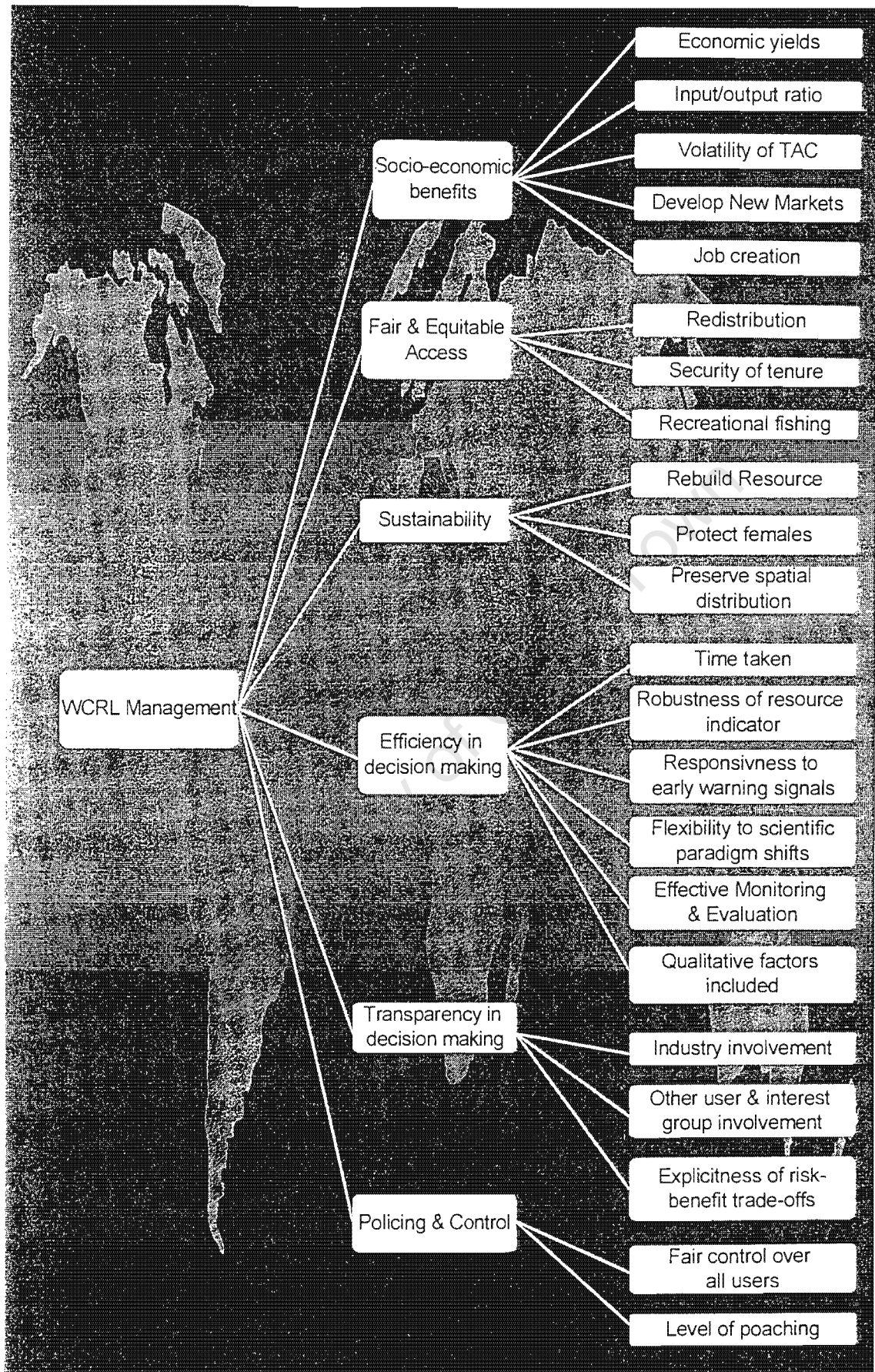


Figure 7.1. Value Tree for the Future Management of the West Coast Rock Lobster Fishery

3. Dam capacities for two proposed new dams (ranging from  $0 \text{ m}^3$  to  $206 \cdot 10^6 \text{ m}^3$ , where  $0 \text{ m}^3$  represents the case where no new dams are built).
4. Percentage of rural population supplied with water standpipes (i.e. sharing with not more than 2 other households) (ranging from 10% to 40%)
5. Percentage of the rural population (not included in 4 above) supplied with access to a standpipe within 100m of their dwelling (from 30% to 75%)

So, for instance, one particular policy scenario might be defined as having values of (-2, 20,  $136 \cdot 10^6$ , 20, 40) for the above policy elements.

Constructing the policy scenarios for the West Coast Rock Lobster management problem proved much more difficult than constructing the value tree in Figure 7.1. had been. Although many options had been identified in the SODA maps, this list of options was far from complete for dealing with the problem issues and achieving the stated objectives in Figure 7.1 (cf. Appendix B p. 226). Looking at this list, it is clear that the options identified in the SODA model are quite broadly defined, and generally more conceptual, rather than providing detailed descriptions of possible alternatives. For the MCD-Analysis it was necessary to construct more comprehensive policy scenarios, providing more detailed plans for future action.

By considering the objectives in Figure 7.1., a list of policy elements was formed using knowledge which had been gained largely through attending the WCRLWG meetings, SODA interviews and workshop. The afternoon session of the workshop had also been aimed primarily at obtaining the different policy elements. The initial policy scenarios (numbered I to VI) can be seen in Table 7.1. below. Issues such as the evaluation period (i.e. how long the OMP should run for before re-evaluation - element no. 1), the duration of the planned stock rebuilding (element no. 6), and target recovery level for stock rebuilding (element no. 6) were key issues which had arisen, and needed to be included in the scenarios. In this way, the MCDA model forced participants to think more precisely about the details, and implementation of their ideas.

In order to generate these six initial policy scenarios, the various participants' views and perspectives were considered. We found it particularly useful to consider what we thought different parties and interest groups might prefer under each policy element, based on their input given in the cognitive maps. In this way, each policy scenario was constructed to, in some sense, represent one or more of the main stakeholder groups' views (as we imagined

Table 7.1 Initial Policy Scenarios

SCENARIOS	I	II	III	
1. Evaluation period (years)	5 year OMP	Evaluation & scientific debate each year initially, in parallel with 3 yr. OMP	3 year OMP	
2. SFAC	Status quo	Have a separate SFAC for WCRL	Combine SFAC & WCRLWG into one group	
3. Modelling & data	Status quo	Research the informal & recreational sectors to assess true economic yields.	Status quo	
4. Weighting of abundance indices	Set initially through debate in WCRLWG and kept constant until next evaluation	Debated each year in WCRLWG	Each interest group represented in WCRLWG assign weights & take averages at each evaluation	
5. Simulation game for industry ⇒ risk-benefit trade-offs	trade-offs at each evaluation	trade-offs at each evaluation	trade-offs each year	
6. Target recovery level by 2002	50%	40%	25%	
7. Maximum drop in TAC p.a.	40%	10%	5%	
8. New-entrants	Phase-in period* 3 years	5 years	3 years	
	Total TAC transferred	21%	20%	30%
	% of new allocation to hoop-nets	100%	Not specified	70%
9. Coastal Zoning	Yes	No	Yes	
10. Fishing rights : (after phase-in period*)	term of allocation attrition % p.a. (term is infinite)	infinite 2	10 0	20 0
11. East of Hangklip	Trial run for zoning	Reserve	Open for fishing	
12. Community co-operatives, landing sites & processing factories	co-ops; centralised landing sites & processing factories	Individual companies monitored & audited; centralised landing sites	co-ops; centralised landing sites & processing factories	
13. Policing	involve & educate community for 'anti-poaching' monitoring	70% of fishing levy into increased policing by SF inspectors & heavier penalties for poaching	Levy into education in community & organising policing scheme involving community and industry	
14. Fishing levy (% of revenue)	1% * price per ton * quota (t)	10% * price per ton * quota (t)	2% * price per ton * quota (t)	
15. Fishing restrictions (commercial fishery)	Status quo	Status quo	Size limit down 5mm	
16. TAC for Recreationals	15% of industry TAC	Status quo	10% of TAC	
17. Fishing restrictions (recreational fishery)	Bag limit of 4	TAC = 10% of industry TAC	Bag limit of 4	
18. % TAC transferable between zones	0%	30%	20%	
19. Recreational fishery	20% of industry TAC; control by bag limits, min sizes, seasons, etc.	TAC = 15% of industry TAC; control by bag limits, min sizes, seasons, etc.	TAC = 20% of industry TAC; control by bag limits, min sizes, seasons, etc.	
20. Research (lobsters & management)	100% of fishing levy	30% of fishing levy	0% of fishing levy	

*Table 7.1 Initial Policy Scenarios (cont.)*

SCENARIOS	IV	V	VI
1. Evaluation period (years)	Evaluation & scientific debate each year initially, in parallel with 5 yr. OMP	Annual evaluation -include qualitative arguments (operational + marketing factors) and quantitative research of operational influences on CPUE's	4year OMP; survey fishermen on how to determine a socio-economic index to eventually use in the OMP
2. SFAC	Status quo	Combine SFAC & WCRLWG into one group	Have a separate SFAC for WCRL
3. Modelling & data	WCRLWG agree on procedures before any numerical analysis.	Status quo	SFRI & OLRAC independently check model
4. Weighting of abundance indices	Initially set by WCRLWG and monitored annually - only change weights before the next evaluation date if major scientific paradigm shifts	Set initially by WCRLWG. Annually present the overall picture and scenarios for each individual index. Debate within WCRLWG if discrepancies exceed acceptable limits.	Each interest group in WCRLWG assign weights annually - use as input in the OMP
5. Simulation game for industry ⇒ risk-benefit trade-offs	trade-offs at each evaluation	trade-offs each year	trade-offs each year
6. Target recovery level by 2002	25%	40%	50%
7. Maximum drop in TAC p.a.	15%	25%	20%
8. New-entrants	Phase-in period* 5 years	10 years	2years
	Total TAC transferred 25%	60%	20%
	% of new allocation to hoop-nets 50%	Not specified	100%
9. Coastal Zoning	Yes	No	Yes
10. Fishing rights : term of allocation.	5 years	infinite	30
(after phase-in*) attrition % p.a. (term usually infinite)	0	5	0.5
11. East of Hangklip	Trial run for zoning	Trial run for zoning	Open for fishing
12. Community co-operatives, landing sites & processing factories	co-ops; centralised landing sites & processing factories	Individual companies monitored & audited; centralised landing sites	co-ops; centralised landing sites & processing factories
13. Policing	80% of fishing levy into increased policing by SF inspectors	70% of levy into education in community & organising policing scheme involving community and industry	Independent NGO involve SF, industry & community in policing
14. Fishing levy (% of price per tonne)	3% * price per ton * quota(t)	7% * price per ton * quota (t)	1% * price per ton * quota (t)
15. Fishing restrictions (commercial fishery)	Status quo	Size limit up 5mm	Status quo
16. TAC for Recreationals	10% of industry TAC	Status quo	No explicit TAC
17. Fishing restrictions (recreational fishery)	Bag limit of 4	TAC = 10% of industry TAC	Bag limit of 4
18. % TAC transferable between zones	15%	30%	10%
19. Recreational fishery	20% of industry TAC; control by bag limits, min sizes, seasons, etc.	TAC = 10% of industry TAC; control by bag limits, min sizes, seasons, etc.	TAC = 5% of industry TAC; control by bag limits, min sizes, seasons, etc.
20. Research (lobsters & management)	20% of fishing levy	30% of fishing levy	50% of fishing levy

them to be, that is). It was not important that we got it right at this stage (i.e. that each scenario accurately reflected a particular participant's preferences); rather, this approach was adopted simply to make it easier for us as helpers in constructing scenarios which i) made sense, and ii) attempted to cover the full spectrum of stakeholder preferences.

It should be pointed out that these six preliminary policy scenarios are far from comprehensive, and represent but a small sample of possibilities. Rather, they are a form of generic alternatives [Keeney (1992)]. These initial policy scenarios were merely to provide a framework for inspiring creative thought, and generating ideas for tackling the problems identified, in line with the stated objectives. As such, the aim of this exercise was not to find the optimal policy scenario, but rather to stimulate discussion through interaction with, and exploration of the model.

As Stewart & Scott (1995) point out, the scenarios at the outset should be broadly defined and as representative as possible of all possible policy options. As the process proceeds, and "consensus starts to emerge" [Stewart & Scott (1995)], the range of policy scenarios to be considered usually reduces. Eventually, this might lead to a short-list of policy scenarios which could be discussed, and a plan of action chosen therefrom. In this way, the model is useful for identifying those areas of disagreement which significantly influence the outcome of the decision, and provides a basis for further negotiation.

However, before negotiation and discussion can take place, the various interest groups' values need to be determined and modelled individually. Stewart & Scott (1995) suggest that each stakeholder group evaluate the policy scenarios separately, before bringing together the different parties, and seeking consensus. As they point out, each group is generally faced by it's own set of conflicting objectives which they need to work through in deciding which policy scenario they feel is best.

### **7.3. The first attempt at analysis**

It was decided to hold a trial-run with the model, in order to obtain participants' comments, which could be used to update the model. Once updated, the model could then form the basis for a decision conference. Interviews were initially arranged with four participants. During

these first few interviews, the participants were asked to select approximately five objectives from the value tree in Figure 7.1. which, in their view, were the most important, and to rank them from most important to least important. The four people interviewed ranked their chosen objectives as follows:

**Table 7.2** *Rankings of key objectives for various stakeholders*

Rank	Jerry	Bob	Fred	Sam
1	Redistribution & security of tenure	Rebuild the resource	Level of poaching	Level of poaching
2	Fair control	Protect females and large males	Sustainable fishing	Redistribution
3	Effective monitoring of the resource	Robustness of resource indicator	Economic yields	Effective monitoring & evaluation
4	Rebuild the resource	Responsiveness to early warning signals	Monitoring the resource	Recreational fishing
5	Volatility of TAC	Time taken	Qualitative/ operational factors included	Robustness of resource indicator
6		Preserve spatial distribution	Flexibility to scientific paradigm shifts	Research in natural sciences
7				Research into management schemes

During each interview, each participant was then asked to consider the six preliminary policy scenarios in Table 7.1, and to rate each according to the five or so criteria they had selected. For each criterion in turn, they were required to score the six policy scenarios on a scale of 0 to 100, where 0 represented the worst and 100 represented the best performing scenario on that criterion. It was explained that these policy scenarios were very preliminary and that the main aim at that stage was to assist them to think creatively about different alternatives, making improvements to the existing policy scenarios where appropriate.

As they applied their minds to these initial six policy scenarios, they could be successively adapted into more effective policies for achieving their chosen objectives. Several changes were made to the scenarios, and are already included in Table 7.1. For example, the two shaded squares in the table were introduced after Jerry raised these issues in the interview, and suggested that they needed to be included. These two policy elements introduce ideas of how

new entrants could be allowed into the fishery, and the changes to fisheries rights allocation required should this occur.

## 7.4. Problems encountered ...

It was at this stage of the analysis that difficulties arose. Firstly, the policy scenarios appeared too complex for any sensible comparison or evaluation. Secondly, the MCDA model, as we had defined it, was too broad. Both these problems are considered in more detail below.

### 7.4.1. Dealing with complexity

Participants found it difficult to view each policy scenario as a whole (and to score them as such), preferring to rather work along each row and select which alternative they felt was best in that particular row. This reflected the difficulty they experienced in synthesising the vast impacts and complex inter-relationships between policy elements in deciding on the possible impact of a policy scenario on each criterion.

One participant explained the predicament as follows: "There are probably about 50000 interactions - I can't deal with them - maybe a computer could." The main difficulty here was that of establishing causal relationships for determining the outcomes of various policy elements, and more particularly, combinations of the policy elements making up a scenario. Another feature of the scenarios which made analysis difficult is the vast number of permutations which are possible. Consider the following example: What would be the impact of:

1. giving so-called 'informal' fishermen (who had been denied commercial quotas in the past) access rights to fish East of Hangklip (in effect a reserve area at present, since no commercial fishing is allowed there) [policy elements no. 8 and 11], together with
2. a strategy for rebuilding the resource by 50% by the year 2002 [element no. 6], and
3. building into the OMP a rule preventing the TAC from dropping more than 10% in any one year, for obvious economic reasons [policy element no. 7]?

It is impossible to predict what influence these actions would have on the resource itself, the political dynamics surrounding the fishery, the economics of the fishery, or poaching and policing, for instance. Furthermore, how would these actions influence one's decisions on

regulation of the recreational fishery [policy elements no. 16,17 and 19], policing strategies [element no. 13], or data collection [elements 3 and 12]?

Although these causal relationships were depicted in the SODA map, it gives no real idea of the magnitude, or clear implications, of these relationships. Major uncertainty still shrouded the possible outcomes of the policy scenarios. So, complexity and uncertainty were proving overwhelming at this point. There were so many considerations; no-one was willing to commit themselves without more concrete knowledge about what might happen in future political decisions, changes in the resource, or poaching for instance. The old 'messy' problem issue had arisen again.

Under situations of such complexity and uncertainty, decision makers generally have no choice but to adopt a satisficing approach in their attempt to make the best possible decision in the situation. Gut-feel and intuition are relied upon, given the limited information and time constraints. By choosing to work along each row, rather than viewing each policy scenario in its entirety, participants displayed a natural tendency to divide the problem into easier-to-handle sub-components. This is similar to what Ackoff (1981) refers to as the 'research approach' to tackling problems (cf. Chapter 4). As Leschine (1988) points out, decision-makers generally deal with problems "by selective and sequential attention, and by applying decision rules which provide for local rather than global rationality", concentrating on those issues which are of urgent and current concern.

Under this mode of working (selecting the best option in each row in turn), elements no. 1, 6 and 7 of the OMP in Table 7.1 are considered independently of whether (and how) new entrants should be allowed into the fishery (no. 8). Of course, in reality, any developments in the access rights issue will be taken into account by those planning and implementing the OMP, but probably not in an explicit manner. In any case, this style of management is reactive, rather than proactive. Furthermore, the OMP is intended to remain in place unchanged, until its next re-evaluation (in 3 to 5 years time). So, as far as total allowable catches (TAC's) are concerned, the issue of access rights, for instance, cannot be brought to bear on the decision process until after the 3 or 5 year period.

As was mentioned in Chapter 6, the outcome of the political decision of whether to allocate access rights to newcomers had crucial ramifications for the OMP. A key component of the

OMP is the strategy to rebuild the resource, and allowing newcomers into the fishery was thought to have important implications for this rebuilding strategy since it would:

1. Increase the number of users in the fishery, requiring that the quota cake be cut into a larger number of smaller pieces. This raises the question of economic viability. What impact would the reduction in quota have on the existing fishing companies? Allowing new entrants in is likely to exert upward pressure on TAC's, with increased pressure on reducing the extent of the rebuilding strategy.
2. Those already in the fishery would not support long-term rebuilding at the cost of lower short-term catches, if they had no guarantee of sharing in the benefits of the long-term rebuilding program i.e. no security for future access.
3. It was believed that allowing newcomers into the fishery would have a marked effect on the level of poaching, which was an important consideration in projecting future biomass levels - necessary for deciding on the extent of rebuilding required.

Another important example which illustrates the interconnectedness of the OMP decision with the broader issues surrounding the fishery, is that of stakeholder participation and transparency, and how it would be influenced by the implementation of the OMP. It is plausible that certain groups will be empowered, and others disempowered, through implementing the OMP in the form in which it was being proposed. Thus, it is impossible to escape these issues when developing the OMP.

Up until now we have tried to tackle the messy complexity in a holistic manner [Ackoff (1981)]. The SODA model attempted to include all aspects of the decision-making context, covering issues from access rights and redistribution, to the internal workings and structures of decision making in the SFRI and SFAC.

#### 7.4.2. Dealing with an inter-organisational group on diverse issues

In adopting a holistic approach to modelling the decision environment, the MCDA formulation of the problem as we had defined it (cf. Figure 7.1), appeared to be too broad. It cut across several decision making boards and levels. Other researchers in MCDA have also experienced

difficulties in this regard. Lootsma (1989) points out that “particularly in public administration, there are many ... actors who prepare a decision via a complicated network of policy committees, advisory committees, pressure groups, lobbies, etc.”. Several aspects of the problem, as we had defined it, fell beyond the scope of the WCRLWG mandate, even though they were important to the WCRLWG and the development of an OMP. As a result, the players interviewed were not in a position to comment on several of the issues, such as redistribution and allocation of fishing rights to new entrants for example, which is ultimately a political decision. This is also reflected to some degree in the criteria which were selected (cf. Table 7.2) which generally fall more within each individual’s area of responsibility.

Keeney (1992) points out that “no analysis addresses everything. Therefore, in drawing implications from such analyses, it is critically important to be clear about what objectives have and have not been addressed” (p.85). Hence, it is important to properly structure the problem, determining those objectives which are fundamental for the *particular* decision context. In this way, the fundamental objectives represent the decision-makers’ values in the specific decision context, and help to bound the problem. Fundamental objectives can be derived either:

1. by focusing on the strategic objectives, and considering their bearing on the particular context, or
2. are “pushed out” using a means-ends logic, i.e. by identifying goals in the immediate context and then exploring broader, more fundamental objectives which encompass these immediate goals. This is done by considering whether the identified goals (i.e. in the immediate situation) are considered to be fundamentally important in themselves, or whether they are merely means to a more fundamental objective (cf. Figure 3.2 ).

In our case, the specific context we were looking at was the operation of the WCRLWG in providing scientific advice to decision makers at higher levels, with a particular focus on the development of an OMP.

In retrospect, it is obvious that our problem depicted in Figure 7.1 was too broadly defined. However, this is in fact a major part of the problem ... the fishing industry and others had, not without reason, been pointing out that the OMP deliberations up until that point had been too narrow, focusing on the biological aspects of the fishery, without much explicit consideration of the broader management issues. The cognitive maps and SODA workshop had clearly shown that these broader issues were critically important to the OMP debate. A good example

of this already cited, is that of the impact of access and policing on strategies for stock rebuilding.

So, the working group *did* need to consider how policy decisions taken at higher levels would effect their decisions, including the development of the OMP. Hence, although several of the policy elements (such as those relating to giving access to new entrants) are beyond their control, it could nonetheless be a useful exercise to consider which courses of action would be best (i.e. amongst those elements over which they *do* have control) given various scenarios/outcomes of the higher level decisions.

Our policy scenarios effectively provided this broader decision making context within which the WCRLWG would have to operate, and might have been useful for considering possible actions under different future scenarios. This, however, would require that assumptions be made about what the political decision makers at the higher levels would decide - never an easy task. The need to make these assumptions is perhaps not an insurmountable obstacle and, together with sensitivity analysis, might have yielded very interesting insights. However, since we were working with an 'inclusive' group, representing extremely diverse views, as opposed to a 'teamlke' group within a single organisation, it is unlikely that consensus would have been reached on these assumptions about the future. Furthermore, due to the complexity of the scenarios, and resulting difficulties in synthesising the impacts of a particular scenario on the decision environment (alluded to above), such an analysis was not feasible.

The participants generally were not prepared to *guess* what actions the decision makers at higher levels would take, seeing it as a waste of time. If it were practically possible to consider the different scenarios in Table 7.1, it would, no doubt, provide a more holistic approach to decision making. This more holistic approach could, in theory, prevent many of the pit-falls embedded within current and traditional fisheries management practice. By focusing on models of resource biomass, important aspects of the fishery and marine ecosystems are often neglected, or dealt with in an ad hoc and inadequate manner. However, when faced with situations of such complexity and uncertainty, key decision makers have no option but to rely on gut-feel and intuition, to a greater or lesser extent. Furthermore, it was evident from this first exercise, that it is not possible to take a more holistic approach without including a broader spectrum of role players, such as the ministers responsible for making the broader

policy decisions. For all practical purposes, this was not possible, given that the group already comprised ten individuals representing relatively diverse interests.

So, in order to proceed, we needed to find a way of managing the complexity within the SODA model in translating it into an initial and operational MCDA model. In this first attempt, we had taken the goals, strategies and options from the map and tried to simply insert them into an MCDA framework. This approach clearly was not sufficient.

## 7.5. New direction through Value Focused Thinking

It was at this point that Value Focused Thinking (VFT) provided valuable insights as to how the problem could be bounded, and helped us towards a more workable MCDA formulation of the problem.

Circumstances had forced us to redefine the decision context; in particular, to narrow it down and consider only a sub-section of the strategic decision context captured in the SODA model. Keeney (1992) emphasises that every individual and organisation has strategic objectives which, even if not explicitly written down, guide all decision-making. Strategic objectives play an important role in guiding decisions since they 'frame' the decision. The VFT approach was useful for identifying those objectives which are fundamental for framing the *specific* decision context, without losing sight of the broader strategic objectives (cf. Figure 3.2.). As Keeney (1992) points out: "a specific decision context is only a part of a larger one, which is itself only a part of a still larger one, until the strategic decision context is reached. Achieving the objectives in a narrower decision context is one of the means to achieving the objectives in the broader decision context".

In our case, because of the group we were working with, it was logical to focus on the effective future operation and management of the WCRLWG as the specific decision context, taking into account the different stakeholders' views. This led to the selection of those objectives from Figure 7.1. which were considered i) essential in considering the development of the OMP and ii) related to issues which fall within the mandate and operations of WCRLWG, and over which the working group has some degree of control. From these, a fundamental objectives hierarchy (FOH) was constructed (Figure 7.2. below). The FOH is shown above the dotted line, with the means-ends objectives network (MEN) below. This shows the connection

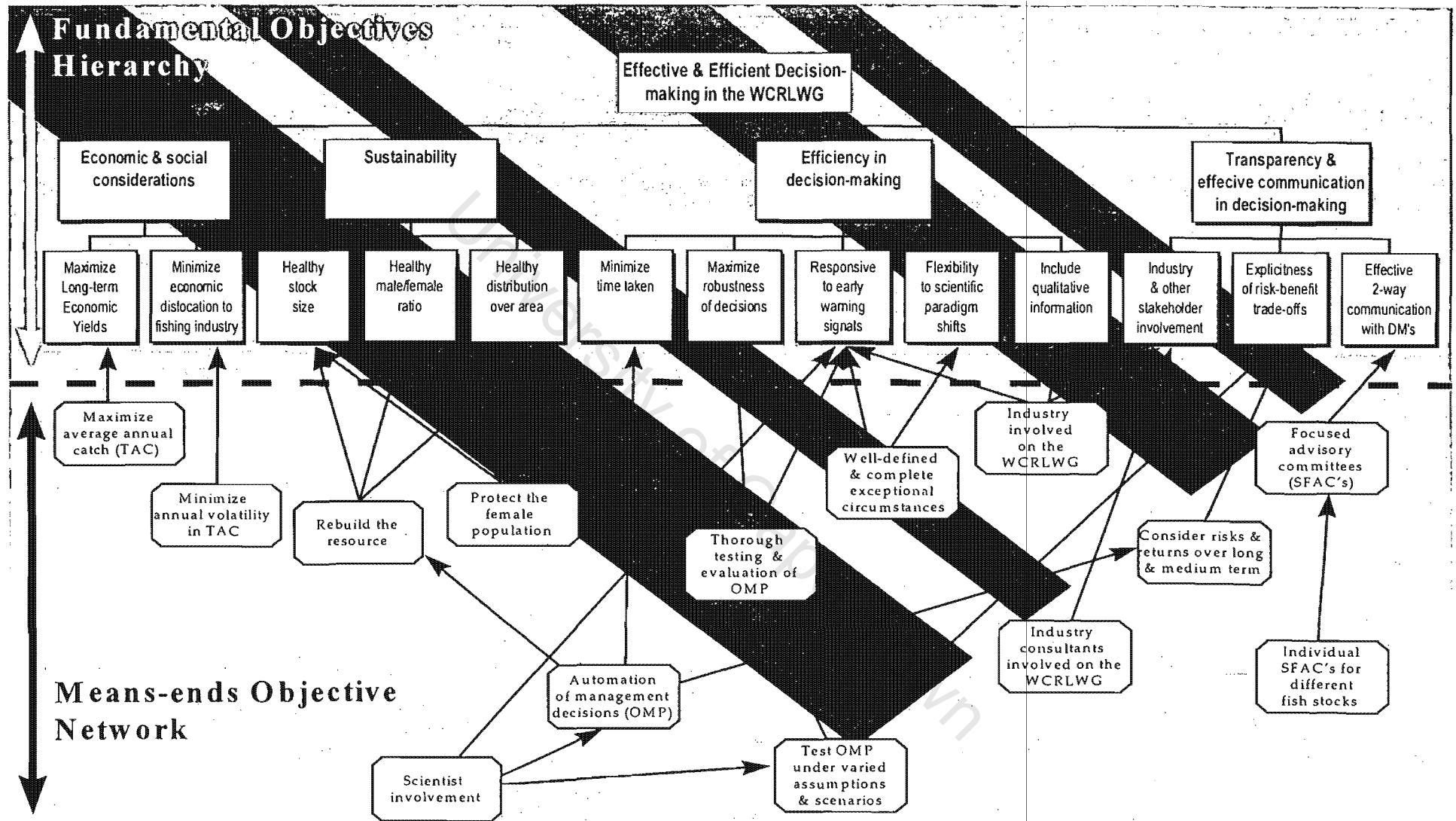


Figure 7.2. Fundamental Objectives Hierarchy and Means-ends Objective Network for the West Coast Rock Lobster Working Group

between those objectives which are considered to be fundamental (i.e. ends in themselves), and those which are means to achieving these higher objectives.

The main difference between the FOH and MEN is in the links between the various objectives. As explained in Chapter 3, the thirteen fundamental objectives branching off from the four major objectives in the FOH can be thought of as components of (explaining in more detail) the four major objectives. On the other hand, the means-ends objectives below the line are linked by arrows, denoting causality. A particular means-ends objective might lead either to another means-ends objective, or to a fundamental objective. The relationship here is causal, showing the means to an end. In addition, a particular means-ends objective might influence several other fundamental or means-ends objectives (denoted by two or more arrows emanating from it). Fundamental objectives, on the other hand are connected to one and only one of the four higher objectives, since they explain in more detail that particular objective. The FOH and MEN proved an effective framework for structuring the objectives in a meaningful way, which also lends itself naturally to an MCDA application thereof.

Constructing the FOH was no straightforward task, since it entailed differentiating between fundamental and means-ends objectives. Some time was spent deciding which were fundamental to the effective and efficient operation of the WCRLWG, and which were just means to achieving these higher (fundamental) objectives. Keeney (1992) points out that “the choice of fundamental objectives is a creative process that requires considerable judgement” [p. 82].

He gives the following guidelines and desirable properties to look out for in choosing fundamental objectives. They should be:

1. *Essential* : representing the fundamental concerns and “reasons for interest” in the decision situation.
2. *Controllable* : not greatly influenced by factors outside the scope and specifications of the possible alternatives.
3. *Complete* : this means that one should drop an objective from the list if:
  - 3.1. alternatives cannot be differentiated with respect to that objective,
  - 3.2. the impact of the alternatives on that objective is not known, or is too much effort to determine,

- 3.3. the scope of the decision context is limited by those involved in the process, with the particular objective falling without their area of responsibility.
4. *Measurable and operational*
5. *Decomposable* : i.e. preferentially independent
6. *Non-redundant*
7. *Concise*
8. *Understandable* : easily communicated and understood in facilitating discussion and influencing decisions

It was decided that those objectives which are essential to the working group's decisions and, in particular the development of the OMP are i) sustainability and ii) efficiency in decision making. Also important are iii) socio-economic factors and iv) transparency and effective communication. The other objectives in Figure 7.1., such as security of tenure, policing, and fair and equitable access can be excluded for all three reasons given under point 3 above (completeness).

Once these four core fundamental objectives had been identified, thorough consideration was given to dividing them into their 'sub-components', leading to the thirteen fundamental objectives which branch off from these four, as shown in Figure 7.2. These thirteen were chosen after a careful review of the SODA model. The FOH and MEN, constructed in this way, can be seen to fit within the broader strategic context of the SODA model.

## 7.6. The second attempt at MCDA modelling

Interviews were again arranged with several participants. At the start of each interview, it was explained that:

- in the previous work with them, the emphasis had been on strategic planning. During that process, the group had taken a broad and relatively long-term look at the issues facing the rock lobster fishery.
- Within this strategic framework, we were now taking a narrower focus, concentrating on the shorter-term activities and decisions of the WCRLWG.

Each participant was then shown the FOH, and asked to comment on it. At this stage, only the top half of Figure 7.2 was shown to them, without any of the means-ends objectives shown below the dotted line. It was explained that the fundamental objectives represent those

issues which they as a group, or individually, are fundamentally concerned about, and which are ultimately and fundamentally important to the working group's operations and decisions. It was emphasised that the aim of constructing the hierarchy was to make explicit the working group's core objectives, and that it could be used to guide decision making in the next few years. In particular, the FOH could provide future direction and guidance in a manner which was consistent with the broader strategic objectives. Participants were asked to check that they agreed with the FOH, and that nothing had been left out. At the same time, they were reminded that it related specifically to the WCRLWG's decisions, and that issues such as access rights did not fall within this scope.

Once they were happy that the FOH was satisfactory for achieving its purpose, they were asked to:

1. rank the four major objectives ... economic & social, sustainability, etc., where 1 represented most important, and 4 least important;
2. within each of the four major objectives, rank those within (i.e. in the second row)
  - Economic & social (1-2)
  - Sustainability (1-3)
  - Efficiency in decision making (1-5)
  - Transparency (1-3);
3. considering the second row on it's own, rank the most important six or eight, or more if they wished.

Once this had been done, they were again shown the FOH, but this time as in Figure 7.2, showing the means-ends objectives, and the connection between them and the fundamental objectives. It was explained what means-ends objectives are: that they represent more detailed goals which, by achieving them, will contribute to the higher (fundamental) objectives. Participants were then asked to consider those means-ends objectives already below the line, and their links to the higher objectives, making changes where necessary. We pointed out that we suspected there were many more, and that they should think of other means-ends objectives to 'fill the gaps' below the line. In this way, they were encouraged to consider each of the thirteen fundamental objectives in turn, identifying further means-ends objectives which might contribute to the achievement of the particular fundamental objective. Several were added, and are already included in Figure 7.2.

## 7.7. Analysis of results and observations

During the interview with Sam, the objective “Effective (2-way) communication with decision makers” was added. This issue is important since, after it was raised, several of the players agreed that the working group recommendations are often not properly understood by the decision-makers at higher levels, or put forward with the forcefulness or thoroughness with which they were debated in the working group. As a result, the recommendations sometimes are not implemented, even though they are sound ones. This point was noted whilst considering the objective previously called “Transparency in decision-making” in Figure 7.2., which was later changed to include the aspect of communication as well. This is a good example of how Value Focused Thinking can raise ideas which are important for more effective ways of working.

In the interview with Bob, the FOH in Figure 7.2 provided a useful framework for discussing the pros and cons of the OMP as he saw it. Table 7.3. below captures the salient points of this discussion.

**Table 7.3. To OMP, or not to OMP?**

Pros	Cons
1. A strategy for systematic, long-term stock rebuilding. Unlike with annual assessments (i.e. status quo), less chance of the rebuilding strategy being frustrated by focusing on socio-economics each year.	1. Less flexible to scientific paradigm shifts - BUT reviews will take place every 3 years and exceptional circumstances can over-ride the OMP at any time.
2. Explicit trade-off of long and medium-term risks and benefits.	2. Qualitative information not included.
3. Industry more involved in medium/long-term planning - (giving trade-offs between average TAC over the period, and volatility for example)	
4. Reduce time spent each year on setting TAC - more efficient decision making.	
5. Maximise long-term economic benefits through more effective long-term planning.	
6. Minimum annual volatility will be included in the OMP. In order to keep the credibility of OMP, the exceptional circumstances clause must only be employed to reduce the TAC if a major, catastrophic event occurs. Therefore, the OMP won't draw on the exceptional circumstances clause to just drop TAC by 20%, say.	

