DECISION MAKING AND NEW ZEALAND CUTFLOWER GROWERS

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Abstract

This thesis reviews the literature on decision making and proposes two decision-making models: a generic model of primary production systems and a model of cutflower growers, and attempts to validate both. From the literature, twelve decision-making models from a range of sources (theoretical, empirical, primary and non-primary production systems) are reviewed from a soft systems perspective, and a new seven-phase generic model is developed. These seven phases are: Problem detection and prospecting; Problem definition; Acquisition of information; Consideration of alternatives; Making a choice; Implementation; and Checking and judgement. A survey of 26 cutflower growers endorses the generic model, and it is expanded to describe the steps used in decision-making by cutflower growers. Further analysis and validation of the cutflower decision-making model occurs by conducting a single case study on a sandersonia grower.

The proposed generic model incorporates the best features of all the models reviewed, and it has a number of key differences from other models:

- It shows the cyclic and iterative interrelationship of the components,
- All the phases are highly dependent on a number of factors, including the goals, aspirations and preferences of the decision maker, and external factors,
- A new dimension called 'Prospecting' has been added to 'Identify problem' as it can be an important trigger to start the decision making process, particularly in relation to new crop choices,
- 'Judgement' is used during the checking process, and is strongly influenced by the way people learn. The process of learning is a synthesis of finding out and taking action much as the process of decision making is,
- The new model reflects decisions made under all degrees of uncertainty and risk. It also describes the decisions made over a range of decision types, whether they are operational, tactical or strategic.

Analysis of the case study revealed that further modifications were required to the newly proposed decision-making model of cutflower growers. These included restructuring the model so that 'Information' is a much more intrinsic part of the decision making process as it is involved in all phases of the decision-making process. The phases of 'Problem detection and prospecting' and 'Problem definition' were considered to be too similar to warrant two categories, therefore they were combined. The phases 'Consideration of alternatives' and 'Choice' have also been combined, not only because they are similar actions but also because of the higher iterative relationship the two have.

Keywords: cutflowers, decision-making models, decision-making behaviour, information, primary production systems.

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Chapter 1: Introduction

1.1 Introduction

"What we do in this world is determined by the way we see it. If we want to change the way we do things, we need to change the way we go about our seeing" (Bawden & Macadam (1991)).

Making decisions is something that we all do. One could therefore reasonably assume that decision making and decision-making behaviour would be well understood by everyone. This is far from reality. Definitions of decision making are hard to find and to ascertain concisely, both in the textbooks and by people who make numerous decisions every day. What is known though, is that there are two main components of any decision situation: the decision maker, and the environment in which the decision is made (Hardaker, Lewis, & McFarlane (1970)). If all people who made decisions exhibited similar decision-making behaviour and were similar in personality, and if the environment in which all decisions were made were also similar then understanding decision-making would be straightward and clear. Like life itself, decision making is in fact a complex process even though we do not generally realise this. Some people may ask the question then, "Why should we bother to understand decision making ?". The answer to this depends on why you would want to know. These questions are deliberately recursive, much like the decision-making process, but there is a good answer.

This study programme has immediate relevance to the commercial horticultural environment of the cutflower industry. This industry is made up of about 3300 growers and people who service it. Most operations grow crops in relatively unsophisticated structures. Approximately 80% of growers' operations are classed as small, and the larger ones produce the greater part of the export flower crop (de Graaf (1998)). Approximately half of the national cutflower production of $NZ46 million is exported (Collins (1999)). This constitutes an international market share of 0.5%. Until about 15 years ago the number of cutflower crops grown in New Zealand was very limited, concentrated around chrysanthemums, carnations and roses, but now a very wide range of crops is grown. The industry has a long-term vision, based on its strategic plan (New Zealand Flower Industry Federation Inc (1999)), of its products being "new, vibrant, exciting and naturally the preferred choice of world markets". To achieve this goal the industry must be market-driven not product-driven (New Zealand Flower Industry Federation Inc (1999)), by supplying customers with products of the required quality and type, and when they want them, not when it is easiest or cheapest for the grower to supply them.

Primary production operates as an open and highly complex system affected by natural elements, cultural requirements, prices and interactions of many of these factors (Anderson, Dillon, & Hardaker (1985); Lentz (1998)) with management objectives and practices. Cutflower growers also operate in the same system, but they must also contend with highly volatile fashions, meeting market demands, and competitive marketing. Therefore they must constantly make decisions on what crops to grow, and when and how they will grow them; as well as where and how they will market their flowers. These decisions are made even more complex when many crops are grown. Few studies of decision-making behaviour have been carried out in the agricultural sector and even fewer in the horticultural sector, particularly for cutflowers. Given an operating environment of complexity, uncertainty and risk, cutflower growers must be in a position to make the best decisions they can.

1.2 Purpose of the study

1.2.1 Overall objectives

The overall purpose of this study is to improve the researcher's understanding of the decision-making behaviour of cutflower growers.

1.2.2 Development process

This study was initially directed towards improving the development and delivery mechanism of Decision Support Systems (DSS) because the results could be put to use in the writer's current working environment. As both the study and the work progressed, it became apparent that this initial topic was too broad for the scope of the study and that the decision-making component of DSSs (for both the client and the developer) required detailed analysis before it could be studied. Such a shift in the research question during the study is neither uncommon nor undesirable (Eisenhardt (1989)). Focus may even shift from theory-validation to theory-building.

Part of this change in research topic emphasis has occurred because of the writer's view that it was unlikely that the industry would adopt a proposed DSS. This is because of its initial hard systems design (defined in Appendix A5.1), the writer's better appreciation of the complex environment in which growers operate, as well as changes in the personnel in the writer's working environment. Development of the research topic is well reflected in Figure 1.1. The spiral shows the relationships between Puzzle Solving using Basic Research, and Situation Improving using Soft Systems (defined in Appendix A5.2), and the role of each in research. The terms 'Basic Research' and 'Applied Research' are often used to describe the type of research that is carried out in New Zealand research agencies, whereas a more holistic approach based on soft systems research methods is more likely to make a difference by improving a situation.

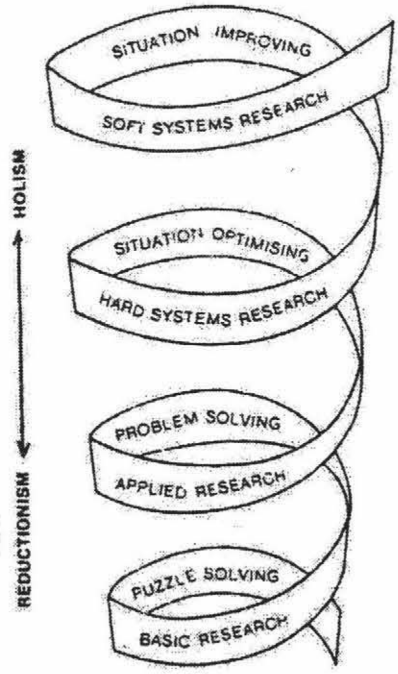

Figure 1.1. A hierarchy of problem solving methodologies (Source: Bawden & Macadam (1988)).

To gain an in-depth understanding of the way a group of people think, decide, and act on those decisions would require drawing on the methods and principles of the social and behavioural scientists.

1.3 Major research methods

Yin (1994) describes five major research types used in social and behavioural sciences. These are experiments, surveys, analysis of archival information, histories and case studies. Each strategy is a different way of collecting and analysing empirical evidence, following its own logic and each has its own advantages and disadvantages. All can be used for three research purposes: exploring, describing, or explaining a situation. Even though each strategy has its own distinctive characteristics, there are large areas of overlap among them (Sieber (1973)). Yin (1994) uses three conditions to decide on which strategy to use. These conditions are:

1. The type of research question posed,
2. The extent of control an investigator has over actual behavioural events, and
3. The degree of focus on contemporary as opposed to historical events.

Table 1.1 shows these three conditions and shows how each is related to the five major research strategies in social sciences.

Strategy	**FORM OF RESEARCH QUESTION**	**REQUIRES CONTROL OVER BEHAVIOURAL EVENT ?**	**Focuses on contemporary events ?**
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival analysis	Who, what, where, how many, how much	No	Yes/No
History	How, why	No	No
Case study	How, why	No	Yes

Table 1.1. Relevant situations for different research strategies (Source: Yin 1994).

The first condition to be satisfied according to Yin (1994) is the form of the research question. These questions are one of five types: "who", "what", "where", "how" and "why". In general "what" questions may either be exploratory, in which any strategy could be used, or about prevalence, in which surveys of the analysis of archival records would be favoured. "How" and "why" questions, which are more explanatory in nature, are likely to favour the use of case studies, experiments or histories.

The second step to be satisfied by Yin (1994) is the degree of control required over the behaviour of the subject in the research. Only research by experimentation can manipulate the behaviour of research subjects.

The third step to be satisfied by Yin (1994) is the degree of focus on contemporary rather than historical events. Some history and archival analysis strategies are the preferred research methods when dealing with historical events as access to the relevant subjects may not be possible.

In choosing a research strategy the first and most important step is to identify the type of research question to be asked (Yin (1994)). Once the research question has been decided, the research strategy can be defined as the form of the research question provides an important clue regarding the appropriate research strategy to be used.

1.4 Data collection and analysis methods

The research question to be asked in this study programme was:

"What is the decision-making behaviour of New Zealand cutflower growers ?"

Once the literature review was completed and the decision-making model was described, two data collection and analysis methods were decided on and used to answer the research question. Firstly a survey and then a case study were conducted. These two different sequential research strategies combined qualitative and quantitative approaches to data collection and analysis. This type of research approach is called a "mixed method" study and is described in detail by Tashakkori & Reddlie (1998). There are strengths and weaknesses to any data collection strategy, and use of multi-methods approaches permits the researcher to combine the strengths and correct some of the deficiencies of any one source of data (Patton (1987)). Some of these advantages include triangulation (Patton (1987)), complementarity, initiation, development, and expansion, and are described by Greene, Caracelli, & Graham (1989).

1.4.1 Survey

The initial study was to provide a broad insight to the decision-making behaviour of cutflowers by interviewing a number of them. Of the five research strategies available to choose from, a survey was considered the best for a number of reasons. Of the five research types it best answered the main focus of the research question. This question was of an exploratory nature and could be used to develop a hypothesis on cutflower grower decision making and propositions for further inquiry. A survey strategy utilised a wide range of other question types which provided the breadth of knowledge required in this study that most of the other research types, except archival analysis, did not provide. Archival analysis uses past data, and the focus of this study was on contemporary events, so this research strategy was discounted. The third criterion of Yin's was the degree of control exhibited over the subjects. In this proposed study, no control of the research subjects was required or desired so their behaviours in their natural settings could be observed, therefore an experiment was discounted as a research strategy. A survey would also provide a broad-based opportunity to observe and analyse a phenomenon previously inaccessible to scientific investigation (Yin (1994)).

A telephone survey was considered to be the best type of survey because of time and financial constraints, and the personal contact that could be achieved to allow probing and more open questions to be asked if necessary.

1.4.2 Case study

The first part of the multi-method approach was to gain a broad insight to the decision-making behaviour of cutflowers growers by carrying out a survey. The next step in the research approach was an in-depth analysis of key points of the findings of the survey. A case study was considered to be the best research method for in-depth analysis for a number of reasons. Case studies are particularly useful where one needs to understand some particular problem or situation in depth (Patton (1987)). A case study uses "how", and "why" questions suitable for an in-depth study, which are more explanatory in nature, along with histories and experiments. However, carrying out experiments requires control over the event, which was neither required nor desired for the study, and histories do not require control over the event but focus on past events, not the contemporary requirements.

Case studies can be both single - and multiple-case studies. In this instance, it was decided that an in-depth single case study would meet the requirements of the overall objectives of the study programme given its time constraints, but it is realised that even though one case study is adequate, a greater number would be better. A single case study still gave the researcher an in-depth understanding of a situation.

1.5 Organisation of the thesis

To achieve the overall objectives this report of the study is organised into six Chapters as outlined below:

Chapter 2 gives a summary of the review of literature on decision making and decision-making models in primary production systems and proposes a new generic decision-making model. This Chapter was initially written as a paper that is currently in print for the July issue of the Journal of Applied Systems Studies.

Chapter 3 attempts to validate the generic model proposed in Chapter 2 and expands this model to describe New Zealand cutflower growing systems. This Chapter was initially written as a paper to follow on from the contents of Chapter 2, and is also currently in print for the July issue of the Journal of Applied Systems Studies.

Chapter 4 is a description of an in-depth case study of a grower who primarily produces sandersonia as a cutflower. It reveals the processes involved in his specific decision-making activities, and describes this decision-making behaviour over the range of decision types relating to his crop production cycles and methods.

Chapter 5 discusses and compares the findings of the case study given in Chapter 4, and the literature review given in Chapter 2, Chapter 3, and other relevant papers. The findings are also analysed against the two proposed decision-making models: a generic one (Chapter 2), and one of New Zealand cutflower growing (Chapter 3); and a number of changes to these models are proposed.

Chapter 6 summarizes the conclusions drawn from the literature, the survey and the case study described in earlier Chapters, and makes recommendations for further research.

The multi-method approach was useful because it added breadth and depth to the study, and overlapping and different data could be collected and analysed.

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Chapter 2: A Review Of Decision Making

This Chapter analyses the reviewed literature and then suggests a new generic model of decision-making. This Chapter has been reformatted from a paper currently in print[1]. Because of editorial constraints on page length for journal publication three described models have been included in Appendix 1.

2.1 Abstract

Many writers in the management literature have described management and decision-making processes, and have built descriptive and econometric models. Few descriptions have been made in the agricultural sector. The decision-making behaviour of horticulturists and in particular cutflower growers has been investigated even less. This paper reviews the literature on decision-making behaviour from a soft systems perspective including twelve decision-making models from a range of disciplines. Some models describe the decision-making process as an iterative process, others as a linear one. Each of these models can be categorised solely or partially as one of five accepted schools of thought described by Keen & Morton (1978). Analysis of these schools of thought indicates that the decision-making behaviour of agriculturalists and horticulturists falls most easily into *"the individual differences approach"*.

Based on the review of relevant literature, and empirical evidence, a generic seven-phase model of decision–making for primary production systems is developed.

Keywords: Conceptual systemic models; Decision making; Learning

2.2 Introduction

Agricultural production processes are characterised as open and highly complex systems affected by weather, soil, insects, diseases, weeds, nutrition, prices and interactions of many of these factors [Anderson, Dillon, & Hardaker (1985); Lentz (1998)] with management objectives and practices.

The need for more and better information on which people can base their decisions is not new. Neither are the descriptions of decision-making behaviour in the literature. Although there are numerous publications on decision making, there is still not a full understanding of the behavioural aspects of how people make decisions. This may be partially explained by the progression of theories that most researchers and teachers have used that started with "who" makes decisions. This has now progressed to "how" managers make decisions [McGrew & Wilson (1982)]. The normative approach describes how a "rational" person *should* make individual decisions given full information and an economic goal. The more realistic descriptive approach uses holistic studies to describe how managers *actually* make real decisions in a world of uncertainty [Öhlmér (1998); Öhlmér, Olson, & Brehmer (1998)], and how decision makers try to satisfy their personal values while being partially aware of all their options in the environment [Jabes (1982)].

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[1] Decision Making and Decision-Making Models in Primary Production Systems.
JL Catley, EM Hurley, EA Cameron, AJ Hall
In print for publication in the Journal of Applied Systems Studies.

Models and descriptions of agricultural decision making are generally based on normative, reductionist approaches [Wilson & Morren (1990); Öhlmér *et al.* (1998)]. Reductionism allows reality to be fragmented and studied as a representation of the whole. This is in contrast to holism that says no matter how much the individual parts are studied, the emergent properties possessed by the whole cannot be understood unless studied in its entirety. Use of traditional reductionist approaches may indicate that the developers of science-based models and descriptions do not adequately understand the dynamic and holistic nature of agricultural-based production system decisions and therefore cannot adequately explain growers' behaviour. Öhlmér (1998) lists examples where farmers are not using management services and tools to the extent expected. This lack of understanding may also explain why farmers do not always adjust production as anticipated by politicians and researchers, and why environmental policies and regulations very often have complex effects [Wossink, de Koeijer, & Renkema (1992)].