After the interview with Bill, he also suggested that the FOH had convinced him that the group should be continuing along the OMP route, despite having received complaints from the fishing industry in that regard.

Table 7.4. below gives a summary of the preferences expressed by the different participants interviewed [cf. Gregory & Keeney (1994)]. The individual rankings can be found in Appendix C.

***Table 7.4. Summary of Priorities***

	Range of individual ranks for major objectives <sup>1</sup>	Range of individual ranks within major objective categories <sup>1</sup>	Aggregate ranking of selected objectives
<b>1. Economic &amp; Social considerations</b>	2-4 (3)		
1.1. Maximise long-term economic yields		1-1 (1)	2
1.2. Minimise annual volatility in TAC		2-2 (2)	
<b>2. Sustainability</b>	1-1 (1)		
2.1. Healthy stock size		1-1 (1)	1
2.2. Healthy male/female ratio		2-3 (2.4)	
2.3. Healthy distribution over area		2-3 (2.6)	
<b>3. Efficiency in Decision-making</b>	2-4 (2.9)		
3.1. Minimise time taken		2-5 (4)	
3.2. Maximise robustness of decisions		1-4 (2.3)	3
3.3. Responsive to early warning signals		1-3 (1.6)	4
3.4. Flexibility to scientific paradigm shifts		2-4 (2.7)	
3.5. Include qualitative information		3-5 (4.4)	
<b>4. Transparency &amp; effective communication</b>	2-4 (3.1)		
4.1. Industry & other stakeholder involvement		1-3 (1.9)	
4.2. Explicitness of risk-benefit trade-offs		1-3 (2)	
4.3. Effective (2-way) communication with decision makers		1-3 (2.1)	

From this table, the following conclusions can be drawn:

1. Sustainability in using the resource was unanimously considered to be of the highest priority. Therefore, the WCRLWG's most important job is generally seen as ensuring a continued healthy stock size. This includes monitoring the male/female ratio and

<sup>1</sup> The average ranks are given in brackets

distribution of the resource over area, which both have important implications for the health of the resource.

2. The other three major objectives were rated as being similar in priority, on average. On closer inspection of the individual rankings, it would appear that efficiency in decision making was considered more important by the government officials, and slightly less so by the industry (see Appendix C for details). However, this is largely a result of the industry ascribing a higher rank to transparency and effective communication, as one might expect.
3. All participants stressed the importance of quick response to early warning signals i.e. if stocks were in danger of falling below some minimum level. In order to ensure speedy response, the right systems need to be in place to identify the potential problems early on. In addition, the decision making machinery needs to ensure a quick reaction time. This has particular relevance for the OMP. The so called 'exceptional circumstance clause' of the OMP should clearly specify what actions to take under various circumstances, to override the OMP in averting a potential disaster, if necessary.
4. A further issue on which most agreed was that the WCRLWG's models needed to be robust. In other words, even if a particular data point was inaccurate, or the data in general was sparse for instance, the outcome of the decision should still be relatively close to the 'best' option, had more accurate, or up-to-date data been available. This is particularly important given the great uncertainties surrounding estimates of biomass and resource productivity (i.e. number of eggs laid, and growth of individual lobsters) which will affect future stock levels.

The four objectives selected in the final column of Table 7.4. are those which all participants had included in their individual selection of the five or so most important objectives. The 'aggregate' scores were determined by averaging the individual ranks, and ordering the averages from smallest to largest. Other objectives which were not selected by everyone, but are also important (selected by at least three individuals) are:

- minimise annual volatility in TAC,
- healthy male/female ratio,
- industry & other stakeholder involvement,
- explicitness of risk-benefit trade-offs, and
- flexibility to scientific paradigm shifts.

This table provides a basis for Value Focused Thinking, for creating alternatives (or decision opportunities) through reflection of the fundamental objectives. A useful starting point would be to ask participants how the status quo situation measures up against the fundamental objectives above [Gregory and Keeney (1994)]. As discussed in Chapter 3, each objective should first be considered independently, generating options for achieving each. Thereafter, by grouping them into pairs, threes, etc., an even broader spectrum of possible alternatives can be generated.

Keeney (1992) points out that people often anchor on existing or previously mentioned alternatives (what he calls “alternative focused thinking”), or on only a part of the value structure. This is particularly true in our case, where the focus of the group’s efforts had been on economic yields, TAC volatility and rebuilding of the resource in developing the OMP, with little or no explicit attention given to how the OMP would affect industry involvement, transparency, or communication, for instance.

The FOH in Figure 7.2., and Table 7.3, provide a good basis for future exploration of alternatives for achieving the objectives. Furthermore, MCDA analysis could be useful for evaluating different options. However, time was fast running out. Despite strong objections to the whole concept of the proposed OMP (particularly from fishing industry quarters), a deadline had been set by the ‘powers that be’, by which the OMP had to be implemented. The deadline was around July 1997, approximately only two months after the above interviews were conducted.

The proposed OMP was already at quite an advanced stage, despite the fact that many of the above objectives had not been considered in any explicit way in developing the OMP. Perhaps these other issues had not previously been considered all that important for the problem at hand. A more likely conclusion is that there had simply not been the time to consider these broader aspects of the decision in any explicit or deep manner. Another important point here is that it appeared to us that previous planning sessions had not included as rich a spectrum of stakeholder values and perspectives as this exercise had.

As a final caveat, John, after ranking the objectives, stressed that the above ranking can only be effective if:

- the issue of effective policing and control is urgently addressed,

- the question of fair and equitable access be addressed, and approached in good faith by all role players,
- accessibility to data be given to independent scientists for verification of biomass model estimates, and
- decision-makers are accountable.

## 7.8. Choosing an OMP

In the following few months, the working group's task was to consider the output of several computer simulation runs, using various OMP<sup>1</sup> formulas, and to compare them for robustness, volatility and average TAC over the period under consideration. At the end of the few months, a single OMP algorithm would have to be chosen by the director of the Sea Fisheries, in consultation with the SFAC, from the handful of relatively similar options. However, several industry participants and independent scientists were at this stage still not convinced that the concept of an OMP, as it was proposed, was a good idea.

At this point in the decision making process, MCDA held great potential for evaluating the different OMP alternatives. In consultation with several of the participants, objectives and alternatives were considered for an MCDA model for evaluating which OMP to choose. The following objectives were identified, derived largely from the FOH and MEN in Figure 7.2.:

1. maximise average TAC over the period (Cave)
2. minimise the volatility in TAC over the period (V)
3. rebuild the resource
4. maximise robustness
5. responsive to early warning signals.

Jerry had played a significant role in designing and testing the OMP algorithm. He came up with the following dimensions for OMP alternatives:

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<sup>1</sup> The OMP being developed consists essentially of a set of decision rules, where the TAC for the following year is based upon a biological model of the resource. In this way, the TAC is automatically determined each year, for a period of 3 years. At the end of the 3 years, the OMP formula will then be revised, before continuing in a similar fashion for the next 3 or so years. Each year, new data is fed into the OMP, which then automatically calculates the TAC for the following fishing season. The period for which the OMP would run had previously been 5 years. However, during the SODA workshop, general consensus was obtained on 3 years as a more appropriate duration

1. The level of TAC at the start of the OMP, which would apply in the first year (initial test values of 1750 mt., 1870 mt. and 2040 mt. were suggested),
2. The biomass recovery level aimed for in ten years time (20%,30%, 40% or 50%).

There were therefore 12 options on the table, denoted as 1750MT20, 1870MT20, 2040MT20, 1750MT30 and so on.

A VISA model was constructed to demonstrate how an MCDA analysis could fit usefully into our intervention at this point, in order to evaluate the different OMP's. Perhaps more importantly, a decision conference, using VISA, could yield fruitful discussion for the creation of new OMP alternatives, or for adaptations to the existing ones, in order to make them more desirable. However, the working group decided that their task was not to evaluate or choose between the twelve alternatives, but simply to check that each of the twelve was scientifically sound from a conservation perspective, and representing different sets of economic and conservation trade-offs, within some prescribed limits. In particular, the working group needed to ensure that the alternatives forwarded were sufficiently robust. This shortlist, would then be passed on to the SFAC, and then the director for final selection. Unfortunately, there was insufficient time for deeper consideration of other possible options or refinements to the existing OMP alternatives.

There was no opportunity for a decision conference, where it is envisaged the MCDA model would have been extremely useful, for discussing and developing the alternatives to be passed on to the SFAC. It was also not possible to take the VISA model to the SFAC, to assist them in evaluating the twelve or so alternatives, since we had had no prior involvement with them as a group. Nonetheless, the potential usefulness of the MCDA model, both for generating, and evaluating alternatives is evident. For this reason a 'paper-exercise' was done, to show how VISA could be used to model this crucial evaluation phase of the decision process. This is presented in the next section.

However, at that time, it was decided that the working group would consider the twelve OMP alternatives under various robustness tests. Each robustness test represented some extreme scenario. For example, suppose that current model estimates seriously under- or over-estimated the actual resource biomass. Or, how would each of the different OMP alternatives perform if there were to be a once-off catastrophic event some time in the future, which wiped-out a significant percentage of the lobster population? Which OMP formulas would

be particularly hard hit by such deviations, and which would cope well under the circumstances? A list of the robustness tests is given in Appendix D (p.232). Numerous computer simulations were run to consider how the various OMP formulae would perform under each of these robustness tests. It was decided that the working group would judge robustness by viewing graphs and visual inspection of the computer output. After consideration of the robustness test results, most of the twelve OMP were forwarded to the SFAC for their consideration.

## Evaluating OMP alternatives using VISA - a 'paper-exercise'

The aim of this exercise is to demonstrate how VISA could have been employed with the WCRLWG, had we had the opportunity. The paper-exercise below focuses mainly on the evaluation of the identified alternatives. However, as mentioned above, a decision conferencing workshop using VISA would have been useful not only for evaluating the alternatives, but more importantly, for generating ideas in a group context. During the process, participants would focus particularly on generating creative ideas for improvements to the current alternatives, as well as for new and better alternatives. Therefore, this exercise does not claim to emulate a decision conference in any realistic way, but rather focuses on how the VISA model might develop through such a process. Particular attention is given to sensitivity analysis, which gives some idea of the iterative and interactive nature of such modelling exercises.

### **Constructing the VISA model**

The initial VISA model is shown in Figure 7.3. overleaf. First, the value tree was constructed. The criteria included are derived largely from the FOH and MEN in Figure 7.2., incorporating all the issues which relate directly to the decision at hand. At this stage, the decision focus was quite narrow. The OMP alternatives being considered concentrated on the technical aspects of the formula to be used, with elements such as "transparency and effective communication in decision-making" (cf. Figure 7.2) assumed to be out of the way. 'Initial TAC' was added as an objective to represent short term economic considerations, as compared with 'Average TAC' which is more concerned with longer term catch rates.

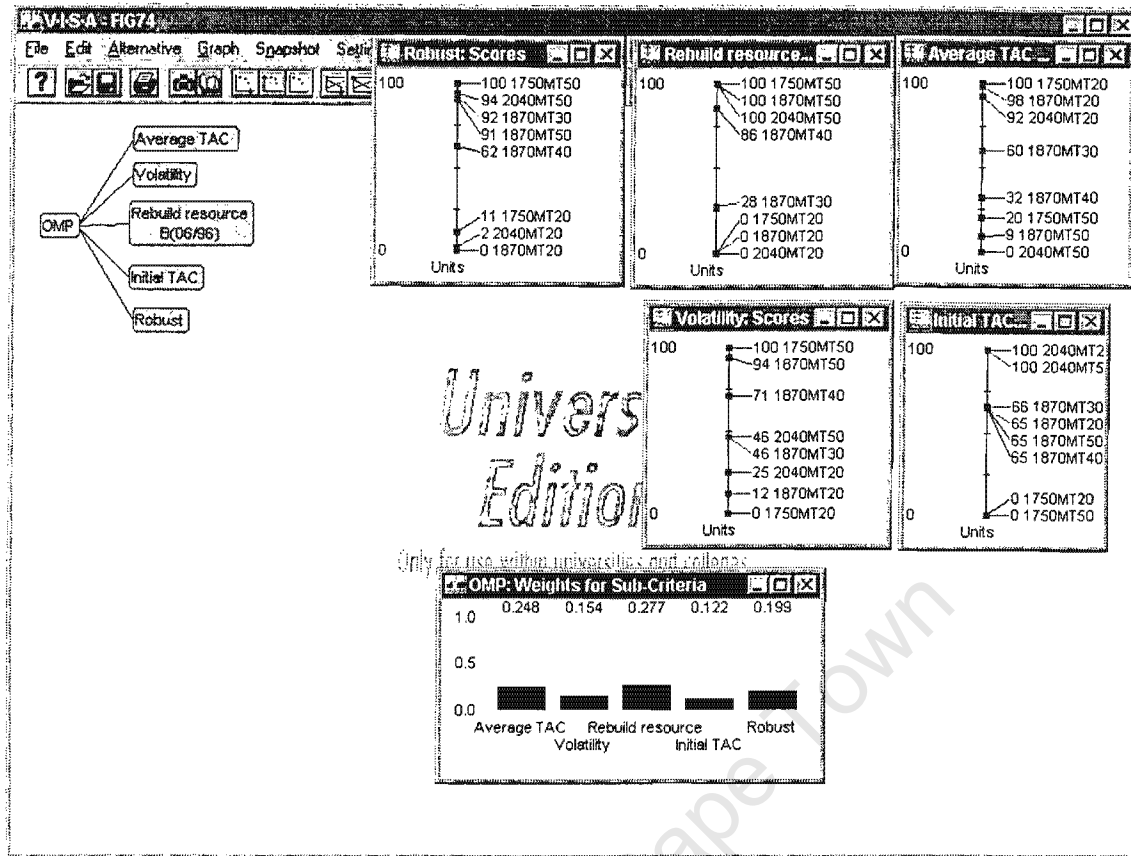


Figure 7.3. Initial VISA model for the paper-exercise.

Each of the five criteria are measurable (operational), such as average TAC and volatility, and were considered visually (in tables and graphs) by the working group members. A selection of these tables and graphs can be found in Appendix D (source: working group document WG/06/97/WCL23). For each of these criteria, a sample of eight of the twelve alternatives are scored in VISA. The best option (i.e. most preferred) was given a score of 100, and the worst (least preferred) a score of zero. These scores can be seen on the thermometer scales in Figure 7.3. These are the same eight which were considered in the working group meeting. The SFAC would of course need to consider all twelve in coming to a decision.

In scoring the alternatives, different parties might have significantly different scores on a particular criterion. For example, some might feel that a rebuilding strategy of 50% is best i.e. aim to increase the resource biomass by 50% over the next ten years. Others would say that that is too high (that given current estimates of resource biomass, the resource would be pushed up to a level beyond the maximum sustainable yield (MSY)), and therefore, that a 20% rebuilding strategy would be better. In practice, the different parties would need to

negotiate this point out, and come up with a consensus solution. We will assume that the higher the rebuilding percentage, the better. This is not an unrealistic assumption, given the general perception that stocks are presently in a rather unhealthy condition. The current low stock level has precipitated partly due to the strange low growth rates experienced in the resource over the past decade.

The question which the VISA analysis does address, is the trade-off between the various objectives in the value tree. For example, between higher rebuilding strategies (conservation of the stocks) and higher average TAC's (economic benefits). Again, consensus would need to be reached on these trade-offs, stressing the need for a decision conferencing workshop, where the VISA model could be explored by the group and the solutions tested for sensitivity under various assumptions. In this way, the various parties' values can be structured and explored.

The five criteria were also weighted to reflect their relative importance. These initial weights (shown in Figure 7.3.) were chosen to reflect the previous results shown in Table 7.4. From these initial inputs, we could see which alternatives performed better under that particular preference structure. The results are shown below:

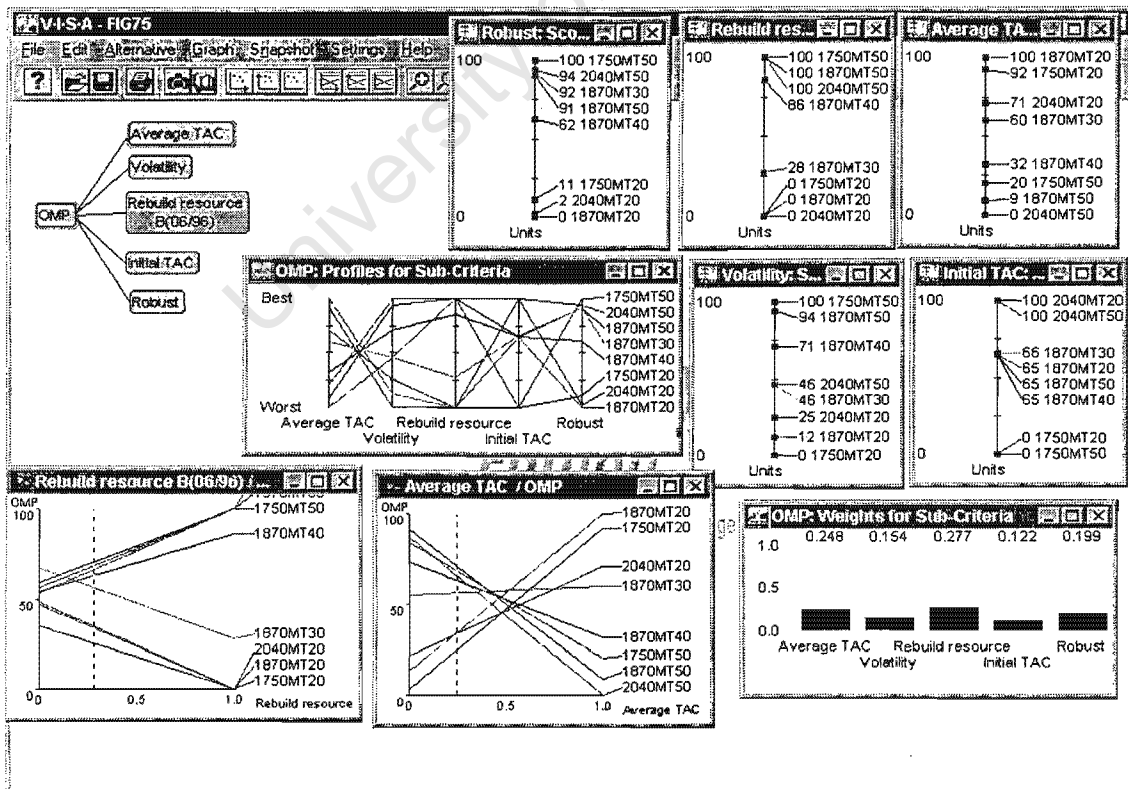
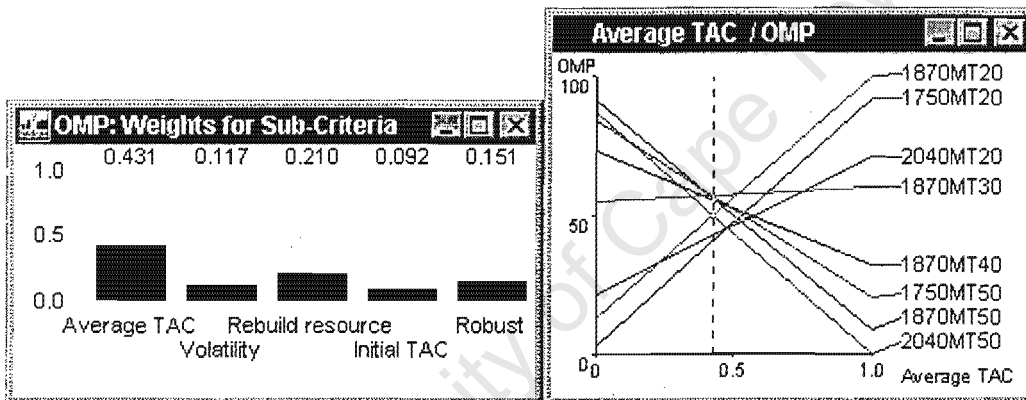


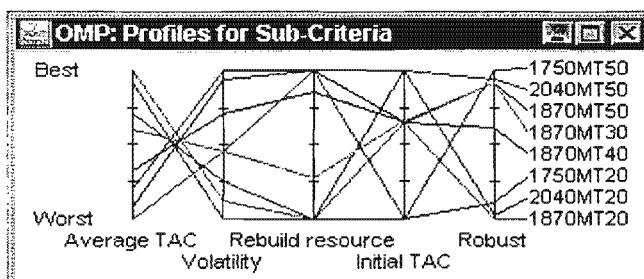
Figure 7.4. Initial evaluation of alternatives

From the two sensitivity diagrams, it is clear that the high rebuilding strategies (50%) are favoured, with 1870MT50 coming up tops, closely followed by 1750MT50 and 2040MT50. The overall score is read off the y-axis (named OMP) at the point where the dashed line intersects each alternative's line. The line which has the highest score at the point of intersection is the 'optimal' solution, under the given scores and weights. The 'Rebuild resource (06/96)/...' sensitivity diagram also shows that any increase in the 'Rebuild resource' weight will lead to these high rebuilding options being even more favoured. This is seen by simply shifting the dashed line along the x-axis towards the right. On the other hand, the 'Average TAC/OMP' diagram shows that a significant increase in the average TAC weight (and perhaps also initial TAC) is required for lower rebuilding strategies to be more acceptable. In fact, the average TAC weight had to be raised to over 43% before 1870MT30 came out tops.



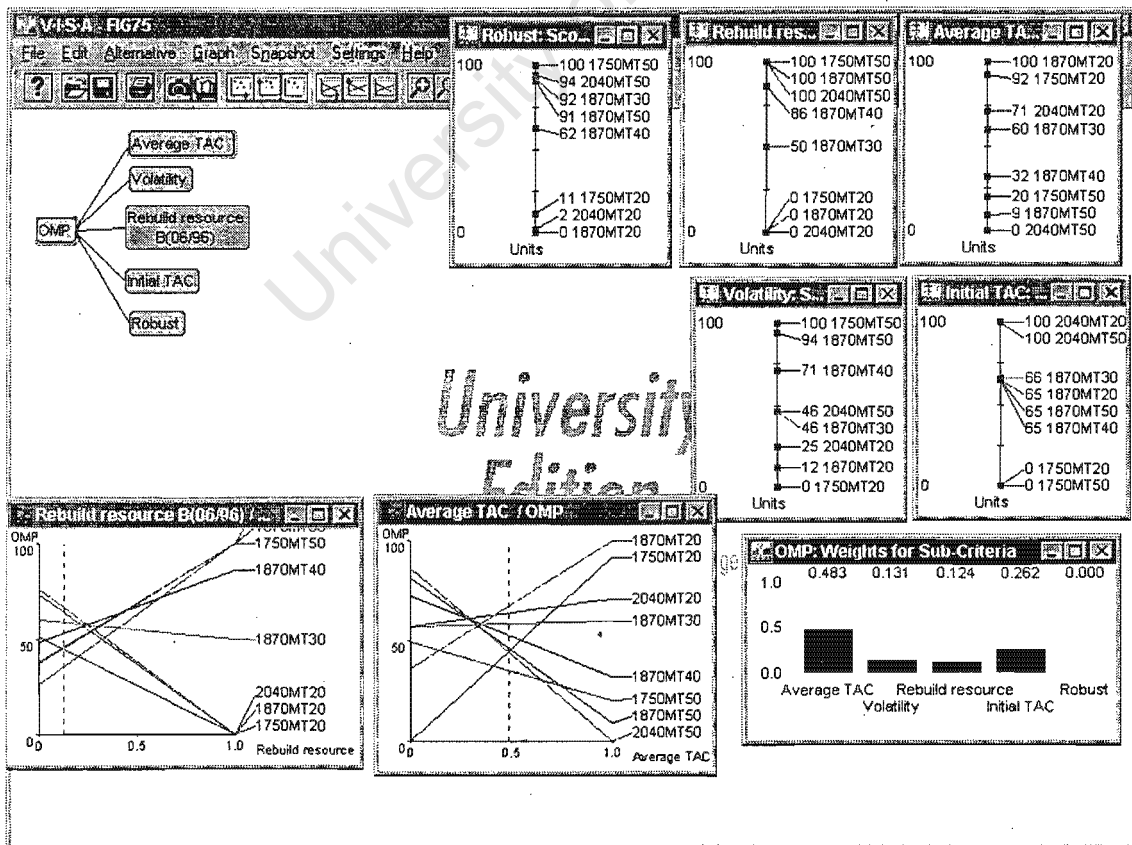
**Figure 7.5. A large increase in the Average TAC weight required to change the outcome**

So, even though the 50% rebuilding options performed relatively badly on average TAC (see the Average TAC thermometer in Figure 7.4.), a significant increase in the average TAC weight is required before lower rebuilding policies are acceptable. This did not make sense at first, and the question was asked why this was so. On closer observation of the model, it was clear that the high rebuilding strategies have strong scores not only on the rebuilding criterion, but also on volatility and robustness. In addition, those with high initial TAC's (e.g. 2040MT50) also score highly on Initial TAC.

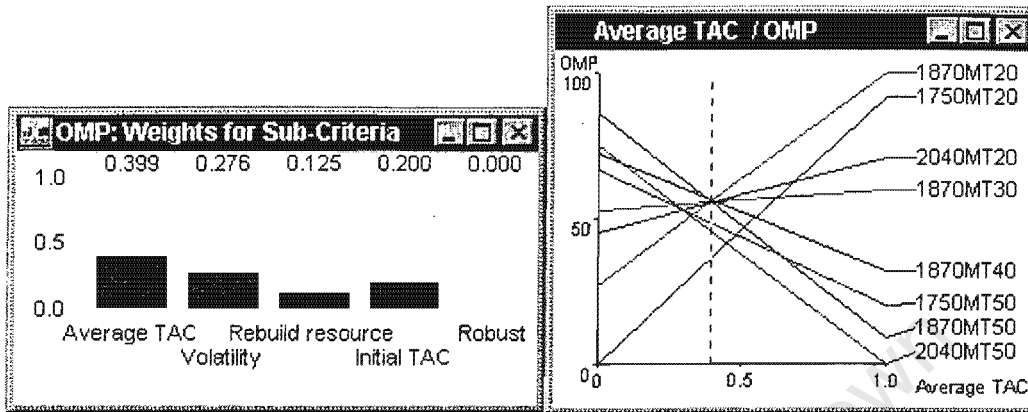


This result did not feel quite right, and it was decided to review the situation. On closer inspection, it was decided that the robustness scores were highly uncertain; considering the OMP model outputs again, all eight alternatives appeared to fare similarly in the robustness tests. During the earlier scoring of alternatives on this criterion, it had been difficult to differentiate between them by simply viewing the results in the tables, as contained in the working group document. This highlighted the need for more in-depth information, and perhaps even a more unambiguous or operational definition of robustness. In the absence thereof, it was decided to ignore robustness as a criterion, and its weight was set to zero.

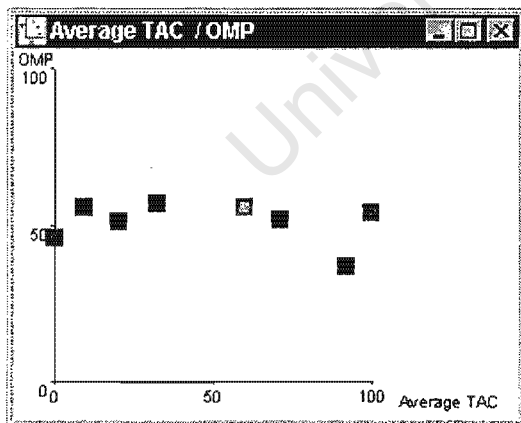
Furthermore, it was felt that the difference between a 20% rebuilding strategy and a 50% rebuilding strategy is not as important as had initially been weighted. It was decided that a 20% rebuilding policy is already going a long way to solving the problem of unhealthy stock size. For this reason, the weight for 'Rebuilding resource' was reduced. It was also felt that a significant gain in value would be obtained by increasing the rebuilding strategy from 20% to 30%, but not so much by increasing from 30% to 50%, say. To reflect this, the score for 1870MT30 on the rebuilding criterion was revised (from 28 to 50). The updated model is shown below:



Now, 1870M20 scores highest, followed by 2040MT20 and 1870MT30. However, the Average TAC weight now looks a little too high. The average TAC weight was reduced slightly, leading to the following situation:

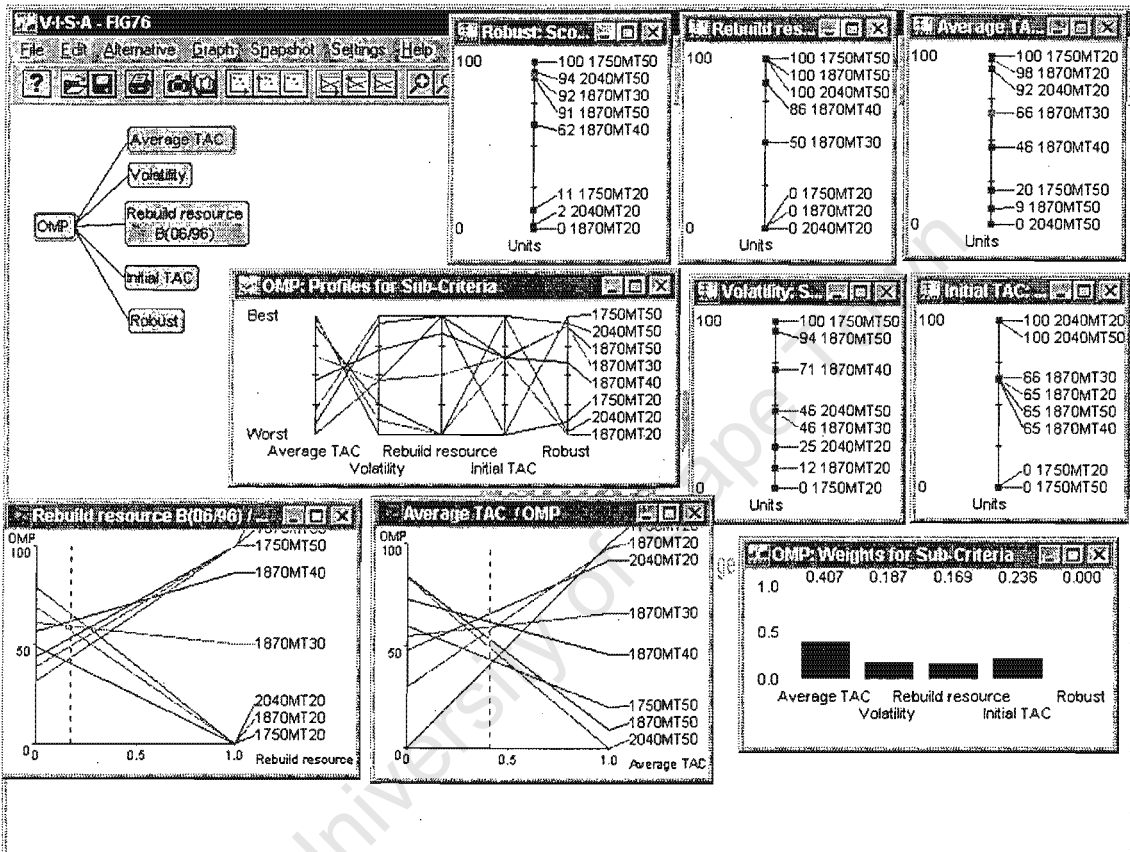


In this diagram, several alternatives look good as potential solutions. 1870MT40, 2040MT20, 1870MT30 and 1870MT50 are all close contenders. In this situation, it was decided to look at a particular plot showing how the alternatives scored on average TAC against the overall scores. This was done, since it was felt that, once a reasonable rebuilding strategy had been put in place (30%, or even 20%, say) average TAC was significantly more important than the other criteria. This plot is shown below.



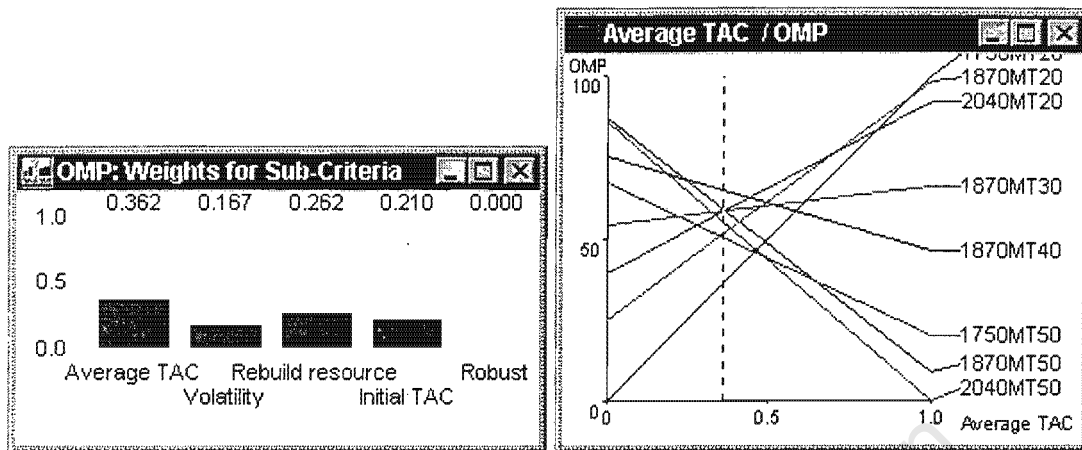
This plot points out just how close the various alternatives are on overall score. However, although 1870MT40 has the highest overall score, it does not score very well on average TAC. For this reason, it was felt that 1870MT30 and 1870MT20 look like better options.

However, we were still not quite happy with this solution, and decided to review the average TAC scores. It was felt that the difference in average TAC between the three 20% rebuilding options was marginal compared with the other rebuilding options. As a result, these three options were re-scored, all taking values near to 100. The scores for 1870MT30 and 1870MT40 were also re-appraised. The adjusted scores are shown in the average TAC thermometer below:



In this case, 2040MT20 has the highest overall score. This was rather unexpected; from the previous analysis, we felt that 1870 was a more appropriate initial TAC than 2040. On closer inspection, it seemed strange that 2040MT20 should be less volatile than 1870MT20 and 1750MT20 (i.e. scoring better on the minimising volatility objective). This did not make sense. It was generally thought that a higher initial TAC would lead to lower rebuilding, and consequently greater volatility, as was in fact suggested by the results for the 50% rebuilding options (see the volatility scores thermometer). This interesting observation would possibly not have emerged if it were not for this exercise, and should be followed up, to see whether the volatility scores do in fact make sense.

We were much happier with the model now than we had been earlier. However, it was decided to see the effect of again increasing the weight for 'rebuild the resource'.



In conclusion, it would appear that the best choice would be either 1870MT40 or 2040MT20. However, as suggested above, further investigation is required to find an unambiguous measure for robustness, as well as for investigating the apparent anomaly in volatility scores.

## Chapter 8

# Conclusions & Recommendations

## 8.1. Reflection on the intervention

### 8.1.1. Who was our client?

A striking feature of the intervention with the WCRLWG and other participants, was how successful SODA was at building a client-consultant relationship with *many* of the participants.

Eden et al (1989) stress the importance of deciding who one's client is early on, in order to manage the political process thereafter. They suggest that the consultant should identify a single person, or small group of people as one's client, in order to ensure their commitment to the process. Our approach, by necessity, was different. It was crucial that we were seen as being impartial and unbiased, and not working for any particular individual or group. This was essential to ensure the willing participation of various parties in the group problem structuring process, in which they would be willing to learn from others' perspectives. On at least one occasion, it was necessary to convince participants that we were working independently, before they would share information with us. As a result, the intervention yielded less consensus and commitment than would no doubt have been the case, if we had selected a particular individual or stakeholder group as our client. However, this was not our intention, particularly in view of the calls for a more participative approach to fisheries management (cf. Chapter 2).