Thus, the aims of this paper are: (1) to review the current literature on decision-making behaviour and decision-making models in taking a strongly behavioural approach and; (2) to suggest a model of decision making based in systems analysis, that considers the complex and volatile environment in which decisions have to be made. A systems approach emphasizes the learning process and the need for multiple viewpoints of a problem solution [Checkland (1981)].

2.3 Decision-making paradigms

Keen & Morton (1978) have classified the literature on decision-making processes into five paradigms, ranging from entirely normative to entirely descriptive. Their diagnostic approach to studying decision making examines the process and structure of decisions in contrast to the more functional perspective used by managers, or the analytical classification used by management scientists. Each approach highlights key issues and often directly contradicts some other approach.

1. *The economic, rational concept:* This is the classical normative theory of decision making, based on theorems. It assumes that there is a single decision maker who is rational and completely informed, and is thus able to evaluate all alternatives. The decision maker is dissatisfied with any solution other than the best [Cyert, Simon, & Trow (1956); Cyert & March (1963)]. Many managers and behaviour-orientated management scientists reject this paradigm as impracticable and over-idealised. Nonetheless, it remains a dominant influence in economic analysis and with management scientists.

2. *The satisficing, process-oriented view:* The paradigm states that the aim of the decision-making process is to find the first cost-effective alternative by using simple heuristics, or rules of thumb, rather than optimal search techniques to make the best possible decision [Cyert *et al.* (1956); Simon (1965)] (satisficing and heuristics defined in Appendix A5.3 and A5.4).

3. *The organisational procedures view:* This concept of decision making focuses on the formal and informal structure of an organisation, its operating procedure, and channels of communication. Cyert & March (1963) offer a complete statement of this approach.

4. *The political view:* This approach is an extension of the economic rational approach – it emphasises procedures and consistency of behaviour and defines the organisation in terms of its structure and operations. However, many political scientists consider that decisions are made in relation to political constraints, aspirations and interactions. Allison (1971) regards the decision-making process as a personalised bargaining process between organisational units whereby the decision makers have strong individual preferences and vested interests, frequently dominated by bargaining and conflict. Keen & Morton (1978)

state that those who hold this view argue that power and influence determine the outcome of any given decision, so only small deviations from the status quo are normally possible.

5. *The individual differences approach:* This view argues that a decision maker has an unique and individual personality and style which strongly determines his or her choices and behaviour, and the outcomes of the decision process [Keen & Morton (1978)]. In the past few years there has been an increasing interest in this last paradigm.

2.4 What is decision making ?

Decision making is such a common activity that rarely is any thought devoted to discovering its reality. Definitions of decision making are hard to find. One's concept of the decision process largely predetermines one's response to other people's logic, behaviour and opinions. According to Keen & Morton (1978), the rational ideal stresses the need for definition of objectives, consistency and comprehensive analysis, whereas the pluralist tradition argues that it involves a multiplicity of goals and values, with fluid objectives, and incremental and situational analysis. Byrd & Moore (1984) describe decision making as "not a precise activity". The introduction of McGrew & Wilson (1982) is more definitive, stating that the concept of decisions and the study of decision making are "concerned with the choice between alternatives in a complex world". Simon (1960) cited in McGrew & Wilson (1982) extends this further by saying that "decision making as a process should not be reduced simply to a choice among alternatives" but "involves conceptualisation of the problem to be solved and the description of how that final choice is made". Jabes (1982) considers the person who is making a decision and defines decision making as "a complex process, unique for each individual in accordance with his perceptual, motivational and value makeup".

There are two main components of any decision situation. The first is the decision maker, and the second is the environment within which the decision must be made [Hardaker, Lewis, & McFarlane (1970)]. The decision maker may be an individual, a firm, or any other managerial entity, and is the fundamental but complex participant in decision making. Humans have many limitations, biases and emotions which all affect how and when a decision is made.

The environment often confounds the decision-making process by the existence of equally attractive, unattractive, or competing alternatives, and uncertainty. Orasanu & Connelly (1995) state that there are eight characteristics of real-world decision-making settings. These are: ill-structured problems; uncertain dynamic environments; shifting, ill defined or competing goals; action/feedback loops; time stress; high stakes; multiple players; and organisational goals and norms. Catley, Hurley, Cameron, & Hall (2000) have identified many of these characteristics as part of the decision-making environment of cutflower growers.

A decision is the cumulative sequence of stages of choice between alternatives. This is regardless of whether a conscious decision is made, and is the result of goal-directed behaviour made by an individual, in response to a certain need or want to resolve a problem, [Johnson, (1978) cited in Öhlmér (1998); Lentz (1998)].

The decision is regarded by McGrew & Wilson (1982), for example, as the end-state of decision making, but others [Hardaker *et al.* (1970); Giles & Stansfield (1980); Öhlmér (1998)], use more empirical approaches, and consider the decision-making process to also involve implementation and verifying the results of the decision. This implies that decision making is not a single step process. Many theorists have described decision-making strategies. The Agricultural Economics textbook by Kay & Edwards (1994) for example, describes the process of decision making as a "logical and orderly sequence of steps", which if followed, "will help any manager make a decision in a logical and organised manner". Miller and Starr (1967) cited in Byrd & Moore (1984), describe "incremental improvements" in moving towards an improved solution. Lindblom (1959) describes the process as "muddling through" and Mintzberg, Raisinghani, & Theoret (1976) describe decision making, based on their studies, as a "groping, cyclical process".

2.5 Decision-making models

There have been many attempts to analyse the decision-making process. One of the earliest was made by Wallis (1926) in his book *'The Art of Thinking"* cited in Mayer (1977), where he suggested four phases (Table 2.1). These stages are based on introspection by Wallis and others, and consider what they think they are doing when they solve problems, rather than on psychological experiments or observations. This approach has been the norm until recently.

Even so, since then, and currently, observations have shown that some of these elements described by Wallis are realistic. One of the first to outline the real world of decision making, Polya (1957), described four steps in his book *"How to Solve It"* cited in Mayer (1977). Polya's first three steps relate to the iterative phases described by Simon (1965). Mintzberg *et al.* (1976) initially described a similar trichotomy, but then further divided the phases.

Before the writings of Polya another Gestalt psychologist, Duncker (1947), concluded that problem solving proceeded in stages, going from general solutions to more specific ones, with the original problem being continually reformulated. Since Duncker, there have been more sophisticated attempts to investigate how problems are reformulated into smaller problems or sub-goals. One such technique developed by Restle & Davis (1962) was based on the idea that problem solving involves individuals going through a number of independent and sequential stages and solving a sub-problem at each stage, which allows the solver to start work on the next stage.

Mintzberg *et al.* (1976) proposed a strategic framework for organisations which concurred with basic conclusions of Witte (1972), cited in Öhlmér *et al.* (1998), delineating distinct phases of the strategic process, but not in postulating a simple sequential relationship between them. Their framework resembles Simon's but uses different terminology, and more phases.

Since the late 1970's many more decision-making models have been developed. For the purposes of this paper three categories: empirically, theoretically and agriculturally based models are recognised. Some of those discussed will fall into two of the three categories. The models of Hardaker *et al.* (1970); Rae (1977); and Giles & Stansfield (1980) have been reviewed, are theory-based, and describe decision-making as an iterative process. These models are an advance on those described in farm management texts. These texts either state explicitly, or seem to imply, that steps should be followed in a linear order for all decisions. A number of examples are cited in Öhlmér *et al.* (1998), using five to eight linear decision steps.

During the same timeframe, empirical studies by a number of agricultural management researchers (Table 2.1) found that decision makers do not follow a linear process. These researchers include Hardaker *et al.* (1970); Witte (1972) and Johnson (1976, 1986, 1994), all cited in Öhlmér *et al.* (1998); and Bawden & Macadam (1983). Lipshitz (1995) also reviews nine models from different non-agricultural settings. Each deals with real-world decision making by individuals.

Recently Öhlmér *et al.* (1998) synthesised conceptual models described in the literature into a single model (Appendix 1, Figure A1.1) but expanded it using farmers' decision-making behaviours gleaned from 18 case studies. Aubry, Papy, & Capillon (1998) studied the actual decision-making processes in the technical management of a crop, but because it describes specific crop management decisions it is not listed in Table 2.1.

In this and the previous section, the five decision-making paradigms have been described and a number of decision-making models have been reviewed. Each of these models can be classified, wholly or partially, as one or more of these decision-making paradigms. Table 2.1 shows the similarities and differences of some of these models described under eight headings. The model proposed by Bawden & Macadam (Appendix 1, Figure A1.2) is the only one that seems to make a conscious effort in deciding if the decision choice was a good one or not. The first column of Table 2.1 shows our suggested phases. Here, the eighth phase of Bawden & Macadam's model has been included in the authors' seventh phase. Many of these steps overlap and influence each other and not all of the steps are always involved. All of these models describe an iterative approach to decision making.

2.6 Aspects of decision making

Section 2.6 of this paper describes the development of understanding of decision making over time, and the various steps involved in this process. Unfortunately, real-life decision making is far more complex than shown in these steps as human emotions and attitudes are part of a dynamic and uncertain environment. Only Bawden & Macadam (1983); Aubry *et al.* (1998); Öhlmér (1998); and Öhlmér *et al.* (1998) have attempted to describe the "real face" of the decision maker taking a holistic perspective, even though during the same time period numerous studies have been carried out on decision-making behaviour, and the complex environment in which decisions are made.

Our phases	**Wallis (1926)**	**Simon (1965)**	**Öhlmér *et al.* (1998)**	**Rae (1977)**	**Bawden & Macadam (1983)**
1. Problem Detection			Problem Detection	Identify decision problem	Perceive problem
2. Problem Definition			Problem definition	Problem definition	Define problem, select features of problem, apply scientific explanations
3. Acquisition of Information	Preparation	Intelligence		Specify ways to overcome problem or alternatives	Generate alternative solutions
4. Consider Alternatives	Preparation Incubation	Design	Analysis and Choice	Specify ways to overcome problem or alternatives. Evaluate alternatives	Evaluate alternative solutions
5. Choice	Illumination	Choice	Analysis and Choice	Identify best alternative	Select optimal solution
6. Implement			Implementatat-ion		Implementation
7. Check and Judge Outcome	Verification		Checking, bearing responsibility	Accept consequences of actions	Validate outcome & judge problem solved

Table 2.1. Summary of the decision-making models reviewed.

2.6.1 Problem framing and prospecting

Definitions of a problem are varied. Lentz (1998) states there is a problem when someone is dissatisfied by a present or predicted situation. Wilson & Morren (1990) define it as "a perceived change that threatens a person's well-being or survival", or "a concern", while Holyoak (1990) states a problem arises when there is a goal - a state of affairs wanted to be achieved. Sitkin & Pablo (1992) state a problem can be viewed by a decision maker in either a positive or negative light, as an opportunity or a problem; or viewed by one person as an opportunity but by another as a problem [Wilson & Morren (1990)].

To resolve a problem, it must be perceived. A problem may be unseen to the person it affects, until it develops to become obvious. Both Öhlmér *et al.* (1998) and Catley *et al.* (2000) noted this in their studies, particularly when decision-makers' incomes are dropping. Not all problems can be easily described and few have readily apparent solutions. Öhlmér *et al.* (1998) found in some situations farmers had to search for the causes of the problem and in others the cause was known once the problem was realised. Even when a problem is detected, a decision is not always made, if a problem is not considered large enough, or too difficult to solve.

Identification of a problem may not be the only impetus in wanting to make a decision. Many cutflower growers, for example, continually assess and trial the crops they consider could be the best to grow in the future even though there is no perceived problem with their current suite of crops [Catley *et al.* (2000)]. They strive to achieve the goal they have for growing crops they are happy with. They also assess and trial new technology in the same way. Therefore the first phase in some decision-making processes may be in prospecting. The problem is *how* to decide on what crops to consider growing to meet their goal.

2.6.2 The decision process

The types of planning decisions that agriculturalists and horticulturists make, as a result of these problems, opportunities or prospecting, can be categorised as operational, tactical and strategic (defined in Appendix A.5.5). They were first defined by Anthony (1965), using the word "management" instead of "tactical". Simon (1965) later adopted these terms, and Keen & Morton (1978), Stuth & Stafford Smith (1993) and Lentz (1998) have subsequently also used these categories. Operational decisions include pest and disease management, irrigation and glasshouse control. Minimum judgement is required for these decisions as the tasks, goals and resources have already been defined. Tactical decisions are a mixture of planning and controlling, and relate to choices on obtaining and using resources once per cropping season. Strategic decisions can involve deciding on the company's objectives, changes in direction and on obtaining the resources to meet objectives. Such decisions are mainly orientated towards planning with time frames from 1 to 10-20 years. These include decisions about constructing new greenhouses, developing new marketing channels, and introducing new products.

Each of these decision types can be structured, semi-structured or unstructured. Structured decisions involve situations where the procedures to follow can be specified in advance and a decision's outcome can be determined with certainty if a specified sequence of activities is performed. Decisions of this type do not necessarily require a manager for them to be well made [Keen & Morton (1978)]. Unstructured decisions involve decision situations where it is not possible or not desirable to specify in advance most of the decision procedures to follow. Many decisions in the real world are unstructured, because they are subjected to many random or changeable events or involve many unknown factors or relationships. Tactical and strategic unstructured and semi-structured decisions are considered to be of greatest concern to decision makers [Gorry & Morton (1971)] and this is highly evident in agricultural decision making. Lentz (1998) summarises these complexities in his diagram of the tasks of a horticultural manager, and Stuth & Stafford Smith (1993) for an agricultural manager.

When the decisions are combined with the degree of structure they contain they can be shown as a two-dimensional framework describing nine categories in a horizontal and vertical continuum (Table 2.2). Keen & Morton (1978) describe each of these nine categories.

Management Activity			
Type of decision	**Operational**	**Tactical**	**Strategic**
Structured			
Semi-structured			
Unstructured			

Table 2.2. A framework of management activities based on level and purpose (adapted from Keen & Morton (1978)).

Any problem could result in any of the nine categories described in Table 2.2. Operational problems lend themselves more to structured decisions, (or rules of thumb), while strategic decisions require the decision maker to call on all their intellectual skills.

2.6.3 The decision maker

There is no universal profile of a decision maker. Payne, Bettman, & Johnson (1993) observed that individuals seem to make decisions using a variety of strategies, ranging from careful and reasoned examination of alternatives to simple and fast rules of thumb. They also have unique combinations of skills and knowledge, [McKenney & Keen (1974)] cognitive style, age and education level [Nuthall & Bishop-Hurley (1996)], and individual values and goals [Öhlmér *et al.* (1998)], and beliefs. These values and goals affect and may be affected by the outcome of a decision-making process, and are strongly intertwined with a person's beliefs. Fishbein's model of *"Behavioural Intention towards an Act"* as cited in Maughan (1980) makes a clear distinction between each of these.

According to the theoretical view of Hardaker *et al.* (1970), the decision maker is driven to achieve certain goals and objectives, based on their preferences between monetary and non-monetary factors and feelings about risk and uncertainty, for the long term or short term or both. Non-monetary factors include family decisions, the expected responses of their family, friends and colleagues, environmental sustainability, pleasure and pain, feelings of conscience, general well being and aesthetics. Shrader, Mulford, & Blackburn (1989); Öhlmér *et al.* (1998); and Catley *et al.* (2000), though, found most of their subjects had not formulated either formal or informal goals or strategic plans. Their values, similar to those listed by Hardaker *et al.* (1970) and "their gut feelings" identified in Shrader *et al.* (1989), were also the basis of the decision-making behaviour observed by Catley *et al.* (2000).

Making a decision is even more difficult when the limited processing capacity of people is considered [Hogarth (1980); Payne *et al.* (1993)], as they (including experts) have great difficulty in judging probabilities, making predictions, and coping with uncertainty. Hogarth (1980) extends this. His four major consequences of limited human information processing are:

1. People's perception of information is not comprehensive but selective,
2. People cannot simultaneously integrate a great deal of information, therefore they process information in a predominantly sequential manner,
3. Information processing is dependent on the use of mental operations that simplify judgemental tasks and reduce intellectual effort,
4. People have limited memory capacity.

Shepard (1964) suggests that the need to choose between alternatives often creates conflict for decision makers as they are not sure how to trade off one attribute for another, nor which attributes matter most. Slovic (1990) and Shafir, Simonson, & Tversky (1997) state that people have the ability to decompose decision problems, but cannot easily recombine them to arrive at an optimal or even satisfactory over-all decision. Research by Slovic (1990) has demonstrated that the information-processing mechanisms used in making choices are often quite different from the mechanisms employed in judging single options. As a result, choices and evaluative judgements of the same options often differ to a considerable extent.

Decision makers often attempt to resolve such conflict by seeking reasons for choosing one option over another. Experimentation by Slovic (1975) found people do not choose between apparently equal alternatives at random. They resolved the conflict by selecting the superior alternative in the most important dimension, to provide a compelling reason for choice. Contrary to this, the preference reversal phenomenon of Lichtenstein & Slovic (1971) states when people attach a higher value to one of two options, they often choose the one perceived to have the lower value. Shafir *et al.* (1997) noted that the positive features of options loom larger when choosing, whereas the negative features of options weigh more heavily when rejecting. At times, the conflict between available alternatives is hard to resolve, which may lead decision makers to seek additional options, to delay their decisions or to maintain the status quo. The reasons for this are based on the value of the best available option, and on the difficulty of choosing among the options under consideration [Tversky & Shafir (1992)].

2.6.4 Time

Time has two dimensions in this context. Time constraints can cause personal stress, and shifts in the decision-maker's thinking [Payne *et al.* (1993)] because decisions have to be made sooner than desired. Timing is even more crucial as the human decision maker is prone to making errors, particularly when a decision is made under time constraints [Hogarth (1980)].

Decisions are continually being made, but often must be made before definitive outcomes are known, although more information becomes available as time progresses. This means the decision maker can draw only on historical evidence and best guesses about events that will happen at some future time as the basis of a decision [Hardaker *et al.* (1970)]. Time influences the importance the decision maker places on optimising or justifying a decision. When time is not limited then optimising and justifying decisions are made. When time is limited though, it causes information overload and a sense of confusion that can paralyse inexperienced decision makers. Contrary to this traditional view of choosing between alternatives Klein, Calderwood, & MacGregor (1989) state that proficient decision makers still manage to be effective under high stress and time pressure, where they rarely compare among alternatives, but select an action appropriate to the situation.

2.6.5 Risk and uncertainty

There are three environmental conditions under which decisions are made; certainty, risk, and uncertainty. Certainty exists when the outcome of alternative actions can be accurately predicted. Risk is defined by Sitkin & Pablo (1992) as the extent to which there is uncertainty about whether potentially significant and/or disappointing outcomes of decisions will be realised. There are three major sources of risk involved in producing agricultural commodities: production risk, market risk and financial risk [Kay & Edwards (1994)]. Separation of these three types of risks is not simple though. Decisions on the choice of growing a crop, its area, or its timing will involve both market and financial risk effects. Crop failure means exposure to all three types of risk.

The New Collins English Dictionary defines "uncertain" as "not able to be accurately known or predicted " or "liable to variation". Uncertainty can be limited or complete or anywhere between these two forms, and the more uncertainty associated with a problem, the more difficult the decision-making process is. Four sources of uncertainty have been identified by Orasanu & Connelly (1995) and observed by Catley *et al.* (2000) in their study. These include incomplete information; unreliable or ambiguous information, rapidly changing situations and purposefully misleading information. Catley *et al.* (2000) also found that some cutflower growers were deceived purposefully by other cutflower growers.

The definition of risk by Sitkin & Pablo (1992) captures three outcome dimensions; uncertainty, expectations, and potential, and is most commonly associated with outcome uncertainty. A person's propensity to risk, defined by Weber & Milliman (1997) as the observed likelihood of a person taking or avoiding risk, is determined by two personal attributes: their *risk preference* and their *risk perception*. Risk preference is a person's character trait of being attracted or repelled by risk; whereby the preference for achievement is stronger in some individuals than their desire to avoid failure as illustrated by research by McClelland (1961). Risk perception is a person's recognition of the risks involved in making a choice. Individuals are not consistent at risk seeking or risk avoiding across domains or situations, due to their perception of risk, relative to their stable risk preferences. These differences have been demonstrated by Sitkin & Pablo (1992) and Weber & Milliman (1997); and can change with time. MacCrimmon & Wehrung (1990) found more mature decision makers were consistently more risk adverse than those less mature. Testimony given to Catley *et al.* (2000) also supports this. Both these personal traits combine to form three basic groups of people: risk-averse, risk neutral and risk seeking [Moore & Thomas (1988)] and all variations between extremes [Weber & Milliman (1997)].

The risk that a decision maker will take is also influenced by factors other than their propensity to risk. Sitkin & Pablo (1992) conclude that the characteristics of the organisational context and that of the problem itself are also important. Others include: the group composition, the organisation, cultural risk values, leader risk orientation, and organisational controls of the organisation; and the decision-maker's familiarity and their framing of the problem (for example, viewed in a negative or positive light). In particular, there are two views on whether experience (and a person's prior decision-making behaviour) makes a decision maker more risk averse [Tversky & Kahneman (1973)] or not [Thaler & Johnson (1990)]. The prospect theory formulated by Tversky & Kahneman (1973) also notes that positively framed situations led to risk-seeking behaviour, whereas negatively framed situations led to risk-avoiding behaviour.

2.6.6 Information

Hogarth (1980) and Payne *et al.* (1993) consider that how well decision makers deal with a judgemental task is largely determined by whether the information they require to make a decision is presented to them sequentially or simultaneously, because a person's powers of computation and memory capacity are limited. Ideally, it is required in a selective and sequential form. Though there are normally large volumes of data available, to be useful it has to be processed into information, taking time and effort. Information and time can reduce the uncertainty and risk of a decision, and can be the key to success [Wagner & Kuhlmann (1991)]. The information available to the decision maker may be abundant, reliable and highly relevant to a decision, but more often it is sparse, unreliable and of doubtful relevance as in cutflower growing [Catley *et al.* (2000)], and agriculture [Hardaker *et al.* (1970)].

Detection of a problem induces the decision maker to engage in searching for information about ideas and options. Initially the decision maker relies on memory or past experiences. If this is not sufficient, then written material and external sources are used [Öhlmér (1998); Catley *et al.* (2000)]. This information is then assimilated and added to a person's knowledge base [Barrett & Jacobson (1995)]. The length of time a person spends on an information search depends on the magnitude of the problem perceived. This explains why Öhlmér (1998) found that many decision makers often detect a problem very late, if at all.

A survey carried out by Ford & Babb (1989) showed that farmers had a preference for external information to be personal, service-oriented and oral. Öhlmér (1998) found public sources of information were not widely used by the farmers surveyed, but that farm and horticultural magazines reached many more farmers than other sources of information. Catley *et al.* (2000) found cutflower growers talked amongst themselves in considering the alternatives when making some decisions. These were more likely to be operational and tactical decisions rather than strategic ones, as the latter could lead to a competitive advantage. The information required for these different levels of farm management is very different for each category (Table 2.3). These information categories and levels are trends rather than absolute values.

Information variable	Operational decisions	Tactical decisions	Strategic decisions
Accuracy	High	←——→	Low
Level of detail	Detailed	←——→	Aggregated
Time horizon	Present	←——→	Future
Frequency of use	Frequent	←——→	Infrequent
Source	Internal	←——→	External
Scope of information	Narrow	←——→	Wide
Type of information	Quantitative	←——→	Qualitative
Age of information	Current	←——→	Past

Table 2.3. Information characteristics (adapted from Keen & Morton (1978))

People's actions are sources of bias. Hogarth (1980) lists these sources of bias in detail in four areas: information acquisition, processing of information, output and feedback.

There are several sources of memory bias during information acquisition [Hogarth (1980)]:
1. The ease with which information can be recalled from memory,
2. The mind does not register what it cannot perceive,
3. People judge their strength of predictive ability by frequency rather than relative frequency,
4. Information that is "concrete" is more salient in memory than information that is abstract.

Sources of bias from the environment during information acquisition include [Hogarth, 1980]:
1. Order effects. Sometimes the first in a series of items dominates, sometimes the latter,
2. Availability bias,
3. The way information is presented and whether it is sought or given.

Biases also occur as a result of selective perception [Hogarth (1980)]:
1. People structure problems on the basis of their own experience,
2. Anticipation of what one expects to see biases what one does see,
3. People seek information consistent with their own views/hypotheses,
4. People downplay/disregard conflicting evidence.

Biases in processing information can be induced by both one's memory and one's environment [Hogarth (1980)]. The bulk of biases result from task variables, the unwillingness to expend mental effort, and the major source - lack of consistency in making a judgement, particularly in being able to apply the same judgemental rule across a series of cases. Bias processing variables include the amount of information, time pressures, data presentation formats, and inconsistent or missing values of information. It is not helped by a general preference to avoid direct comparisons or trade-offs amongst different information sources, and an over-reliance on subsets of information that can lead to choices that are inconsistent with a person's preferences.

Output biases appear to be triggered by the way people express judgement or choice, the way they are required or choose to make judgements, the way responses are recorded, and their outcome preferences. Feedback on judgement is also critical as it effects learning. If no feedback accompanies a person's judgement, then learning simply cannot occur.

2.6.7 Learning

The process of learning is a synthesis of finding out and taking action [Bawden (1991)] and can be viewed as a learning cycle as described by Kolb (1984) (Appendix 1. Figure A1.3). It enables people to make sense out of and gain some control over the ever-changing world. People learn through new and recurring experiences involving other people and the physical environment by adapting themselves to changes and by using new understandings to change the situation being experienced through the way they make decisions. Environments shape people, and people, in turn, shape environments. People learn by doing, seeing the changes in their environment, observing the consequences, absorbing their implications, planning further acts, and producing knowledge for themselves. Problem solving is therefore a learning process.

"What we do in this world is determined by the way we see it" [Maturana and Varela (1972) cited in Bawden (1991)]. Each person sees a different world. It is not just that individuals differ in their interpretation of the same reality – there cannot be the same reality for any two or more observers. Each person goes about "seeing" their "reality" through their own "little window on the world"; a Weltanschauung. It consists of the experiences, feelings, emotions, attitudes, values, morals, beliefs, tastes, personalities of individuals, as well as their patterns of reasoning, and intelligence and their store of knowledge [Wilson & Morren (1990)]. It in turn shapes the way people handle issues in their world [Bawden (1991)], and reflects the personal disposition individuals display as they learn. The uniqueness of an individual's experiences, of the way one goes about making sense out of them, and of one's resulting actions, makes learning very personal. Research by Kolb and his associates indicates that each of us forms a unique approach to learning, problem solving and decision making. This is in relation to the opportunities and challenges faced, the way people apprehend new experiences, how they grasp the issues involved, and how these issues are eventually transformed into knowledge. Thus the way people go about learning will influence that which is eventually learnt and how decisions are made.

2.7 A generic model of decision making

Table 2.1 and Section 2.6 show the components of a number of reviewed decision-making models. In analysing Table 2.1 in a linear form, many of the general steps are similar.

Our proposed model is best presented diagrammatically (Figure 2.1). We have incorporated the best features of all the models reviewed. Essentially though, we consider that modifications based on the key elements of the matrix model by Öhlmér *et al.* (1998), the cyclic model by Bawden & Macadam, and elements of the Kolb cycle described in Section 2.6 and Appendix 1, will help to improve understanding of decision making. The model by Öhlmér *et al.* (1998) is made up of four phases and four sub-processes, some of which (for example, "search for information") are intertwined through all four phases. It is an expansion of a synthesis of conceptual models described in the literature. Öhlmér *et al.* (1998) consider that the matrix is a better representation of how farmers make their decisions, rather than a linear portrayal. Unfortunately, it does not demonstrate either the cyclic or highly iterative nature of decision making. Bawden & Macadam's model is cyclic but not iterative. It does however include an eighth step, judging whether or not a problem is solved. We have included Bawden and Macadam's eighth step as part of our seventh step.

Our model is proposed as a generic model for primary production systems, and contains seven phases. These phases are listed in the first column of Table 2.1 for comparison with some of the models that have been reviewed.

There are a number of key differences in our proposed model. Firstly, many of the papers cited list only the model components; and do not attempt to show the cyclic and iterative interrelationship of these. Secondly, we want to emphasize that all the phases are highly dependent on a number of factors. These include the goals, aspirations and preferences of the decision maker; and external factors which influence their views of and actions in the real and complex world; the degree of risk and timeframes they are making their decisions under; and of course, the nature of the problem or prospecting needed. Thirdly, we have added a new dimension to identifying a problem. Prospecting is not included in any of the literature cited but was shown to be an important trigger to embark on these decision making steps in relation to new crop choices [Catley *et al.* (2000)].

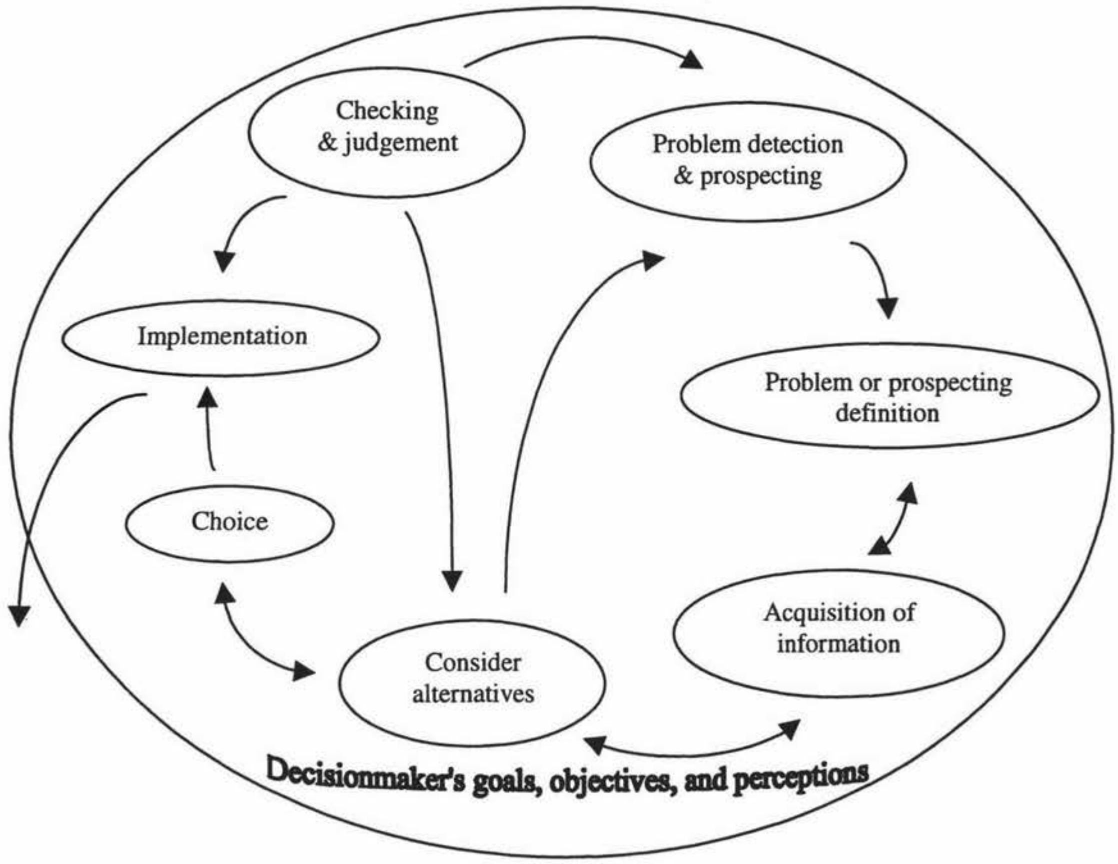

Figure 2.1. Developed generic model.