However, the client-consultant relationship with Bill should be highlighted. He was ultimately responsible for the decision on the OMP. The WCRLWG recommendations were channeled through him to the higher decision makers. Although we did not single him out as our client, he benefited from our intervention in that it provided him with information on the other stakeholders' views, preferences and proposals. He could then take this information into account in his decision. As was discussed in Chapter 7, on viewing Figure 7.2. he felt that it confirmed his decision. Nonetheless, our intention all along was to involve all

participants in a fair manner, and it was felt that the process did provide each participant with a means to better understand, communicate and influence the decision process. Moreover, by facilitating an intensive exchange of information, the process assisted participants (such as the fishing industry directors) in deciding what position to adopt in negotiations.

### 8.1.2. Group decision support using SODA

The SODA model proved important for modelling the numerous qualitative issues surrounding the development of the OMP. Up until that time, most of these issues had not been explicitly modelled or considered by the working group, with the emphasis being on quantitative modelling of the fish stock.

Although the working group consists solely of scientists, there was the need to look at the broader context and issues surrounding the scientific modelling of the resource via the OMP. It appears that this is not normally done in any formal manner, with socio-economic and political issues often dealt with in an ad-hoc manner. The focus at this level is generally on the 'scientific'. It would appear that this is a major dilemma facing fisheries management world-wide: how to regard qualitative issues in a formal manner (in the context of conflicting views and interests), in addition to formal scientific modelling of the 'systems' under management.

Many qualitative factors are often just as, if not more important, than the scientific, quantifiable aspects of the decision environment. A prime example which emerged from the intervention was that of the perceived impact of poaching on the future of the resource. Linked to this, is the question of how allocating quotas to previously deprived communities, and involving them in co-management, might alleviate the poaching problem. A more general example refers to the difficulties experienced by fisheries managers in incorporating the often qualitative social and economic information in their decisions.

Other factors which are difficult to formally include in the decision process, but which nonetheless are important, include the impact of fishermen's behaviour, weather conditions, and seasonality in market demand, on reported catch rates (CPUEs<sup>1</sup>). CPUEs are used in

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<sup>1</sup> Catch per unit effort

determining the indices of stock biomass, which in turn have a fundamental impact on TAC decisions. Increasingly, it is recognized that managing a fishery involves more than just managing a fish stock; people and industry are the ones ultimately affected by decisions. They too are the ones with an intimate knowledge of the many qualitative issues influencing the fishery .

Our approach deviated from the norm. In providing decision support, the more qualitative and strategic issues surrounding the scientific development of the OMP were considered. In an attempt to incorporate all the relevant views and perspectives on the issues, participants were drawn from a broad spectrum, including fishing industry directors, academics involved in fisheries management, labour union representatives and informal fishermen, as well as government officials on the scientific working group.

SODA was extremely useful for increasing the understanding of the scope of the problem, as well as providing insight into particular problem issues, and the inter-relationships or links between them. It also provided participants with an appreciation for the complexity of the problem, and was effective in assisting the communication of different perspectives and ideas. Furthermore, the method encouraged creative thought, and the generation of novel alternatives. Examples include:

1. Charging fishing companies a fee to fish, which could then be employed to step up enforcement. In addition, such fees could be employed for further research into management schemes, and the development of new markets, which might ease the pressure on the resource.
2. Using East of Hangklip as a trial area for determining the effectiveness of zoning along the coast.
3. Flattening the decision making structures - combining the WCRLWG and SFAC, or having a SFAC specific to the west coast rock lobster fishery, rather than the status quo of having only one advisory committee for all the fisheries together.

However, we found that on certain issues, no real concrete solutions emerged; many were proposed, but it was not apparent which courses of action were best. Some options were in fact in direct conflict with one another, due to different values and views. For example, one participant felt that because South Africa is a third world country, more artisanal methods of fishing should be promoted, and that quotas should be given to small new-comers to the

industry. This would mean a reduction in the quotas allocated to the existing players in the fishing industry, which of course the industry would not readily agree to. Several reasons can be given for and against this proposal. However the final decision depends on the weight given to different objectives and values. For instance, giving quotas to the informal fishermen would be a way (whether effective or not is a subjective debate) of addressing past injustices and restoring equity. Arguments against this option include:

- a) many fishermen are employed by the industry, and share in profit-sharing schemes. Many of them would lose their jobs if quotas were cut, and
- b) the industry provide secure, in and out of season employment and benefits for these employees.

### 8.1.3. The OMP issue

Even though the development of the OMP had been on-going for some time, our experience was that many participants were unclear as to what form the OMP should take, and how it should be implemented. In particular, there were differing views as to the degree to which it should be purely automated and mathematical, or flexible and open to qualitative information in addition to 'hard' data. Even in the final stages, industry were opposed to the implementation of the OMP as it was proposed, feeling that it was too rigid and inflexible. The scientists, on the other hand stressed that that is the point of the OMP - even though there are fluctuations in the indices of biomass, the rock lobster is a slow growing animal. Trends in stock size can only really be seen over several years. As a result, it was their argument that it is not sensible to base annual TAC decisions on short-term fluctuations in the data, but rather to consider the trends in the abundance indices over several years.

The study was particularly interesting due to the conflicting interests and diverse agendas of the participants involved. Fisheries management is, after all, known to be a highly contentious business. In this arena of public decision making, opponents frequently conceal their views, and information they might have, for tactical reasons. It is less common to see SODA employed in this type of decision context, as opposed to with 'team-like' groups who have a more common purpose (usually from the same organization). It was therefore interesting to see how both SODA and MCDA could be used to provide negotiation support.

In the context of our intervention, negotiation support was required for negotiating around the issue of the OMP - in deciding, for instance, whether it should be relatively rigid and mathematical, or more flexible and allowing more qualitative and subjective information to be included. This was particularly important due to the great change the fishery was undergoing. A closely related issue which also needed to be addressed was the level of stock rebuilding to be adopted in light of the political and economic pressures on the fishery. As was discussed in Chapters 6 and 7, the issue of access rights and redistribution as such, were beyond the scope of this intervention since the politicians and other parties responsible for these decisions were not included. Our focus was on the WCRLWG and, in particular, the development of an OMP.

#### 8.1.4. SODA and MCDA for negotiation support

In this context, it would be quixotic to expect consensus to emerge through the SODA process of group problem exploration and strategizing. Or, for that matter, through a decision conferencing workshop. However, SODA had a crucial role to play in a more modest endeavour; that of facilitating a learning process through the sharing of information and views. The COPE model, incorporating this shared information, provided the framework for negotiation around the key issues. Just as importantly, SODA assisted participants to clarify and articulate their own thoughts and beliefs, which might otherwise have never been explicitly made known. In this way, a model could be constructed of the qualitative and more subjective issues surrounding the fishery. Using the model to negotiate, the group could move towards a more consensual, shared understanding of the problem.

It was our experience that individual interviews with each participant at the outset, were particularly important for gathering a broad base of information and encouraging participants to talk about the problem as they saw it. These interviews were important, firstly, because the participants were from diverse backgrounds, positions and interest groups, with very different views and perceptions. Quite different problem constructions and emphases arose. It is more than likely that there would have been heated disagreement most of the way, if the group were brought together in a workshop from the word go. Cognitive mapping of each individual's views gave people the opportunity to air their views, think deeper about and explore the problem as they personally saw it.

Secondly, the individual attention in the interviews encouraged clients to 'buy-in' to the process. In our view, they 'bought-in' much more than they would have if a workshop had been held at the outset to structure the problem there and then (by means of a group map, perhaps). In this way, the interviews proved very effective for building a client-consultant relationships with the different players. Admittedly, certain players bought-in more than others. The individual interviews seemed particularly important for those players who felt that they were often left out of the process. There was a serious danger of losing these people; of them thinking that our intervention was merely an extension of the existing decision making structure, and that their views would not be taken seriously. For this reason, it was important to state unequivocally that our role was that of impartial facilitator. Despite us making our stance clear from the outset, it was necessary on several occasions to affirm this fact, before they would open up and talk about certain issues.

Kersten (1997) points out that SODA focuses on joint problem definition, which might form a significant component of an intervention in "less competitive or conflicting situations". However, in negotiations, obtaining a complete problem definition is highly unlikely due to strategic maneuvering and some degree of mistrust and concealment. This occurs, despite the necessity for sharing of information and joint problem definition in negotiations.

Although SODA was useful for providing a clear exposition of the reasoning behind different perspectives, it was not possible to reconcile the conflicting views on several issues. This is to be expected, given the complexity and contentious nature of the problem, and the type of group we were working with (what Friend (1990) calls an inclusive group). The different parties had very different agendas and interests. Even if there was general consensus on the nature of a problem issue, there was often significant disagreement about what the implications were thereof, or what actions should be taken in light of the situation.

An eminent example was when several participants noted that the resource had declined significantly over the past few years, and that the fishing industry was suffering as a result. For this reason, several people suggested that the emphasis should not be solely on rebuilding the fish stocks without any regard for the industry's predicament. Fred and Sam argued that any rebuilding strategy should be gradual, in order to give some immediate relief to the already ailing fishing industry (cf. Appendix A p.188 & p.192). This reflected the trade-off between stock rebuilding, and the short- to medium-term economic implications thereof. However, Bill felt that the decline in the stock signified that the resource had dropped to such

a low level that it could no longer support the large fishing industry as it had done in the past. He suggested (as discussed above) that this was a good reason to encourage more artisanal fishing methods, and allow many smaller players to share in the fishery (cf. Figure 6.2). This action would of course place even greater pressure on the existing fishing industry. Although this decision was ultimately a political one, and beyond the scope of our intervention, it was important to bear this issue in mind when considering what level of stock rebuilding the OMP should strive for.

Due to these conflicting interests, our intervention reached the stage when negotiation support was required to assist the group in their deliberations. For this reason, an initial MCDA model was constructed to be used in a decision conference, where the different parties' values and preferences could be structured. This would add further structure to the problem, and help participants to better understand others' values. The decision conference could also help to break the stalemate, by identifying those areas of disagreement which really mattered to the outcome of the OMP decision [Phillips (1990)].

Kersten (1997) notes that, whereas decision analysis and MCDA have concentrated on working with all stakeholders at once in providing negotiation support, in practice it is rarely possible to get the different parties to "use the same system". For this reason, most negotiation analysis methods focus on helping a particular player by considering what actions are most beneficial for that player given the various possible actions of other parties (p.340). Kersten (1997) however, feels that MCDA is useful for negotiation support. Using MCDA in a decision conference facilitates a learning process, where players can learn about others' aspirations and objectives. This is essential for the formulation of compromise offers in bargaining and negotiation.

We found the MCDA approach useful in this regard. Although the SODA map did identify major areas of disagreement at the strategic level, the participants appeared to accept these differences, perhaps feeling that the map was intended to be inclusive - which it was. However, at this stage, there was no attempt to reach a consensual view of the problem, with the different parties 'agreeing to disagree', and accepting that others' agendas and interests were opposed to their own. It was only when they considered the policy scenarios in Table 7.1., and started proposing what they thought would be best under each policy element, that differences in view really became an issue. The disagreements which arose lead to an "intensive exchange of information" [Kersten (1997)]. At this point, it was useful for us to

refer back to the COPE maps to consider why different people thought the way they did, and provide justification for their preferences.

So, in our situation, although there was disagreement at the strategic level, this only really became an issue when decisions had to be made at the operational level. In this context, Bryson's (1995) suggestion makes a lot of sense - that working towards consensus at the macro (strategic) level lays a foundation for resolving conflicts at the micro level.

Strangely enough, when we bounded the problem, focusing on the purpose and operation of the working group (cf. Figure 7.2.), participants did agree more or less on the relative importance of the different objectives, as demonstrated in Table 7.4. This agreement on the fundamental objectives was a good starting point. However, much work was still required for a consensual view of which alternatives were best under these objectives. Although it was not possible to conduct a full decision conferencing workshop due to time constraints, MCDA could have an important role to play here. MCDA confronts participants to consider how their preferences differ from others, and the influence of these differences on the evaluation of particular options. How the participants score different alternatives, reflects their personal preferences. This enables participants to compare their preferences with others' in the decision conference, and understand why other people prefer one option to another. This exchange of information might lead to a consensual view of the problem; different individuals' scoring of the alternatives might move closer together as they develop compromise proposals or jointly soften their limitations [Kersten (1997)].

## **8.2. Integrating SODA and MCDA**

### **8.2.1. The benefits of an integrated approach**

It is clear from the above discussion, and previous chapters, that there are several reasons why a facilitator might want to incorporate both SODA and decision conferencing (MCDA) in an integrated approach to decision support. As was stated in Chapter 4 (cf. Table 4.1 p.87), a particular consultant's approach will, in practice, draw on both of the diametrically opposing philosophies of decision support. However, SODA and decision conferencing (using VISA) are two distinct ways of providing decision support, each with its own proponents. Few have bridged the gap to use both methods together in an intervention. When they have been used together, it generally involved two facilitators working together, one an

expert in SODA, and the other in decision conferencing [Belton et al (1997)]. Furthermore, there has generally been little overlap of the two, with SODA typically used to structure the problem initially, and then MCDA used to further explore values, and evaluate alternatives, thereafter.

Similarly, in our case SODA was used at the outset to appreciate the complexity and multiple perspectives of the situation. A primary aim at this stage was to facilitate a learning process, whereby different parties could learn more about the problem from the other stakeholders. Therefore, it was our intention to structure the problem in a way which captured the richness and complexity of the situation, without trying to simplify, or break it down into sub-components. This entailed a divergent exploration of the often subjective views, and modelling of these qualitative issues surrounding the management of the fishery. Once we were happy that the problem had been effectively structured and negotiated, and that the different participants had a better understanding of *all* the relevant issues and perspectives, it was possible to adopt a more convergent approach. MCDA was then to be used to focus in on the evaluation of alternatives. Decision conferencing would facilitate further learning, through the structuring of different parties' values and preferences.

### 8.2.2. Difficulties experienced

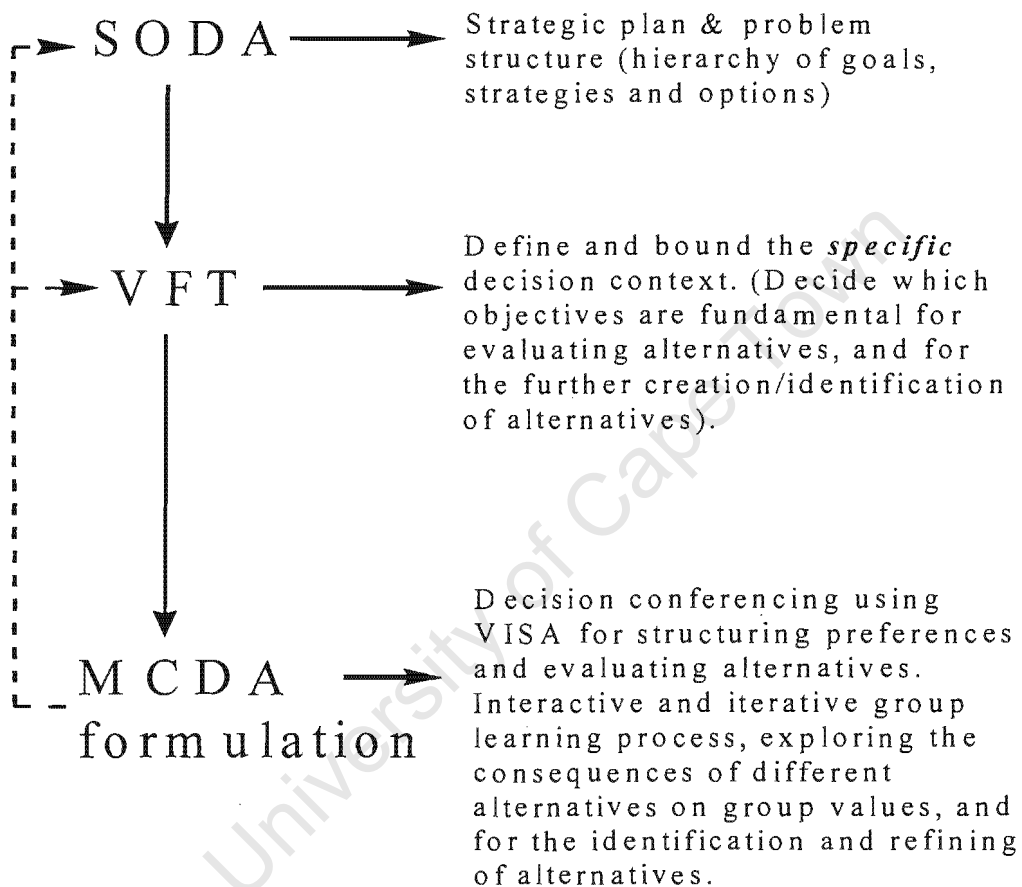
In this study, significant progress was made in translating the SODA model into an MCDA framework. However, as was discussed in Section 7.4., several difficulties were experienced. The first attempt at interpreting the SODA model in an MCDA framework was, no doubt, over-optimistic at that stage in the intervention. The concepts of Value Focused Thinking should have been introduced at an earlier stage in order to better manage the information in the SODA map whilst structuring it according to the MCDA paradigm. However, it is nonetheless useful to consider the following differences between the two approaches (SODA and MCDA), in order to understand why the difficulties arose:

***Table 8.1. : Key differences between the SODA and MCDA approaches***

<b>SODA</b>	<b>MCDA</b>
1. divergent exploration of the problem, with focus on an "internal, social process"	1. convergent modelling of the situation, where the problem is generally seen as 'external' to the client group (cf. Table 4.1)
2. emphasis on the strategic	2. emphasis on the operational (evaluation of more detailed alternatives)
3. purely qualitative information modelled, showing concepts and relationships	3. quantification required in terms of the outcomes of relationships, and preference structures

### 8.2.3. Bridging the gap using Value Focused Thinking

The Value Focused Thinking methodology proved invaluable for bounding the problem, and focusing attention on the particular decision context, without losing sight of the broader strategic context. The approach we eventually followed in the intervention is shown in Figure 8.1.



**Figure 8.1. Translating the SODA model into an MCDA framework**

It is envisaged that these phases should be iterative in future research, as denoted by the dashed lines.

In this way, VFT bridged the gap between the SODA model, and the construction of an MCDA model. Belton et al (1997) note that the structural differences between the cognitive map and value tree make this transition no easy task. However, it was our experience that VFT was an effective way of easing this transition, by considering the SODA model, and

identifying fundamental objectives therefrom. In particular, the differences between the links in the SODA map and the value tree (representing both “direct and indirect” causal relationships in the COPE map [Belton et al (1997)]), presented no major problems when viewing the problem through the guidelines given by Keeney (1992) for structuring fundamental and means-ends objectives. However, it should be noted that it was not possible to simply take the concepts and links in the cognitive map and insert them into a value tree structure. Rather, by viewing the SODA model through the framework of VFT, a FOH and MEN could be constructed

Table 8.2. below shows several similarities between SODA and VFT. This comparison gives some clues as to why VFT might be effective for translating the SODA model into an MCDA framework.

***Table 8.2. Similarities between SODA and VFT***

1. The output which both SODA and VFT strive to produce is similar: a hierarchy of goals, and means (or strategies) by which to achieve those goals. In addition, the SODA model also includes options, which the FOH and MEN do not. However, VFT is also very concerned with the creation of alternatives, by focusing on the FOH and MEN.
2. Both explore the ultimate objectives in the situation, by asking questions such as: “What are the implications of that?” or “Why is that important?”. Critically analyzing what has been said by the client, the consultant asks further questions which delve into the issues raised. In this way, ideas and issues are raised, and the problem definition expanded. In this way VFT, like SODA, also adopts a divergent approach to thinking about problems.
3. Both take an empathetic approach at the outset in order to understand the problem as the client sees it. Attention is given to different perspectives by interviewing participants individually at first.
4. Both merge the ideas and concepts raised by different participants; by a merged map in SODA, and an inclusive list of objectives in VFT.

It is also useful at this point to consider some of the differences between SODA and VFT:

***Table 8.3. Differences between SODA and VFT***

1. There are significant differences in the presentation of information, and in the use of technology for analysing and manipulating it. The SODA model gives more explicit information (more divergent), and a clearer picture of the *overall* problem environment. In order to manage the magnitude and complexity of the model, the COPE software is used to update and explore the model in the workshop. VFT on the other hand is much more focused on values for directing the decision process, with graphical representation of just the objectives (either fundamental, or means-ends), rather than a comprehensive model of the entire problem.
2. Since the merged map in SODA is anonymous (each person’s say has an equal weight), participants are encouraged to ‘change their minds’ about the situation as they see how others’ ideas link into their own. In this way, consensus is encouraged. This is not done at the same level of detail in VFT, where group cognition is captured by merging objectives hierarchies.
3. VFT uses attributes to clarify the meaning of objectives, and so reduce ambiguity. In SODA, the precise meaning of an objective is given through negative-poles and the context of that concept

within the cognitive map. Meaning is implied by looking at the neighbouring concepts with feed into, or from it.

4. SODA pays more explicit attention to the group process, with consideration of human cognition (drawing on PCT), and the political dynamics within organizations (drawing on theories of organizations).
  5. VFT concentrates on creating alternatives through consideration of the objectives hierarchy, whereas SODA considers explanations for concepts, and how one concept might influence another (as well as negative poles of concepts), in identifying alternatives for achieving higher goals. In SODA, alternatives emerge whilst viewing the model as a whole.
  6. VFT encourages the identification of decision opportunities by considering fundamental objectives without regard to a particular decision context. This is not done in SODA.
  7. Keeney and McDaniels (1994) suggest taking the process one step further: identifying measurable attributes for the criteria, and constructing a utility function. They stress that this is useful for 1) translating strategies into operational practice; hence improving communication within an organization and 2) clarifying the organization's strategic values and providing input for informed debate and negotiation.
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There was no time for a decision conference due to the tight deadline for the OMP implementation. Nevertheless, a 'paper exercise' was conducted using VISA, in order to demonstrate the potential benefit of such an exercise at that point in the exercise in order to learn more about the problem. It also demonstrated that the problem had been structured to such a point that enabled a relatively easy transition to MCDA modelling.

However, the eventual VISA model for evaluating OMP alternatives (Section 7.8) covered a very small section of the original strategic problem addressed by the COPE map. Several key issues, such as the impact of poaching and access rights on the OMP debate were not included in the fundamental objectives hierarchy in Figure 7.2., since these issues were outside the scope of the working groups control. Nevertheless, the implications of poaching and access rights on the OMP were explored in the SODA map, and the thinking therein could be borne in mind in deciding on stock rebuilding targets in the OMP, and the degree of flexibility required in managing the resource from year to year.

If more time were available, it would have been a good idea to further explore the fundamental objectives in Figure 7.2. to consider possible alternatives for improving the operation of the working group. For example, the issue of whether, or how, qualitative information might be included in decisions is particularly important. A related issue is that of stakeholder involvement and communication in decision-making, and how it might be influenced by different OMP's. The fundamental objectives hierarchy in Figure 7.2. was intended not merely for evaluating OMP alternatives at the time, but rather for guiding the future policies and decisions of the working group.

## 8.3. Recommendations for future research

### 8.3.1. Group decision support in fisheries management

In summary, the GDSS methods which were employed in this research show great potential for assisting with today's fisheries management problems. This potential lies particularly in facilitating a more participative management approach (enabling co-management), and providing a framework for negotiation and bargaining within a managed group process. Furthermore, they provide an effective means for incorporating the important qualitative information inherent in the economic, social and political dynamics of fisheries which, up until now, have been dealt with in an ad-hoc manner. There is much potential for further research in this area.

Particular difficulties were encountered in the intervention due to the hierarchical nature of decision-making structures, involving a large number of actors on several advisory boards and committees. This is often the case, not only in fisheries management, but also in many other areas of public decision making. Lootsma (1989) points out that such factors often limit the success of decision support in practice. Therefore, this will also be a useful area of future research in order to consider how GDSS methods can be used when working in such situations, involving many actors at different, and relatively autonomous, levels in the decision process. One option, as does sometimes occur in consulting practice, is for management consultants to work together as a team, where each consultant is responsible for aiding a particular group or committee. These consultants can then interact with each other, and bring together their findings to structure the larger problem environment.

### 8.3.2. Integrating SODA & MCDA

As Belton et al (1997) suggest, there is potentially much more benefit to be derived through an integrated decision support approach which uses SODA and MCDA *in parallel*, as opposed to in series. However, both methods have their own proponents, each with their own style of working with groups. For this reason, the empirical research which has been done in this field has generally involved two facilitators, one an expert in SODA and the other in decision conferencing. Therefore, future research should consider the practical implications

of how a truly integrated approach to using the two methods could be used. In addition, several theoretical aspects relating to the different philosophies driving the two approaches (cf. Table 4.1.) should also be addressed.

### 8.3.3. Strategy for managing the west coast rock lobster fishery

It will be particularly useful to follow-up this intervention with the WCRLWG. In particular, the FOH in Figure 7.2. can provide the insight for creating future alternatives and decision opportunities. Due to time constraints, not much time was spent with the group thinking about how the fundamental objectives could be achieved. This, after all, is the essence of VFT - using one's values to guide the generation of action plans. Furthermore, the SODA model contains much useful information on issues beyond the immediate scope of the OMP e.g. on strategies for policing and future research. As such, the SODA map can be used as an EIS and referred to in future decision-making. As Bryson (1995) points out:

*“it is highly unlikely that any organization will experience all or even most of the benefits of strategic planning the first time through - or even after many cycles of strategic planning. For one thing, strategic planning is simply a set of concepts, procedures and tools. Leaders, managers, and planners need to be very careful about how they engage in strategic planning because their success will depend at least in part on how they tailor the process to their specific situation. ... the process will work only if enough key decision makers and planners support it and use it with common sense and sensitivity to the particulars of their situation.”*  
[p.7]

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It has also been found that the framing of a problem i.e. the way in which information is presented, has a substantial impact on how problems are perceived and what solutions are proposed [Tversky & Kahnemann (1981)]. Hence, the way in which a problem is represented (e.g. by visual display) is extremely important in decision support practice [Massey & Wallace (1996), Belton, Ackermann & Shepherd (1997)].

The result of using judgement heuristics is that decision makers often fail to properly define the problem, and many times do not fully appreciate the magnitude, complexity and implications of the problem. Heuristics also tend to stifle creative thought in generating new alternatives, leading to sub-optimal and biased decisions. In such cases, the 'solutions' often prove ineffective, or even worse, are the cause of even more complicated predicaments in future [Ackoff (1981)].

Hence, decision analysts, strategic planners, and the like, have an important role to play, to prompt a structured, yet creative approach to tackling strategic problems.

## 4.3. Organisations & Group Decision-making

### 4.3.1. Resolving, Solving or Dissolving...

Ackoff (1981) stresses that working on 'messy', managerial-type problems "requires planning, not problem solving". He differentiates between three broad approaches to planning ...

#### Resolving

Many managers adopt this approach in decision making, relying heavily on their experience and intuition (gut-feel). Due to time constraints and insufficient information, they often choose a 'solution' which *satisfices* (satisfies and suffices) rather than looking for the *optimal* solution [Ackoff (1981), Radford (1990)]. Decisions are often highly subjective, and open to bias. Quantitative analyses *are* used to assist in decision-making; however, their

findings are not used exclusively, but rather included in “the pool of judgement that is dominated by qualitative experience” [Ackoff (1981)]. Ackoff links this mode of problem solving with the *clinical approach* to decision support, where the emphasis is on facilitating group participation. The clinician’s role is ostensibly that of convenor, encouraging creativity and co-operation between team members. The clinician focuses on the ‘subjective’, behavioural science aspects of the decision process.

### **Solving**

Problem *solving* (also called the *research* approach) aims at obtaining the *optimal* solution to the problem, relying heavily on mathematical or simulation modelling. Although this approach aspires to complete objectivity, those employing it (such as operational researchers) often resort to the *clinical* approach (or *resolving*) when dealing with the ‘subjective’ aspects of the problem that do not lend themselves to quantitative analysis. ‘Solving’ invariably requires that the system under consideration be broken down into easier-to-work-with sub-components, which are analysed independently.

### **Dissolving**

Ackoff advocates *design* orientated planning (also called problem dissolving), recognising the need not only for the clinical (taking a holistic view, encouraging participation, and focusing on behavioural science), but also for the research approach (formulation of independent parts of the problem and quantitative modelling). The designer combines the skills of the researcher and the clinician. Eden (1990a) and many others also emphasise that consultants should combine the skills of the behavioural scientist with those of the analyst. Rather than satisficing or optimising, the designer *idealises*, considering how the decision environment (viewing the ‘system’ as a whole) can be altered or redesigned in order to achieve some *ideal* solution. He combines the ‘know-how’ of both the resolver and the solver in order to achieve this; Ackoff suggests that the problem designer should employ the tools and methods of the problem solver, but ‘synthetically’, rather than ‘analytically’.

### 4.3.2. Why groups?

Most decisions in organisations are taken within a group setting. In fact, Zionts (1997) stresses that the concept of a single decision-maker is a myth. Even the 'individual' decision maker is influenced by the views of those around him as he interacts with his environment [Roy (1993)]. Managers often face situations in which they seek the views and judgements of fellow colleagues, 'bouncing their ideas' off them [Smit & de J. Cronje (1992)]. This is particularly true when the decision is complex and the possible outcomes shrouded in uncertainty. Managers frequently include those working 'at the coal face' in decision making, in order to obtain a greater cross-section of ideas, leading to a broader perspective and understanding of the problem [Ackermann (1990)].

The diversity of human experience and individuality provides an opportunity for better decision-making: firstly, more information is available - decision-makers can learn about, and make more sense of the problem situation by seeing and understanding the perspectives of others. Secondly, more inventive and innovative solutions are likely to be identified when more participants are included. Whether these creative and innovative solutions will be accepted by the other participants is another question.

Complex situations often require the combined effort of experts from various fields. The management team might bring together the precision of the financial expert, the enthusiasm and flare of the sales or marketing representative, the drive and entrepreneurial spirit of the manager or director, and the creativity of the R&D executive [Kepner & Tregoe (1981)]. Each brings to the decision process their own expertise and perspectives. When operating as a team, these different members need a common language for communicating and working together. Not all members will understand the technical know-how and models of the financial expert, for instance. In our strategic planning exercise for the future management of the west coast rock lobster resource, scientists, fisheries managers, fishing company directors, labour union representatives, and fishermen were brought around the table together. Our intervention process needed tools and methodologies which would encourage the different parties to contribute to the decision process, and enable them to effectively communicate their perspectives to other participants.

So, the main aim of creating a team within an organisation is to draw on the experience and expertise of individual members, and to consider the issue from different perspectives [Eden (1989)]. In government and public decisions, the decision process is invariably perceived to be more transparent (and decisions more readily accepted) when stakeholders and interest groups are constructively involved [Keeney (1992)]. One of the prime goals of MCDA, for instance, is to assist decision makers in the public sector (and in organisations) to properly consider the concerns and interests of vested interest groups [Stewart (1992) p. 571]. Keeney (1988) emphasises that stakeholder groups should be involved early on in the process, otherwise they might feel that the decision has already been taken. Their constructive involvement is requisite for them to feel that the process is legitimate, rather than their involvement being seen as mere window dressing. Group decision processes also assist managers to communicate and explain the rationale behind their decisions to subordinates or stakeholders more easily [Smit & de J. Cronje (1992)].

#### 4.3.3. Types of group

Friend (1990) identifies three different types of groups:

1. *teamlike groups*, who work ‘corporately’ towards a *common* goal.
2. *partnership groups*, comprising representatives from two or more organisations working on a joint project; with a common cause or common objectives.
3. *inclusive groups*, including representatives from various interest groups with different goals and interests.

The decision support consultant’s task is much easier when operating with the first two types of group, where participants work consensually. With inclusive groups, on the other hand, the consultant’s role is not merely group facilitation, but also conflict resolution [Friend (1990)].

Friend has found it useful, when working with ‘inclusive’ groups, to start off by focusing on specific issues for decision and negotiation, and to then “work outwards from this focus”. This is very much in line with Bryson’s (1995) experience of strategic planning in the public arena. In his ‘Political Decision Making Model’ (PDMM), the emphasis is on the resolution

of individual issues, “which by definition involve conflict, not consensus” (p.11). This approach is diametrically opposed to the ‘rational planning model’, which at the outset assumes consensus on “goals, policies, plans and actions” (p. 11). Bryson however, stresses that the PDMM is not intended to supplant the ‘rational planning model’, but that both should be used either individually, or in conjunction, as and when appropriate. SODA also focuses on issues (called clusters) initially, encouraging negotiation and resolution of the issues in question through a social learning process. This learning process is achieved through the clear exposition and contrast of individual perspectives relating to the issues in question. The tendency to focus on issues was clearly seen in our SODA workshop, where the participants focused on the OMP issue.

#### 4.3.4. Group Dynamics

*“The portrait of the organizational actor that emerges from theory and research is that of a perceptive and pragmatic bargainer: vigilant, discerning and cognitively flexible when dealing with opponents.” [Kramer (1995) p.96]*

Organisational politics and power dynamics play a significant role in group decision-making. Meetings are often dominated by one or two key actors, particularly when senior managers are involved. Their ‘power’ frequently lies in their freedom to ‘write the agenda’, to guide the direction of discussion [Eden et al (1983)]. More junior members tend to refrain from stating their views in order to ‘save face’; for fear of raising ‘obvious’ or ‘stupid’ questions. Group participants might also mask their real views and interests for tactical reasons, with the option to change their views and allegiances as the negotiation process progresses [Jelassi et al (1990)].

Organisations are ‘negotiated enterprises’ [Eden (1989)], comprising small groups or coalitions of individual actors playing a ‘political game’ [Eden et al (1983)], influencing and manipulating others in order to achieve their own goals and ambitions [Kramer (1995) p.95]. Like any game, there are rules to be adhered to - the successful political actor knows that he needs to be seen as “energetic, assertive and decisive” by “the right people” [Eden et al (1983) p.6].

This organisational culture requires that actors present their views and ideas as proposals or solutions [Eden et al (1983)]. Frequently, the thinking behind an individual's proposal is not fully explained or articulated, and remains camouflaged. As Kepner & Tregoe (1981) put it :

*"What information was used and how it was used remain invisible. "I don't see how you could arrive at that" is our ordinary way of expressing the fact that thinking is an inside job." (p.27)*

As a result, the decision process often reduces to a political contest between opposing views or 'solutions'. Eden et al (1983) note that, as a result of this culture in organisations (of presenting proposed solutions to the problem, as opposed to asking together "what is the problem?"), actors learn little about the nature of the problem from others' perspectives. With little sharing of information or wisdom between individual participants, positions tend to only change "for reasons to do with short-term internal political games" [p.105]. This approach to decision making stifles creativity and imaginative thought.

Bryson (1995) also stresses that "arguments about organisational structures and systems are really about who is empowered or disempowered by different designs" [p.69]. He suggests that the planning process should therefore focus on the strategic objectives of the organisation. Agreement on the ultimate purpose and values of the organisation provides the foundation for further consensus and conflict resolution, and can "frame most of these conflicts in such a way that they facilitate the purpose and fulfilment of organisational ends." Bannister & Fransella (1986 p.23), looking at conflict resolution from a PCT perspective, concur with this approach. Considering the hierarchical nature of personal construct systems, they suggest that conflicts can be resolved by focusing on the most superordinate, relevant constructs.