Fourthly, our model indicates the possible phases in a range of decision-making situations that have been described throughout the text in this paper. It reflects decisions made under all degrees of uncertainty and risk, for example, some problems will be identified and solved under complete certainty - not a common occurrence in primary production. In most real-world situations risk and uncertainty will be present to varying degrees. Decisions on problems of greater uncertainty and perceived risk will be more iterative in nature, as the decision maker relies on increasingly greater amounts of information and past experiences. Our model also describes the decisions made over a range of decision types, whether they are operational, tactical or strategic. The time frame after identifying a problem will vary depending on the problem, and decision type, and the decision maker.

2.8 Conclusions

Decision making and decision-making models have been described in many disciplines over the last 75 years. Much has been learnt about decision making over this period of time, but it has only been in recent times that decision makers are considered to be highly individualistic, and can be swayed in the decision-making process by many interacting complex personal and environmental factors. This knowledge has come about through increased empirical studies rather than making theoretical assumptions about decision making and decision makers.

Unfortunately there is still a large gap between those who develop decision-making models and those who endeavour to understand why decision makers behave the way they do. This paper is an attempt to bridge this gap, firstly by reviewing the literature on decision making from a theoretical, and an empirical point of view, as well as behavioural and psychological approaches. This paper concludes that all decision making is potentially cyclic and iterative; and that the steps taken are highly inter-related. Decision making will occur on identification of a problem or for prospecting. Every decision and decision maker behaves in a different manner and timeframe depending on personal goals and experience, and the nature of the existing environment. These conclusions were combined with the best features of the models reviewed, to form the model shown in Figure 2.1.

This paper touches only the tip of this highly complex and dynamic topic, but sets the scene for a more detailed study and analysis of New Zealand cutflower growers that will follow this paper. It also highlights points to consider and raises many theoretical and empirical questions for researchers in this area to consider and develop.

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Chapter 3: Cutflower Model Development

The Chapter attempts to validate the generic decision-making model suggested in Chapter 2 by analysing data gathered from within a group of cutflower growers in New Zealand, as well as deciding on its applicability to cutflower growers. This Chapter, like Chapter 2 has been reformatted from a paper currently in print[2].

3.1 Abstract

Although cutflower growing is a worldwide multimillion-dollar industry, few studies have been made of the decision-making behaviour of cutflower growers or the environment in which they make these decisions. The sale of flowers is lead by ever-changing fashions, and the economic and personal reasons that encourage people to enter or leave the cutflower growing industry. Growers have to make constant decisions about what crops to grow, when, and how; and where and how they will market their flowers. Their decisions are based on their past experiences, their values and their attitudes, and the availability of information. These points are discussed in this paper, and a behavioural approach is used as a basis for discussing these points. The conclusions drawn are based on telephone interviews with cutflower growers from the Central Region Flower Growers' Group (New Zealand). Validation of a generic model of decision making developed in an earlier paper is attempted.

Keywords: Conceptual systemic models; Decision making; Information

3.2 Introduction

Many decision-making models have been, and are being, described for other disciplines [Öhlmér, Olson, & Brehmer (1998)] but very few about horticulturists. Recently, Öhlmér (1998) and Öhlmér *et al.* (1998) have described decision-making processes within agriculture. Aubry, Papy, & Capillon (1998) have also modelled farmers' decision-making processes during the technical management (defined in Appendix A5.6) of an annual crop. In New Zealand, Rae (1977) described the decision-making cycle for farming. Lewis (1981) also described decision-making in horticultural firms on a theoretical basis, but did not develop an empirical model of decision-making in horticultural firms.

Cutflower growers in New Zealand must contend not only with the complexities of the natural elements, but also with highly volatile fashions and competitive marketing of their product, where they are price takers. This paper proposes to validate the generic model of decision-making developed in Catley, Hurley, Cameron, & Hall (2000) using a sample of New Zealand cutflower growers. This paper also identifies and describes the diversity of individual grower's decisions, the processes they go through to make these decisions and their reasoning. The resulting information will assist the participants in the cutflower value chain to gain a better understanding of decision-making behaviour of cutflower growers, so they are better equipped to service growers' needs. It will also allow cutflower growers an insight into the conscious types of decisions they make and the reasoning behind them.

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[2] Decision-Making Behaviour Of New Zealand Cutflower Growers.
JL Catley, EM Hurley, EA Cameron, AJ Hall
In print for publication in the Journal of Applied Systems Studies.

The objectives of this paper are to: 1) describe the decision-making processes used by New Zealand cutflower growers based on data gathered from an in-depth telephone survey of Central Region Flower Growers' group; and 2) validate the descriptive model of decision-making developed earlier by Catley *et al.* (2000) using New Zealand cutflower growing systems.

3.3 The New Zealand cutflower industry

The New Zealand cutflower industry is young and collectively relatively unsophisticated. It is made up of ~2500 highly diverse and competitive individuals and transient businesses. Many belong to a regional or product organisation, which comes under the umbrella of the newly formed national cutflower growers' organisation, FloraFed. These growers are spread throughout New Zealand, but the highest concentration is in the Auckland region. Growers can be usefully categorised in the following ways as: full-time or part-time growers, new growers or established growers, and by the number of generations the family has been growing. All growers fall into several categories. There are few statistics on New Zealand cutflower growers other than having their names listed on a very recently created database held by FloraFed and not publicly available due to stringent New Zealand privacy laws. There is also room for improvement in knowledge of how and why growers make decisions.

Most growing operations are run as family units, and many have other sources of income. Large proportions of these growers produce a highly diverse range of cutflower crops in relatively unsophisticated growing structures. The New Zealand cutflower industry is made up of a high proportion (~80%) of small growers, but the larger growers produce the majority of the export flower crop. Just 20 members of the New Zealand Exporters Association produce more than 95% of the total export turnover of cutflowers [de Graaf (1998)]. This has not changed a great deal in 17 years, as in 1981, fewer than ten full-time growers collectively exported ~80% of the cutflower crop [Ivess (1981)]. Although there is a stable core of growers, survival of individual growers' businesses is considered to be tenuous, as there is a high attrition rate. It is commonly considered that two out of five growers will not be operating three years after they have started growing.

Until about 15 years ago the number of cutflower crops grown in New Zealand was very limited, concentrated around chrysanthemums, carnations and roses. In the mid-eighties, as economic downturn occurred and as customers became more aware of global fashion trends, many growers were forced by either dropping profits or the prospect of falling profits to start looking for alternative crops to grow. This started a flood of new crops entering the market place. With this, changes occurred on growers' properties: they started to grow a range of crops rather than one or two, and they had to be constantly aware of market demands and make frequent decisions about what crops to grow, and learn how to grow them.

Today, approximately half of the national cutflower production of $NZ46 million is exported [Collins (1999)]. This constitutes an international market share of 0.5%. The most important export crops are cymbidium orchids ($NZ 19.1M (fob)), zantedeschia ($NZ 9.7M (fob)) and sandersonia ($NZ 3.8M (fob)) [Collins (1999)]. Almost 70% of New Zealand flowers are exported to Japan, 5% are destined for the United States, 4.5% go to the Netherlands and 2.5% are exported to both Italy and Hong Kong [de Graaf (1998)]. These exported crops are sold either through an exporter or broker at a fixed price or then auctioned, and sold directly overseas. Locally sold product is generally distributed through the auction-based markets in the main centres; or sold directly to florists, supermarkets and other retail outlets.

3.4 Grower survey

Using a behavioural approach [Dillman (1978)], standard telephone interview techniques were used to conduct this in-depth survey. A letter was sent on 25th August 1998 to a random sample of 50 of the 90 known members of the Central Region Flower Growers' Group, which draws its membership from the southern North Island of New Zealand. The letter asked if they would be happy to be interviewed by phone for ~20 minutes within the next month. Four people declined to be interviewed. Members of this specific growers' group were selected because the interviewer believed they were a highly representative subset of New Zealand cutflower growers, and because of their expected abilities to describe their own decision-making behaviour, based on Theoretical Sampling according to Glaser & Strauss (1967). The aim of data collection was to learn incrementally about this sample.

The telephone interviews (Appendix 2) were conducted between the 15th September and 2nd October 1998. All interviews were taped, and then transcribed. Once 26 interviews had been conducted, it was likely that new information would not be forthcoming (Theoretical Sampling Saturation according to Glaser and Strauss (1967)), so no further interviews were carried out. Once all the interviews had been transcribed, key concepts were systemically extracted. All the growers interviewed had succeeded in remaining in business for the first crucial three years.

3.5 Survey findings and discussion

The New Zealand cutflower industry is made up of a highly diverse group of people. Those who took part in the telephone survey were no less dissimilar. The authors consider this sample was robust enough to describe much of diversity of the decisions made within the cutflower growing industry in New Zealand. Some were second generation growers; others were new growers who had changed or retired from other careers. Most of the growers grew a range of crops, on a range of different sized operations. They had been growing for an average of just over 16 years (range: 3-50+ years).

From among the paradigms described in Catley *et al.* (2000), analysis indicates that New Zealand cutflower growers fall most easily into *"the individual differences approach"* paradigm described by Keen & Morton (1978). These growers behave very much as individuals (or partners). Simon's approach, *"the satisficing, process-oriented view"* describes the goals of a decision-maker as making a good decision, but not necessarily the best possible decision. This description most closely resembles the approach taken by growers, given their constraints of time, money and uncertainty [Simon (1965)].

The interview data show that all growers made a range of strategic, tactical and operational decisions in their starting to grow flowers, or during the course of their yearly and daily operations. Catley *et al.* (2000) describe a generic model in which the decision-making process, regardless of decision type, is seen as a seamless loop involving: problem detection and prospecting, problem definition, information gathering, consideration of alternatives, choice, implementation, and checking. Feedbacks are provided from these choices made and the checking done to consider other alternatives. Further checking or consideration of alternatives can give rise to the detection of new problems or opportunities. The above decision-making activities provide a framework for presentation of the results, and validation of the generic model.

3.5.1 The decision-makers' environment

For cutflower growers to be skilled and profitable, they must possess a sound knowledge of a range of horticultural disciplines. These include crop culture and management, technology and using machinery, personnel skills in handling labour, and knowledge of government legal policies and laws. They must also be astute marketers with a sound knowledge of how the market operates, what the present price levels are and how they are expected to change in the short and long term.

Every cutflower grower is different but the survey indicates that Central Region Flower growers have very similar decision-making drivers to those described by Öhlmér *et al.* (1998) - their goals, values and beliefs. These goals are based on their preferences between monetary and non-monetary factors; their feelings about risk and uncertainty [Hardaker, Lewis, & McFarlane (1970)]; their abilities to filter and assimilate large volumes of information given the limitations of human processing [Hogarth (1980)]; and their experience in cutflower growing, and what they have learnt about past decision-making experiences. Individually the blends of these driver elements are as numerous as the number of growers surveyed, except for one common goal – making a profit. Even so, some growers are more profit driven than others. The growers interviewed listed many goals. For example:

> "*I want to leave something for my wife and the kids*",
>
> "*I wanted an independent life, to be self-employed and to make the best of it*",

and

> "*I want to be debt-free in x years*".

The personal circumstances of the growers and their age influenced formulation of these goals. Many of those who were growing flowers on a part-time basis were less profit driven than the younger full-time growers. Several part-time growers said that they would make quite different decisions, particularly on the crops they were growing, if they were full-time growers, yet other part-time growers were actively striving to grow economically viable crops of the highest quality. The few values that growers cited were not financially orientated. For example:

> "*I want to leave my land in a better state than I bought it in*".

A number of growers had views that were strongly influenced by how long they had been growing flowers. Some of those who had been growing for some time did not like new growers or people who were buying 10-acre blocks and planting flowers just to get around local body planning permission. For example:

> *"There is a lot of competition, because lots of people have small blocks", "There are too many hobbyists and part-timers, and a lot of retired people. They swamp the markets and tend to produce inferior quality",*
>
> *"There is more production around especially of "fodder" crops that erode the price of others away. They are competing against your flowers".*

In contrast, newer growers said,

> "*Established growers didn't like to talk as they thought you were threatening their patch*", and
>
> "*Growers are very secretive*".

Several growers suggested that planning was the hardest part of growing. Of the 26 growers interviewed, 19 had a long-term plan. Only some of these growers had formal written down long-term plans and goals. Most of these growers were those who had taken over family businesses or had changed career paths to go into cutflower growing. These plans were developed over a period of time by a formal process.

> "*I'd done a strategic planning course... part of that was to do a business plan*",
>
> "*We have a formalised plan...31 pages worth, that is reviewed every 6 months*".

Other growers found it difficult to formulate a formal long-term plan

"I try to have goals and aims...but they are often hard to attain because things happen that you don't expect to happen, especially in my sort of business".

or had not seriously thought about long-term plans,

"No, I just hope that I am growing something",

or had plans in their minds.

"I have a very good picture in my mind of where I am and where I am going".

"You have got to be flexible. Know your overall goal, but sometimes you have to shift the pieces around to get there. Things change and you have to go with it, you have to be flexible in changing varieties", and

"The plan changes all the time but the direction is the same".

Many of these growers could not see that changing their short-term goals could leave their long-term goals intact.

"I don't have any goals and objectives because things change all the time".

The growers' environment has a profound effect on their decision-making behaviour. It confounds the decision-making process with competing alternatives, uncertainty, and other decision makers. Making decisions as a cutflower grower is fraught with uncertainty. Complete and/or reliable information is rarely available, particularly in a rapidly changing market.

"Nobody could tell me what I was going to make off this...I couldn't really even do any budgets or anything because I had no idea what I'd be earning...".

Nearly all of the growers interviewed had a partner in the business. For these partnerships to be successful many businesses had specific roles for each partner.

"I deal with the money side of things and the picking and my wife does the grading, packing and delivery of the flowers. We both sort out how we will market things".

Compromises were made to suit individuals' needs.

"She doesn't operate that way so there have to be compromises",

"We have had to adjust to short-term goals as we have different long-term goals",

"One of us needs more social contact than the other... ".

A grower's decision-making behaviour is also influenced by the familiarity of the problem.

"It took 5 years to figure out how to...and now I can do it straight away",

"You never stop learning – it's an age thing".

And whether the problem is viewed in a negative or positive light,

"I am constantly looking out for new lines".

Changes to legislation affecting growers through the Resource Management Act (1991) and the Health and Safety in Employment Act (1992) also affect how and why growers make decisions.

3.5.2 Problem detection and prospecting

According to Kay & Edwards (1994), there are three types of problems that are found in agriculture and horticulture. These are *what* to produce, *how* to produce, and *how much* to produce. Cutflower growers also have to make decisions about *when* to produce. When a person decides to enter the cutflower growing business, answers to each of these questions will influence their decisions on the location and type of land they will eventually grow on. Their answers will formulate short and long-term goals.

Kay & Edwards (1994) also consider that each of these questions has three basic characteristics: the goals to be attained; the limited amount of resources available; and the alternative ways to use the limited resources in attempting to attain the goals. The following statements are examples of the problems that growers indicated they wanted to solve:

"How can I make a better profit?",
"I need to increase my income over the winter months",
"How do I change my lifestyle?",
"I need to change jobs, because I am sick of current job",
"I want to be self employed",
"We need more farm income",
"I want something to keep me busy",
"Profits are dropping, therefore I need to change the crops I am growing or when I grow them",
"I need to spread my labour requirements out".

Growers facing these problem types do not always systematically answer particular questions before moving on. Often they cannot as the alternatives or the choices made will affect other decisions.

Holyoak (1990) states that a problem arises when someone fails to achieve a goal - a state they want to achieve. To resolve a problem, it must be perceived. The growers interviewed considered that problem perception was a "slow realisation" rather than a "bolt of lightning" except for pest and disease incursions. Once perceived, a person may not act on solving it immediately or at all. Dropping profits of cutflower growers are a good example of this. Growers said they either suddenly became aware of dropping profits even though they had been occurring for some time, or they were aware that profits were dropping off but they decided not to do anything about it until they dropped below a certain level.

Perception and identification of a problem may not be the only impetus in wanting to make a decision. Many of the cutflower growers interviewed were always on the lookout for opportunities by continually assessing and trialling the crops they considered could be the best to grow in the future even though they had no perceived problem with their current suite of crops. Their past experience and "gut feelings" had told them that the prices of their current suite of crops would eventually drop, and that they had to start looking for new opportunities rather than waiting until it became a problem. They also take the same approach to new technology, particularly to reduce their labour requirements (and their labour bill). Therefore the first phase in some decision-making processes may be in prospecting, particularly when making crop type decisions, where the problem is to decide on what crops to consider growing to meet their goal, rather than saying:

"I need to change one or some of the crops that I grow".

3.5.3 Problem framework and definition

A problem, according to Sitkin & Pablo (1992), can be viewed by a decision maker in either a positive or negative light, as an opportunity or a problem; or viewed by one person as an opportunity but by another as a problem [Wilson & Morren (1990)].

The greatest variation in the types of decisions that the growers interviewed made, was in making strategic decisions. The growers interviewed did not use terms such as strategic, tactical, or operational decisions, or even short and long term decisions, they just spoke of the specific decisions they had to make, so the classification arises out of the researcher's analysis. Strategic decisions can involve deciding on the business' objectives, changes in direction and on attaining the resources to meet objectives. Such decisions are mainly orientated towards planning with time frames from 1 year to 10-20 years, and can include decisions about constructing new greenhouses, developing new marketing channels, and introducing new crops or products. This is not surprising, as the background of each was often quite different. To start growing, eleven interviewees had to buy land – four bought established properties, and five bought bare land with the express desire to grow flowers. For these people this was a conscious decision

"I want to grow cutflowers, and I have to find a means of doing this".

Two growers had no specific use in mind for the land that they bought. Ten growers already had the land when they decided to enter the flower growing industry. All of these people were running some other form of land-based business, such as farming.

Some of the reasons given by them for entering this industry were:

"I liked flowers and gardening and wanted to make some money out of it",

"I wanted to work from home", and

"I needed to offset the agricultural downturn".

Invariably this group started out on a part-time basis, and five are still part-time growers.

A total of five growers did not have to make land-type decisions because they moved into an established, family-run enterprises. Four of these growers did not join their family businesses immediately. They either went overseas or started out on other career pathways, but eventually decided to go home and work in the family business. Interestingly, the grower who joined the family business on leaving school was one of the oldest growers interviewed. Those who bought established properties or started working on the family unit initially continued with the same crops that were being grown.

After establishing where the crops were to be grown, choosing what crop(s) to grow was the next biggest decision. Crop choice was the decision that all growers spent the most time talking about. Demand for flowers is dictated by fashions that change rapidly. Many of the growers surveyed realised this and wanted to grow flowers that were in demand, but they had great difficulty in predicting what the trends would be and the returns for growing a new crop. The growers interviewed tend to make tactical or strategic crop decisions, but not both. Tactical decisions are a mixture of planning and controlling, and relate to choices on obtaining and using resources each crop cycle.

When growers were asked what type of problems they faced, nearly all were identified as operational and tactical problems rather than strategic ones. Again, decision types were not mentioned by name. Operational decisions are daily or weekly decisions and includes pest and disease management, irrigation and greenhouse control. Some said that they had very few problems in making such decisions due to their experience, others had a lot of problems solving them because of a lack of information or contacts to ask. Of those who did have problems, they were concerned with inclement climate, pests and diseases and off-the-property-bottlenecks such as transportation and the way the markets operated.

There was a great deal of variation in the ways in which the interviewed growers aimed to achieve their long- and short-term goals. Some growers were very fixed on the crops they had planted or planned to plant up to several years in advance, even though a new opportunity may have arisen.

"You couldn't afford to chop and change the whole time".

Other growers took the opposite view.

"You have to be adaptable to the conditions that prevail",

as demand for flowers is fashion-based. Many growers also had the flexibility of utilising unused land if they desired. Deciding to grow a new crop was made easier for these growers, as they did not necessarily have to drop one of their current crops for a new one.

3.5.4 Acquisition of information

In making decisions all growers knew that they required information to help them, but how people tried to gather that information and how much they gathered varied considerably. To make decisions, information is vital, but many of the growers interviewed found it was very difficult to identify who could help them, or where they could get the required information.

This was particularly apparent when a person had just entered the industry. They found that initial contacts were difficult to make, but once they made one or two contacts, information was a bit easier to find. Most new growers wanting to buy land or an existing business tried to acquire as much information as possible. They found it very difficult to get information from other growers about how to get into floriculture and/or what to grow because they were regarded as potential competition, and several growers now believe they were given inaccurate or corrupt advice. These growers realised later, that the information provider could see they lacked experience, so they believed they were taken advantage of. This situation was made worse because they did not seek information from a sufficiently wide range of sources. These growers did not gather more information for a number of reasons: they did not know where to get it; they were turned away by other growers they asked; or didn't think it was necessary to ask anyone else. Friction between new and established growers, as stated by a number of growers, seemed to arise because new growers are invariably part-time growers. It is considered that new growers tend to produce a low quality product that has detrimental effects on the prices that established growers get on a frequently already over-supplied market. In contrast, a few growers took the view that if potential new growers were given all the facts, they may either decide that floriculture is not for them, or start out producing good quality flowers that do not affect the prices the established growers receive.

As growers became more experienced, they found that they were seeking different types of information – information that was specialised and either difficult to locate or not available at all. This more specialised information was commonly cited as cultural information about a new crop that a grower was contemplating to grow or one that they had decided to grow. New Zealand is known for growing new and novel niche products. Information on these crops is often non-existent or only available overseas and if so, commonly in a foreign language. This scenario was discussed by a number of interviewed growers. Talking to other growers was often cited as a good means of overcoming a lack of useful information. In these situations though, growers often resorted to a "*trial and error*" approach because they didn't want other growers to know what new crops they were considering.

The interviewed growers used a very wide range of sources of information; local and international magazines, books, the Internet, government researchers, private consultants, exporters and other marketers, other growers, conferences, grower meetings, and property visits. In New Zealand there is no free professional or consultancy service for cutflower growers, and this forces growers to use their own methods to gather information. Many growers interviewed considered that exporters are not always helpful as they are always being inundated with inquiries of what to grow. Those growers who mentioned this said that they had to suggest a crop to the exporters who would then give their opinion on its potential. According to several growers, the exporters did not always get it right. Consultants were considered by many of the growers interviewed to be the ones who should be able to best bridge the gap between theory and practice, though growers had mixed views of them. Those who had had a major disaster or problem often said that they should have gone to a consultant, but those who had gone to a consultant often said that they were ineffectual or gave them incorrect advice. Talking to other growers was regarded by many as the best way to solve an operational problem

> "*rather than talking to the so-called expert*".

Many of the growers interviewed mentioned what other growers had done about a certain problem, reinforcing this as an important means by which growers made their decisions. Others refined this by saying that watching and observing was more important, and other growers said that

> "*learning is more than observing - it's done by doing*".

Whatever sources of information were used, many of the more experienced growers confirmed their information from a number of sources. New growers often said that they quickly learnt this was the approach that they also had to take.

All of the growers coming from other land-based farming were cautious in their approach to growing flowers and sought good accurate information, because they had had some previous experience with a highly changeable primary producing industry.

3.5.5 Consider alternatives

After a problem has been acknowledged and identified, a range of alternatives needs to be formulated in making a decision. Shepard (1964) suggests that the need to choose between alternatives often creates conflict for the decision makers, and they are not sure how to trade off one attribute for another, nor which attributes mattered most, particularly when there are no guaranteed outcomes, as in cutflower growing.

Many decisions made by cutflower growers are unstructured, because they are subject to many random or changeable events or involve many unknown factors. Structured decisions involve situations where the procedures to follow can be specified in advance and a decision's outcome can be determined with certainty if a specified sequence of activities is performed. In contrast, unstructured decisions involve decision situations where it is not possible or not desirable to specify in advance most of the decision procedures to follow.

Tactical and strategic unstructured and semi-structured decisions are considered to be the most difficult to make and these types of decisions are perpetually being made by the cutflower growers interviewed. They have to make decisions on what crops to grow in an environment of uncertain prices and demand. All of the growers surveyed grew a suite of species or cultivars, and most of them did not have systems to analyse comparative (relative) performance that told them how their crops were performing in relation to each other. They considered that growing a suite of crops reduced their risk if they had crop failures and slumps in prices, and it evened out their production and labour demands. Leutscher, Renkema, & Challa (1999) state that the same issues have to be considered in pot plant production, particularly in relation to the uncertainty associated with crop growth and price formation. Decisions of this type are even more difficult when the crop may not be ready for harvest until several years after it is planted. Growers also considered that there needed to be a differentiation between crop species and cultivars. Both the crop species and cultivar type have to be right, as flower colour and shape are probably more important than the actual crop species. For example, all rose cultivars will sell most of the year, but for Valentines Day only red ones will do.

The approach and the timeframe that the cutflower growers interviewed took to consider alternatives were quite varied. They weighed up the options of buying a bare piece of land or buying an established property. Some wanted to grow cutflowers because the lifestyle was appealing. Others took a strong business approach, and said

> *"I was looking for a business I could run myself"*.

These growers identified cutflower growing as the best option amongst a range of businesses on the market at the time when they were looking. The most detailed approach taken in deciding to grow flowers was to do a SWOT analysis[3], and to get as much information about flower growing and potential businesses as possible. This grower had been a manager in his previous job and was looking for a business opportunity in any area, not necessarily in floriculture. He felt that there was a lot at stake in deciding on what type of business he would buy so he wanted to gather as much information as possible. The least detailed approach was where no

[3] Analysis of Strengths, Weaknesses, Opportunities and Threats.

alternatives were considered. There were several growers who started growing cutflowers by making instant decisions, or

> *"just drifted into it".*

Many growers interviewed were constantly on the lookout

> *"for something"* [a crop]

that they considered would be a winner. Whatever new species or cultivar was being considered, many growers had set criteria. A number of criteria were considered:

- expected returns/m^2,
- colour,
- scent,
- production/m^2,
- stem length,
- liking the crop,
- having the right climatic and soil environment to grow the crop in,
- how it would fit into the current suite of crops,
- its natural flowering time, post harvest qualities,
- ease of crop establishment and time to flowering.

Growers also had to consider whether they wanted a crop for the export or local market, whether they wanted to grow annual or perennial crops, and what time of year they wanted to harvest a crop.

No one grower considered all these criteria, but they used the ones that were most appropriate for them. For some it was a very formal process, and for others

> *"I don't really know how we decide things, its funny isn't it, you just sort of muddle along and work things out".*

Those who used a formal approach started off with a list of potential crops they had identified themselves through gathering information, and then gradually whittled the list down as the criteria were considered. This was done by weighing up the pros and cons of each crop in a highly iterative and recursive fashion. Other growers were more bound by tradition, especially when they started out growing. Several of the growers who joined the family unit talked about the differences in the way they made decisions from their parents, particularly in the crops they grew. They found their parents less willing to change crops even though it was apparent returns were dropping. This may have been because their parents had grown the same crops for so long, and were not used to having to make crop changes that were quite often rapid, and to crops that they knew nothing about.

Identification of a potentially good crop was regarded as either a slow or rapid process depending on the crop and the grower involved. After reading and talking to people many growers said they trialled crops. These trials often lasted between a year and five years. One grower grows and test markets four to five new varieties each year, but many do not do any trialling or do so on a much smaller scale. Those survey participants who grew large areas of a new trial crops suggested

> *"You need to grow a good sized crop so that you can see what the market potential is"*
> and
> *"You can't tell how a crop will sell if you only grow and sell small volumes".*

Those who grew smaller areas of a new crop said

> *"The crop needs to be well tested to see if I can grow it".*

Whatever approach is taken

> *"it's a matter of trial and error"* or

"suck it and see".

Whatever their decision, it is made more difficult by the lack of information and the turbulent economic times.

Most of the growers surveyed considered that there is no point heating a glasshouse over winter because the extra returns do not compensate for the extra costs involved. These same growers said that florists do not seem to appreciate the extra cost that had gone into producing such a product, and would not pay more. As a result of this growers endeavoured to grow a suite of crops in their natural growing seasons that dovetailed into each other so that they had a continuous stream of different flowers. This has the major advantage of providing a constant year-round income, as well as providing staff with year round work, and enabling the grower to employ better skilled staff. A number of growers indicated that they had difficulty maintaining a good cashflow in the winter, because they had not adequately identified these winter flowering crops. For them it was a matter of trial and error.

Cutflower growers must also consider alternative marketing outlets and practices, as do other groups of primary producers. Many of the growers interviewed realise that they are price takers if they do not sell their flowers directly. One grower put it aptly:

"I want to sell flowers rather than putting them on the market".

Many growers are not in a position to sell directly but there are a number who are and have set up their own marketing channels with great success. Cutflower growers can sell through auction markets, or directly to supermarkets, and florists on the local market; or export either directly or through a wholesaler. These export options can mean that their produce is auctioned. The auction system is generally characterised by wide variability in prices primarily due to seasonal and daily fluctuations in supply, which are totally unlinked to the costs of production. This method of sale provides highly uncertain prices of their product and makes it very difficult to formulate production decisions.

When growers were asked what problems they had had in the last year, they all cited operational problems, for example, pest and disease problems. Prioritising operational decisions was not regarded as a problem, nor were tactical or strategic decisions other than setting long-term goals. Even in growing a single crop, there are many decisions on timing and activities that have to be made. These choices are compounded when more crops are grown as each has its own cultural requirements that must be assimilated and prioritised. An indication of the number of decision choices that may have to be made is graphically illustrated by Wossink, de Koeijer, & Renkema (1992) who identified 1400 cropping variables based on economic, environmental and technological choices in growing two cultivars of potatoes.

Given the limitations of human information processing, the limited amount of new information that people can absorb, and the complexities of often simultaneous decisions, that have to be made involving crop types, scheduling and cultural requirements, a formidable task is created. These situations are potential opportunities for packaging refined information with data manipulations, using techniques such as linear programming as decision support packages, to complement and support the decision maker.

Linear programming is potentially part of a cutflower grower's tools in evaluating alternatives for making decisions on what crops to grow, and in what proportion, but it is not commonly used. Cutflower growers have a range of alternative crops to grow, and because of fashion trends these crop decisions are made relatively frequently, but it leads to volatile prices that would be hard to determine. Even so, they are many financial criteria that have to be considered when choosing a new crop or evaluating the current suite of crops. Rae (1977) considered that glasshouse crop management problems appear to be particularly amenable to solution by linear planning models, because there is intensive use of both land and labour that are in limited supply, therefore it is important to plan for optimal resource use and allocation between crops. Even where crops are not grown in a glasshouse or protected structure linear programming would enhance the crop decision-making process, but this is made more difficult when long-term crops are grown. Not only are there fluctuations in income generated from that crop, but production of these crops will eventually fall away, and improvements in technology and changes in demands and preferences of consumers take place over time.

3.5.6 Choice

Whatever the choices made by the growers interviewed, there was great variation in the processes to make and implement them, as well as whether the grower was happy with the outcome at a later time.

Even with a list of criteria to consider, choosing crops to grow was a major dilemma for all the growers interviewed. The growers took a number of approaches in solving this problem. Most were highly aware that their margins were narrow, so these decisions had to be right even though there was not enough good information. Some growers took a very quantitative approach to selecting new crops, while others solely grew crops they liked. Several growers made instant, uninformed decisions on growing a new crop

> "*I bought the bulbs on the spot*"

Quick but informed decisions on growing a new crop were made when an opportunity arose, by both growers who took a quantitative approach, as well as those who did not. Ultimately, all the growers based their decisions on the perceived risk of failure, but in some cases the risks associated with a crop had not been established, so were considered to be low. Many of the growers initially used criteria to reduce their alternatives, but based their final choice on

> "*gut feelings*", "*trusting their feelings*" and "*good feelings*",

which were tempered by their judgement and past experience, and weighing up all the pros and cons. Many growers considered that if they were going to grow a new crop they had to start doing so

> "*before word gets out about it*".

Some growers, those who were more experienced, considered that if plant material was difficult to source, and/or it had a long crop cycle, and/or was expensive to buy (many perennial crops), or was difficult to grow, it would be a good crop to seriously consider. In contrast other growers (for example, new entrants) interviewed, considered that the crop had to be easy to grow.