It is important that the management scientist recognise the complexities of organisational culture and politics for three important reasons. Firstly, he/she needs to effectively manage decision processes within that organisation, ensuring non-domination by the most powerful players in order to obtain a diversity of ideas and perspectives (as described by PCT). Secondly, they need to understand the problem as it is seen through their client's eyes; to empathise with their client [Eden et al (1983)]. Messy problems are frequently fraught with subjective complexities, where even communicating the problem can be difficult. As a result, the consultant needs to model or structure these qualitative, and often subjective, aspects of organisational life in order to assist their clients to make more sense of them. Thirdly, with

the 'power' to plan the agenda, the consultant too becomes a political player. In order for their recommendations to be accepted, they need to play the 'game' according to the rules; to package their services in a manner which is considered useful in the particular organisation. Any successful political actor knows that "he must present proposals within the language and the broad goal framework that top management have laid down as good for the organisation" [Eden et al (1983) p.6]

#### 4.3.5. Negotiation : Conflict and Consensus

*"The two essential aspects of any strategic situation are conflict and cooperation. Rarely are different people's aims identical; interactions typically involve some (polite or impolite) conflict. Equally rare are situations of pure conflict, in which one person's gains equal the other's losses. Even the fiercest conflict has some commonality of interest, some scope for cooperation."* [McMillan (1992), Ch3]

Conflict can have both destructive and beneficial consequences [Parsons (1993)], and has on numerous occasions been an agent of progressive change [Raiffa (1982)]. Conflicting opinions frequently arise as a result of the different information sources available to the various opponents [Parsons (1993)]. Bringing together different views (which are fashioned by different information sources, or interpretations of the same information) can lead to a better understanding of the problem. This, in a nut-shell, is the philosophy behind SODA. Kersten (1997) emphasises that the formulation of a *joint problem definition* is essential in negotiations, but notes that it is seldom possible, due to the tactical concealment of personal perspectives and information resulting from mistrust between opposing parties.

When working in groups, two complex processes are continually in progress: communication and decision making [Kersten (1997)]. Conflict arises when the interests and values of individuals or interest groups differ significantly from those of other players. This conflict is further exacerbated due to the various parties frequently not knowing what the other participants' views or values are in negotiation situations. Hence, effective communication is crucial.

Most negotiation theories stress that information is the basic requirement for effective negotiation in that it enables the participants to develop their bargaining positions [Thompson et al (1995)]. Negotiators spend much of their time thinking about other parties' views, objectives and tactical positions. Keéney (1992) points out that knowing one's own preferences, as well as other stakeholders' objectives and value trade-offs greatly facilitates the negotiation process. Knowing which issues are more important to the other stakeholders enables the negotiator to concede on those issues, with the aim of contending more strongly for other issues which are more important to themselves. In this way, a form of co-operation can result, and the exchange of information facilitates the exchange of compromise offers [Kersten (1997)]. As Daellenbach (1997) puts it: "What you want is affected by what you can get and how easy it is to get, and vice-versa." Generally, the more one knows about others' objectives and preferences, the greater one's bargaining power [Kersten (1997)].

Kramer & Messick (1995) point out that studies in negotiation have approached the topic from four different angles:

1. A *normative* (prescriptive) approach based on game theory and economic theories,
2. An *individual differences* approach focusing on personality factors,
3. A *cognitive* (information processing) approach, including judgement heuristics and biases in negotiations, and
4. A *structural* approach, based on sociological conceptions of bargaining.

Because information is such an important ingredient in negotiations, it is logical that most researchers in the field of negotiation have focused on theories of cognition and information processing (no. 3 above) [Thompson et al (1995)]. However, the social aspects of negotiation and influence of social context on cognition and negotiation has, until recently, been largely ignored by researchers [Kramer & Messick (1995)]. Further research has, and is being conducted on these social processes of negotiation.

Despite the importance of joint problem structuring as proffered by negotiation theory and management science, it is often undervalued in organisations, being considered a "distraction from the rush to find solutions" [Eden et al (1983) p.104].

Kersten (1997) lists the following generic phases involved in negotiations, which should be considered by the designer of 'group decision support systems' (GDSSs) and 'negotiation support systems' (NSSs):

1. Agree on the location and mode of communication

This includes deciding on the mode of information exchange, and which decision support tools to use, as well as the use of experts, mediators and facilitators.

2. Agree on the agenda

This step involves the formulation of at least a partial problem representation.

3. Exploring the problem

During this phase, participants i) decide on what position to take, ii) assess opponents' positions, and the strength of their bargaining power, and iii) decide on initial strategies. Brainstorming exercises, or the use of computer-based support (such as COPE), may be useful for facilitating this consideration of alternative views and conceptualisations of the problem. Keeney (1992) [p.239] stresses that participants should, at this stage, identify their own, as well as their opponents' objectives, and possibly also specify value trade-offs. This would enable participants to formulate their 'best alternative to a negotiated agreement' (BATNA) [Raiffa (1982), Keeney (1992), Kersten (1997)].

4. 'Narrowing the differences' and bargaining

The next step is to identify the key *issues* for negotiation, and to search for possible resolutions for each. Keeney (1992) suggests that "issues and fundamental objectives have a natural relationship", and that issues should be identified by considering one's own, as well as one's opponents' fundamental objectives [p.238]. In particular, a negotiator should bear his opponents' objectives in mind in guiding compromise offers or concessions. So, during this phase, there will be an exchange of proposals, and individuals selecting strategies and revising aspiration levels (for which MCDA might be particularly useful). This softening of aspirations and standpoints may allow the expansion of the set of feasible alternatives, and lead to new alternatives being discussed [Kersten (1997)].

5. Search for agreement and improvement

In this final phase, all the areas of agreement and disagreement should have surfaced, and compromise offers presented in an attempt to resolve individual issues. The analyst or facilitator should endeavour to suggest alternatives which all parties prefer more than the achieved compromise i.e. a 'post-settlement settlement' [Kersten (1997)].

### 4.3.6. The Importance of *Process*

*"A process of accommodation between participants is necessary before a problem focus can emerge which will carry assent and commitment to consequential actions." [Rosenhead (1989)]*

The *process* by which a decision is made significantly influences peoples' acceptance of and satisfaction with the decision. In offering decision support to a group, the facilitator must manage the decision making process as well as analysing and manipulating the content of the problem[Eden (1990a)].

There are two important aspects to managing a group decision process. Firstly, stakeholder participation and the constructive involvement of interested parties usually leads to the chosen alternatives being perceived as fairer and more acceptable than the same alternatives would have been, with little or no stakeholder involvement [Keeney (1992) (p.219)]. "Stakeholders should be involved early in a decision process. This increases their willingness to cooperate, since it lets them see that the decision has not already been made" [Keeney (1992) p.96]. In our intervention with the WCRL working group, stakeholder involvement was identified as a fundamental objective by the group. In fact, the whole process which we facilitated (through the SODA interviews and workshop) had this in mind, as we attempted to involve all players equally in the decision-making process.

The second aspect of managing process is that, by considering different perspectives in a politically stable and uncontentious manner, a richer problem definition results. In this way, participants get a better idea of the "big picture", and invariably a better understanding of the "real problem" at hand.

## 4.4. The Consultant in Decision Support

### 4.4.1. The Role of the Consultant

The management scientist has an important role to play in private and government organisations in this day and age, where decisions need to be defensible and consistent, true to the values of the decision makers, stakeholders, and, in certain cases, the general public.

Decision aid should help decision makers to make better sense of messy problems, enabling them to justify, and document the rationale behind, their decisions [Stewart (1992) p.571].

The consultant's primary task in a particular situation might be to facilitate and guide a group process; providing unbiased and 'objective' chairmanship of a meeting or workshop, so facilitating a participative and 'fair' decision process. This is often necessary when dealing with contentious issues or contending interest groups. A chairman affiliated to any one interest group (perhaps elected by the other group members) usually finds it difficult to participate in the debate and, at the same time, direct the proceedings in an objective manner [Ackermann (1990)]. If GDS software is used to provide structure for debate and decision, it is crucial to have a facilitator to operate the software, enabling the manager to focus solely on the problem at hand [Ackermann (1990)].

As facilitator, the consultant has the 'power' to direct discussion in meetings, and can use various techniques to prevent domination of the meeting by key individuals [Eden et al (1983)]. This is likely to lead to greater participation, and the consideration of a broader cross-section of ideas by the group, which in turn is likely to yield greater creativity [Ackermann (1990)]. In a corporate setting, employees are often unable to be totally frank or open about their views due to the organisational politics and culture, or simply because their thoughts with respect to the problem are not clear, and their understanding limited [Eden et al (1983)]. Managers might enlist the services of the consultant to provide an unthreatening atmosphere, encouraging individuals to talk openly about their problems.

The MS/OR consultant's task requires that he perform two tasks concurrently: managing the decision *process* whilst, at the same time, analysing the problem *content* [Eden (1989)]. In order to do so effectively, he needs to combine the skills of the technical analyst with those of the behavioural scientist [Eden (1990)]. This is the essence of Ackoff's design approach to planning. GDS tools and methods should be designed in such a way to assist and enable the consultant in this formidable task. They should encourage group participation, so fostering commitment to the process, as well as enabling the analyst to build models of, and analyse, the problem [Ostanello (1997), Eden (1988)].

Bennett (1990) identifies four types of help which the OR consultant can provide his client. The first, and often the primary aim of any intervention, is to facilitate a learning process,

assisting clients to effectively communicate and think through messy problems. Friend (1990) points out that the 'products' of a particular decision support approach are not always 'visible', but might be 'invisible' qualities, such as providing an effective learning process or 'commitment package', or persuading individuals to alter their perspectives towards some consensus view of the problem. When working with a group, the consultant's primary emphasis will be on assisting the group to arrive at a decision to which all participants are equally committed [Friend (1990)]. As such, he should strive to create a climate which is conducive to the mutual appreciation and understanding of different perspectives of the participants [Daellenbach (1997)].

The second key role of the consultant is to explicitly represent and structure information into a meaningful format, from within which the problem can be constructively viewed and discussed. Thirdly, consultants can bring new ideas and a fresh (outside) view of the situation, perhaps challenging the client's thinking [cf. Stewart (1996)]. Finally, the fourth type of help is that of providing formal analyses and modelling of the problem.

#### 4.4.2. The Influence of Personal Style

The management science consultant "starts from a position of considerable influence over the group process" [Friend (1990)]. The choice of *which* decision support tools to use, *when* to use them, and *how* to use them in a particular situation are his. Methods used should be compatible with the personality and style of both the consultant, and the client organisation or decision group [Vari & Vescenyi (1984)]. Consultants generally should, and do, adopt a flexible and contingent approach to decision support [Cropper (1990), Friend (1990)]. How various methods are to be used to guide the decision process (perhaps using several tools or approaches in combination) frequently only unfolds during the intervention.

A particular consultant's style, and approach to any decision context, is largely influenced by his/her personal philosophy of decision support, and the technologies within their repertoire [Cropper (1990)]. It has been observed that, even within a particular soft-OR methodology, different consultants use the *same* methods *differently*, bringing their own personal style to bear on the way in which the methods are used [Cropper (1990)].

Amongst other things, the consultant must decide on:

1. who to involve in the process, i.e. who the 'client' is [Eden (1989)],
2. when to work with the participants individually, and when to work in a group-setting [Bennett (1990)],
3. the extent of input and effort required by clients and consultant [Cropper (1990)],
4. the level and extent of formal, quantitative analysis and how it should guide the overall decision process,
5. the amount of iteration (cycling through) in the intervention process [Cropper (1990)],
6. what measures to take when conflict arises [Friend (1990)].

The way in which any individual consultant approaches these issues is dependent on their own personal style and expertise. Cropper (1990) identifies two extreme philosophies of decision support (similar to Ackoff's *research* and *clinical* approaches). The first sees decision support as an *analytical* (or intellectual) process, whilst the second views it as a *social* process. Cropper stresses that any individual consultant's approach will be a synthesis of these two streams of thought. The table below summarises the key differences between these two approaches, and the implications for decision support practice.

<b>Analytical (intellectual) process</b>	<b>Social process</b>
<u>The client</u> The 'client' is assumed to be singular, having a consensual view and common purpose.	The 'client' is seen in a pluralistic manner, as having diverse interests and views.
<u>The problem</u> Problems are dealt with in an abstract manner and seen as 'external' to the client group - "attention is focused outwards onto a problem as represented and manipulated by a model".	The 'social approach' presumes that the problem is internal to the client group. The focus is on the "internal, social process" of negotiating a problem definition, in an attempt to capture and understand the complexity of the situation.
<u>The technology</u> The technology provides a "normatively privileged" framework, which is used to order information and assist clients to focus on those features of the problem which are seen as critical when viewed through this framework.	Technology strives to capture the clients' own perceptions and framing of the problem, using the clients' own language to do so. This forms the basis for a "group-developed and owned vocabulary for describing and bounding the problem."
<u>Role of the consultant</u> The consultant is seen as an expert guiding an intellectual process, and providing the 'privileged framework'.	The consultant's primary role is to facilitate communication and understanding of alternative views, by managing the "social process of enquiry".

## Chapter 5

# Problem Structuring Approaches and Methods

Until recently, relatively little research was done on the problem structuring phase of decision analysis. This is perhaps surprising in light of the unanimous acknowledgement of its critical importance in management science and OR consulting practice [Von Winterfeldt (1980), Keller & Ho (1988)]. For a long time, the so-called ‘art’ of problem structuring took second place in the management science literature, with most research endeavour focused on the technical and mathematical aspects of decision analysis and quantitative operations research techniques [Henig & Buchanan (1996), Woolley & Pidd (1981), Evans (1989)]. In recent times however, the topic of problem structuring has received, and continues to receive, much attention - in particular, several problem structuring methods have been developed over the past few decades under the banner of ‘soft OR’.

In addition, the MCDA community have in recent years, almost as with one voice, called for the development of a broader approach to the MCDA paradigm of decision support [Bouyssou et al (1993), Kersten & Noronha (1996)]. Implicit in this call, is the embracement of the need to incorporate research from other fields (such as cognitive science and organisational theory) in developing strategies for structuring problems and managing group decision processes [Roy & Vanderpooten (1996), Bouyssou et al (1993), Kersten (1997), Ostanello (1997), Stewart (1997)].

## 5.1. Four broad streams of thought

Woolley & Pidd (1981), in their paper ‘Problem Structuring - A Literature Review’, identify four broad ‘streams of thought’ on the topic of problem structuring:

1. The checklist stream
2. The definition stream
3. The science research stream, and
4. The people stream.

The *checklist* approach involves systematically searching for causes of the problem, ‘ticking off’ potential causes, until the actual cause is found, which can then be dealt with or eliminated. This stream of thought is epitomised by Kepner & Tregoe’s (1981) approach. The *definition* stream, on the other hand, seeks primarily to identify various elements of the problem, with the view to modelling the problem situation. These ‘elements’ of the problem might include objectives, alternative options, actors, etc..., as in the case of MCDA and decision analysis paradigms. The *science research* methodology has its foundation in data collection and observation, with the emphasis on obtaining ‘objective’ information to help decision makers to better understand the problem. Finally, the *people stream*. This approach has already been covered in some detail in the previous chapter, particularly under the social approach to decision support. Under this stream of thought, problems are considered to be subjective, and “functions of peoples’ perceptions” [Woolley & Pidd (1981)]. The basic aim of the people stream approach is to clearly articulate and accurately represent individual perceptions, in order to facilitate a shared perspective and negotiated definition of the problem. An important point which Woolley & Pidd raise is that the people approach presupposes that the role of OR includes that of convincing one’s client to modify his or her perceptions, if necessary.

## 5.2. Strategies for dealing with complexity

MacCrimmon & Taylor (1975) identified four basic strategies for reducing complexity, which can be employed to facilitate understanding and diagnose problems. The four strategies are:

1. determining the problem boundaries,
2. identifying changes in the decision environment which might be responsible for, or have lead to the problem,

3. factoring complex problems into sub-problems,
4. focusing on the controllable components of the decision environment.

Kepner and Tregoe, in their book, *The Rational Manager* (1965) were early pioneers in using and advocating the first two of these strategies. According to their approach, an initial problem 'deviation statement' is fleshed-out by considering the identity, location, timing and magnitude of the problem [Kepner & Tregoe (1981), Watson & Buede (1987)]. By determining what "is" and "is not" part of the problem, one can focus on those areas which have been identified as problematic. For example, if one out of five identical machines in a factory is not working, one would consider what is different about the one broken machine? Attention is focused on identifying the features of the broken machine which are different from the operational ones. In the case of the one broken machine, it may recently have been serviced, and a part replaced by a new, 'pirate' part which does not work satisfactorily on this make of machine [see Kepner & Tregoe (1981)]. So, possible causes are identified by considering these points of difference between the "is" and "is not" sectors of the problem environment. Particular attention is given to changes in the "is" sectors which may have precipitated the problem.

The third strategy: decomposing a problem into sub-components and solving each sub-problem, can be useful. However, as has already been stated in the previous chapter, this mode of working is not effective when there are significant inter-relationships between the various problem components [e.g. Drucker (1974), MacCrimmon & Taylor (1975), Volkema (1983)]. Finally, focusing on those sectors of the decision environment which are controllable can be an important starting point for considering what actions are feasible.

Several individual structuring methods can be listed under each of MacCrimmon & Taylor's four broad strategies, as was in fact done by Volkema (1983). Volkema notes however, that most (but not all) of the methods under each of these categories, assume a correctly defined problem to start with, and are problem 'reductionist' in nature - breaking the problem down into easier-to-handle sub-components.

### 5.3. Approaches to defining problems

*"The key issue in definition is how problems should be represented..." [Smith (1989)]*

Complex decision situations challenge not only the decision makers' cognitive abilities, but also the skills of the consultant providing decision support [MacCrimmon & Taylor (1975)]. The way in which they represent or define the problem usually has a significant influence on the outcome of the intervention, and the solutions proposed [Volkema (1983)]. Hence, it is important that the helper clearly represents the problem in a way which is useful and effective in assisting the decision-making group. From the research which has been done on the subject of problem formulation, Smith (1989) identifies the following basic approaches to **problem conceptualisation and definition**:

1. *Gap specification* - considering the 'gap' between the current state, and some preferred or desired state. This derives from Newell & Simon's problem space theory (cf. Chapter 4). Defining problems by means of such a 'deviation statement' often comes naturally [Kepner & Tregoe (1981) p.40].
2. Identification of *obstacles or constraints* precluding the achievement of one's objectives.
3. Specification of *goals, values and preferences*.
4. Description of *goal or solution states*.
5. Enumeration of *strategies and means* to achieving goals.
6. *Causal diagnosis* - considering possible causes of the problem. Kepner & Tregoe (1981) note that people continually use 'cause and effect' thinking in their everyday construing of the situations around them.
7. *Statement of knowledge, facts and beliefs* relevant to the situation. This includes not only the facts known about the situation, but also subjective views and beliefs relating to the situation.
8. Consideration of *different perspectives*.

We shall see later on in this chapter that the SODA approach inherently employs most of these techniques, combining them into a 'single package'.

The various approaches essentially attempt to get to the core of how people think; to understand how individuals construe problems, as well as how creative and innovative ideas are generated. It is perhaps no wonder that so little attention has been paid to this subject by management scientists. Bannister & Fransella (1986) suggest that it was not until recently that even psychologists started to present a clearer picture of human cognition and inquiry:

*"The behaviourist view of persons as docile organisms, totally shaped by their environment, has yielded ground over the last thirty years, to the tide of cognitive psychology. Psychologists have, with great effort, reached an obvious conclusion in their labours - if psychologists can think then it may be that their subject matter (people) can think."*  
 [Bannister & Fransella (1986)]

## 5.4. Convergent versus divergent formulation of the problem

*"While it may not be difficult to define the original problem, narrowly construed, such a definition has little value in the face of the situation's complexity. On the other hand, a comprehensive problem definition might be impossible to devise, just as complex messes seem impossible to solve. While it's essential that problems be regarded as potentially complex, it's also necessary that this complexity be bounded."* [Smith (1989)]

In formulating real-life problems, there is usually a conflict between the desire to focus one's attention, and the need to explore the problem in a 'divergent' manner, to ensure that important considerations are not ignored [Smith (1989)]. Problem structuring practitioners have also found themselves in this dilemma: whether to structure problems in a convergent (problem reductionist) fashion, so reducing complexity, or whether to adopt divergent (problem expansionist) paradigms to structuring [Volkema (1983), Abualsamh et al (1990)]. A narrowly defined problem, though easier to define, is likely to be of little use if it does not fully encapsulate or appreciate the complexity of the situation [Ackoff (1962)]. On the other hand, a comprehensive problem definition, which attempts to capture the multiple dimensions and complexities of the situation, may be impossible to define, or of little *practical* use in assisting decision makers. The categorisation of problem structuring methods into either of the categories (convergent or divergent) is not always clear cut. For example,

simply identifying criteria and alternatives, and evaluating alternatives using decision analysis, is a convergent approach. However, the DA process, viewed in totality, is not normally as simple as that, due to the ill-structured nature of decision problems.

As was discussed in Chapter 3, it is particularly important that management scientists fully understand the problem (as seen through the eyes of their client (s)) to avoid analysing the 'wrong problem'. This is particularly important in the light of the shift from predominantly well-structured to more ill-structured and messy management-type problems. It is for this reason that, in this thesis, a divergent approach to problem structuring, SODA, was employed at the outset, to appreciate and retain the inherent complexity of the situation. However, we felt that, after considering the 'big picture', it would be useful to employ MCDA to focus in on the problem in an attempt to reduce the complexity, whilst still retaining the salient points. The use of SODA beforehand would ensure that important considerations and aspects of the problem would not be overlooked or ignored in the MCDA analysis. Furthermore, SODA is particularly useful for managing the process and encouraging participants to buy into any further analysis.

#### **Convergent thought in general problem solving ...**

*"When a problem is first discovered, it is rich in solution possibilities. As the process continues, however, assumptions and constraints are added in an effort to bring manageability and closure to the problem. These limit the scope of the problem and the range of possible solutions." [Volkema (1983)]*

People seldom display divergent thought in decision making. When formulating problems, we tend to adopt convergent conceptualisations of the problem environment, in an attempt to make sense of problem issues. Keeney (1994) notes that when considering a problem, decision makers often think of the most obvious solutions, such as those which have been used most recently or frequently in similar situations, and anchor on these. In this way, the range of options generated is usually unnecessarily narrow [Keller & Ho (1988), Keeney (1992)]. Keeney (1994) further notes that people tend to "move quickly away from the ill-structured to the well-defined, from constraint free thinking to constrained thinking." As was already discussed in Chapter 4, the mind lives by the principle of 'cognitive economy'.

For this reason, Keller & Ho (1988) give several guidelines for inspiring creativity in generating options. Their option generating procedures (discussed earlier in Chapter 3) encourage decision makers to explore less travelled pathways and regions within the cognitive network, by considering goals, attributes, states and options to unlock the doors to these pathways in the cognitive network. Cognitive mapping in SODA also encourages decision makers to think divergently, to look not just at the issue in isolation, but rather to broaden their perspective and consider how other issues might be related to, or influence the central issue(s).

However, most policy analysis methods invariably seek to reduce complexity [Ackermann et al (1989)] and although convergent structuring heuristics are normally more *efficient* than divergent approaches, they are often less *effective* [Abualsamh et al (1990)]. In practice, the convergent conceptualisation of problems often renders 'solutions' which satisfice, and hence are frequently used by the 'resolving' (clinical) manager (cf. Section 4.3). Volkema (1983) warns that although problem reduction is ostensibly the most efficient and rational route to understanding complex problems, it is common to focus so quickly on solutions that the problem is never fully understood or appreciated. In addition, it is widely believed that creativity is the key to finding effective solutions to complex problems, and that divergent structuring heuristics will lead to greater creativity, and a better formulation of the decision environment [Evans (1989), Abualsamh et al (1990)].

For this reason, various researchers have developed problem structuring methods which encourage problem expansion. These problem expansion methodologies invariably start with some statement (or label) of the problem, and ask exploratory questions such as: "Why is that important?", "Does this have important ramifications for some other issue, or is it important in itself?", "What are the consequences of that?", "What factors explain this situation?", or "What strategies could be adopted to achieve this goal, or remedy this situation?" [Eden (1989), Volkema (1983), Keeney (1992), Abualsamh et al (1990)]. These questions, asked repeatedly, help to identify goals, and further expand upon them, until the 'fundamental' or ultimate goals have been identified, and strategies explored for achieving each of them [Ackermann et al (1990), Smith (1989)]. Keeney's value focused thinking, for example, uses this style of questioning to identify the 'strategic' and 'fundamental' objectives. By considering these fundamental objectives, VFT enables the analyst, and their clients, to effectively bound the particular decision context (so defining the solution space, and guiding

the search for possible plans of action for achieving the various identified objectives), without losing sight of the broader strategic context. In this way, VFT provides useful insights into defining a *specific* decision context. Strategic objectives are furthermore useful for identifying decision opportunities (cf. Chapter 3).

Volkema (1983) notes that once a particular problem definition has been formulated, people display aversion to reformulation of the problem. It has been observed that the amount of information required to change a decision is much more than that required to make it in the first place [Volkema (1983)]. This fact supports the importance of adopting a divergent approach to defining the decision context from the outset. Volkema recommends that planners adopt a problem expansionist approach to structuring problems, suggesting that they devote “more time and energy to the formulation process and considering as many different perspectives of the problem as possible”. This, as we shall see, is one of the key tenets of SODA.

Problem expansion heuristics broaden the scope of the problem, making it more expansive by relaxing pre-imposed boundaries in the mind of the individual decision-maker, which otherwise significantly influence the decision makers’ thinking [Volkema (1983)]. This invariably leads to a broader spectrum of solutions being generated. In other words, the ‘solution space’ is enlarged [Keeney (1992), Volkema (1983)]. However, in aiming to retain the complexity of real-life situations, it is crucial that divergent structuring methodologies also provide the means for managing this complexity [Ackermann et al (1989)]. The COPE software, developed out of the SODA approach is usually very effective in this task, as shall be seen in the next few chapters.

## **5.5. Strategic Options Development and Analysis (SODA)**

The remainder of this chapter gives a brief description of the SODA approach to decision support, including cognitive mapping, which is a key technique used during the SODA process.

SODA (like other soft OR methods) provides the consultant with a means to partially structure, and systematically analyse, previously unstructured situations [Rosenhead (1989)]. It focuses particularly on facilitating group participation in a strategic thinking process [Eden & Radford (1990)]. The SODA process strives to include the diverse and subjective views of each participant, and starts out by interviewing each participant individually. This ensures that each team member has a fair chance to air their views [Bennett (1990)]. The result is that, in effect, as many definitions of the problem arise as there are participants [Bennett (1990)]. This leads to a richer formulation of the problem, which appreciates the complexity inherent in messy problems [Eden (1989)]. These individual problem definitions are then merged into a single, all-encompassing view of the problem, which is later debated and negotiated in the 'SODA workshop'. In the workshop, the primary aim is to obtain a consensual, or group perspective of the problem [Eden (1989), Massey & Wallace (1996)].

This said, it is important to stress that SODA is not merely a problem structuring *method*, but rather a *methodology* [Eden (1990b)] assisting the consultant to facilitate a group process whereby his/her clients' thoughts can be clearly articulated and structured. In order to do so, SODA draws on various theories about problems, groups and organisations. SODA's primary aim is to help members of the problem solving team to understand each others' views in such a way that it facilitates effective interaction between team members. [Eden (1989), Massey & Wallace (1996)]. The complex, and often highly political problems faced by management teams in organisations requires a sensitive and flexible modelling approach - which SODA provides.

*"SODA is ... a method which derives from an explicit theoretical framework about organisations, groups and problems, which informs a conceptual framework about the nature of the consultant's role" [Eden 1990b)].*

Eden's cognitive mapping technique [Eden (1988)], used extensively in SODA, provides *qualitative* (as opposed to quantitative) modelling of the decision environment [Ackermann & Belton (1994)]. Cognitive mapping seeks primarily to model the subjective ideas, views and beliefs of the individual [Eden (1989)], using as its conceptual basis, Kelly's Personal Construct Theory.

### 5.5.1. Cognitive mapping : The process

The SODA process usually starts with a series of interviews, where each team member is interviewed individually. In this way, special attention is given to each individual's perspective. In the initial interview, there is no pre-planned agenda. Rather, the consultant starts with only a problem label, and actively maps the ideas of the client as they are raised. The recorded concepts, and inter-relationships (denoted by arrows) in the map, provide the cues for further questions, and exploration of problem issues as the interview progresses. In this way, the consultant and client together explore the implications of the model as it unfolds during the interview.

In Figure 5.1, a portion of a map from one of these interviews is displayed. When questioned about what he saw as the main problem facing the management of the west coast rock lobster resource, the particular participant pointed out that there was "too much extraction" from the resource. I (as interviewer/ facilitator) proceeded to ask what a satisfactory alternative might be to this situation. His response was: "a limited number of 'industrial' users". This response formed the opposite pole to the initial statement. The ellipses denote the words 'rather than'. So, concept number 1 is read as: 'Too much extraction *rather than* a limited number of industrial users'. This opposite pole gives further meaning, and clarifies the concept, as explained by personal construct theory. This is important, since the very same words can mean quite different things to different people [Eden et al (1983)]; as Kersten (1997) points out, communication is a complex process. As can be seen in Figure 5.1, many concepts do not have explicitly stated opposite poles. In these cases, the concept should be taken to have an implicit opposite phrase [Cropper et al (1990)]. The numbering of concepts is simply for reference purposes, and assists with future analysis of the maps.

From this initial concept, the problem definition was fleshed-out by considering i) the ramifications of this, and other concepts later identified, and ii) possible explanations for each concept. So, my next question was: "What is an explanation for there being too many users?". The answer was that there was currently a lot of illegal use of the resource. This was added as concept no. 2. Further exploration of the problem continued in a similar manner, exploring the possible consequences of, and explanations for each concept. In this way, the

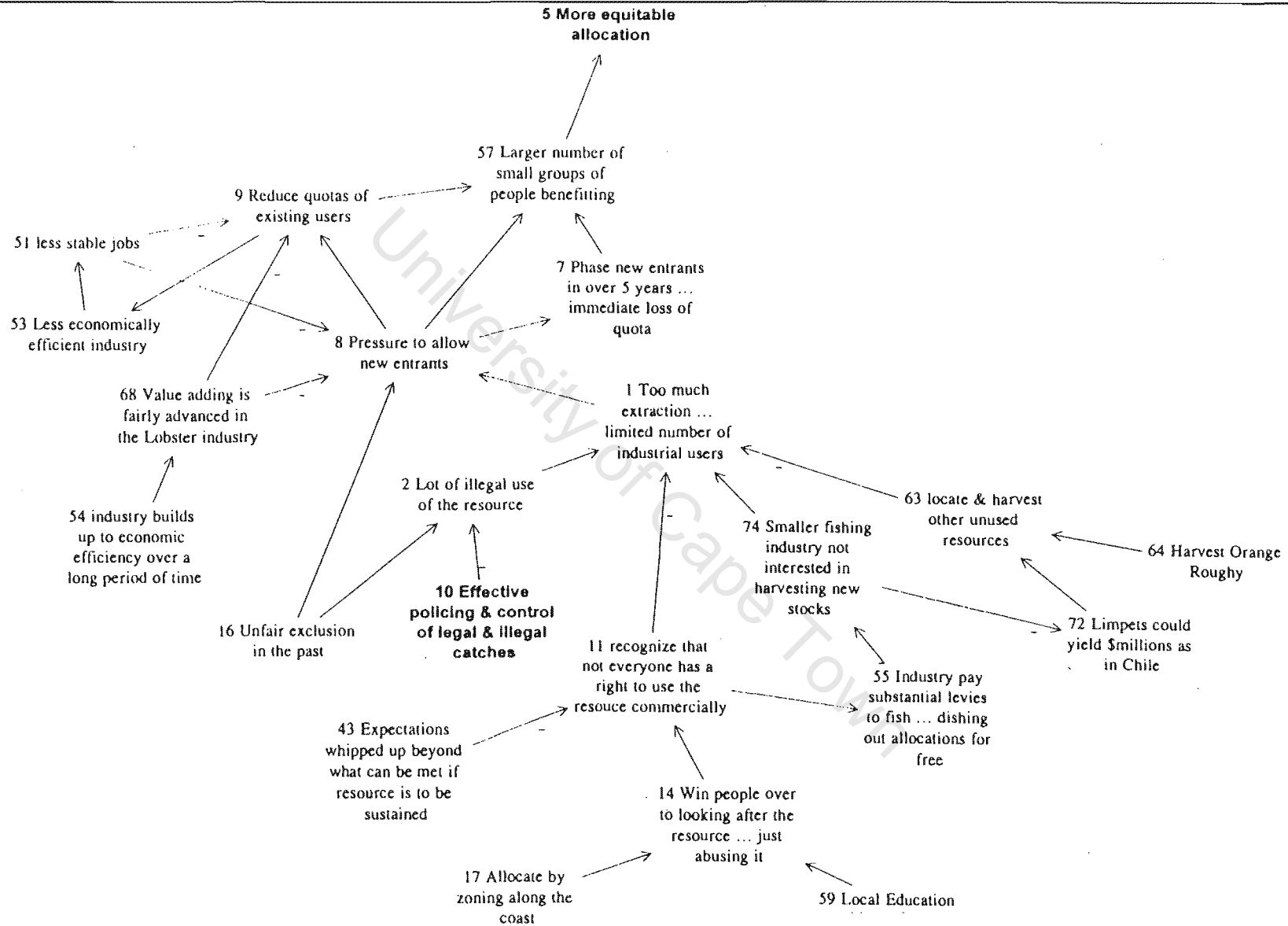


Figure 5.1. A portion of a cognitive map drawn in an interview.

problem definition was expanded. By continually questioning the consequences of concepts, goals and objectives are identified. Through this process, as with VFT, it is determined whether an identified objective is merely a means to some higher end, or whether it is an 'ultimate objective' (i.e. 'motherhood' and 'apple-pie' concepts), as discussed in Chapter 3.

The arrows linking the various concepts show the inter-relationships between different concepts i.e. the influence a concept might have on another, where the concept to which the arrow points is 'explained' by, or perhaps a result of, the explanatory concept. By following the arrows from one concept to the next, one can follow the train of thought of the interviewee. A negative arrow (such as that between concept no. 11 and concept no. 1) shows an inverse relationship, implying that the subordinate concept (in this case, no. 11) leads to the negative pole of the superordinate concept. Hence, what the interviewee meant was that it should be recognised by decision makers, and the South African community alike, that not everyone has the right to use the resource commercially, and that this realisation naturally leads to the limiting of the number of commercial users of the resource. This map provides a good, though brief, introduction to the access rights issue, as it relates to the west coast rock lobster fishery. Just by looking at this map, it is clear that several trade-offs have to be made in any decision relating to access rights. Political, economic and development issues all come into the equation. There is clearly potential for an MCDA approach to the problem.

In the first interview, the consultant adopts an empathetic approach, encouraging the client to articulate and 'talk about' his/her problem [Eden et al (1983)]. At the same time, it enables the consultant to understand the problem as seen through the client's eyes. In this way, the initial emphasis is placed on the individuality of different interpretations of the problem situation.

Although the consultant adopts the pose of 'active listener' [Eden et al (1983)] in the first round of interviews, their role in structuring the problem should not be under-estimated. He actively synthesises and interprets what the decision maker is saying during the interview, whilst representing the information in the map. Often, the client's ideas are disjoint and their understanding of the problem limited. The map helps the clients to formally articulate and structure their ideas and thoughts about the problem, leading to them better understanding their problem. At the same time, the analyst applies his/her understanding to what the client is saying, and how the client interprets the situation. Therefore, the map represents not only

analysis can indicate the relative importance of various concepts. The potency analysis is also particularly useful for identifying and considering the effectiveness of different options.