3.5.7 Implementation and checking

The growers interviewed implemented their decisions in a number of ways. The time taken from developing the concept of growing flowers to getting started; and in growing a new crop varied considerably, from starting immediately, to taking 6 years, (mean - 1 year). When they had decided on what crop to grow, some chose to trial small areas of a crop, while others went straight into growing a crop on a large scale, so they could got a good feel for its market potential. Some also did simulated transportation trials and/or post harvest trials, but all considered it was important to learn how to grow the crop, and or to see how it fitted in with their current crops. The more often they have to make choices on new crops to grow the better they are at

> "*getting it right*" and
> "*slotting it into their current suite of crops*".

Those growers who sold directly to their customers grew some of the most diverse ranges of crops, and trialled the most new crops. They are experienced growers who know which crops are the most profitable for them, because they have good record-keeping systems. They also have close contacts with the customers, who give them quick and accurate feedback.

Other growers had record keeping systems to monitor the profitability and their businesses, but not the profitability of individual crops. Some had custom-made or off-the-shelf computer packages and others had manual recording systems. Some did not have any recording systems.

Many growers also constantly monitored trends on cutflower prices by empirical means, using publications, the Internet, observing the markets, talking to other growers and using their "gut feelings". These techniques provided them with the best available information on how their individual crops and businesses were performing and how they were likely to perform, even though the most knowledgeable trend sources such as marketers were not always able to give them the right predictions. Knowledge gained from evaluating outcomes of past decisions is used by many of the growers to give them confidence to use or not to use the same process again. This type of feedback is important as many growers knew that they

"could have been better at managing their whole business",

by *"managing their crops better"* and *"spreading their risks"*.

A major drawback of the systems was the amount of time that was required to plug in the data.

3.6 A model of decision-making behaviour

Section 3.5 uses the headings shown in the generic model developed in Catley *et al.* (2000). Specific key elements of the growers surveyed were interlinked and laid on top of the generic model (Figure 3.1). This figure shows that a model of decision making for New Zealand cutflower growers seems to be accurately described by the generic model.

Even though New Zealand cutflower growers are a highly diverse group of people, they all have very similar decision-making drivers – their goals, values and beliefs. These goals are based on their preferences between monetary and non-monetary factors; their feelings about risk and uncertainty; their abilities to filter and assimilate large volumes of information, and their past experiences. The balance of these components will vary, but they seem to be common in the decision making of those growers interviewed.

The course and time taken by an individual grower in making a decision will also vary. The variables include: the nature of the problem; the gravity of the problem, its decision type; the degree of perceived risk and uncertainty; the timeframe in which a decision has to be made; the amount of information that is required to satisfy the decision maker and the availability of that information. Input into the processes at each step varies considerably – some growers thought fleetingly about a particular phase whereas another grower would have spent many hours satisfying themselves about their approach to the same phase.

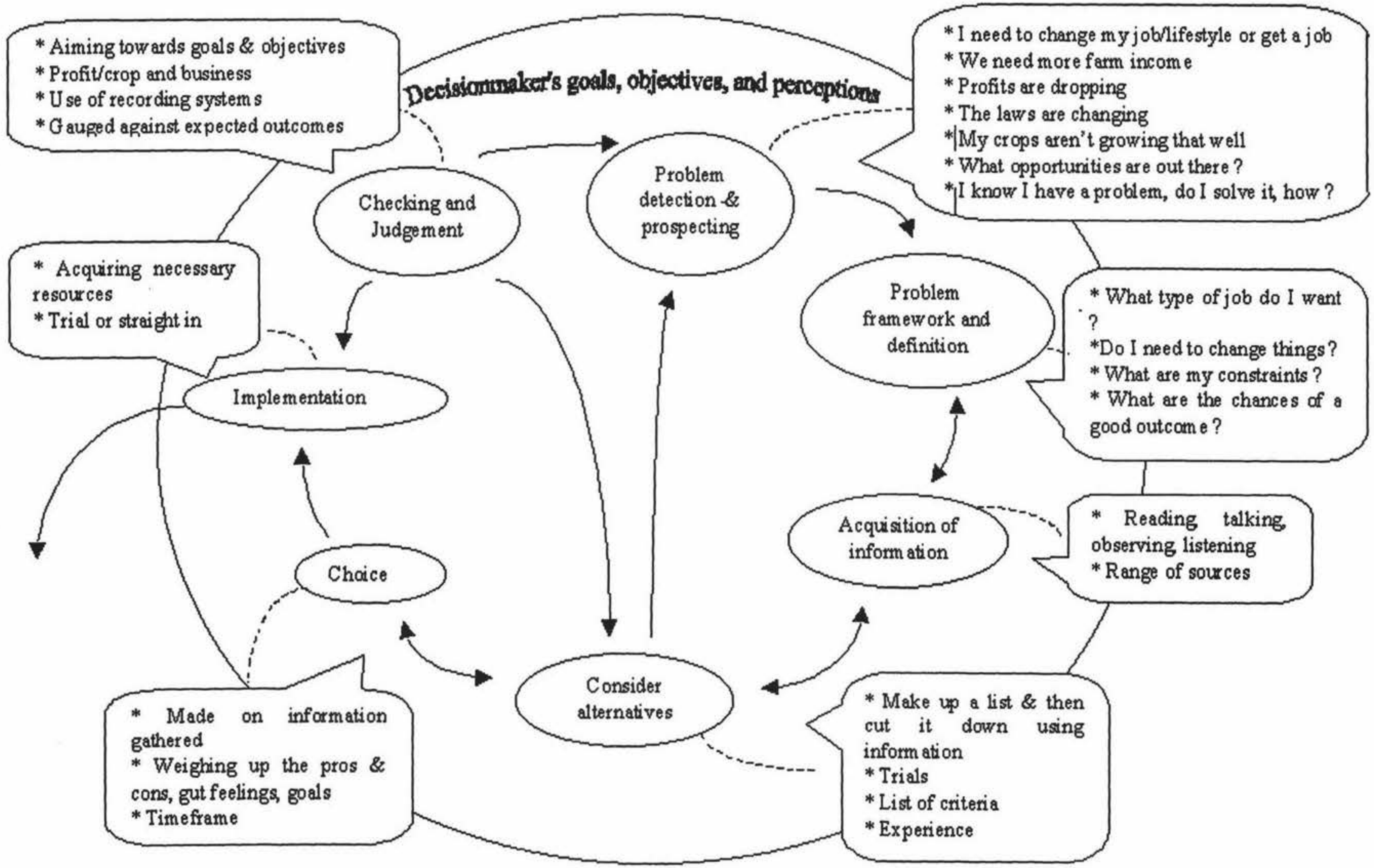

Figure 3.1. A model of decision-making behaviour of cutflower growers.

3.7 Conclusions

Catley *et al.* (2000) recognises the diversity of decision types, decision maker's behaviour, and the problem environment; and concludes by developing a generic decision-making model for primary production systems. This paper builds on the concepts identified and explored in Catley *et al.* (2000). Firstly, it considers the "whats", "hows" and "whys" of decision-making behaviour using New Zealand cutflower growers as an example, and secondly it attempts to validate the generic primary production model of decision making developed in Catley *et al.* (2000).

The conclusions drawn in gathering and analysing the data for this paper show that the cutflower growers interviewed are a diverse group of people who exhibit decision-making behaviour that can be well described by the model developed in Catley *et al.* (2000). Exploration of the types of decisions they make, and *how* and *why* they make them resulted in a number of key conclusions.

Problem detection and frameworking are critical to problem solving. The ability of a grower to do this is based on their unease of a problem situation and their past experiences at solving problems. These attributes varied considerably amongst growers. All growers consider information is critical to help them solve their decision problems. Unfortunately this is one of the most difficult aspects of decision making to deal with as the information needed is often not obtainable (either not existing, undetectable, incomplete, or in the wrong form (i.e. either too detailed or not detailed enough)). The decision type that poses the most problems is in deciding on what crop to grow. Information to make these decisions is more difficult to find and analyse as growers have to attempt to forecast an outcome. To overcome this lack of information it was clear that growers often rely on their "gut feelings" in making the decisions.

How can the conclusions of this paper be used to enhance production systems ? For any type of information to be of use to growers it must be relevant, timely and in an appropriate format. To increase the chances of this occurring, information providers must understand and allow for the variety and complexities of grower's goals in a dynamic operating environment. If information is to be delivered in the most appropriate form, providers must also understand how and why the grower requires the information. This will only come about through understanding the grower and their decision-making behaviour, and this paper is a step toward enhancing this understanding.

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Chapter 4: The Case Study

This Chapter is a description of an in-depth study of a grower who primarily grows sandersonia as a cutflower. It reveals the processes involved in the grower's specific decision-making activities, describes his decision-making behaviour over a range of decision types relating to crop production cycles and methods, and identifies whether the model developed in Chapter 3 to describe the decision-making behaviour of cutflower growers is applicable.

4.1 The method

After deciding on the research strategy, a short-list was made of growers who could be interviewed. The concept of a studied population is considered crucial, as the population defines the set of entities from which the research sample is to be drawn (Eisenhardt (1989)). It is important to carefully consider the potential case to minimise the chances of misrepresentation and to maximise the access needed to collect the case study evidence (Yin (1994)). For this case study six criteria were thus considered:

- whether the grower was considered by others in the industry to be a good grower,
- whether the grower grew sandersonia as a major part of the operation,
- whether technologies were used,
- the distance from Palmerston North, where the researcher was based,
- whether the grower was regarded as a good interview candidate,
- whether the grower was willing to participate in a case study.

To ensure that neither parties did not find the interview process too onerous it was decided to visit the grower on at least two days, a week apart and in two sessions, one in the morning and one in the afternoon. There was the option to extend the interviews to a third day if necessary. Given this plan, a list of topics was drawn up (Appendix 3). The first choice grower was contacted by phone and asked if he would be interested in participation in the case study. He was also asked if he had any objections to typed manuscripts being prepared, and confidentiality issues were discussed. After he agreed to being interviewed, the best days to visit were decided. This verbal conversation was followed up with an e-mail message to him confirming the dates of the interviews and arrival times.

The grower interviewed in this case study was chosen because he met a number of the six criteria:

- he is regarded by other sandersonia growers as a "good" sandersonia grower,
- he uses some technologies, but is not regarded as the most technologically advanced grower,
- he was known to the researcher,
- he lived within reasonable commuting distance of the researcher.

His description as a "good" grower can be demonstrated by the progress his company has made in the short of number of years it has been growing cutflowers, the status he has amongst local sandersonia growers and the reputed quality of the products that the company produces.

The interviewed grower is the founding partner of a company that has three other partners. The founding partner was interviewed alone during the course of all sessions except when his daughter (also a partner) was interviewed. This occurred during the second interview as she develops the detailed weekly plans of the all required tasks to be completed for each year, a year in advance.

On arrival for the first interview all the partners and several staff were met briefly during a quick walk around. To begin the formal part of the interview, permission again was sought to tape the interview, and handling of confidentiality issues and the timeframe for the day were discussed. The postgraduate study programme was also explained as well as the format of the proposed interviews. Part way through the first afternoon session, we went for another walk around the property.

The second interview followed a similar format to the first one and included an interview with the founding partner's daughter. The format of all the questions was very similar to those attached in Appendix 3. During the interviews, notes were made and diagrams were drawn of the detailed cropping programmes (Appendix 4).

After each morning session the interviewer left the property and reviewed the data over lunch. Each afternoon session began with a review of a number of quick queries relating to the morning session. During the course of the interviews, documents were collected as secondary data and are again referred to in Chapter 5.

4.2 Data analysis

In Palmerston North, the tapes were transcribed to ensure accuracy, and to enable appropriate analysis to be undertaken. For verification, a copy of each transcription was e-mailed to the grower. The first transcription was reviewed in preparation for the second visit the following week. On completion of the two sets of interviews and the transcribing, the data were manually summarised and classified according to the steps defined in the decision-making models in Chapters 2 and 3. Following this, connections were made between meaningful relationships of the categories used.

4.3 Management system and history

Because no components of a system exist in isolation, a summary of the "whole" grower's system or operating environment will be given first, before reducing it into smaller parts for closer study. Figure 4.1 demonstrates the structure of this system as it is, a complex one: its performance depends on the internal structure as well as a whole group of controllable and uncontrollable external factors and the interaction of all of these.

The founding partner bought the property as bare land before retiring from the public service about 15 years ago. Initially, he and his wife grew Asian and European pears, and ran a fruit packhouse. They then diversified into growing vegetables before starting to grow flowers about 5 years ago. These changes in crop type were introduced in order to improve business profitability.

At the time the case study interview was conducted, the property had a 600 m^2 glasshouse, a 220 m^2 greenhouse (Figure 4.2) and a 3300 m^2 shadehouse (Figure 4.3), and the area under the shadehouse was in the process of being trebled. No open ground land was used. The packhouse on the property has been extended over time. As many as ten staff work during the busiest times of the year. There are six permanent staff. Four of these people are in the partnership. These include the founding partner and his wife, and their daughter and her husband. The founding partner's daughter and her husband have been in partnership for a year after working for the company for a year beforehand. The number of partners in the company has increased to coincide with expansion in production.

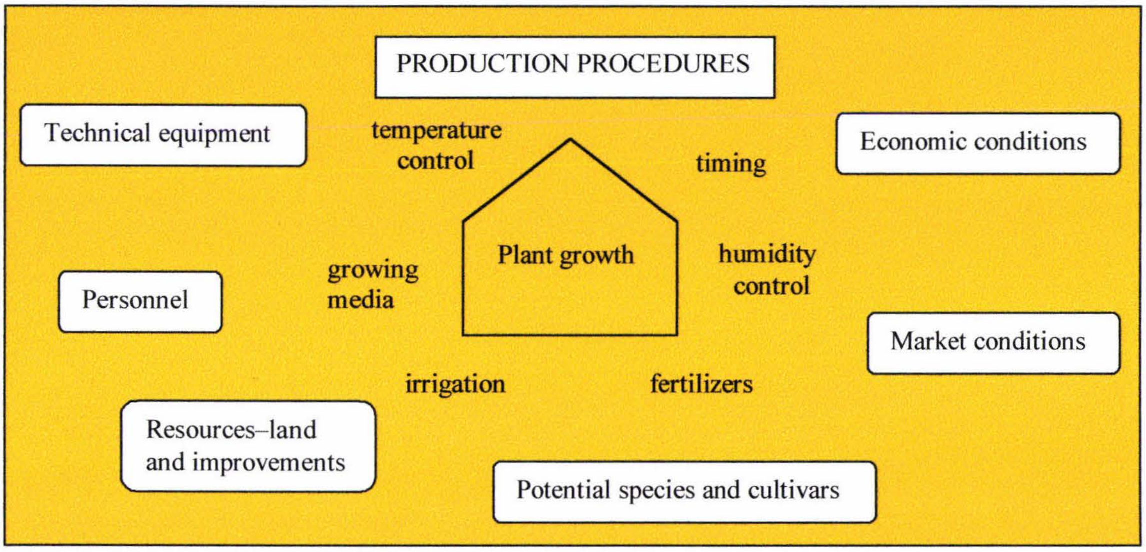

Figure 4.1. The grower's operation as a complex system (adapted from Lentz (1998)). The components and their interactions are too numerous and complex to include in this diagram.

All the partners' skills and knowledge are based on practical experience. The founding partner has gained detailed knowledge through extensive reading, scanning the Internet, attending conferences and through interacting with local and national sandersonia groups, and he often puts this knowledge to the test through trialling. The founding partner was brought up on a tobacco farm and considers he has "green fingers". While this grower considers himself to be conservative but innovative, he believes in following rather than leading.

Company activities have been organised so that each partner is in charge of a particular area. The son-in-law is in charge of the outside production, the daughter is in charge of the packing shed, and the founding owner is in charge of the flowers in the greenhouse and the glasshouse, and also has the overall control of making sure everything is co-ordinated. The founding partner is also required to check those who supervise jobs in case someone happens to go off sick or is unavailable.

Figure 4.2. A view of the grower's greenhouse.

Figure 4.3. Part of the grower's shadehouse

All the partners' agreements are by consensus, not by vote. The partners have monthly meetings when they discuss all points of their operation. Each one apprises the others of what they have been doing and they make all their big decisions then. This is one of the advantages of all the staff working on one site. If there is any reluctance from any one of the partners then they work their way through the issue before they finally settle on an outcome. Any other meetings are held as and when required, rather than holding over any important matters until the next monthly meeting. They try to make sure they are all involved, that they're not all doing their own purchasing, for example, everyone has got to work to budget. The budget is based on historical information with in-built flexibility

> *"right down to the last dollar".*

This enterprise has grown a number of flower crops since its inception: freesias, christmas lilies, oriental lilies, and asiatic lilies. Now 100% of their production comes from growing sandersonia and callas, where they are totally integrated in growing and selling tubers and flowers of both crops. According to the founder, each of these crops has its own specific requirements and through experience they have decided that they do not want to grow a lot of crops less than 100% well, so they have

> *"limited what we grow so we can more realistically aim for 100% perfection".*

Both their sandersonia crops of flowers and tubers are grown for export markets and are sold through several exporters. Tuber exporters establish tuber grade standards, whereas the company sets the standards for the flowers they export because they are sold under their own brand. They are not concerned about where the product is sold.

The numbers of sandersonia tubers are still being built up. Over the 1999-2000 season they will have between 500,000 and 600,000 tubers, and several hundred thousand flowers. The partners intend to double the tuber figure again next year and then to maintain those levels. They also have sandersonia seed crops coming on and expect to harvest about 2.6 million tubers in 2000.

Until early in 1999 they also operated a flower packhouse but closed this operation down recently. During this operation they were relying on outside people for their income, and

> *"didn't have the same controls as if we were growing the product ourselves".*

This is why they are building up their own numbers of tubers now,

> *"so we can now control our own destiny".*

But

> *"I've told each of them* [other sandersonia growers in the area] *that we'd help them set up their own operation and we'd help them the first year in sourcing products and learning how to pack, learning the standards. I believe in making friends, not enemies".*

4.4 Case Description

Even though New Zealand cutflower growers are a highly diverse group of people, they all have very similar decision-making drivers – their goals, values and beliefs, and they exhibit a similar pattern of decision-making behaviour as described in Chapter 3. This sandersonia grower is no different. His goals are based on his preferences between monetary and non-monetary factors:

> *"We'd go through thick and thin as long as there's going to be a thick again";*
>
> *"Anything that is making money will have priority over others that are not making money";* and
>
> *"I believe in making friends not enemies"*;

his very strong feelings about risk and uncertainty:

> *"If I put all my eggs in one basket, then I'd be in some trouble. It* [a range of crops] *allows you to spread your risk"*;

his abilities to filter and assimilate large volumes of information:

> *"That's* [information] *the biggest problem...there's so much conflict..."*,

and his past experiences:

> *"We had to believe what we were told and we soon found that you couldn't believe all you were being told";*
>
> *"Muggins-me knew better";*
>
> *"We were still fairly green";*
>
> *"We immediately know which ones we can vary from experience."*

The time spent on any one phase of the decision-making process varies considerably with the grower and the phase. These differences in timing occur for a number of reasons including the availability and quality of the information he requires, the nature of problem to be solved, the type of action involved in implementation, the personality and experience of the grower, the way he learns, and his operating environment. Based on these factors a number of decision-making phases used by cutflower growers have been defined in Chapter 3 and they are:

- Problem detection and prospecting,
- Problem framework and definition,
- Acquisition of information,
- Consideration of alternatives,
- Choice,
- Implementation,
- Checking.

These seven steps are the classifications that will be used to describe the results of this case study. They are potentially cyclic and iterative; and are highly inter-related.

4.4.1 Problem detection and prospecting

Many of the problems talked about during the course of the interviews are listed in the first column of Table 4.1. These problems can be anything from trying to stem a decreasing income, to trying solve a technical difficulty in growing a particular crop whether it be venting control in a glasshouse or trying to figure out what potting media is the best to use.

Identified problem	Solution choice
"We find ultimately controlling temperature is our main concern".	*"We know what to do* [to control temperature] *but how do we do it ?".* The grower uses shadecloth to cover his glasshouses in the summer, but if he could find other means of keeping the temperature down he would not put shadecloth on.
"Our problem is that a crop grows so quickly there's not a great amount that we can do".	*"From our own trials we have settled more for bed controlling temperature controls in the glasshouse and the greenhouse more than the total environment".* The grower would be happier if he could remove excess heat in summer but *"I'm not aware of a useful technology".*
"I want optimum conditions in there and I want perfect tubers and perfect flowers; that's my aim".	*"We use a lot of research experimentation here, but we're using outside firms as much as possible as well".* Environmental control or monitoring does not matter in winter because they are not growing any flower crops then. Air temperature probes monitor glasshouse conditions, and they are used to control the automatic venting. *"We may further advance that in due course, but also it depends on the cost".* Soil temperatures are measured manually with a thermometer.
Late frosts	*"I have the heaters set at a very low temperature to come on so that I can sleep when we get a late frost. That's all I have the heating for".*
Irrigation can easily be left on.	*"The irrigation system comes on automatically but has to be manually preset".* He has used equipment in the past to help him decide when to water, *"I'm now back to my finger, and I find it's a better guide, so I'm using experience, knowledge and my finger into the ground every day... The tensiometer is going to tell you for instance what the condition of the ground is at the present time, but it's not going to tell you... whether today it's going to rain or whether today is going to be a sweltering hot day...But I couldn't have done it in the first place, it's only because I've built up that knowledge and information, and the tensiometer would have helped".*
Have to be able to do a correction to the fertilizer levels if necessary.	*"We have fertigation systems set up in the glasshouse, greenhouse and shadehouses, but they are not generally used, unless the need is identified by a nutrient analysis. This allows for easy and quick nutrient adjustments".*
"Our aim is to try and stay in the market for flowers for six or seven months nonstop. Not to just come in with a rush with a large number of flowers and then back out again".	The area under the shadehouse is being trebled at the time of the interview, *"which will allow us an in-between crop".*

Table 4.1. Identified problems and solution choices.

Identified problem	Solution choice
"We want to avoid any potential millennium problems".	*"This year we intend to be out of the market from about 20 December* [1999] *until about the 7-10 January* [2000]*".*
The soil is inappropriate because the ground is stony and has a pathogen build-up	*"The majority of all of our crop is grown in artificial media...In our glasshouse, we picked up diseases when we were growing cucumbers in there, and there are stones in the soil".*
What media to use.	*"I got every conceivable concoction of artificial media and grew a part row of every one of them and just kept carrying out tests until I came up with the best one to grow ... that was all I could do. For the media to be of sufficient and constant quality the raw materials have to be the same for each batch. Each new batch is tested for water holding capacity, air filled space and pH".*
Tuber replacement problems	*"I will be using the 'cut and chuck' method".*
Streamlining the packing shed operations	*"Our aim is to pick, chill and process as fast as possible. So we export as many days per week as we can, so that the product quite often is only from the previous day".* They have three coolstores. *"So the whole time we are packing as well as picking and grading elsewhere. Like if we're packing inside the shed, then we're using the canopy for bringing stock in, grading it out there, and the coolstore for processing it through there. The new stuff never crosses over the processed stuff. You've got to keep it separate".*
"For tuber production we're aiming to get them as early as we can".	*"We know if we can have a lift in January there have been markets in the last couple of years for 'green' tubers which are the tubers which haven't been chilled".*
Reaching the exporters quality requirement standards for tubers.	*"The tuber standards are very very high anyway, though I believe almost unacceptably high... There's absolutely nothing wrong with the majority of tubers that don't reach the standards...All the tubers are planted, harvested and graded by hand. Each tuber is weighed individually... It might be slower than mechanical, but we get zero damage. We've got to have scales that are very very fast reading".*
"We want the buyer asking for our flowers".	*"We maintain our own high quality because it's our name that's on that box. We are not interested in grey areas in flowers. Our name is on the end of every box we produce from here except for one exporter. When there's a glut the standards tighten up, and when there's a shortage, we've got it easier...".*

Table 4.1. continued. Identified problems and solution choices.

The income of the grower interviewed in the case study continued to decrease after the changeover from fruit to vegetable production until he could not bear it any more so he started growing cutflowers. The company's financial status has been identified by the cost and price monitoring methods put in place by the grower since he first started growing horticultural crops and allows for financial comparison with other crops. Initially, this occurred between fruit crops and then between vegetables, and later between vegetable crops and flower crops, and finally within flower crop types.

The grower was readily able to identify technical difficulties in his operating environment. In these situations the desired outcome was known,

> *"I want to maintain a glasshouse temperature of 25 ^{0}C in the hottest summer days",*

but identifying the technical equipment to do this given the grower's specific operating environment, and implementing it, was the problem:

> *"We know what to do but how do we do it ?".*

The grower also actively participated in 'prospecting' described in Chapter 3. This occurred when the partner was deciding on what specific cutflower crops to grow, even though there was no perceived current problem but it was considered that there could be at some time in the future.

> *"There's no guarantee that any crop's going to last".*

4.4.2 Problem framework and definition

Figure 4.1 shows the types of production, management and marketing activities that the grower in this case study has to carry out, based on his goals and those of the company. Problems associated with these activities will often arise, and choices have to be made on how they will be solved. In management theory, decisions associated with these problems are classified according to their context as operational, tactical or strategic. Figure 4.4 illustrates this and offers examples from the case study which substantiate the classifications.

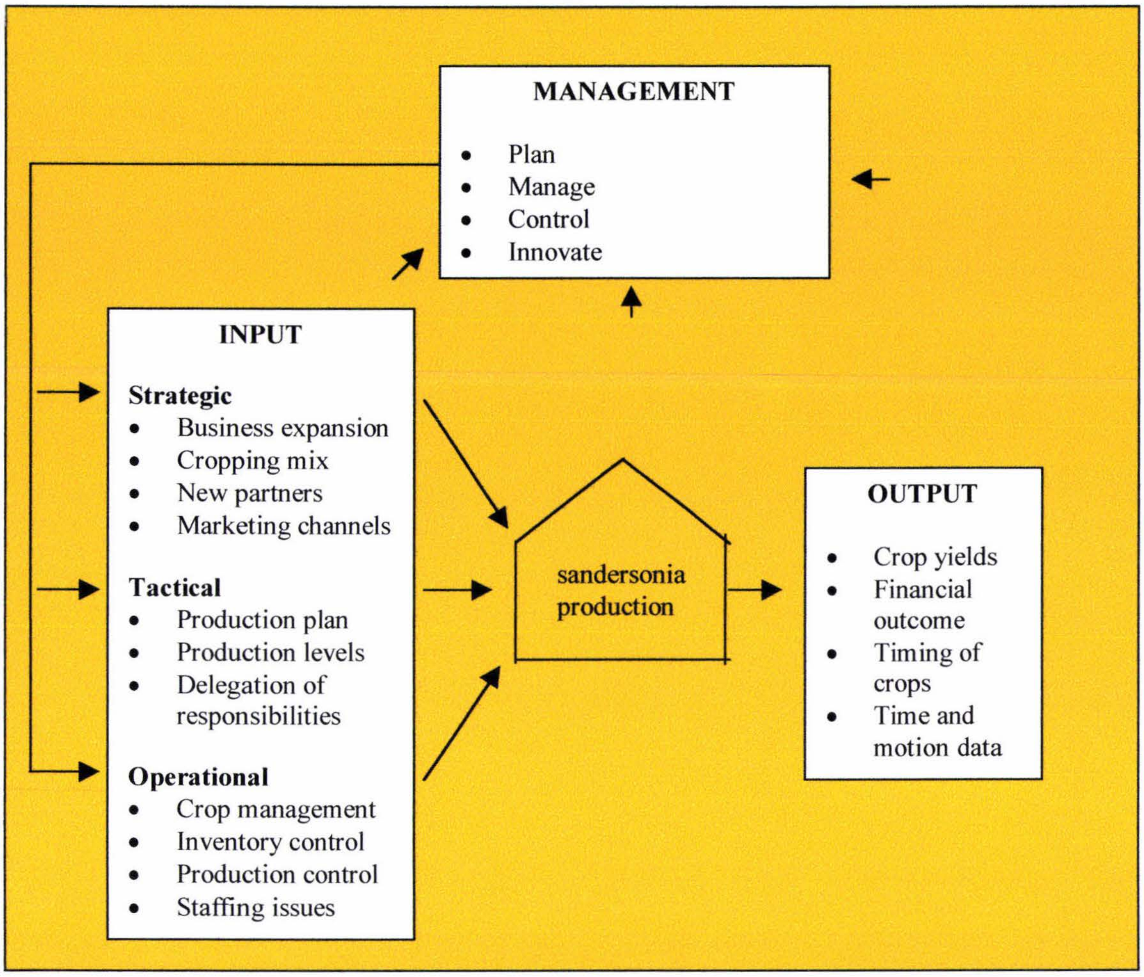

Figure 4.4. Decision types that the sandersonia grower has to make (adapted from (Bawden & Macadam (1983))).

4.4.3 Acquisition of information

The grower gathered information at a number of stages in the decision-making cycle. Firstly, this process occurred during the 'Problem identification and prospecting' and the 'Problem framework and definition' phases. By scanning both internal and external information during these phases the grower became aware of a problem or an opportunity. The grower assessed the situation and constructed a mental picture from his memory and if needed, gleaned other information from written or verbal material. Secondly, to solve the problem, information from the sources deemed best to the grower, was gathered to list and rank the possible alternatives, and then used to make a choice. Fourthly, information can be used for either implementation or trialling. Fifthly, information was gathered after implementation, to justify the decision choice that was made, and can provide new information for future decisions.

When a problem needed to be solved the grower actively searched for the desired information, rather than waiting for the information to come to him. This did not necessarily mean though, that the right information was found. Even though the grower was experienced at gathering information he often found it difficult to obtain. If the problem was considered serious then searching continued for some time, but if the required information was still not found then the activity was abandoned either temporarily or permanently. In these situations, either trials were carried out to gather the required information to improve the situation, or no further action was taken. The useful information was either processed at once, for example, options were planned and evaluated, the consequences were estimated and action was taken; or stored for future reference, either on a computer or filed.

> *"If it's in written form I retain and file that particular written report ready for when I want it ...before that most of the knowledge was in my head, if I died tomorrow it dies with me. So it becomes a more vital document from that point of view".*

This stored information may also be used at a later time to revisit a problem-solving activity that had been put on hold because either the right quality or quantity of information could not be found. This phase of decision making, information gathering, had a major effect on the time that it took for the grower to make a decision.

Over the years the grower also found that his information requirements changed as his experience grew. Initially, he gathered all the available information on a crop; now he wants specific and detailed information. He finds that there is also a lack of information on crop culture tailored to his part of the country or even to New Zealand. This was also the case for growers interviewed as part of the survey described in Chapter 3. The sandersonia grower and other growers, often use consultants as a source of information. However the sandersonia grower finds that the information they provide is not specific enough. This is probably because they have to deal with a range of horticultural crops and do not have the time to have intimate knowledge of any crops.

The sandersonia grower is willing to pay for information if he has a problem to solve. If it is for research on a national level he is still happy to pay for it but

> *"...but my bigger concern is that it's left to only a few growers that end up paying for it".*

He also believes that the flow of information is a two-way process. This grower is not only an information gatherer. He also acts as an unpaid consultant for sandersonia growers in his region. Even though some people in his situation would consider that these other growers were competitors, he takes the attitude that by having a strong local core of good growers they can negotiate collective deals to purchase potting mix, which smaller individual growers cannot do. One of the stipulations of being a member of their local group is that they must allow the other members to visit their property.

The grower uses many sources to gather information and some sources are considered more valuable that others (Table 4.2). He considers the best information source is horticultural magazines, but he also finds it very worthwhile to talk to people, particularly during field days or at conferences.

Information is also gathered on the property. This occurs in a several ways: through current and historical sources, future predictions, and trials. Trials are carried out because the external information sources and or information quality are not considered good enough to risk total implementation (and large financial losses), therefore the information needs to be checked, and adjusted if necessary. Observing *"nature"* is also considered to be very important by the grower because it allows him to feel comfortable about his predictions of whether the season is going to be early or late. The grower makes these observations by watching when the dormant trees around the property are starting to break into bud in the spring or starting to go dormant in the autumn.