*"In order to tidy the model, analysis is carried out. And analysis leads frequently to (re)building."*  
*[Cropper et al (1990)]*

Using these analyses, the consultant grapples with the problem formulation in an attempt to better understand the issue at hand and adds their own flavour to the map, dependent on how they interpret what the client has said in the interview. The consultant, like their client, might place more emphasis on certain issues than on others, or even ignore or neglect to enter some things raised by their client in the interview. So, each individual's cognitive map captures a combined view of the problem - as the interviewer and interviewee together see it. Hence, the need for a second interview with each team member. In this follow-up interview, the COPE map is presented back to the client, to check that the consultant correctly understood and represented the problem as the individual participant sees it i.e. that the map truly reflects his/her perspective. Misunderstandings can be cleared up during the interview as the client views the map and gives further explanatory input where necessary. This is likely to encourage the client to 'buy in' to the process, taking ownership of the map, which further encourages a "warmer, more trusting consultant-client relationship." [Eden (1989) p.31]. Ownership of the map is further encouraged by not abbreviating, but rather using the actual words and phrases of the client in the map [Ackermann et al (1990)].

The second interview also provides the opportunity for expanding on certain issues which were raised in the first interview, or inserting important concepts or links which were omitted in the first interview. Once it has been agreed that the map is an adequate model of how the individual client perceives the decision environment, the consultant can adopt a more proactive, less empathetic approach to decision support. This is done by working with the client on analysing the goal system, and then working down the map towards the options, or alternatively, starting with the options and moving up towards the goals [Eden (1989)].

### 5.5.3. Merging individual maps

Once the round one and two interviews have been conducted, the facilitator goes about merging each of the individual maps into a combined 'strategic' map [Eden (1989)]. Portions of individual maps are combined, by merging common or similar concepts, and inserting

links between concepts in different maps. Merging different individuals' concepts in this way assumes that the different people mean the same thing with the similar words used. In inserting links in the merged map to show relationships between concepts in different individuals' maps, the facilitator exhausts all possibilities [Eden et al (1983)]. In this way, there is a degree of tampering with the individual maps; however, this usually makes the strategic map more interesting for the team members to work on and negotiate in the SODA workshop [Eden et al (1983)]. Team members get to see how others' views and concepts relate to their own, and become more engaged in working on the strategic map. There is however the following caveat on merging maps: the consultant needs to exercise great care in merging concepts and inserting links, and should, in the workshop, confirm with his/her clients that the concepts merged really mean the same thing [Eden et al (1983)].

The initial purpose of the merged map is to encourage team members to change their minds about the way they see the situation, by considering others' views in conjunction with their own. As was stated in the previous chapter, decision makers spend much of their time thinking about what makes those around them tick, and much of their hypothesising about their world is concerned with "the other human beings that make up that world" [Eden et al (1983) p.3]. SODA takes advantage of this, and encourages participants to shift towards a group perspective of the problem, without feeling compromised [Eden (1989) p.33].

The merged map usually consists of many hundreds of concepts. Therefore, it is imperative that the consultant has the necessary tools to handle the richness and complexity in the merged map. The COPE software effectively stores the vast number of concepts and inter-relationships, and enables the consultant to perform several analyses on the information. Some of the most useful of these analyses are cluster and potency analysis, which enables the identification of 'emerging themes' and 'key concepts' [Eden (1989) p.37], and the clustering of concepts in the strategic map into separate sub-maps relating to each particular topic or issue.

#### 5.5.4. The SODA Workshop

Eden (1989) [p.36] notes that the SODA workshop, rather than the cognitive mapping technique, is the most important element of the SODA methodology. As he points out,

“SODA is the *approach* of working with clients, out of which has grown the particular *technique* of cognitive mapping.” [Eden (1989) p.26].

The workshop is normally held away from the office or usual meeting place of the group [Eden (1990d)], with the helper in the chair, as opposed to the team leader [Eden et al (1983), Ackermann (1990)]. The facilitator provides unbiased and objective chairmanship, and can allocate sufficient air-time to each participant’s concerns in an equitable manner. This is achieved by simply going through and discussing the merged map. Each team member has already had ample opportunity to air their views and concerns in the preliminary interviews, and their concerns are represented in the cognitive maps. When working with ‘inclusive’ groups, this leads to a greater feeling of fairness and democracy in the decision making process.

The clusters in the strategic map represent the main areas of concern, as seen by all participants, and provide the agenda for the workshop. The workshop starts by giving an overview of the model, indicating the key issues (clusters) involved, and highlighting the inter-relationships between them [Eden et al (1983)] without going into too much detail. Key goals, strategies and options are high-lighted. From this initial overview of the problem, each cluster is explored in turn. The agenda should allow a ‘cyclical process’ [Eden (1989)], allowing participants to cycle through the map several times if necessary, modifying and elaborating on the model as discussion and negotiation progress. The COPE software is extremely useful in this regard, allowing the map to be expanded during the workshop.

Whilst considering each cluster, team members can see how other participants’ concepts link into their own. Each concept derives meaning from it’s opposite pole, and from the other concepts linked to it (explanations or consequences). In this way, the meaning of a particular participant’s concepts might change when viewed alongside the concepts of others. It is therefore important to cycle through the map several times, so that participants can absorb the change in meaning implied by the new context, within other’s concepts [Eden (1989)]. The strategic map is anonymous; any particular participant does not know which concepts belong to whom, besides their own. This provides a stable political environment for considering the bigger picture, where each concept has equal weight, regardless of how junior or senior the contributor is. This process further reduces the potential for domination of the meeting by one or two of the more vociferous or senior members, and ideas can be

considered on their own merit, without regard to who raised them. In this way, SODA allows each participant to be heard, and ensures that their ideas are fairly considered and negotiated by the group. As a result, each participant can buy in to the process in the knowledge that they will have a fair say in the process. This is a critical step towards a negotiated construction of the problem.

### 5.5.5. Representation of the problem

Several researchers [e.g. Keller & Ho (1989) p.717, Smith (1989)] stress that an individual's cognitive representation of the problem determines the way in which they will go about solving it, and furthermore, that this internal representation of the problem has a major impact on judgement and choice. Volkema (1983) also emphasises the strong relationship between the representation of a problem, and the "domain of solutions and ideas that the representation can produce".

As was stated above, SODA, in representing (or modelling) the problem, employs most of the techniques for conceptualising problems listed by Smith (1989). We look at each in turn:

#### *Gap specification and Goal State specification*

In the cognitive mapping process, SODA encourages creativity in two ways: firstly, by specifying the concepts in the imperative form, including actions and actors [Ackermann et al (1990)]. In this way the model calls for a proactive approach to the problem. Secondly, creativity is fostered through consideration of the opposite pole of concepts - the consultant should constantly encourage their client to think of each concept as being bi-polar, and at times exert pressure on him/her to come up with a satisfactory alternative [Eden et al (1983)]. This satisfactory alternative might provide the remedy for dealing with the particular issue. This, in effect, is *gap specification*; considering the current predicament, which is the 'initial state', and specifying the goal state (satisfactory alternative) for the particular concept. So, in Figure 5.1., and concept no. 1, the initial state was "too much extraction", for which the goal state "a limited number of industrial users" was specified.

*Knowledge specification, Difficulties and constraints*

*“The system of beliefs, captured by a cognitive map, gives an indication of why the situation is problematic. The mapping process helps identify the sense of direction (‘goals’), or disappointment about current direction (‘not goals’)” [Eden (1991)]*

The SODA process starts out by focusing on *knowledge specification*. This is achieved by individually interviewing each person who can potentially contribute to the body of knowledge relating to the problem. Each client’s understanding of the problem is usually limited and their thoughts disjoint, and the cognitive map effectively structures the facts and beliefs about the problem as they are raised, into a useful and accessible information system (EIS) [Eden & Ackermann (1992)]. The consultant commences the first interview by asking the client what the main problem issues are, so encouraging him/her to specify *difficulties and constraints*. As the interview progresses, and the map is elaborated, difficulties and constraints in related areas also arise and are entered as concepts.

*Causal diagnosis, Means and strategies, Ultimate values and preferences*

After the initial concept has been noted, the consultant and client together *diagnose causal relationships*, and causes of the problem, by specifying concepts which lead into (explain), and out from (a consequence of), a particular concept. In addition, the consultant continually builds the hierarchy, looking out for concepts which are potential goals, *strategies* or options [Ackermann et al (1990)]. *Ultimate values and objectives* are identified by repeatedly asking whether a concept is an ultimate end in itself (‘like motherhood or apple-pie’), or whether it is merely a *means* to some higher objective i.e. adopting the divergent approach to problem structuring.

*Different perspectives*

Finally, the SODA workshop brings together many *perspectives* of the problem for discussion and negotiation. Smith (1989) notes further that different problem definitions can arise due to linguistic variations i.e. different meanings ascribed to words or phrases. SODA tackles this problem by using negative poles, and the context of a concept in the map to clarify the precise meaning of the concepts used by participants.

Von Winterfeldt & Edwards (1986) suggest that, although it is not always practical, the decision analyst should consider as many different problem definitions as is possible, before concentrating on one in particular. SODA, by concentrating on each individual participant's definition of the problem, essentially have as many definitions of the problem as participants, which are then merged into one [Bennett (1990)].

### 5.5.6. Cognitive Mapping and Personal Construct Theory

*"How can we achieve teamwork in an activity as individual as thinking?" [Kepner & Tregoe (1981) p.27]*

The consultant's basic aim when working with a group is usually to guide the group to decisions with which all members of the group are equally happy and committed [Friend (1990)]. Massey & Wallace (1996) further stress that GDSS designers need to bear in mind that GDSSs should enable and assist participants to:

1. formulate, structure and view the decision situation in a way which corresponds to, and supports, their cognitive processes, and
2. communicate and work effectively together in a group situation.

The cognitive mapping technique and the overall SODA process, founded upon the broader philosophical framework of PCT for consideration of individuals' (and group / social cognition) attempt to do just that. Kelly, although interested in psychotherapy, "sought to make his psychology comprehensive enough to serve the purposes of those with very different issues in mind" [Bannister & Fransella (1986)]. The rest of this section takes a closer look at how the cognitive mapping technique, developed for SODA, derives its roots from PCT.

Eden initially attempted to use repertory grids (the technique developed by Kelly) for structuring OR problems. He found that, in the OR context, the repertory grids did not reflect Kelly's theory closely enough - and so developed further the cognitive mapping technique [Eden (1988)].

The individual map uses the actual phrases and vocabulary of the client, and as such, is an articulation of the clients internal representation (or construction) of the problem. This is consistent with PCT's **individuality corollary**, which states that: "*persons differ from each other in their construction of events*".

Each concept derives further meaning from an opposite pole (**dichotomy corollary**), and the surrounding concepts in the map. In this way, the map is built using the client's own personal constructs and attempts to represent areas of the client's internal cognitive network.

Each individual map is constructed hierarchically. Goals are at the highest, most superordinate level, with key issues (or strategies) leading into them, and options at the lowest, most subordinate level in the map. This reflects the **organisation corollary** of PCT. This corollary recognises that a person's constructs are linked by ordinal relationships - hence the name personal construct *system*. As already discussed in Chapter 5, the mind operates by the principle of cognitive economy, clustering related constructs into sub-groups of related concepts. The pyramidal and "hierarchy quality of construct systems is what makes our world a manageable place for us." [Bannister & Fransella (1986) p.11] Eden (1988) points out that the hierarchical nature of cognitive mapping reflects his aim to provide structure and model information in a way which is useful in OR projects.

The **sociality corollary** states : "*To the extent that one person construes the construction processes of another, they may play a role in a social process involving the other person.*"

The merged map provides people with a means for seeing others' constructions of the problem situation, and how the others' constructions relate to their own. Their own constructs are set within the broader context of concepts purported by all other participants. In the team map, their own concepts derive new meaning from others' concepts, leading into (explaining) or from (consequences) their own. The team map does not belong to any individual, but rather facilitates a process of negotiation towards a team 'reconstruction' of the problem at hand [Eden (1988)]. After this negotiation process, the map reflects a common, shared perspective of the problem, enabling the team to proceed with a common understanding of the situation (**commonality corollary**).

## 5.6. Problem Structuring and Group Decision Support Methods : What should they attempt to do?

In summary, the following list gives some of the essential requirements for group problem structuring approaches in the field of management science. They should:

1. Clarify, and help decision makers to make more sense of the situation when they don't know what the problem really is.
2. Encourage strategic thought, rather than just providing some routine analysis.
3. Help decision makers to talk openly about their problems.
4. Clearly represent the cognitive processes of decision makers.
5. By so doing, facilitate effective communication of those thoughts within the group.
6. Understand and take account of the political and social dynamics in the situation e.g. prevent domination of the process by one or two participants.
7. Provide as much information as possible; including information on peoples' values, objectives, perspectives & preferences.
8. Inspire creativity and innovation.
9. Counter or correct for biases resulting from judgement heuristics.
10. Consider all parties' perspectives in order to obtain a richer problem formulation.
11. Expand each decision makers' perspective by considering other perspectives, and by so doing, facilitating a learning process.
12. Provide the consultant with a tool which allows him/her to manage the group process, as well as managing the problem content. In other words, to provide a framework which enables them to effectively combine the skills of the behavioural scientist with those of the management scientist.
13. Effectively bring all parties into the process.
14. Consider the client's role and motivations.
15. Be compatible with both the consultants and client's personality and style.

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## **PART III : Fieldwork**

University of Cape Town

## Chapter 6

# Our intervention with key decision makers in the west coast rock lobster fishery : SODA interviews & workshop

### 6.1. Getting Started...

At the outset of the research, we approached the chairman of the working group (WCRLWG<sup>1</sup>) whose task it is to give scientific recommendations for management decisions at the Sea Fisheries Research Institute (SFRI). We expressed our desire to employ various group facilitation and problem structuring methods in an intervention to assist them in their development of an Operational Management Procedure (OMP<sup>2</sup>) for the West Coast Rock Lobster Fishery. The development of an OMP had already been on the WCRLWG's agenda for some time, and the computer models used for estimating resource biomass, and which had provided the scientific basis for previous TAC decisions, were to be used as the basis for the OMP. The basic aim of the OMP is to automate the annual process of determining scientific recommendations (in the form of total allowable catches (TAC's)). The OMP is also a mechanism by which a systematic and long-term stock rebuilding strategy can be engendered. However, discussion on what the OMP would entail, how it would be implemented, and who would be involved in developing an OMP was however in the very

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<sup>1</sup> West Coast Rock Lobster Working Group

<sup>2</sup> An OMP is defined in the government white paper 'A Marine Fisheries Policy for South Africa' as: *a scientifically evaluated process which defines the manner in which the available data on a resource are used to determine the level of a control measure such as a TAC (i.e. the total allowable catch for a given fishing season), thereby incorporating a harvesting strategy.*

early stages. As shall be seen later, several stakeholder groups opposed the idea of the OMP as it was eventually proposed.

We pointed out that the aims of our intervention would be:

- to identify the various stakeholder groups involved, as well as individual representatives for each interest group,
- to interview each representative in order to explore problems concerning them, and identify their perceived objectives for managing the fishery,
- by so doing, to consider the broader picture of stakeholder goals, which may not be included in the technical models which had provided the scientific basis for previous years' decisions,
- to model and analyse the qualitative information obtained in the interviews - to assist with decisions relating to the development of the OMP,
- to hold a one-day workshop with all role-players around the table together, where structuring aids would be used to facilitate communication. It was also mentioned that the workshop would provide us with the opportunity to experiment with various group decision support techniques.

We emphasized that our role would be that of *impartial* and *independent* facilitators in group discussions and analysis. In this preliminary meeting at the SFRI, we went on to identify the following groups and/or representatives (fictitious names have been used to retain anonymity):

Bill (state department),

Bob (state department),

Sam (academic scientist),

Jerry (academic scientist),

Fred (independent scientific consultant),

Frank (independent scientific consultant),

John (industry representative),

Mike (member of the Sea Fisheries Advisory Committee (SFAC)),

Phil (labour representative),

Harry (labour representative).

## 6.2. SODA Interviews & Analysis of maps

In the ensuing few months, each participant was interviewed individually, and a cognitive map drawn during each interview. The cognitive mapping technique was used firstly to guide the questioning and discussion process, and secondly to record the content of the discussion in order to structure the problem. At the start of each interview, participants were asked to specify what they felt were the major problems facing the WCRL management team at that particular time. This particularly broad and divergent approach of questioning was adopted at the outset to encourage individuals to talk about the problem as they saw it. A sample map, as it was taken down in the interview is given in Figure 6.1. overleaf. As Eden & Simpson (1989) point out, the map immediately after the interview is not normally neat, complete or easily legible to anyone other than the interviewer.

After each interview, the recorded information was entered into the COPE software. The notes taken in the interview helped to prompt the interviewer's memory in building the COPE model [Eden & Simpson (1989)]. Once the concepts and arrows had been entered, the maps were analysed and manipulated - i.e. the so-called back-room work. Considerable time was spent considering the links between concepts and how one concept influenced another - inserting new links where necessary. This led to a much deeper understanding of the problem [Belton et al (1997)] - particularly on our part, as consultants. Cluster analysis proved particularly useful for clustering the problem into smaller, easier-to-handle sub-groups of well-linked concepts [Eden (1987)].

### 6.2.1. Follow-up interviews

After analysing each map, inserting links and re-organizing concepts, a follow-up interview was arranged with each participant in turn. In the follow-up interviews, their individual maps were fed back and explored with them, and updated on-the-spot where necessary. These updated individual maps can be found in Appendix A. The key concept (s) in each map have been circled, and serve as a guideline of the general content of each particular cluster map. Objectives are denoted by bold font, and strategies by bold italic.



### 6.2.2. Summary of the various cognitive maps

As might have been expected, different participants displayed different concerns and emphases. What follows is a brief summary of the information included in each participant's cognitive map. Although these summaries are useful for giving a basic overview of the issues, the actual cognitive maps in Appendix A provide a much deeper understanding of the intricacies and complexities of the decision environment.

Bill's map, for example (see Figure 6.2. overleaf), was concerned mainly with the overall fisheries policy, and was closely linked to the guidelines given by the Fisheries Policy Development Committee (1996). He stressed that the management strategies adopted by the SFRI needed to be consistent with the new fisheries policy which was being developed, and highlighted the following key objectives:

1. Transparency and accountability in decision-making,
2. Participation of all role-players in the decision making process,
3. Long-term sustainable use of the resource (as opposed to short-term social upliftment),
4. Development of new markets,
5. Increased job creation and employment opportunities,
6. Fair and equitable access,
7. Management decisions based on the best available knowledge, with a multi-disciplinary approach to decision-making.

As can be seen in Figure 6.2, each of these key areas or clusters is explored, and his ideas on each topic mapped out. Various possible clusterings of the concepts were identified and considered using the COPE software's 'cluster analysis'. The hierarchical clustering analysis (or 'HISSET' analysis) proved particularly useful in this case for identifying clusters. HISSET analysis essentially considers the hierarchical nature of the map, and presumes that each goal has a particular strategy for achieving it [Eden (1987)]. Lines have been drawn in in Figure 6.2 to show these different clusters.

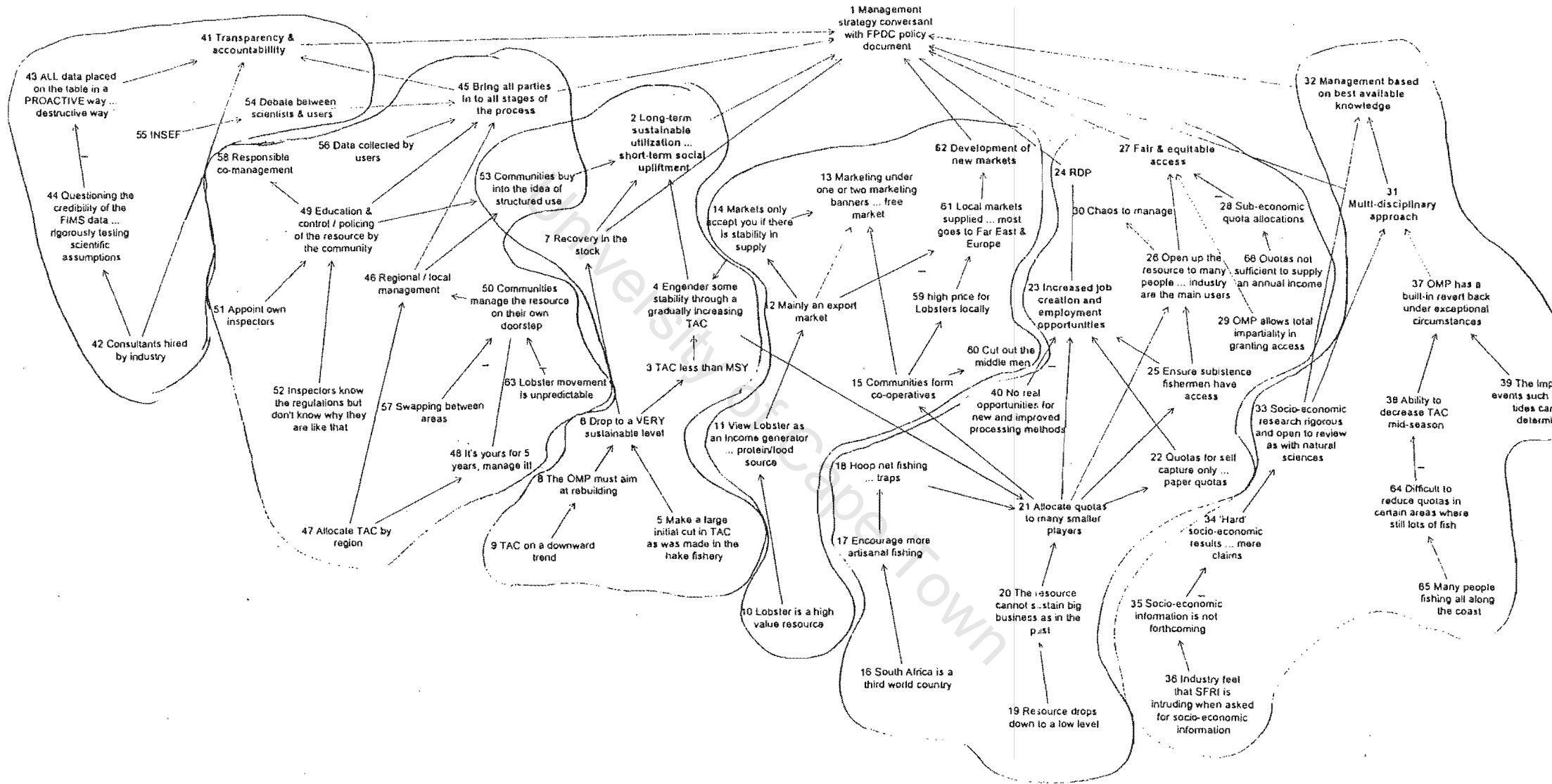


Figure 6.2: The COPE model constructed from the initial and follow-up interviews with Bill

Sam, on the other hand, was concerned mainly with the problem of policing and access rights (cf. Appendix A p. 186). Several interesting options were identified as potential solutions for dealing with access rights issues, policing/poaching, and the development of new markets (see pp. 186 to 191 (maps 1 & 2)). Bob's map centred around the conservation and scientifically sound management of the fish stock, as well as co-management as a means to reducing poaching and increasing transparency. He spent some time thinking about different ways of including all the stakeholders in the development of the OMP and also considered how socio-economic factors could be factored into the OMP (pp. 200 to 202).

John focused on the economics of the fishery and the fishing community's perceptions of the state of the resource (maps 1 & 3 (pp. 196 & 198)). He also expressed particular concern about the vast differences in perceptions as to the state of the fishery and the resource, held by the SFRI and the fishing industry (map 3 p. 198). From the interview and cognitive mapping process with him, it was clear that the fishing industry was hesitant to accept the idea of an OMP because of the multitude of qualitative factors which, until then, had not been openly considered in the OMP debate (maps 1 & 2 (pp. 196 & 197)). For example, although most (if not all) of the participants agreed that a stock rebuilding policy should be adopted, the question was to what level stocks should be rebuilt, and at what rate. Because of the political climate at that time, industry players felt they had no guarantee of their future viability or stability, and were not willing to support any major long-term rebuilding policy until such time as the allocation question had been properly addressed and finalised (map 4 p.199).

John also expressed concerns that the quantitative data used in the models was, on its own, insufficient for guiding decision-making, due to the high uncertainties in model estimates caused by large-scale poaching and recreational fishing (map 1). He further argued that environmental, marketing and other operational factors have a huge impact on catch-per-unit-effort (CPUE) figures, which are fundamental in determining biomass estimates. He pointed out for example, that fishing fleets are often forced to fish at particular times of the year and in poor weather conditions in order to meet consumer demand in different parts of the world, such as Japan (map 1). This, in turn, leads to significantly lower CPUE's than if fishing for quota had taken place in good weather. To bring his point across, he explained that, by altering their fishing strategy and fishing further afield, the fishing industry could obtain better CPUE results. Although this would raise fuel and other fishing costs, it could be

used to manipulate the CPUE figures for more favourable TAC decisions in future years. Hence, he and other industry players were not happy with the idea of a rigid OMP which would determine their future TAC's for the next 5 years, based purely on these quantitative indices and models. Many other issues were raised by John and can be seen in Appendix A (pp. 196 to 199).

Jerry placed most emphasis on modelling in decision making (map 1), and policies for rebuilding the fish stock (map 2 p. 204). Fred, on the other hand, focused attention on economic issues, and the need to balance the rebuilding of fish stocks with rebuilding the fishing industry, in view of the sharp declines in total allowable catch (TAC) in previous years (map 1 p. 192). Harry, representing the informal fishermen, highlighted the political pressures influencing fisheries policy decisions. He stressed that many communities had suffered discrimination under previous apartheid policies, and that these imbalances should be rectified in South Africa's new fisheries policy (p. 206).

It was our finding that the SODA interviews were enjoyed by most participants. Positive feed-back was received from several people. One stated that he had enjoyed the exercise, and that the cognitive map which resulted from the interview with him helped to crystalize his own thoughts about the problem situation (Sam). Another also mentioned that he had enjoyed the interview and cognitive mapping exercise (Bill). On running through yet another participant's map with him in order to clear up any misunderstandings, he commented on how much complexity was captured within the cognitive map, and that it was "scary to see how his mind worked" (Fred). In this way, we found the SODA interviews very effective for developing the client-consultant relationship. In fact, so much so, that some role-players even started to confide in us; more than one person commented 'off-the-record' about their feelings of how decisions were made, and the political complexities and wranglings involved in the decision process. This client-consultant relationship was further strengthened through us sitting in on all the west coast rock lobster working group (WCRLWG) meetings as observers.

### **6.3. Merging maps and preparing for the workshop**

Once all the interviews had been completed, and the individual maps updated, it was time to merge all the individual maps into a strategy/group map. This was no simple task; the COPE

software proved invaluable for analysing, organising and merging the  $\pm 700$  concepts drawn from the individual maps. The various analyses available in COPE (discussed earlier in Chapter 5) proved even more invaluable when working with a map of this magnitude. As Eden et al (1983) point out, there is “so much content”, “so many new ideas” and inter-relationships between issues which emerge, that it is easy for the participants, as well as the helper, to be swamped by all the information. Hence, the need for clear analysis of the data. In this regard, the clusters which had been identified earlier for each individual map facilitated a much easier transition from the individual maps to the merged map. COPE is also extremely useful for detecting vicious loops, for example, which can be difficult to detect when such a loop consists of numerous inter-related concepts. It is also important that the helper present the COPE model in a dynamic and stimulating way in the workshop, to further prevent their client being swamped by the content.

A fair amount of overlap existed in different individual maps, and the following general clusters were formed in the strategic map:

1. Choosing between a simple OMP and an annual review process for determining TAC?
2. Including qualitative factors in decision-making
3. Determining a robust indicator of resource status
4. Rebuilding the industry
5. Rebuilding the resource
6. Employing a multi-disciplinary approach to decision-making
7. Measures for more effective policing and control of the fishery
8. Co-management schemes<sup>1</sup>
9. Developing new markets
10. Providing fair and equitable access rights
11. Ensuring transparency and accountability in management

These cluster maps can be seen in Appendix B. It was found, in analysing and clustering the concepts in the strategic map, that the various clusters were very inter-related. This suggested that each problem issue (i.e. cluster) should not be considered in isolation of the others. For example, *stock rebuilding* (no. 5 above) is a key component of the proposed *OMP* (no. 1),

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<sup>1</sup> Co-management is an arrangement whereby the fishing industry/community play some role in managing, or contributing to the management of the fishery together with the regulatory authorities (in this case SF). Co-management schemes can take many shapes or forms.

and one of the major reasons for having an OMP i.e. to facilitate a systematic, long-term stock rebuilding program. Stock rebuilding strategies however, cannot be considered without also considering the political pressures to give broader *access rights* (no. 10 above), the economic situation and need to *rebuild the industry* (no. 4) in addition to the state of the fish stocks, or in light of the problems of poaching and ineffective *policing* (no. 7 above). Furthermore, the effectiveness of policing in keeping down the level of poaching (possibly through *co-management* schemes (no. 8)) has a fundamental impact on the uncertainty of biomass estimates (no. 3), and the overall precision of the OMP and TAC decisions (no. 1). In addition, it is impossible to consider possible co-management schemes (no. 8) for reducing poaching (no.7), without first considering possible outcomes of the access rights decision (no. 10)(to be made ultimately by the Minister of Environmental Affairs). These are but some of the many inter-relating and complex issues facing our client group.

This strategic map formed the basis for drawing up an agenda for the workshop, and a date was set for the meeting.

## 6.4. The Workshop

The workshop was held at the University of Cape Town, being neutral ground, away from the usual meeting place of the WCRLWG and SFAC. As Eden (1990d) points out, ‘away days’ are often effective for allowing senior managers to think “in an uncluttered way” about strategic issues or ventures. The workshop was divided into two sessions - a morning and an afternoon session. In the morning, the SODA map was explored, providing the participants the opportunity to view others’ perspectives and negotiate a problem definition. In the afternoon, a brainstorming exercise was held, with the aim of consolidating that which was in the merged map into a value tree and, if time permitted, identifying measurable criteria for each objective in the tree.

### Morning session

After welcoming the participants, an overview map of the merged model was presented and cycled through [Eden (1989)] (see Figure 6.3. below). This overview map was created by collapsing the group map onto the selected concepts in COPE.



Although the focus of the workshop was on the issue of the OMP (concept no.135), it is apparent from Figure 6.3. that many of the other issues have an important and direct bearing on the OMP. At the very least, these other factors should be recognised as important in considering the operational management procedure (OMP).

Due to time constraints, we were forced to concentrate on the first two cluster maps (on the OMP, and inclusion of qualitative factors) which were particularly relevant at the time, and to ignore (or briefly pass-over) a large quantity of the other information contained in the group map. Debate initially centered on how qualitative factors could be included in the OMP, with particular reference made to the proposed computer simulation program which would facilitate industry's participation in decision making. In this way, the industry could be involved in trade-off decisions between long-term risk, catch rates and variability in annual TAC. Attention soon focused on the lack of clear political direction with respect to future access rights, and it's implications for the OMP debate. As discussion continued, several participants questioned the purpose, benefits and short-comings of the OMP as it was proposed.

It was stated, for example, that due to the variability in abundance indices, changes in the state of the resource can only be detected meaningfully over a longer period. As such, an OMP is a sensible method of managing the resource for periods of 3 or 5 years into the future. On the other hand however, the proposed OMP was largely numerical; several players suggested that due to the complexities inherent in rock lobster management, a purely mathematical approach was inappropriate, and that continuous scientific debate and deliberation (i.e. on an annual basis) should be strived for, whereby more qualitative factors could also be taken into account. These qualitative factors might include operational, economic or socio-economic issues.

The hierarchical nature of the map helped participants to think in a structured way; goals, strategies and options were easily identifiable due to the different colours and fonts used in the COPE model.

The strategic map incorporated a vast array of different perspectives and information. On the whole, we found that there was broad consensus on many issues. However, beneath the surface of the OMP debate, major differences of opinion existed on important issues which

related to the OMP question; these differences appeared irreconcilable. For example, one participant felt that because the resource is declining and under pressure, the resource will not be able to sustain the large fishing industry in future. He suggested that more artisanal methods of fishing be promoted, and that newcomers be allowed into the fishery which, in his view, would enable a more equitable allocation of quotas and address past injustices [see the map on access rights in Appendix B (p. 222)]. This would mean cutting the cake into a larger number of smaller pieces. In this way, the community could then be involved in managing and controlling the resource, and the poaching problem would hopefully be solved [see maps on poaching and co-management (Appendix B - pp. 219 & 220)].

This view, of course, did not wash down well with those already established in the industry; it would mean that their slice of the business would be reduced. After all, many industry participants felt that the quota cake was already too small due, to a declining resource [see the map on rebuilding the industry - p. 216]. Furthermore, industry directors would be quick to point out that many fishermen are employed by the industry, share in profit-sharing schemes, and enjoy stable (in and out of season) jobs. In addition, the existing fishing industry has taken several years to accumulate the capital and expertise, and are more economically efficient than the informal fishermen would be, contributing more to the economy of the country. These issues are all important for the implementation of an OMP, since the OMP is forward looking with a heavy emphasis on stock rebuilding. As could be expected, the existing rock lobster fishing industry found it difficult to make decisions on setting targets for rebuilding without the security of future access rights [see the map on rebuilding the resource - p. 217]. Obviously, trade-offs have to be made on each of the above issues if a compromise and consensus is to be reached between the different interest groups.

SODA proved extremely effective for providing the group with lots of useful information on the different perspectives. As discussed earlier, information is a key requirement for negotiation. This point was highlighted when, even though planning for the OMP had been underway for some time (several years, in fact), different participants appeared to have quite different ideas on exactly what the OMP would entail and how it would be implemented. Several players expressed surprise in the workshop when it was stated that the absolute deadline for implementation was in approximately seven months time. The SODA maps, in addition to providing the information required for a negotiated definition of the problem, also form an executive information system (EIS) [Eden & Ackermann (1992)] and can be referred

to as a record of the decision making process and individuals' thoughts and perspectives of various issues. As such, the SODA model provides a foundation and guide for future decisions.

At the end of the morning session, it was evident that although SODA had helped in understanding the problem, further negotiation was still required for consensus. It was also obvious that there were several conflicting views and objectives, and that trade-offs would have to be made - if not explicitly, then implicitly. Our intention was to use MCDA (in the 'constructivist' sense) to further facilitate the negotiation process [Kersten (1997)]. Furthermore, it was envisaged that thinking about the problem through an MCDA framework would enable participants to think more convergently about the problem, consolidating that which had been covered in the SODA maps. As Smith (1989) points out, "While it's essential that problems be regarded as potentially complex, it's also necessary that this complexity be bounded."

### **The afternoon session**

We started the afternoon session by introducing the VISA software to the participants. A value-tree which had been constructed during a similar intervention with forestry managers was used as an example. The similarities between the WCRL industry and forestry problem were pointed out. It was explained that the aim of the afternoon session was to construct a value tree for the problem of developing an OMP.

Participants were asked to consider what issues or measures were important for comparing future policy plans (or policy scenarios [cf. Stewart & Scott (1995)]), and to enter these issues on "post-its". Once they had individually thought of all the issues which they felt were important for evaluating different policies (particularly with respect to the OMP) and entered them on "post-its", each person was asked to stick their "post-its" onto five large pieces of paper which had been hung on the walls of the conference room. They were asked to group similar ideas closely together on the large sheets.

Key objectives and strategies had already been identified in the SODA maps, but this brainstorming exercise was intended to consolidate and bound the problem for further analysis, after the morning session had taken a more divergent look at the problem

environment. Once all the “post-its” had been arranged and grouped under broad headings (as in the bottom-up approach discussed in Chapter 3), it was time to bring the workshop to a close. The results of the brainstorming session (ideas grouped under broad headings) can be seen in Table 6.1. below. The wording of the various participants has been retained and, as a result, is quite abbreviated at times.

University of Cape Town

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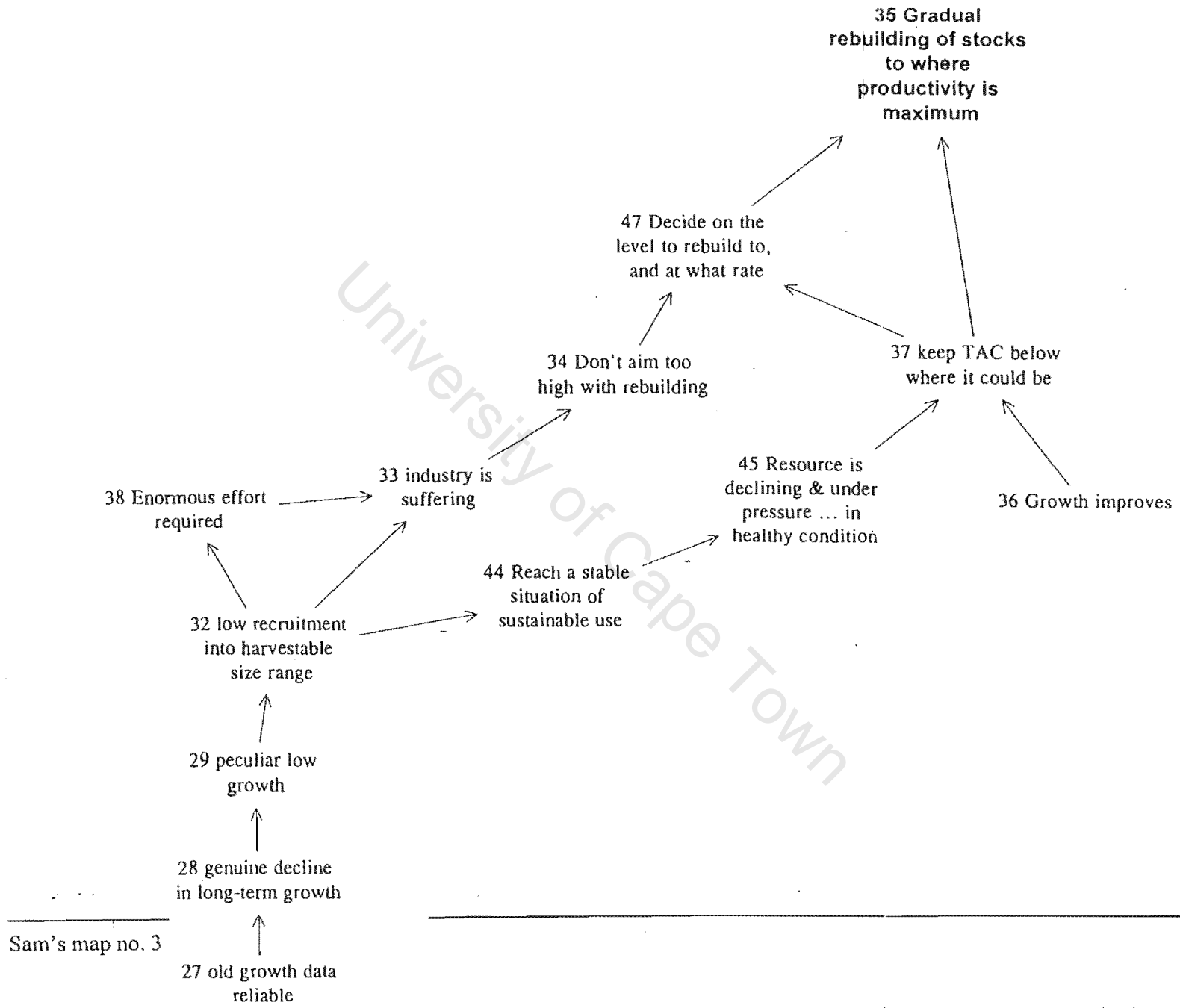
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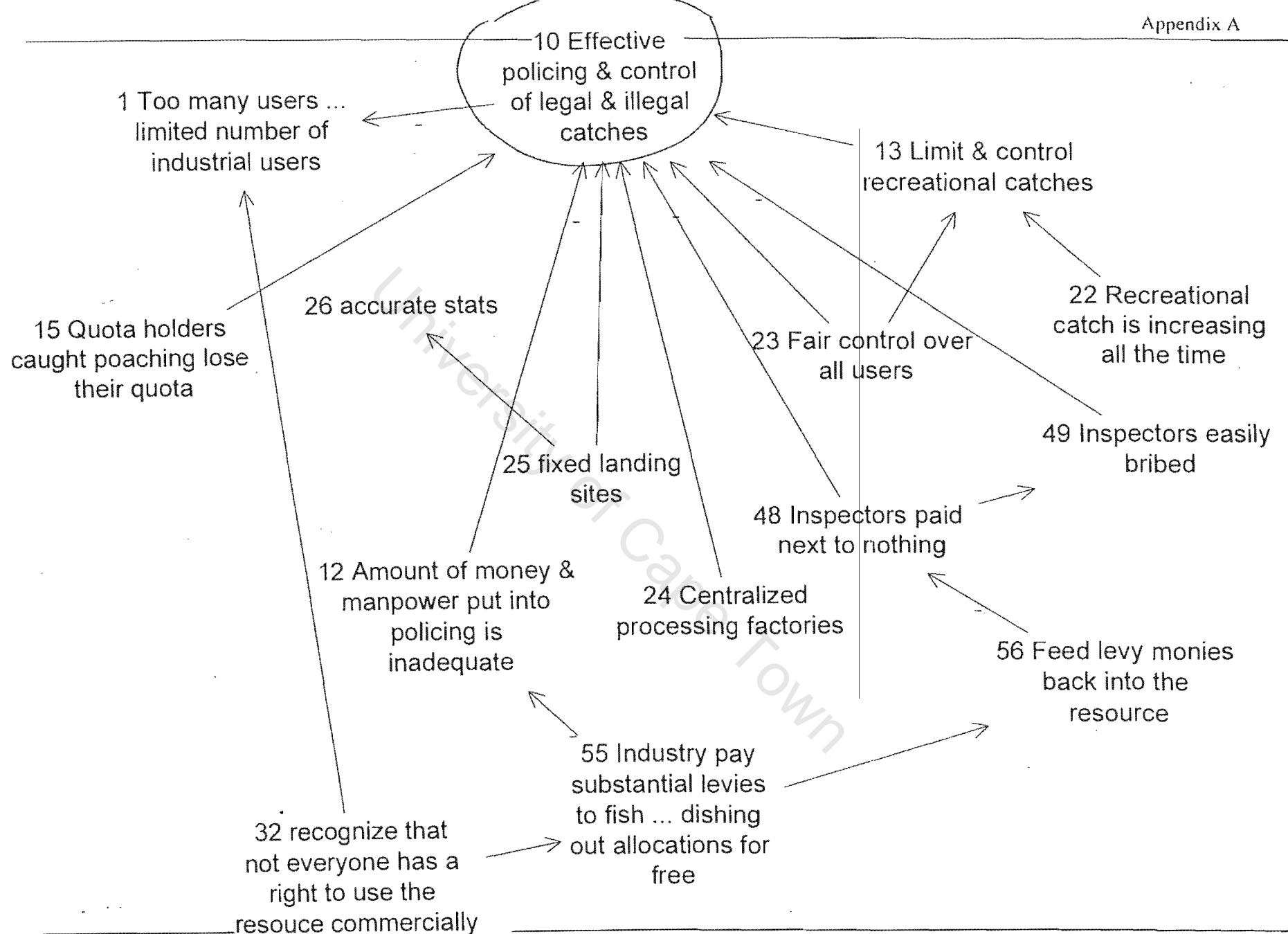
Appendix A: Cognitive maps drawn from  
interviews with each participant

University of Cape Town



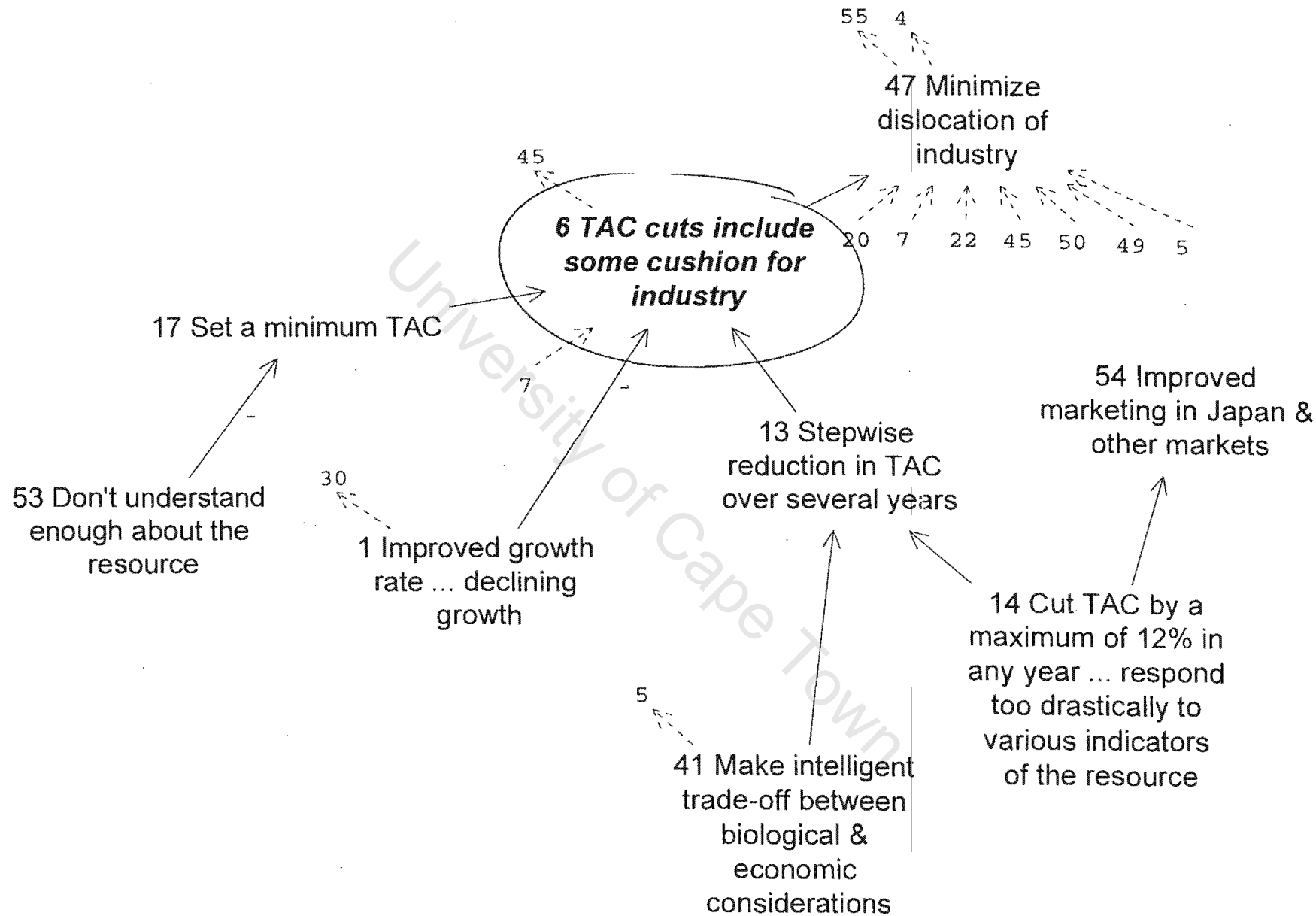












23 Reduce harvesting costs

24 Increased retrenchments

40 Less labour needed

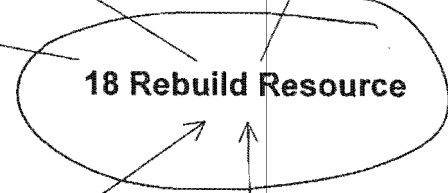
47

22 Prevent another crisis if low future growth rates

25 Higher CPUE

47

20 Less risk of recruitment collapse



35 Reduce uncertainty in model estimates

30 Determine and build up to a specified minimum level of biomass

42 Determine a robust primary indicator of resource status

19 Quantify the benefits of rebuilding the resource

44 Robust to measurement errors, etc

43 Include CPUE & growth data

34 Minimize unquantified risk from unregulated catch

1 Improved growth rate ... declining growth

26 Improve recruitment potential (juvenile settlement) of resource

21 Weigh up the NPV of lower immediate TAC's with increased future Sustainable Yields

38 Reduce illegal fishing

36 Regulate recreational catch

6

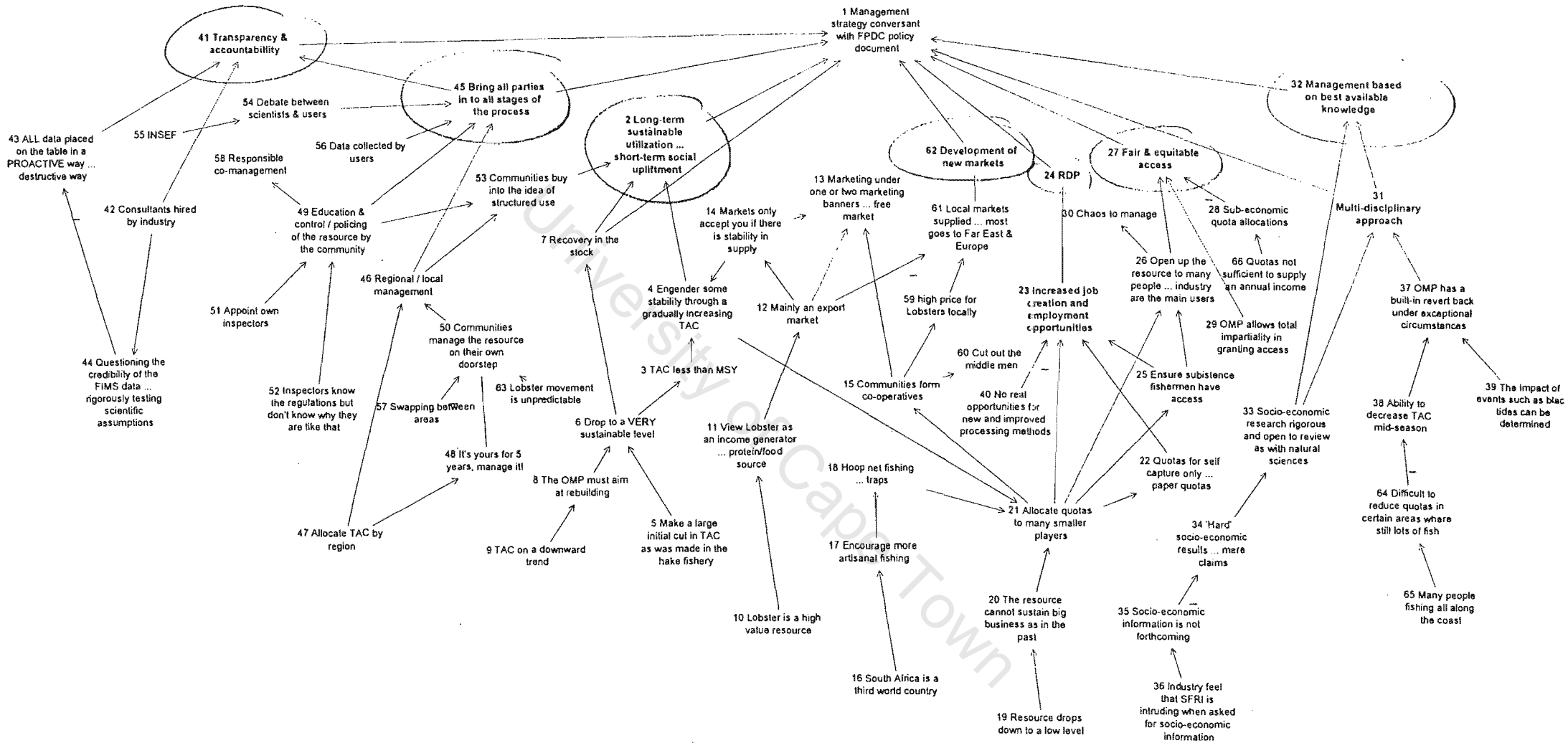
29 Discard damaged females

39 Step up enforcement

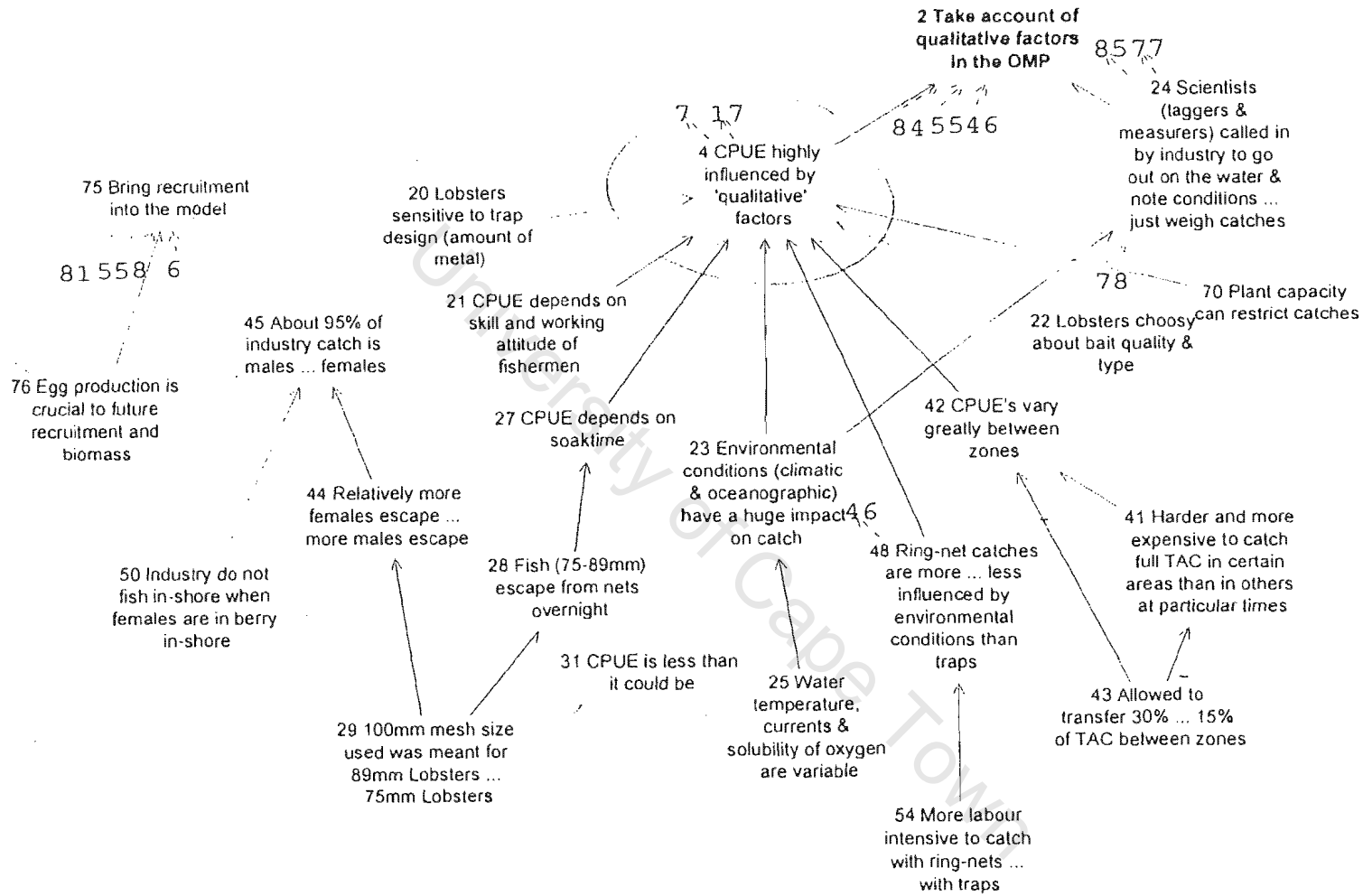
37 TAC for recreational fishery

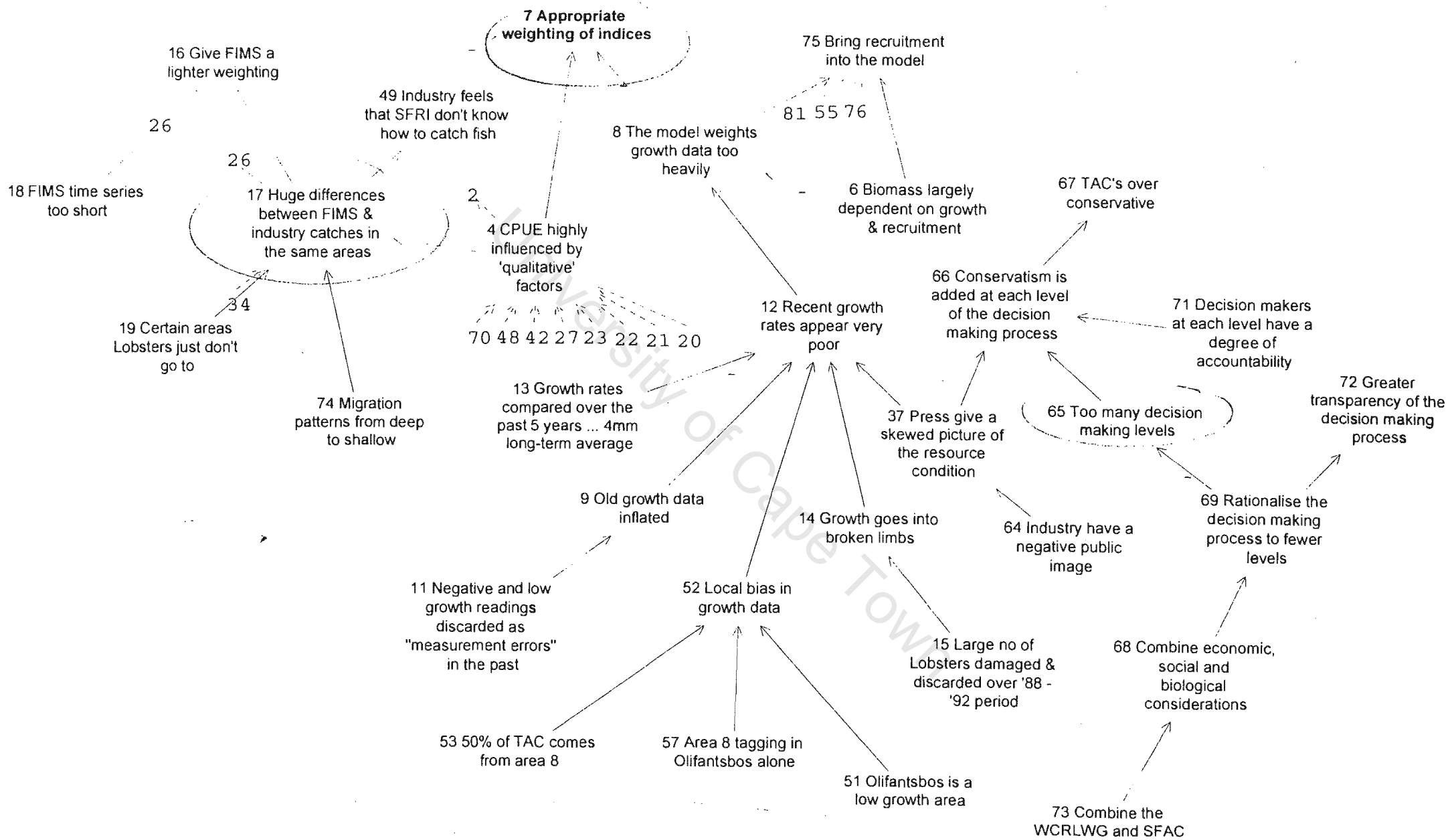
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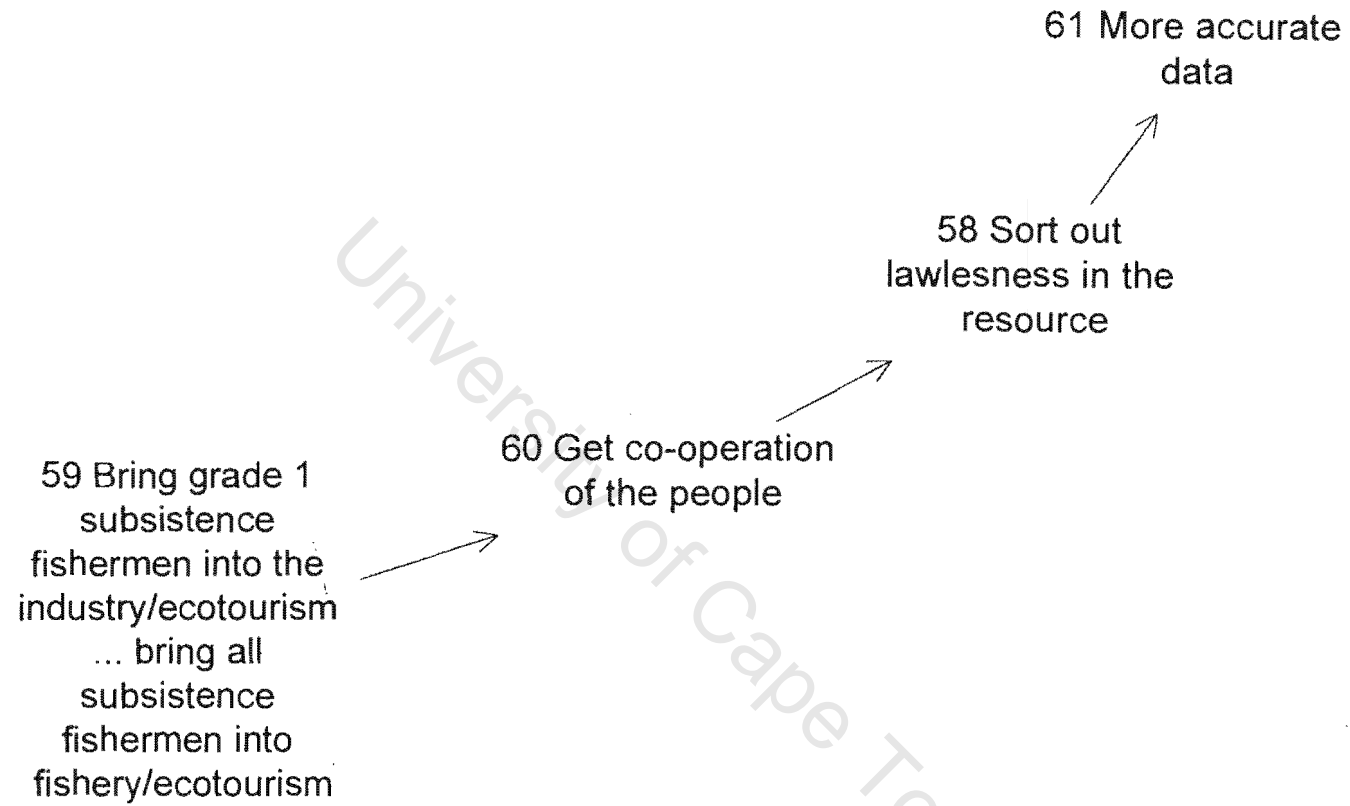
27 Male only fishery

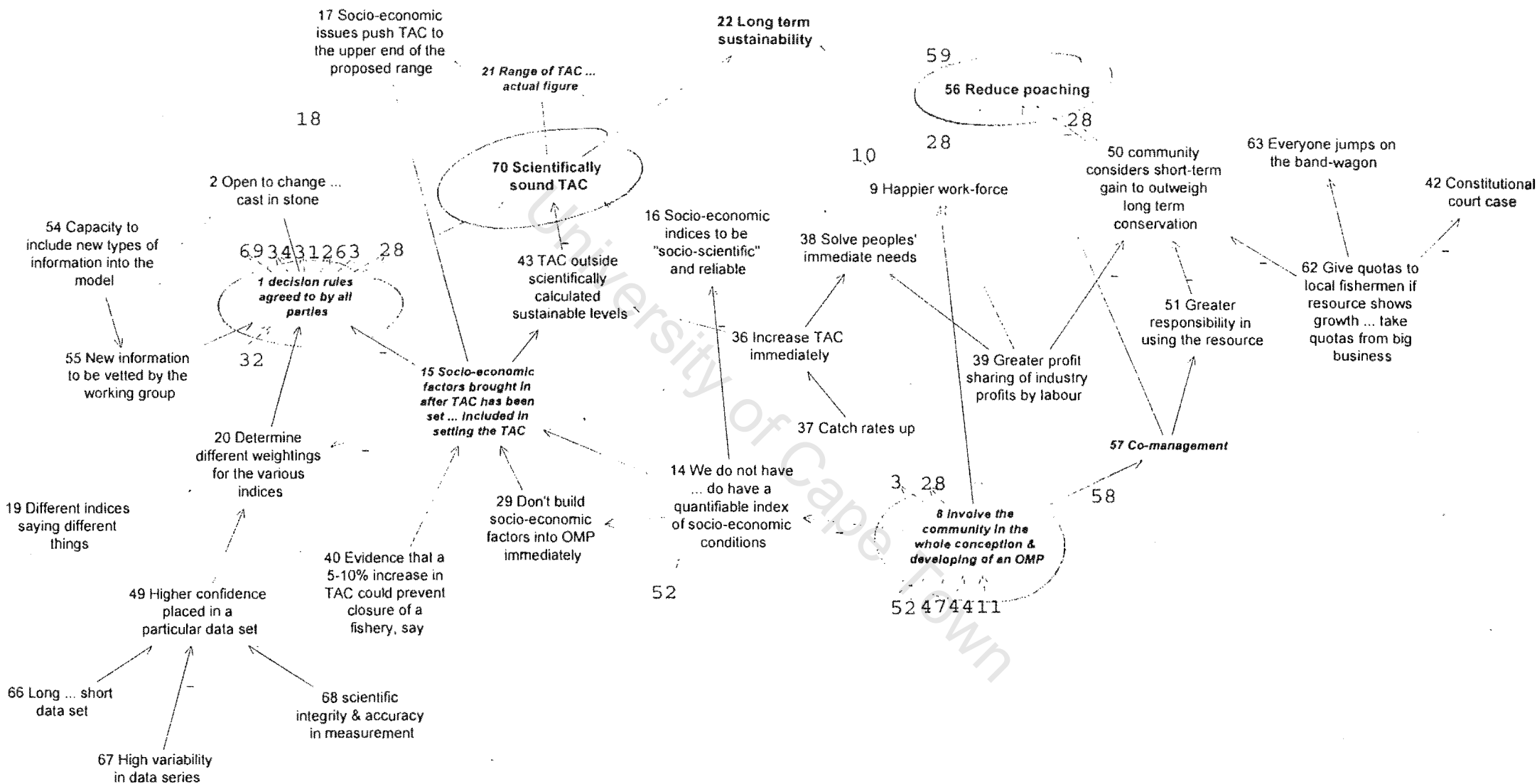














35 Job stability

33 Disruption in industry ... stability in industry

30 TAC not to vascillate greatly

56

28 Everyone buys in to the process

4 Less conflict between parties

31 Some range within which TAC should move

34 Maximum percentage increase & decrease in TAC

11 50 45 8

69 Less room for manouvering around previous agreements

22

70 Scientifically sound TAC

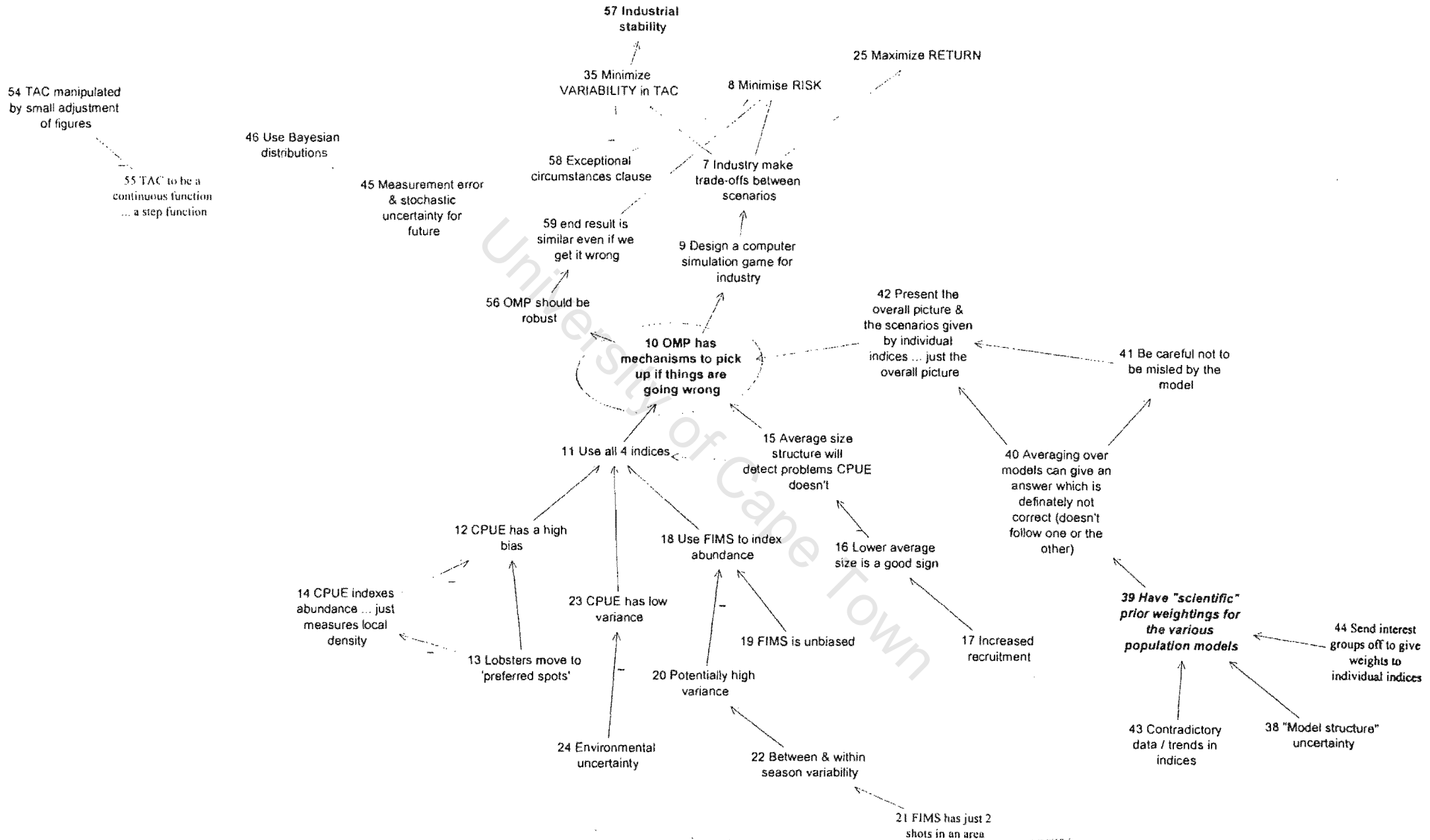
43 16 21

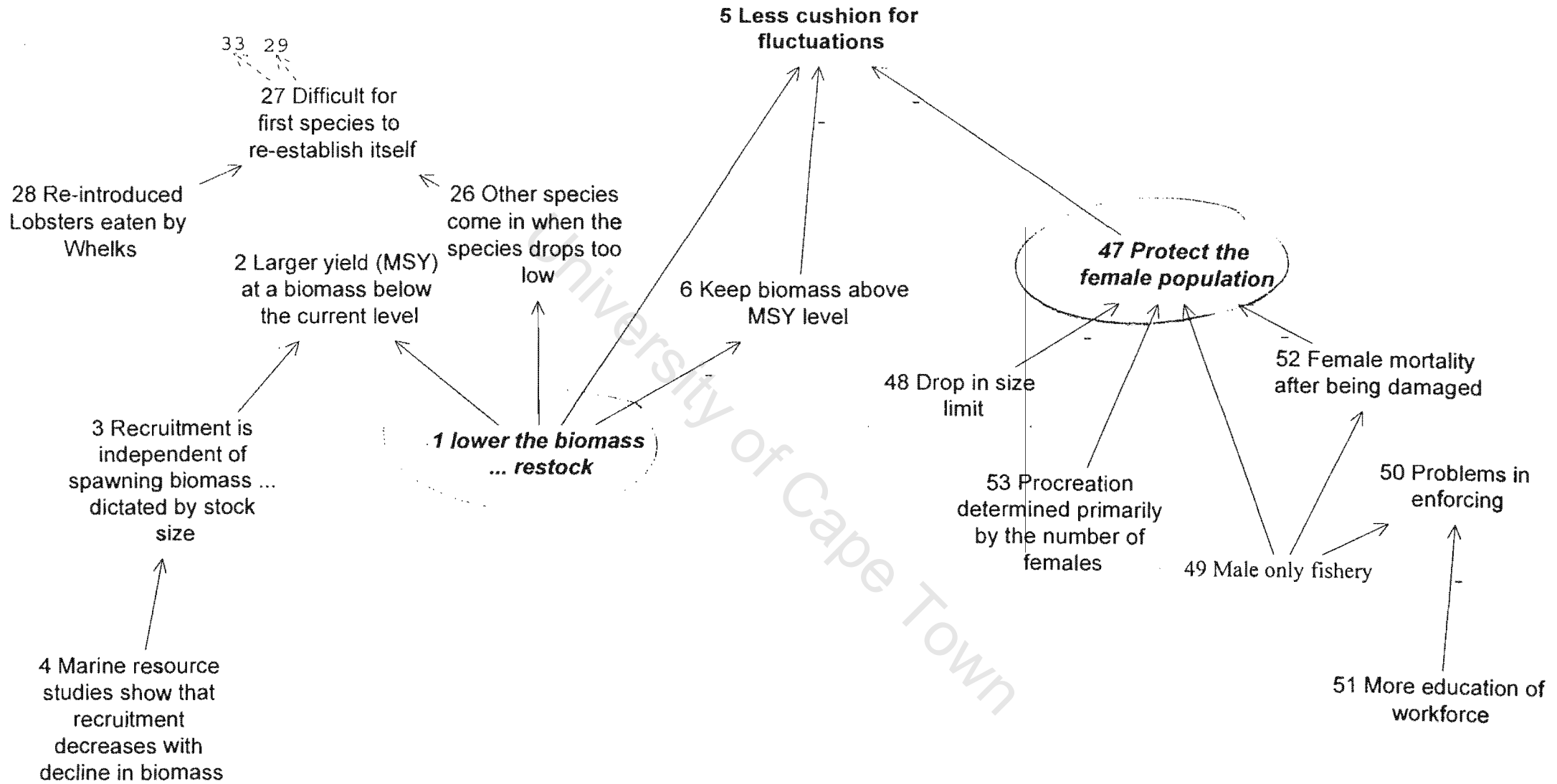
26

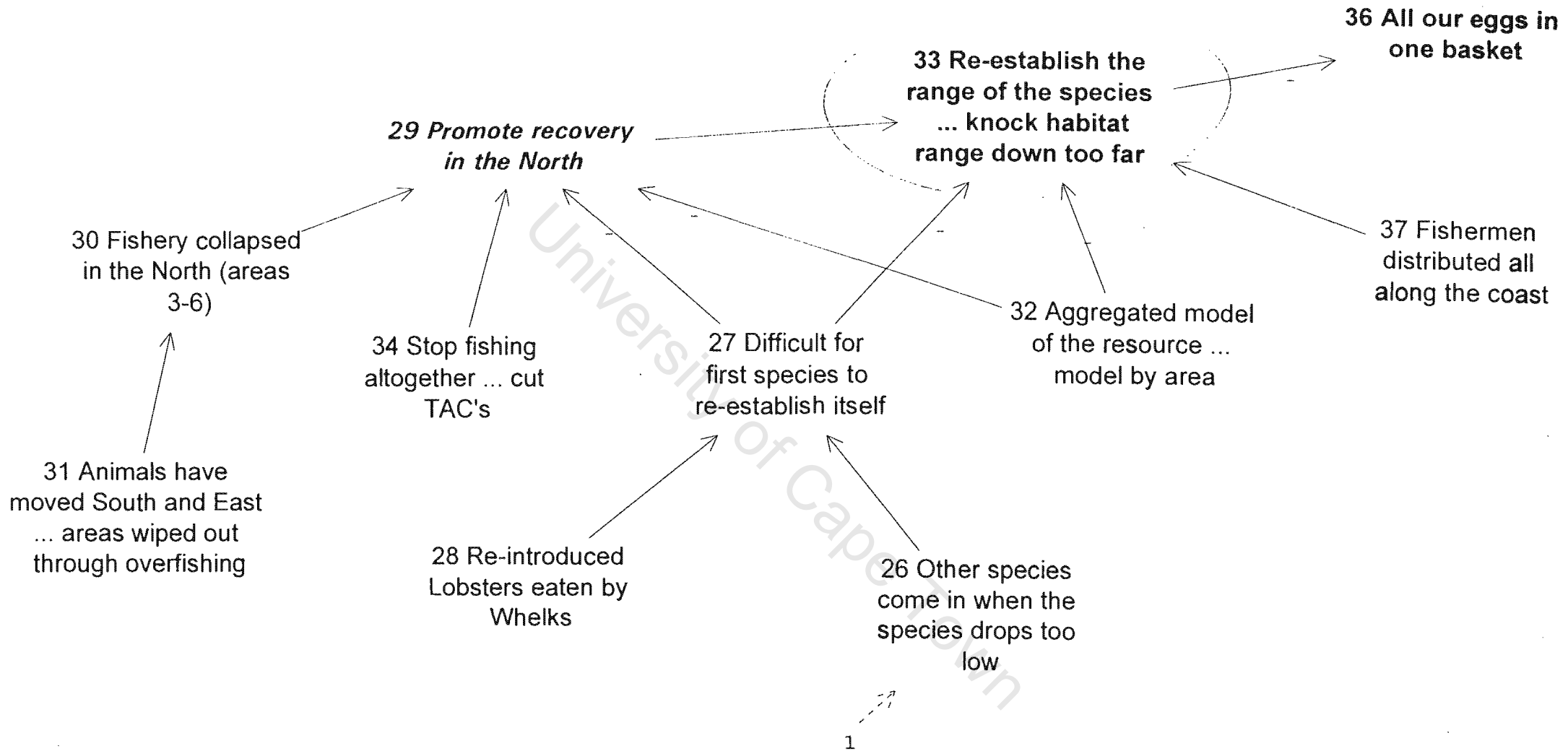
1 decision rules agreed to by all parties

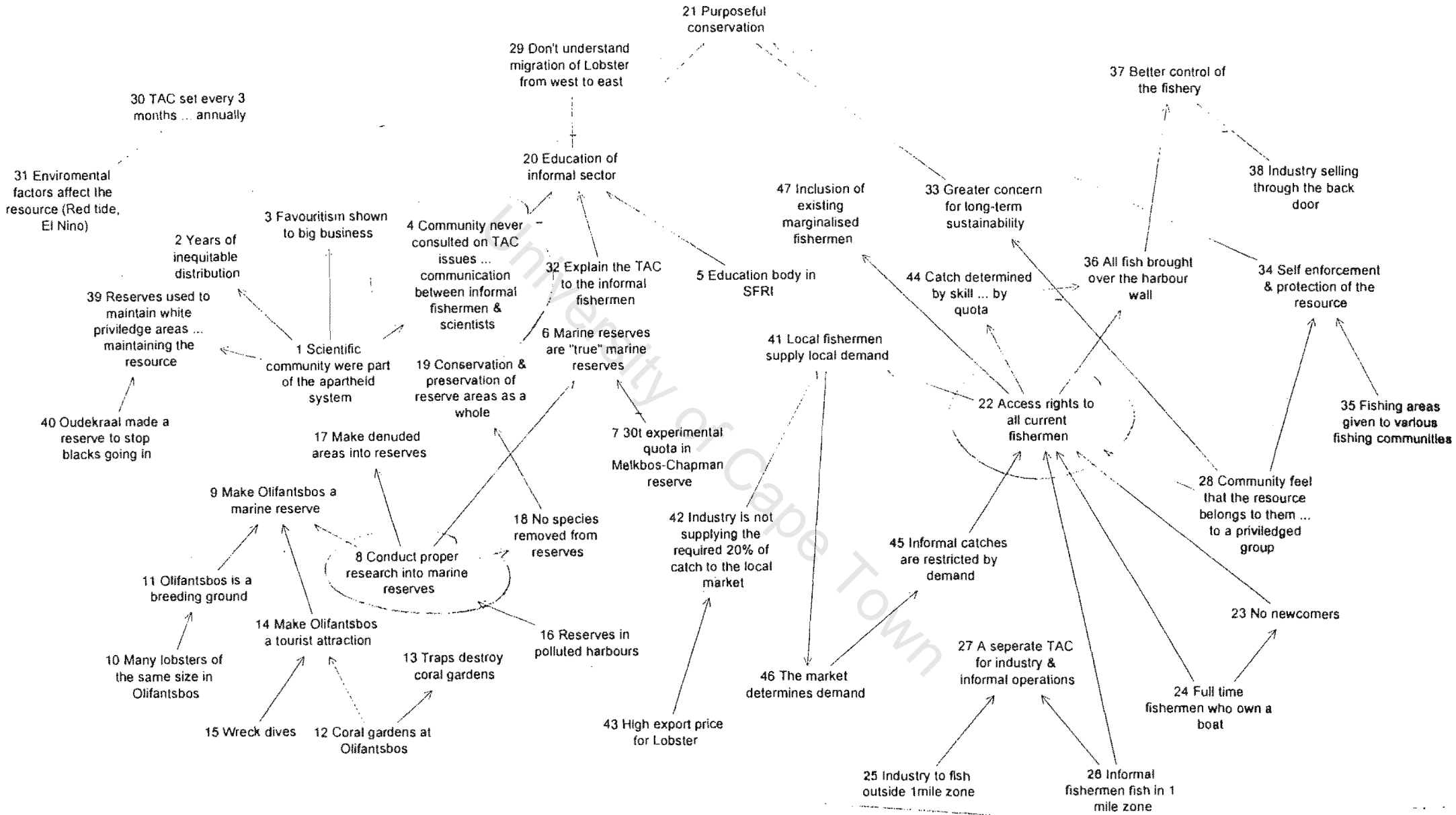
24

3 Transparency ... TAC process seen as a "black box"

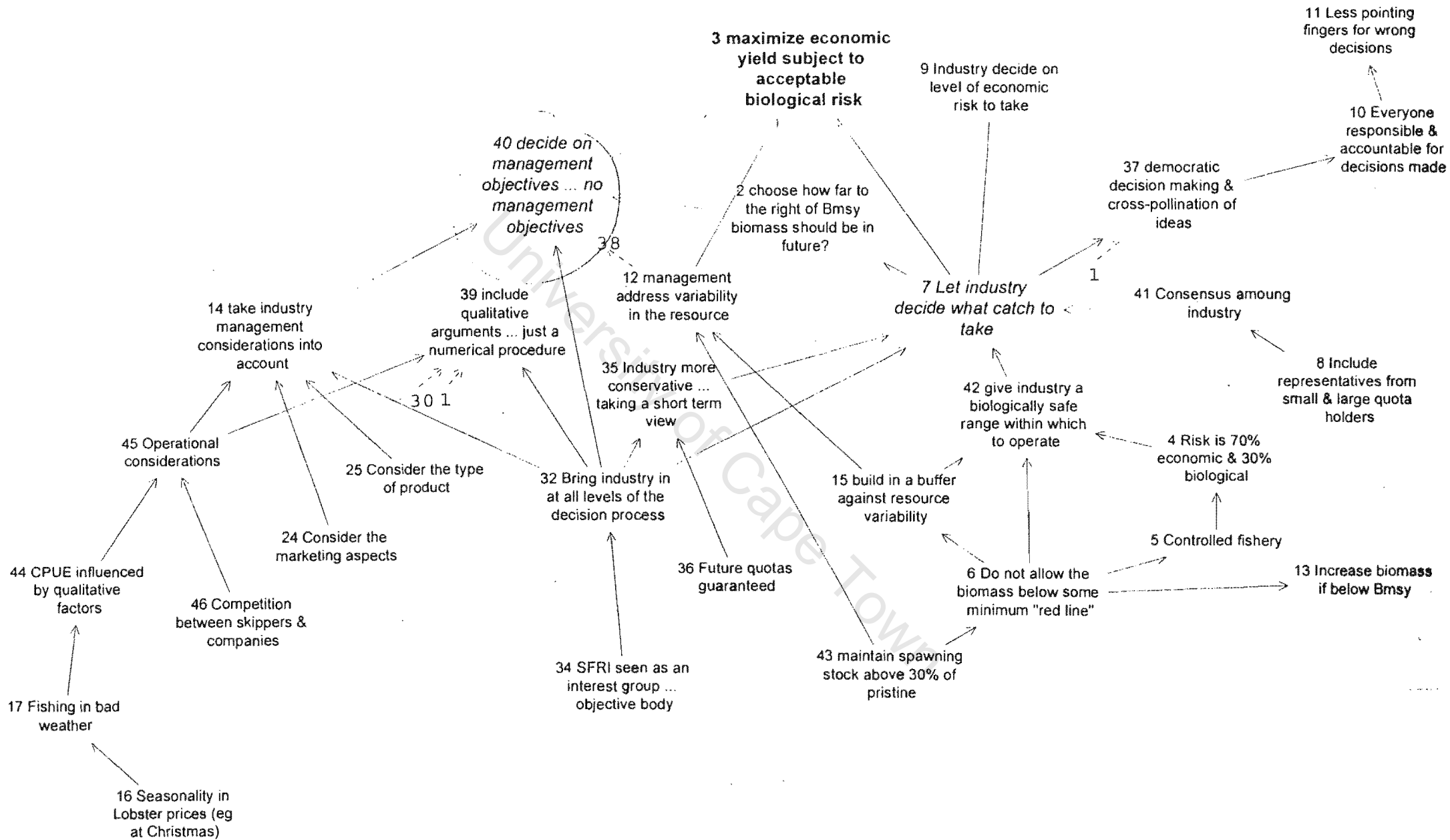


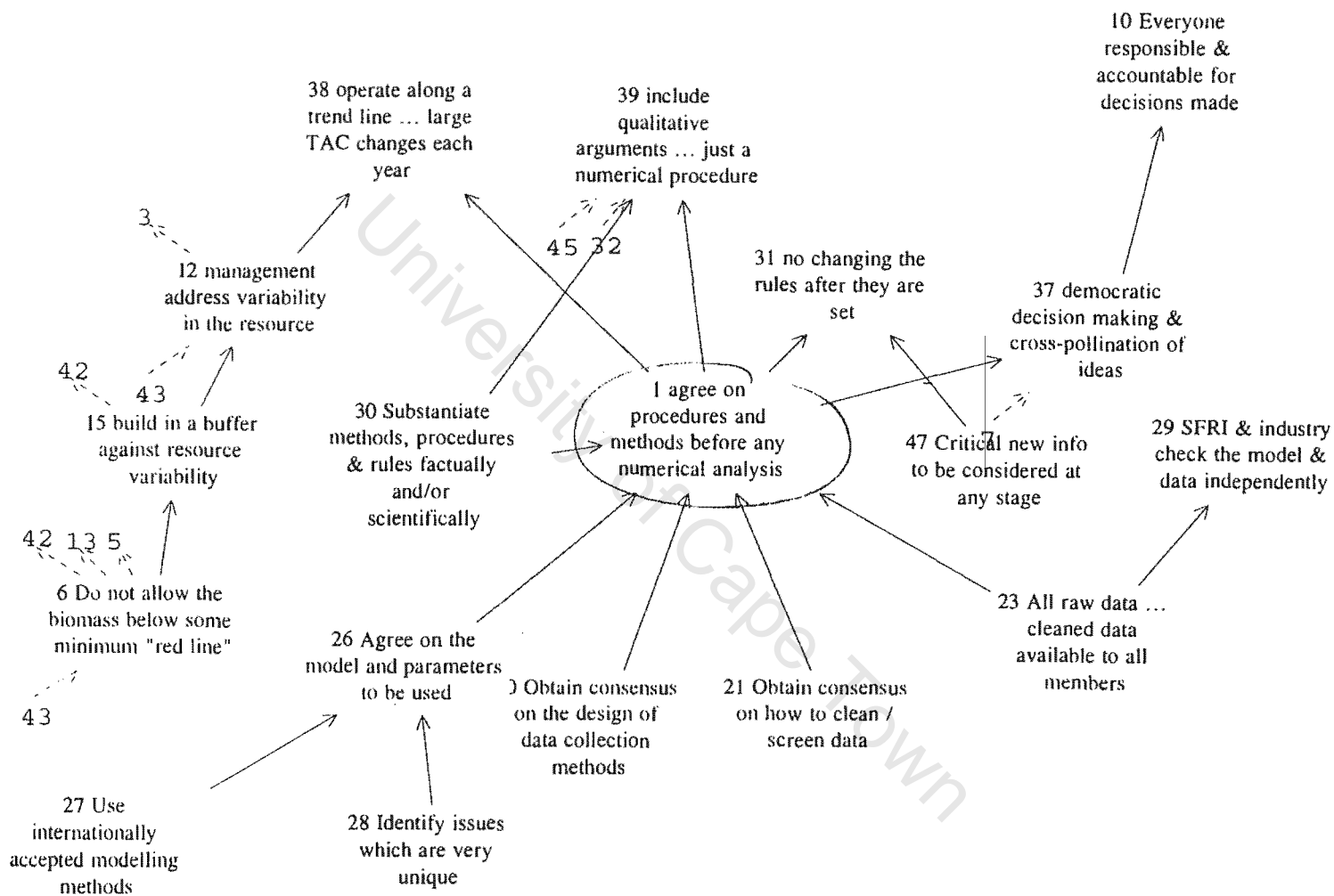


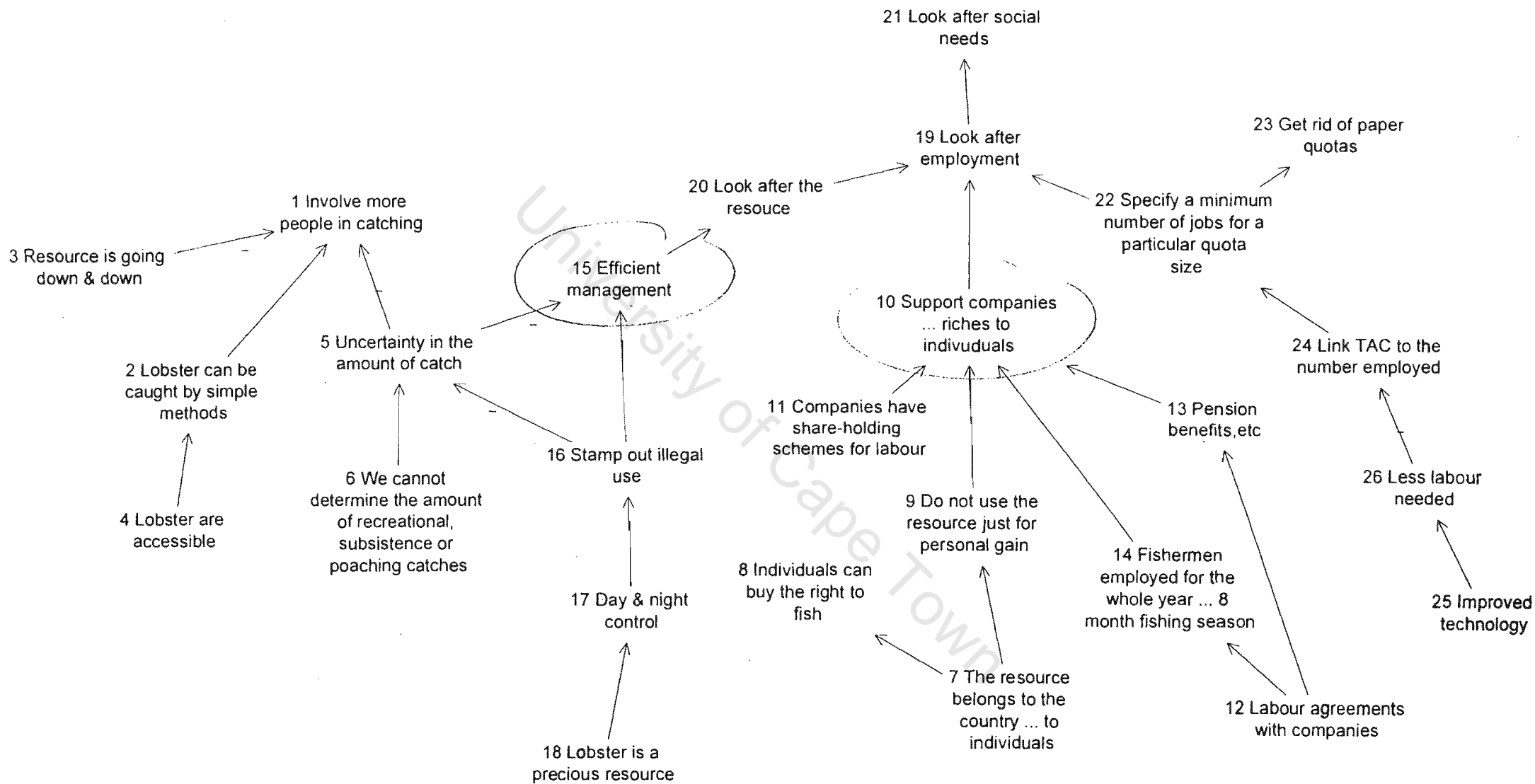








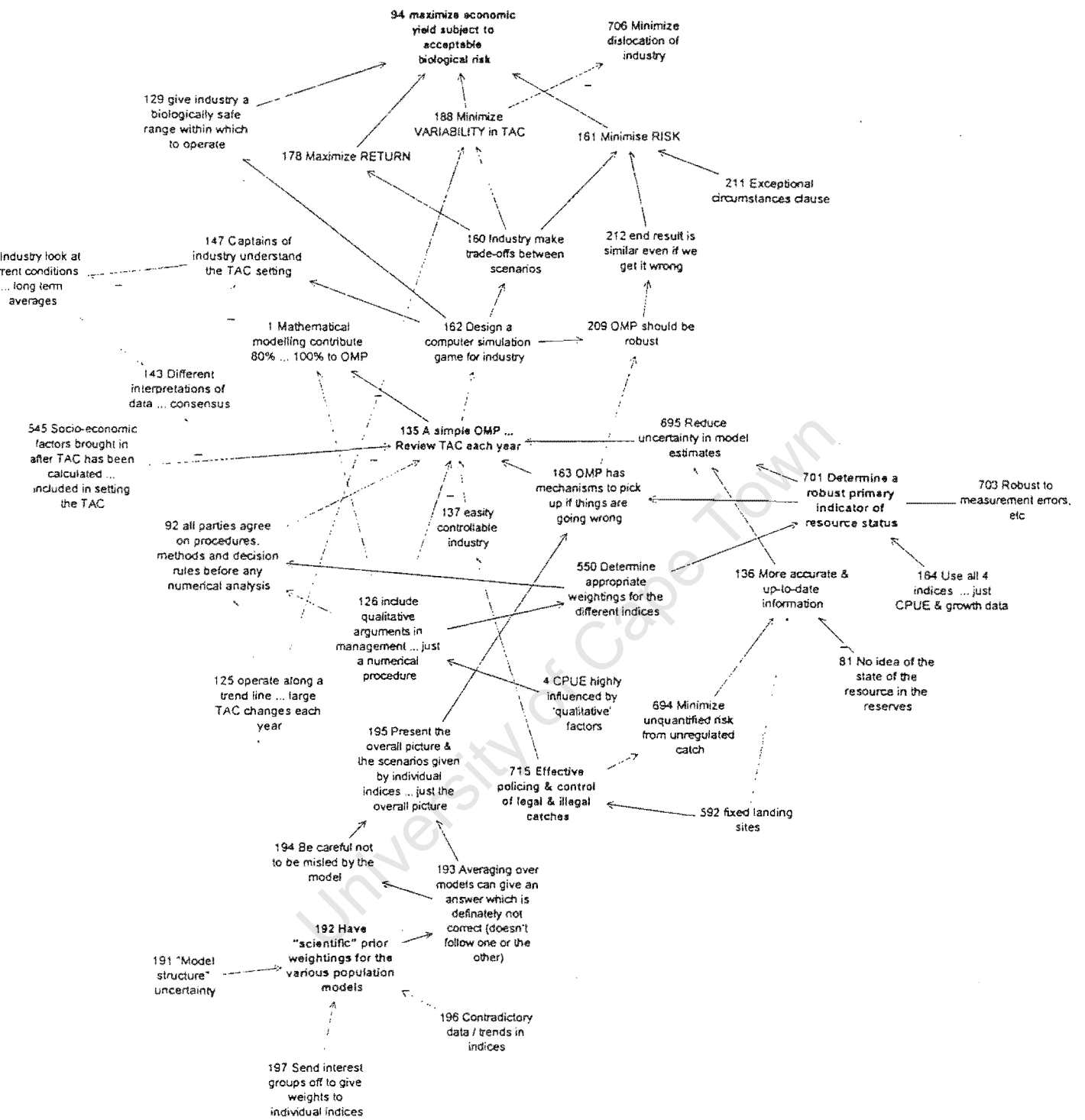


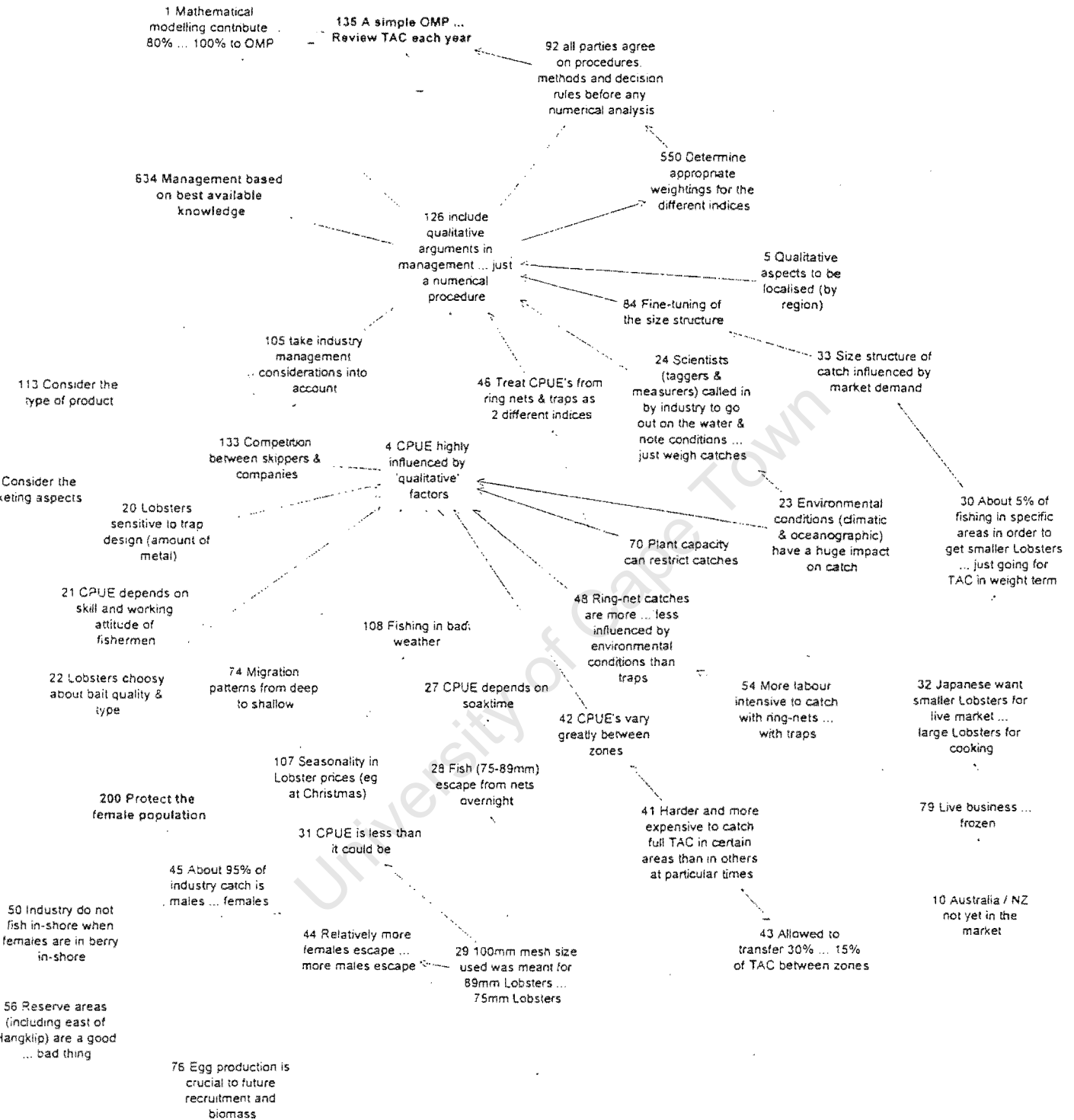


Appendix B: The merged SODA map used  
in the workshop

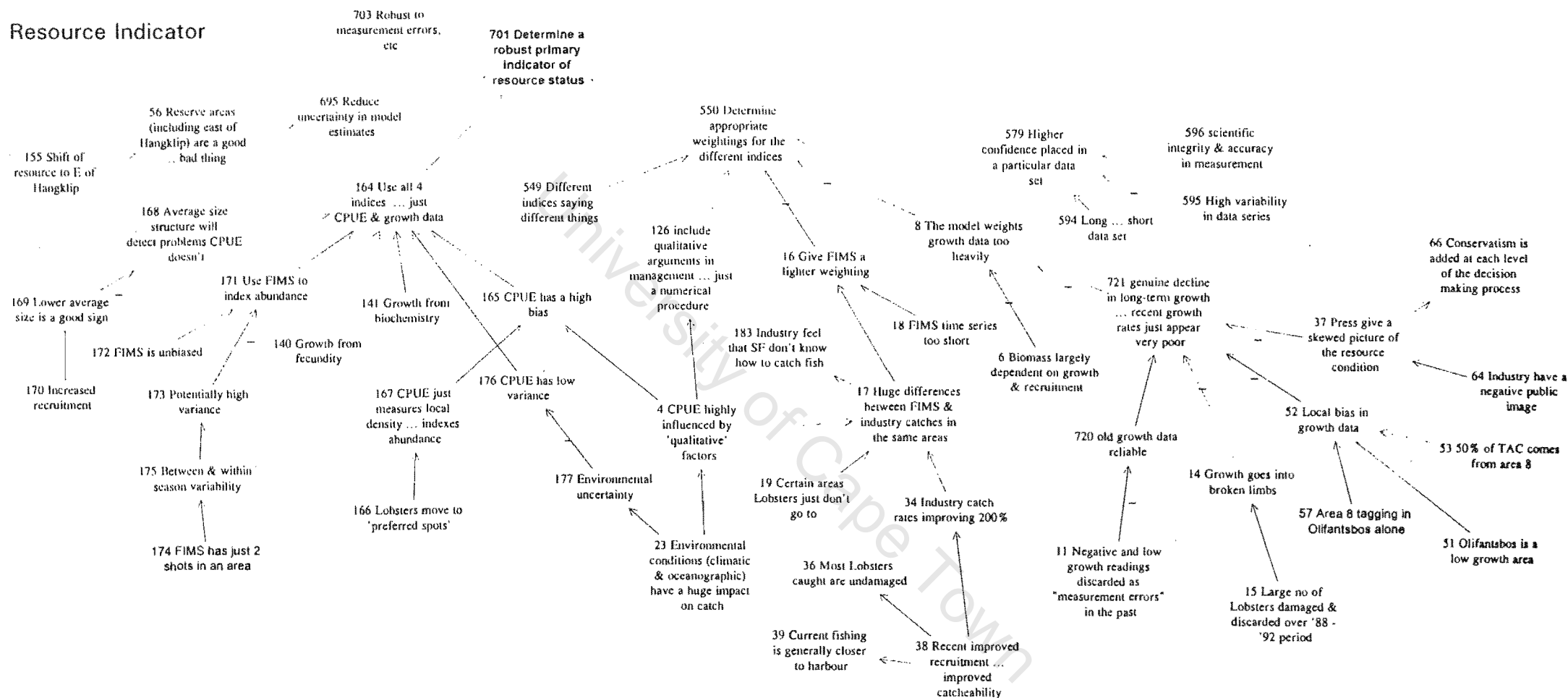
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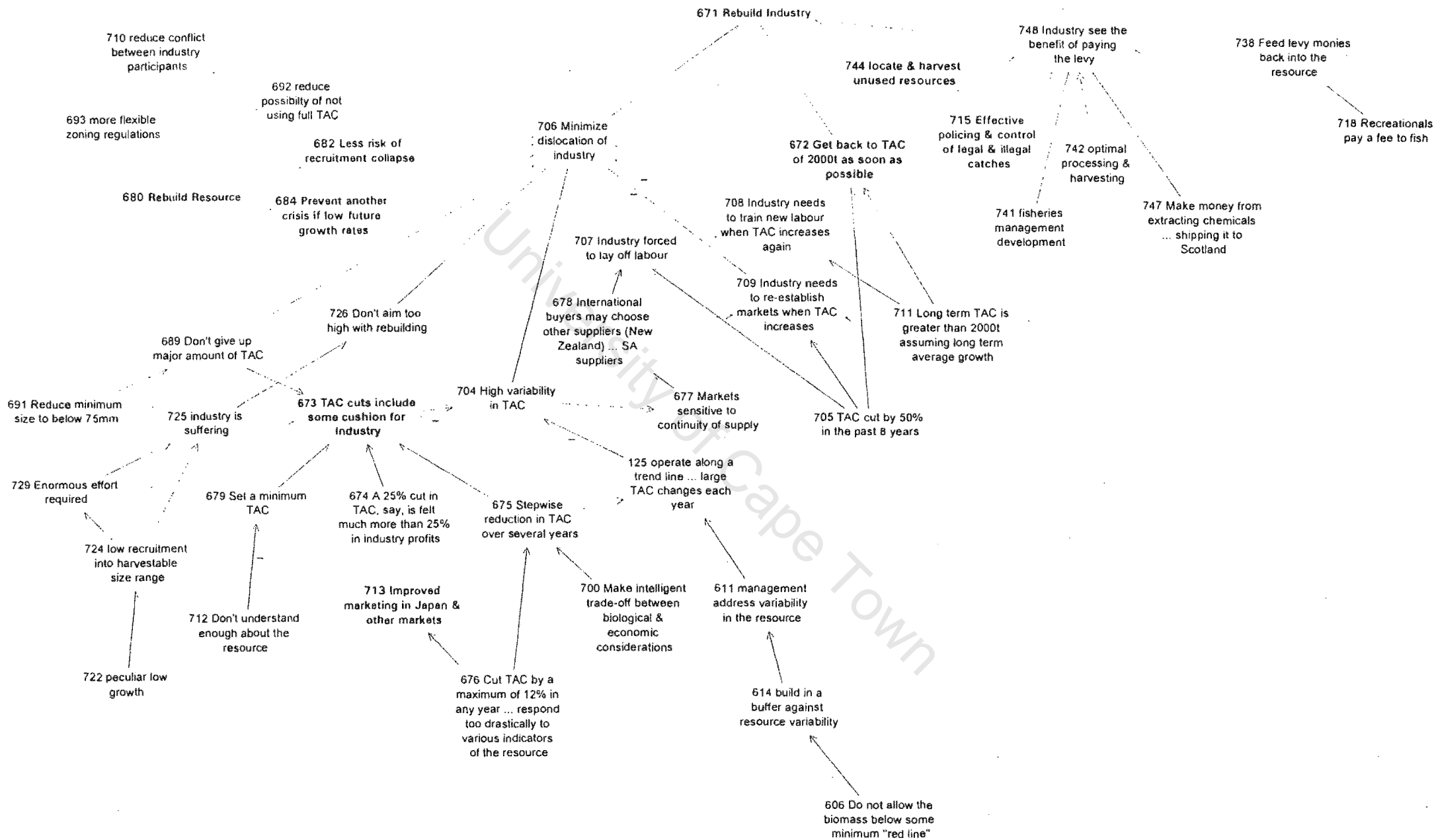


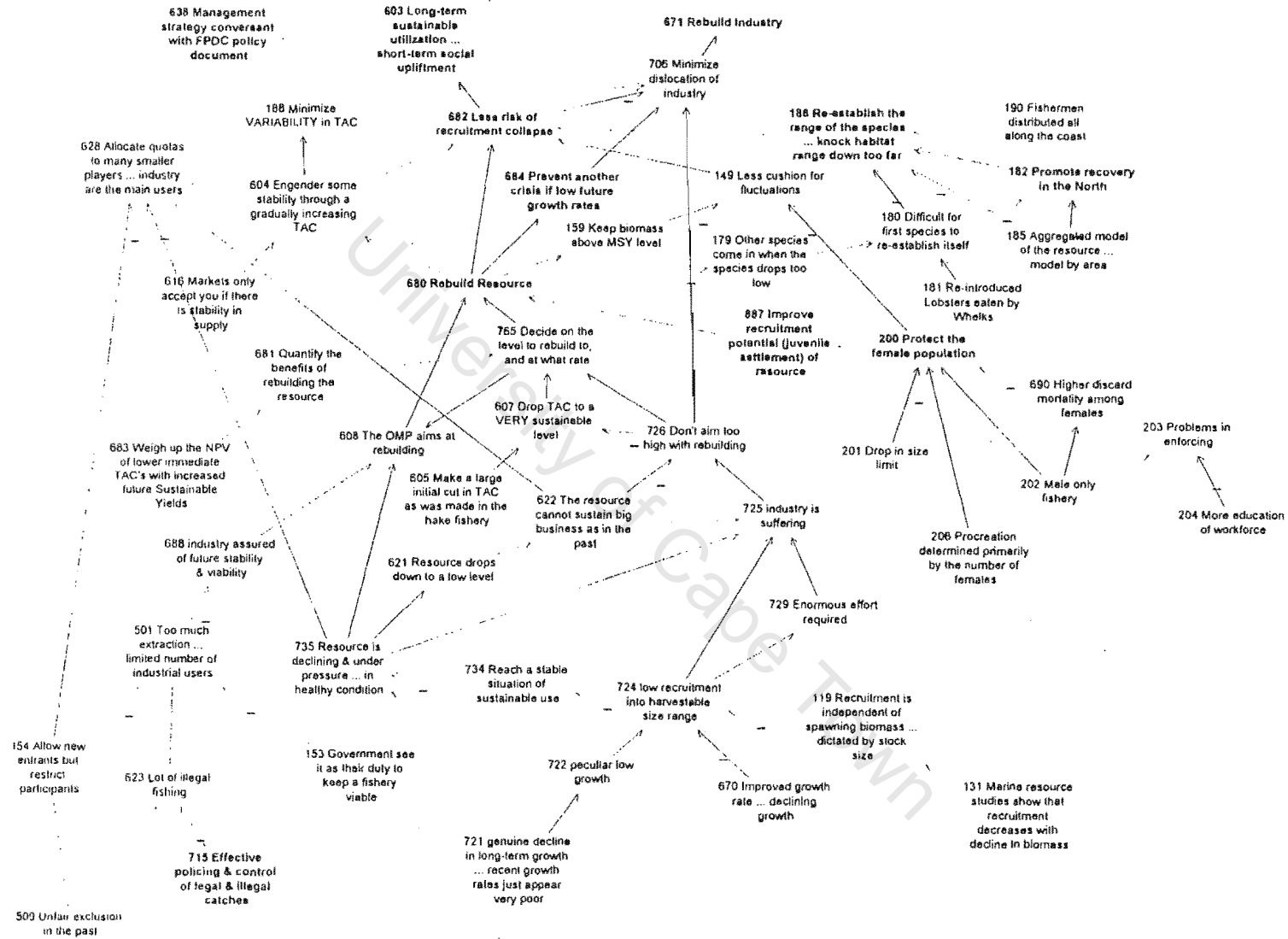


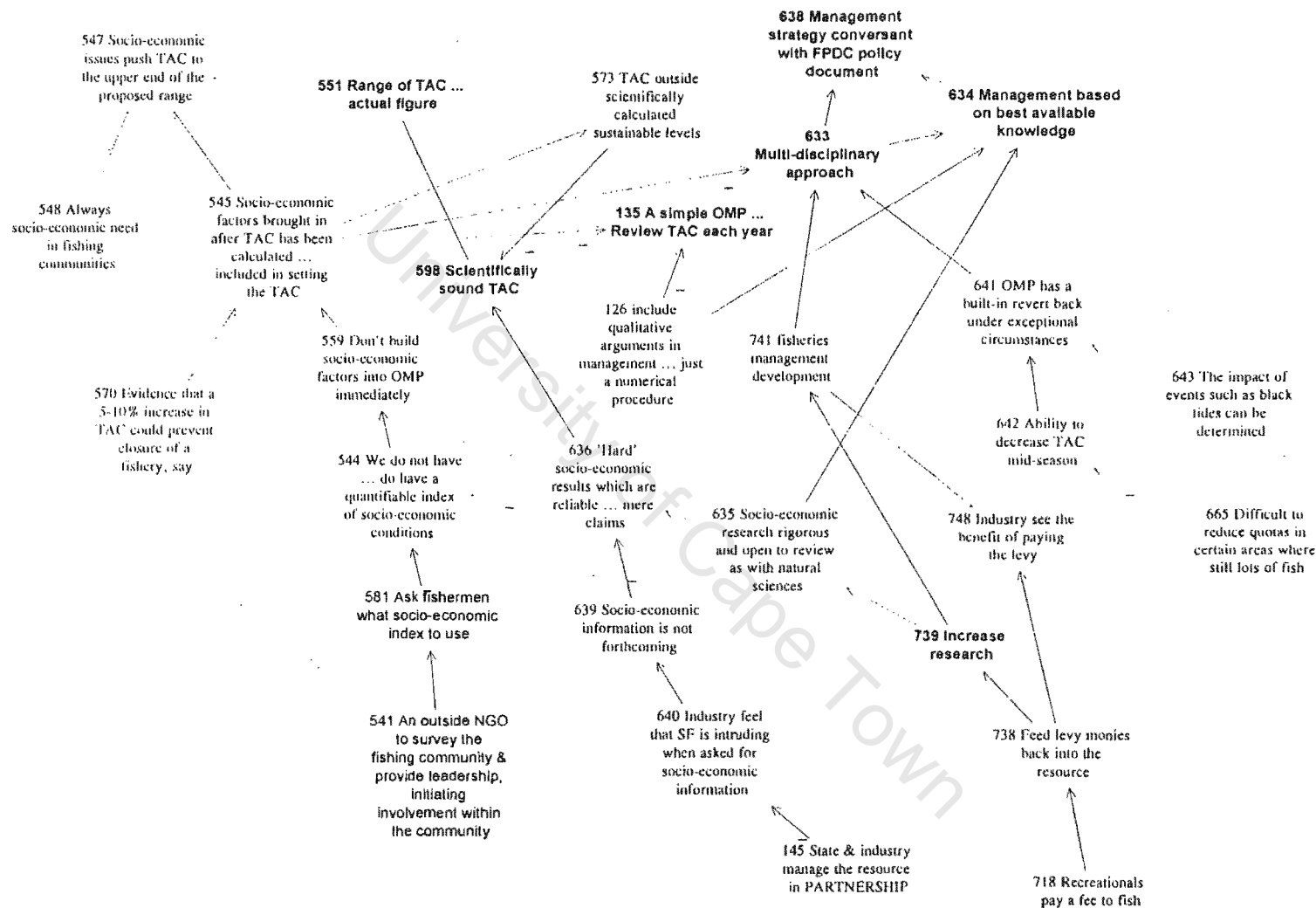


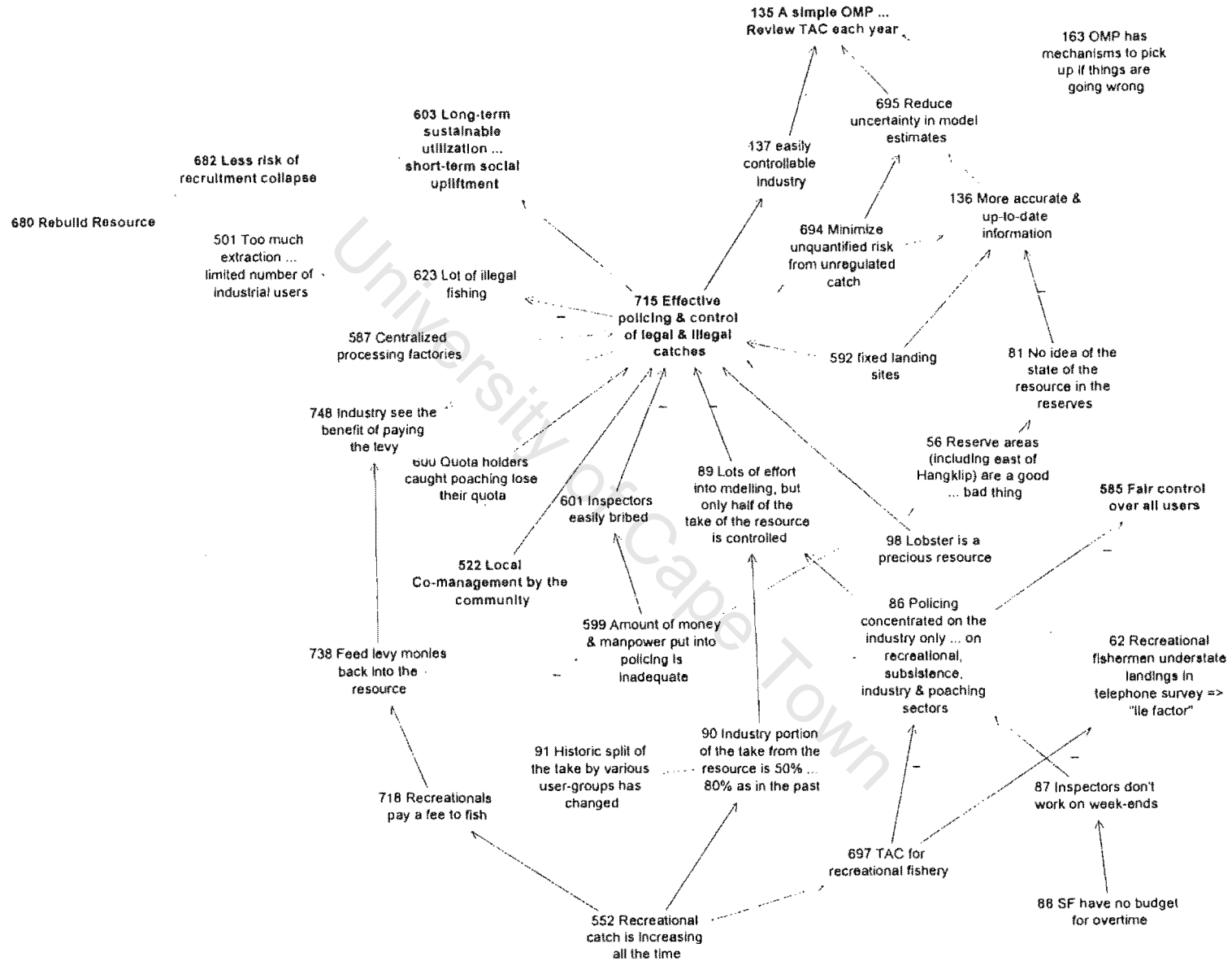
## Resource Indicator

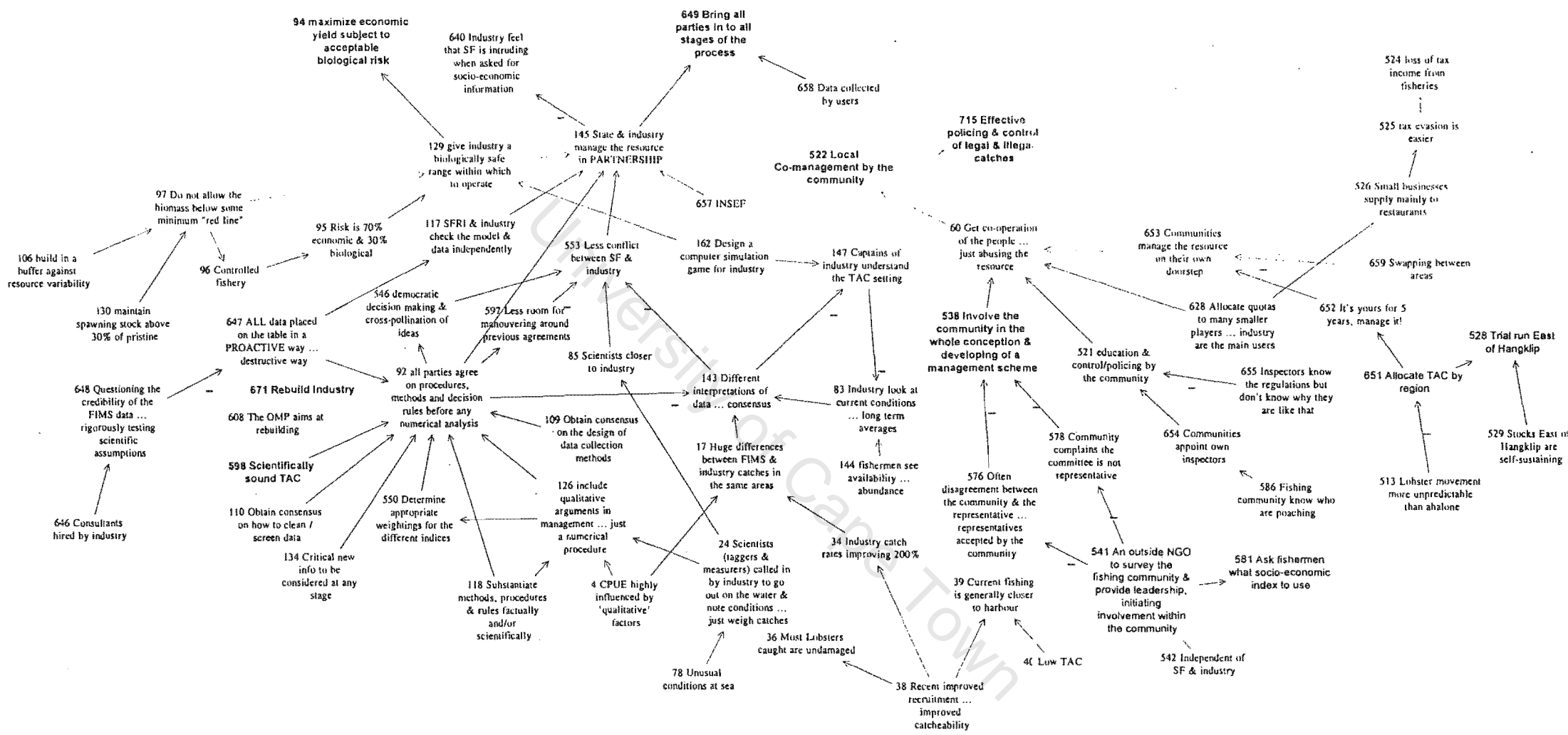




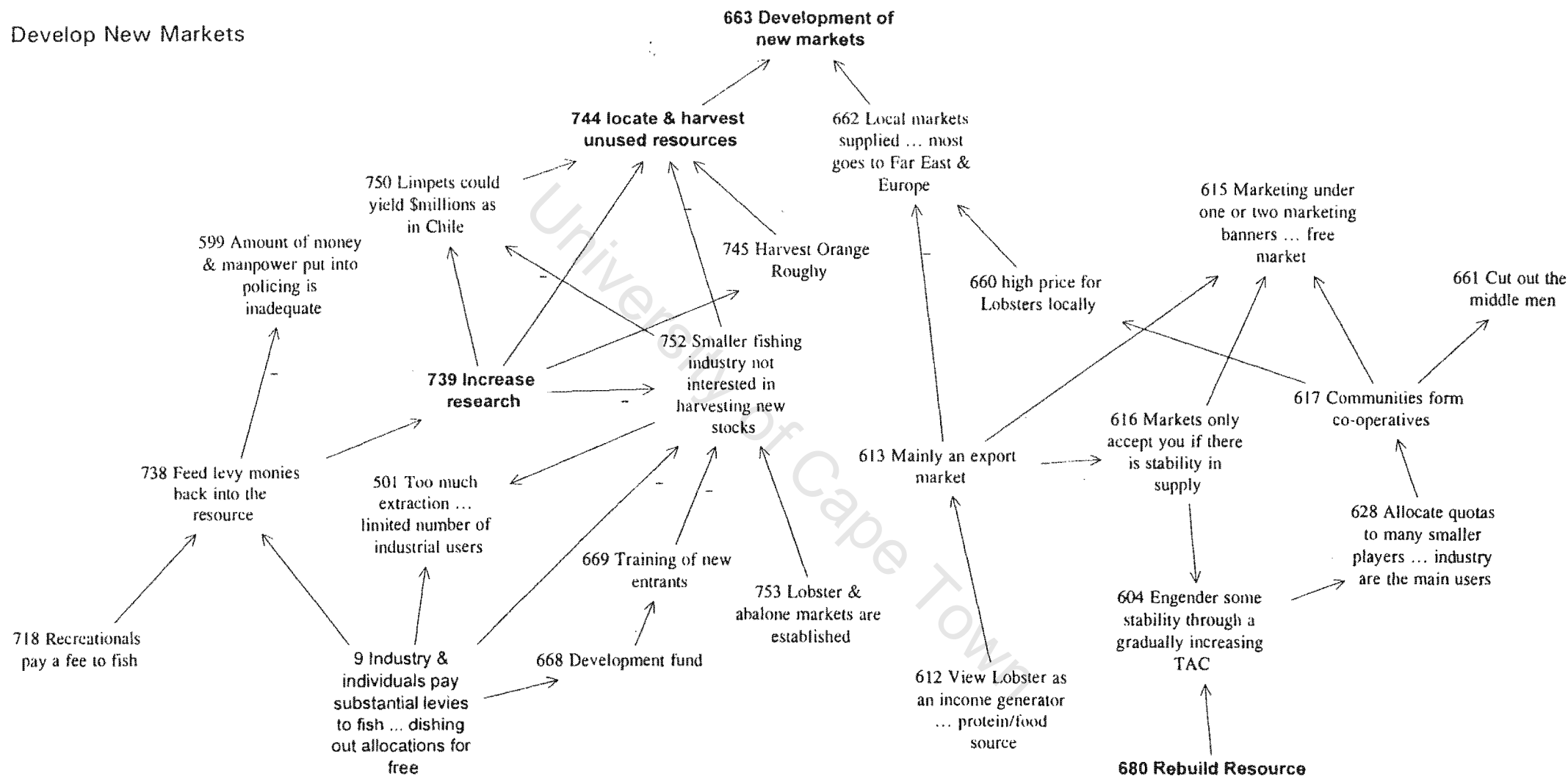




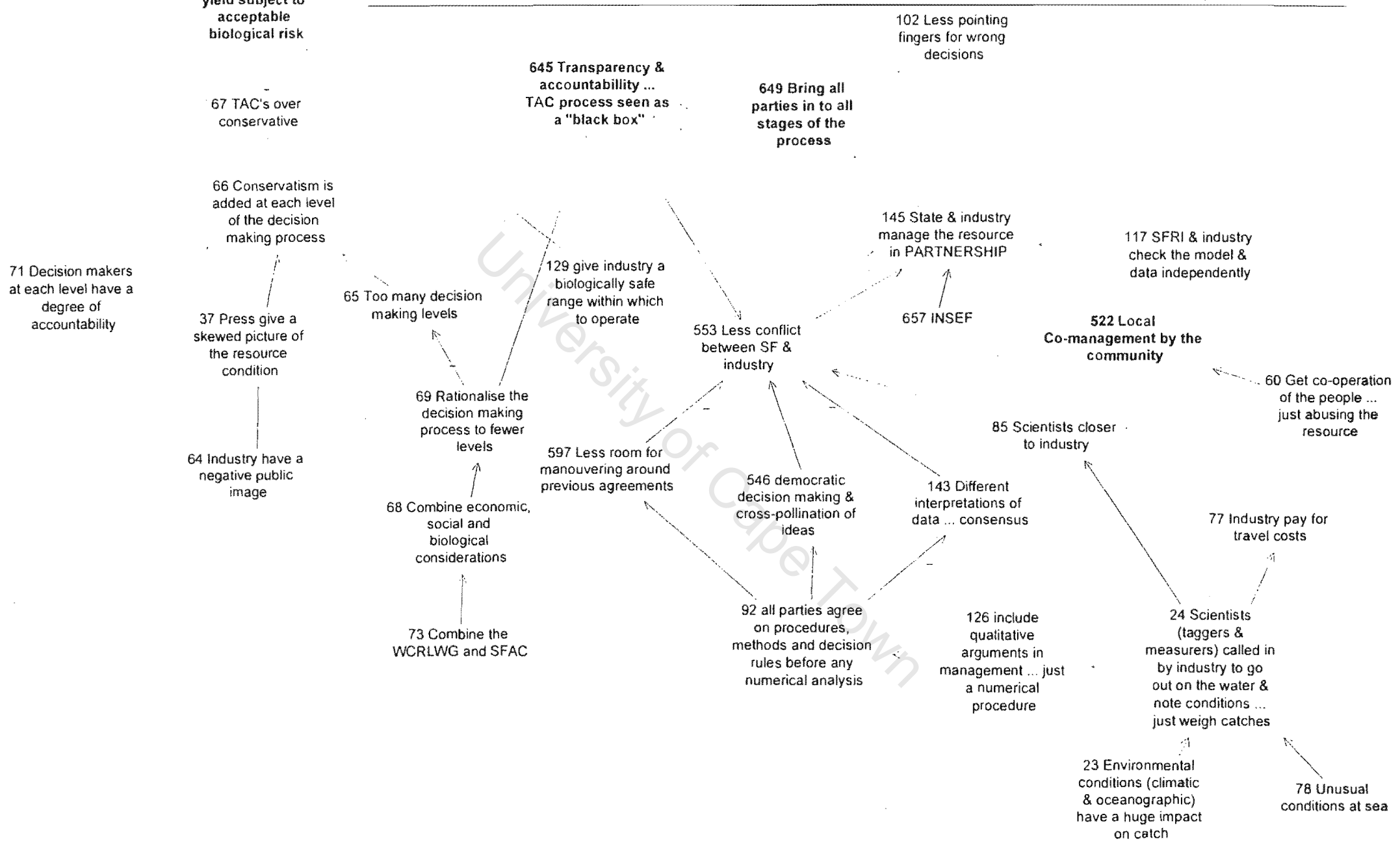




## Develop New Markets







## Management Objectives

- 3 Maximize economic yield subject to acceptable biological risk
  - 6 Re-establish the range of the species ... knock habitat range down too far
  - 5 Job stability
  - 5 Fair control over all users
  - 8 Scientifically sound TAC
  - 3 Long-term sustainable utilization ... short-term social upliftment
  - 5 Increased job creation and employment opportunities
  - 6 RDP
  - 9 Fair & equitable access
  - 3 Multi-disciplinary approach
  - 4 Management based on best available knowledge
  - 8 Management strategy conversant with FPDC policy document
  - 5 Transparency & accountability ... TAC process seen as a "black box"
  - 9 Bring all parties in to all stages of the process
  - 3 Development of new markets
  - 1 Rebuild Industry
  - 0 Rebuild Resource
  - 2 Less risk of recruitment collapse
  - 4 Prevent another crisis if low future growth rates
  - 3 Improved marketing in Japan & other markets
  - 5 Effective policing & control of legal & illegal catches
- concepts

ategies

- 5 A simple OMP ... Review TAC each year
- 2 Promote recovery in the North
- 2 Have "scientific" prior weightings for the various population models
- 0 Protect the female population
- 2 Local Co-management by the community
- 3 Involve the community in the whole conception & developing of a management
- 1 Range of TAC ... actual figure
- 2 Get back to TAC of 2000t as soon as possible
- 3 TAC cuts include some cushion for industry
- 7 Improve recruitment potential (juvenile settlement) of resource
- 1 Determine a robust primary indicator of resource status
- 9 Increase research
- 4 locate & harvest unused resources

concepts

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Policy options

- Industry & individuals pay substantial levies to fish ... dishing out allocations for free
- Allowed to transfer 30% ... 15% of TAC between zones
- Area 8 tagging in Olifantsbos alone
- Combine the WCRLWG and SFAC
- Inspectors don't work on week-ends
- 4 FIMS has just 2 shots in an area
- 7 Send interest groups off to give weights to individual indices
- 2 Male only fishery
- 8 TAC to be a continuous function ... a step function
- 1 Resolve political decision in law
- 2 Hoop-net use to newcomers & trap use to industry
- 8 Trial run East of Hangklip
- 1 An outside NGO to survey the fishing community & provide leadership, initiating invol
- 3 Industry fund & push for interaction with fishermen ... funds allocated by the minister
- 9 Greater profit sharing of industry profits by labour
- 4 Choose representatives from communities
- 7 Set up a committee
- 1 Ask fishermen what socio-economic index to use
- 7 Centralized processing factories
- 9 Manage the recreational fishery as the commercial fishery
- 2 fixed landing sites
- 0 Quota holders caught poaching lose their quota
- 5 Make a large initial cut in TAC as was made in the hake fishery
- 1 Allocate TAC by region
- 5 Stepwise reduction in TAC over several years
- 6 Cut TAC by a maximum of 12% in any year ... respond too drastically to various indic
- 9 Set a minimum TAC
- 1 Reduce minimum size to below 75mm
- 3 more flexible zoning regulations
- 7 TAC for recreational fishery
- 2 Don't understand enough about the resource

concepts

Appendix C: Individual rankings of  
objectives in the Fundamental Objectives  
Hierarchy

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**Table C.1. Rankings by relative importance of the objectives in the Fundamental Objectives Hierarchy (1 ⇒ most important)**

	Bill	Sam	Bob	Jerry	Fred & Frank	John	Mike
<b>I. Economic &amp; Social considerations</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>
A. Maximize long-term economic yields	1	1	1	1	1	1	1
B. Minimize annual volatility in TAC	2	2	2	2	2	2	2
<b>II. Sustainability</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
A. Healthy stock size	1	1	1	1	1	1	1
B. Healthy male/female ratio	2	2	2	3	2	3	3
C. Healthy distribution over area	3	3	3	2	3	2	2
<b>III. Efficiency in Decision-making</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>3</b>
A. Minimize time taken	2	5	4	3	5	5	4
B. Maximize robustness of decisions	3	1	1	1	3	4	3
C. Responsive to early warning signals	1	2	3	2	1	1	1
D. Flexibility to scientific paradigm shifts	4	3	2	4	2	2	2
E. Include qualitative information	5	4	5	5	4	3	5
<b>IV. Transparency &amp; effective communication</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>4</b>
A. Industry & other stakeholder involvement	2	2	2	2	1	3	1
B. Explicitness of risk-benefit trade-offs	1	3	1	3	2	1	3
C. Effective (2-way) communication with decision makers	3	1	3	1	3	2	2

**Table C.2. Rankings of selected objectives, considered most important by the various individuals**

	Bill	Sam	Bob	Jerry	Fred & Frank	
<b>I. Economic &amp; Social considerations</b>						
A. Maximize long-term economic yields		5	4	6	3	1
B. Minimize annual volatility in TAC			5		5	4
<b>II. Sustainability</b>						
A. Healthy stock size		1	1	1	1	8
B. Healthy male/female ratio		3		2		9
C. Healthy distribution over area		8		3		
<b>III. Efficiency in Decision-making</b>						
A. Minimize time taken		4				
B. Maximize robustness of decisions		6	2	4	2	7
C. Responsive to early warning signals		2	7	8	6	5
D. Flexibility to scientific paradigm shifts			8	7		6
E. Include qualitative information			9			10
<b>IV. Transparency &amp; effective communication</b>						
A. Industry & other stakeholder involvement			6		7	2
B. Explicitness of risk-benefit trade-offs		7		5		3
C. Effective (2-way) communication with decision makers			3		4	

Appendix D: Excerpts from the  
WCRLWG document used in determining  
scientific advice for choosing an OMP

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Figure 1: TAC trajectories for the TAC '97 = 1750 MT strategies

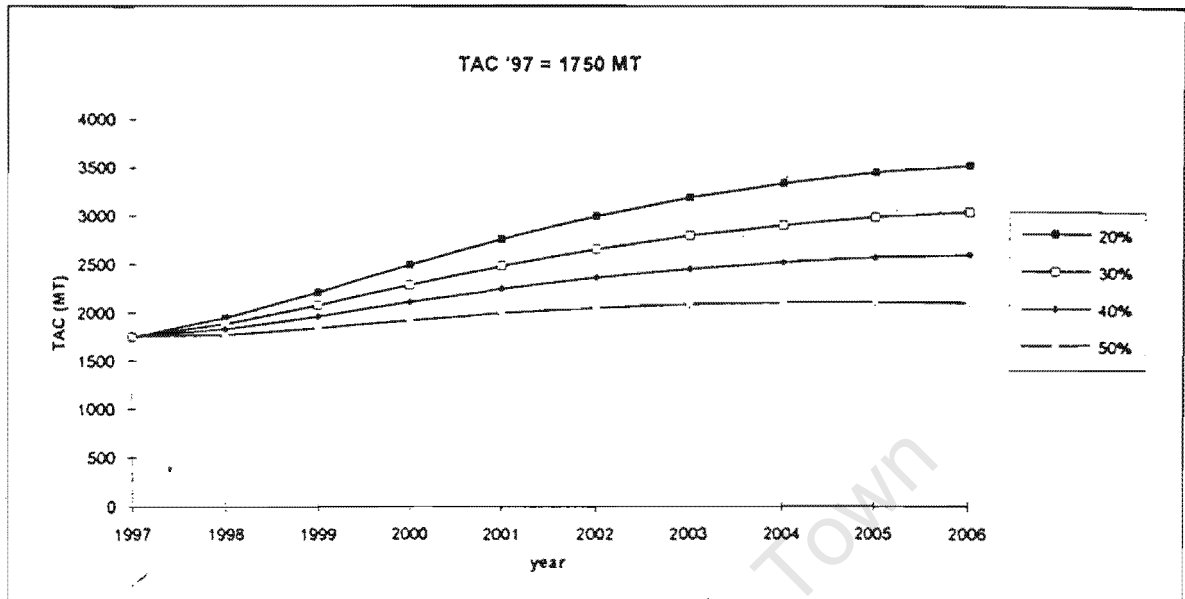
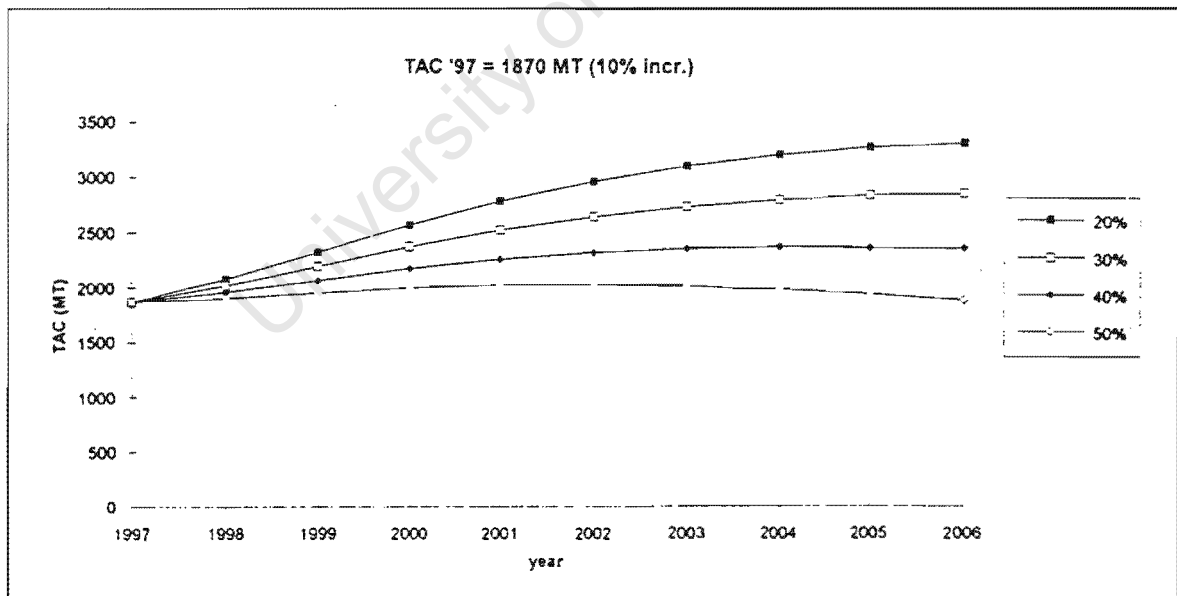


Figure 2: TAC trajectories for the TAC '97 = 1870 MT strategies



## Robustness tests

Two new robustness tests have been included. These are

- e1 episodic event - 50% of all lobsters die in any 1 year in the future.
- e2 CPUE and FIMS fluctuate in correlation

For both these tests, 20 simulations were performed, and the median value is reported.

The other robustness tests are:

- g3 future growth rate is at the "low" level
- g4 future growth rate is at the "high" level
- g6\* ARMA growth for the next 5 years, then a sudden drop to the "worst" case growth for the next 5 years
- r3\* recruitment from 1989 onwards is half of what we currently estimate recruitment to be, and numbers-at-size in 1996 are half current estimates
- r4\* recruitment from 1989 onwards is double what we currently estimate recruitment to be, and numbers-at-size in 1996 are double current estimates
- r6\* recruitment from 1989 onwards is half of what we currently estimate recruitment to be, and from 1990 onwards there is a linear stock-recruit relationship
- $s^m = 0.85$  male survivorship is set at 0.85
- $s^m = 0.95$  male survivorship is set at 0.95
- $d = 0\%$  discard mortality is assumed to be 0%

(The last three of these tests involved refitting the population model to the data)

Tests with an asterisk indicate those tests which were used for stochastic runs.

Robustness tests results are reported in Tables 4-6.

### Base case deterministic results

Summary statistics for all 12 strategies are presented in Tables 1-3 below.

Table 1: Summary statistics for the TAC '97 = 1750 MT strategies

	20% Biomass recovery	30% Biomass recovery	40% Biomass recovery	50% Biomass recovery
$C_{ave}$	2762	2483	2238	1971
V	7.62	6.03	4.37	2.23
B75(06/96)	1.20	1.30	1.40	1.50
TAC '97	1750	1750	1750	1750
TAC '06	3517	3040	2601	2104

Table 2: Summary statistics for the TAC '97 = 1870 MT strategies

	20% Biomass recovery	30% Biomass recovery	40% Biomass recovery	50% Biomass recovery
$C_{ave}$	2742	2480	2210	1958
V	6.90	5.32	3.50	2.54
B75(06/96)	1.20	1.30	1.40	1.50
TAC '97	1870	1870	1870	1870
TAC '06	3292	2841	2353	1882

Table 3: Summary statistics for the TAC '97 = 2040 MT strategies

	20% Biomass recovery	30% Biomass recovery	40% Biomass recovery	50% Biomass recovery
$C_{ave}$	2710	2455	2186	1928
V	6.06	4.90	4.40	5.32
B75(06/96)	1.20	1.30	1.40	1.50
TAC '97	2040	2040	2040	2040
TAC '06	2972	2528	2037	1547

The TAC trajectories for these strategies are shown in Figures 1-3.