Historical information is also used to make decisions in sandersonia crop scheduling. Information is recorded on how long it takes from planting to flowering at different times (hence temperatures) during the year, or how long it takes to carry out one unit of a particular crop activity. This information, along with crop trialling, can also be used for future predictions of crop timing. Even though the environmental conditions can upset the models that have been developed, with careful observations of nature, the grower considers that these deviations will be evident to him early on in the season.

Information Source	Good	Bad	OK	Minimal[1]	N/A[1]
New Zealand magazines	✓				
Overseas magazines	only sees a few			✓	
Newspapers				✓	
Radio				✓	
New Zealand scientific publications	✓ great				
Overseas scientific publications	✓ great when I can get hold of them				
New Zealand grower articles	✓				
Overseas grower articles	✓ great when I can get hold of them				
New Zealand conferences	✓ very very good				
Overseas conferences	I haven't attended one				✓
General field days	✓ very very good				
Specific crop field days	✓ very very good				
Talking to business partners	✓ very good				
Talking to family and friends				✓	
Talking to other growers	✓ good				
Consultants	✓ good				
Scientists	✓ very good				
Exporters	✓ very good				
Local marketers				✓	
Your customers	✓ very good				
End consumers	✓ very good				
Florists				✓	
Tuber brokers	✓ very good				
MAF/other Government offices		✓		✓	
Education personnel				✓	
Horticultural suppliers		✓			

[1]A tick in this column means that the grower does not use these information sources at all or very often.

Table 4.2. The sources of information that the grower uses and how he ranks them.

4.4.4 Consideration of alternatives

The grower always considers a number of alternatives before making a decision choice. He considers he takes a conservative but innovative approach – and relies on trials when deemed necessary.

> *"I don't intend to make any guesses";*
>
> *"There is no guarantee the information is accurate";*
>
> *"I dare not go and plant out an entire crop ... unless I've got full confidence".*

This is because the grower considers that there is no perfect information in an imperfect world, and thus all or most information has to be tried with caution, as he is not prepared to take the risk of a failure. For example, use of information from overseas or other regions in New Zealand may have different outcomes from those anticipated under the grower's conditions, so trials are often run.

Generally the grower also knows his desired outcome, but the major problem arises in being able to identify the ways to do it. This commonly occurs for technical problems such as reducing the temperature in the glasshouse during summer, or controlling humidity. He realises that there are no recipes out there to fix problems such as these because each situation is unique, depending on factors such as the combination of crops being grown, the time of year, the microclimate and the type of growing structures. Therefore, it is a case of weighing up the likely outcome versus the cost of implementing the change.

The grower also considers market research very important, even if it not always reliable. When the partnership had a smaller quantity of flowers they had insufficient volumes to sell through more than one exporter. Now that they have more product, they deal with several exporters. The grower considers that the most important criteria in selecting an exporter is their service and the price they offer,

> *"almost equally is price and the service that they're giving us...so it's not all price related, but if there's 20c difference in stems... we're here to make a profit".*

In contrast, tubers have a pretty consistent price right through.

> *"We're dealing with more than one exporter there, but it's more to protect ourselves... We're trying to hedge our bets by going wider than one exporter... if we relied completely on one we're completely in their hands - if for some reason they decide that they're not going to sell our tubers this year, we've lost our entire crop. At least by going through more than one, we find the competition is there. If they don't look after us then we're not going to supply them".*

Crop timing alternatives also have to be considered; for example, when should sandersonia flower and tuber production occur. Not only does the grower have to consider these options, he also has to weigh up the risks of missing key production deadlines that will affect his ultimate returns, and balancing these activities with his labour and cash flow. Therefore choice and timing are interwoven and are affected by the company's resources to make a large planning matrix.

4.4.5 Choice

The fundamental basis in making decision choices revolves around the grower's constraints and his high standards,

> *"I want perfect flowers and perfect tubers..."*.

Column 2 of Table 4.1 shows the choices made to solve a range of problems on this property. Such decisions depended on the grower's estimates of the chances of its success, balancing labour and cash flow, the grower's perceptions of the quality and completeness of the information gathered. These grower's perceptions, in turn were based on his goals, values, and preferences and past experiences and the company's goals.

This grower spent considerable time making some choices, but also made other decisions very quickly. Some decisions that involved large amounts of money, such as buying the land where they are currently growing, and the decision to grow sandersonia and callas were made quite quickly. In contrast, cultural and technical choices on how to grow either sandersonia or callas were slow, very well planned and deliberate, because a lack of 'how-to' information often necessitated trialling. The speed of making these choices does not necessarily accurately reflect the amount of information collected as the grower routinely uses stored information. It is related to the quality of the information gathered, the type of decision that is being made, and the type of action required for implementation to occur.

The grower makes some choices even though he does not understand the reasoning behind them. For example, he knows that he has to make sure that his tubers get plenty of water when they are first planted, but he does not know why:

> *"...pass. Obviously for some reason I suppose. I can't explain why, but we've already found that we need that early watering in"*.

In past years, a number of other crops were grown, but choices had to be made as it became apparent to the grower that it was better to specialise as

> *"...there is a limit to what we can do"...*

and they wanted to limit the crops they grew so they could

> *"...go for 100% perfection".*

To effectively manage the range of crops grown, each of the company's activities are scheduled and this involves making six choices:

- Deciding where, when and what area of each crop will be planted (based on market requirements, cultural constraints, expected returns, and expected harvest times),
- Deciding what activities will be carried out in associations with planting choices,
- Deciding on the chronological order of daily and weekly operations,
- Prioritizing planting and harvesting and their associated activities, at any given time, but particularly during bottlenecks. In these situations a product that deteriorates is harvested first followed by the activity that is going to produce the best financial outcome,
- Allocating and prioritizing limited resources such as labour or machinery,
- How many staff will be employed (fewer over a longer period of time, or more over a shorter period of time).

Refining all these choices is a continual process and is helped by adjusting their yearly plan based on deviations from what they expect to happen.

> *"Our aim is to stay in the market for so long - six or seven months, we're not worried about lower prices because we know that we will get low prices, high prices and we'll average out ...We don't plant when it suits us, we plant because that's when we know the market wants the flowers or wants the tuber ... I try and anticipate when I believe it's the best time to start supplying, and to plant in accordance with that".*

Longer term planning is based around the company's long-term goals. The partners are fully aware that the means of achieving these long-term goals, based on their short-term goals and activities, might change and that they have to be flexible enough to allow this to occur without too many major upheavals.

"We're using planning four to five years ahead. The further out, of course, the less details we have, but we know what our aim is, what can be achieved, and over what time frame we can achieve that".

4.4.6 Implementation

Implementation within this company occurs in three quite different ways:

- continue in the same manner,
- carrying out a trial of a new crop or cultural technique, or
- a complete changeover.

If the grower identifies a problem but finds no conclusive alternative practice or technology, one of two approaches is taken. He either continues using the same cultural practices, or he trials a practice or technology he considers may work. Taking the second approach means that total implementation of a new practice may be much slower or may not occur if the trial is not successful. No matter how much information is available the grower

"did not follow the [information] *blindly"*

For example, this year the grower decided to do a small trial on breaking up the tubers before planting them. Fertiliser trials have also been carried out in the past, before wider implementation has occurred. Trials were carried out because the grower did not consider that the information that he had been able to gather satisfied all his questions about the implications of full-scale implementation. This was because there was either no information to gather, or the information could not be procured, or it was in the wrong form, for example, it may have been prepared for another environmental or economic situation.

Implementation of a new cultural practice or technology on a wide scale therefore only occurred if the grower was totally convinced that it would be successful, either without or after successful trialling.

As a result of the above situations, the grower made well-considered decisions about implementing a decision. Getting crop timing right was a very important aspect of implementation. There are two highly inter-related parts of crop timing. These are crop planting and crop harvesting and the complexity of this is shown in Appendix 4, Figure A4.2.

In planning crop planting, the firm uses their own production scheduling system called the "Countback" method. They know what day or week they want to harvest a batch of tubers or flowers, and through keeping meticulous records from past seasons they can determine very accurately when each planted crop will flower, but there are occasions when they have to make small adjustments.

> *"We do make small adjustments to what the book says, we don't necessarily stick to it. So we know that for instance the first crop will take about 79 days from planting to picking to flower in mid-October"... "If I anticipated the summer was going to come on that much sooner, then my planning may show that first crop may take 73 days. We try and basically predict just what the weather's going to be doing to our counting"... "A lot of it is by feel, gut feeling, and information... "A lot of it is also based on what trees are doing, movement of them, they seem to know more than we know...That's what we're using for guides. Looking at nature"... "We base this whole thing on what happened the previous year. So we do fine tuning all the time as to what's happening. By keeping those records and seeing whether in fact that has a bearing or even just a one-off. If it's a one-off we ignore it".*

There are number of factors that influence crop scheduling:

- the time of the year, and whether the temperatures are increasing into summer, or decreasing into autumn and winter,
- what structure the crop is being grown in, as some of their protected structures are warmer than others,
- how long the sandersonia tubers have been in the coolstore for, and
- whether the season is considered by the grower to be 'normal' or not.

1

TIMELINE 1999 -2000

June 21	Check s/s tubers Continue building new area, tea-room etc. Clean polyhouse and glasshouse Finish dipping polybins
June 28	Check s/s tubers Continue building new area Plant seeds Put out seed boxes Start building new wind shelter
July 5	Continue building wind shelter Build beds in shadehouse 5 per week Stock-take fertiliser Finish building new area
July 12	Irrigate new seed beds Build beds in shadehouse 5 per week Build wind shelter Check s/s tubers Send away any unsent tissue culture callas to Puke
July 19	Build beds in shadehouse 5 per week Finish building new structure Harvest seed strike Peter - order fertiliser for polyhouse planting
July 26	Begin pre-germination of polyhouse tubers, 10,000 for first 2 weeks, then 5,000 for last week Harvest seed strike Check s/s tubers Build beds in shadehouse 5 per week Finish irrigation
August 2	Plant 2 rows @ 110 boxes for polyhouse, pick 23 Oct Pre-germinate 10,000 tubers for polyhouse planting Check s/s tubers Build beds in shadehouse 5 per week Sort and separate callas

Figure 4.5. Part of the year plan showing scheduled weekly activities.

Unfortunately, because a sandersonia flower crop is of very short duration, the grower realises there is not a lot that can be done to *"put a crop back on track"*, after it has been identified as being "off track". This occurs particularly in the summer months when the temperatures (the major driving force of the time to flowering) cannot be controlled particularly well in the grower's glass and greenhouses; a common problem for cutflower growers in New Zealand. Timing of crop harvest was also important for supplying a product as well as managing their resources. The timing of this was more critical for some crops than others, for example, harvesting sandersonia flowers and 'green' sandersonia tubers, rather than the main crop sandersonia tuber harvesting. Main crop tubers will maintain their quality for a period of time before they are harvested, but flowers and 'green' sandersonia tubers must be harvested at exactly the right time because they are perishable items and for marketability reasons.

Co-ordination of all the activities for each crop type and its rotation must be well planned to ensure they are executed in an orderly manner. To do this, all the possible tasks associated with both the sandersonia and calla crops were timetabled. The company plans weekly activities at least a year in advance. The planning is done by the grower's daughter using a word processing package. Several formats are made. One format gives the jobs that have to be done in any one week for the whole year. For example it records the number of tubers that need to be planted or lifted in any week and the number that will be harvested on a day. In this format, each page shows a number of weeks (Figure 4.5). A planner is pinned on the lunchroom wall so that everyone knows what needs to be done each week but only the daughter and the founding partner know who will be allocated to each job. The other planner details this information and this copy is kept in the office. Each week covers one page in this format. This allows for comments to be added later detailing whether the tasks occurred on time and any other relevant information (Figure 4.6). To show a more holistic view of this, a time line was drawn up during the interviews with the grower (Appendix 4). In the past the founding partner relied on his memory to remember schedules such as this.

> *"It's stored in the brain, and because of my age I can't hold too much there nowadays !!!"*

These weekly activities are based on income recovery and maintenance of the harvested item at a desired stage. Over the years, time and motion studies have been carried out to quantify how long it takes to do so many units of a certain job. Tasks such as harvesting main crop sandersonia and calla tubers can be carried out over a long period of time while still maintaining product quality. To do the job, the number of hours are calculated to decide whether the job will be done more quickly by hiring casual staff, or whether the core staff will spend longer on that task. This will depend on what other "critical" jobs such as harvesting perishable sandersonia flowers and 'green' sandersonia tubers have to be done at the same time, and the costing structures of various activities.

August 23 Plant 2 rows @ 140 boxes for glasshouse, pick 10 Nov (Peter and Tess)

Pre-germinate 13,000 tubers for glasshouse planting (Peter)

Build beds in shadehouse (Dave) 5 per week

Sort and separate count callas (Claire)

Stake and irrigate glasshouse (Tess)

1½ rows planted g/house (R1 & ½ R2)

Shadehouse still being erected (cables being attached)

30 trays of callas completed. (including putting "babies" to bed.

Tubers in polyhouse started coming up. Rows 2 & 5 first, then Row 1.

Row 5 gets last of the sun. (∴ comes up quickly) In future, plant this row first then Row 1, 2, 4, 3 etc.

Figure 4.6. Detailed plan showing planned activities for one week, as well as what actually happened.

The grower has mixed views about the cost effectiveness of automation,

> *"It cuts the risk of errors down. I believe that once I put up solar screens and so forth through, I can do far better than I am now"... "Although I believe there's also a limit to the amount of automation...I find that the amount of sophistication you need is more basic for sandersonia growers. We don't need the sophisticated automation necessarily, as you do with other crops. It is just so quick, planting to harvest".*

The grower also considers that "high-tech" methods are not always the answer, and the "human factor" can override them. An example of this is when he considers that human perceptions are better than equipment such as for deciding when to water a crop. Tensiometers accurately measure the moisture content of the growing media in the grower's shadehouse, but they cannot allow for an approaching rainstorm, that humans can detect. Another example is making innovative use of machinery to carry out a task that would otherwise be done less well or at more cost (Figure 4.7).

Figure 4.7. Simple but effective technology: a fan set up to dry sandersonia tubers.

At the time of the interview the grower could not pinpoint any specific technological problems he had, but he felt that there were always opportunities for improvements.

> *"If we can get output increased without increasing costs and overheads, that's a major accomplishment. Everything comes back to tuber quality and how we achieve that. We are not achieving that yet... information on sandersonia growing is very hard to find"... "The information* [for technology] *part is what I'm more interested in, than how we do the job. Because of how we do the job, I'm happy with a lot of that being left to myself to further enhance, as more money becomes available to do so".*

The grower considered that in his operation no one technology stood out as being better than any another one.

> *"I think each one is part of the whole chain of getting the flowers from planting to growing to picking to exporting them into the customer's hands. Because we're not using the computer as our controller for our whole environment here, the significance of the computer doesn't stand out the same as if we were using that to operate our whole complete operation. In due course it might, because that's advancing further down that line".*

4.4.7 Checking

Checking is an integral part of this company's activities, and occurs in a number of ways such as checking day to day activities, medium-term goals and long-term goals.

All daily and weekly activities revolve around the written plan. At the plan implementation level constant checks are made to ensure that everything is on track. This involves making sure that crops are being planted or harvested when required,

> *"...I'm checking almost daily on the tubers... seeing what happening... so if something is wrong I can..."*

and that the number of people allocated to do task is correct. The "Countback" method has been devised and refined over a number of years, but it is only a guide, so that throughout the growth of any crop its progress is constantly monitored and compared to the anticipated time of harvest. During the various stages of a production cycle checks are made of such things such as the components that make up the growing media, the nutrient status of the media (and crop), the growing temperatures, the moisture levels of the growing media, and the presence of pests and diseases.

Longer-term predictions of crop timeliness are also taken from nature, and if necessary crop planting times may be adjusted. These checks are important as they may identify bottlenecks at some later date for the company, and may affect the volumes of product that exporters or brokers have been advised to expect. On a short-term scale, weekly prices of flowers are also used to decide which exporter will get their product.

Checking on quality is also an important task. As the company has its own brand for sandersonia flowers they have to ensure that their quality standards are high. Even though their sandersonia tubers are not branded the growers must ensure that they are of the highest quality as well. This involves making sure that the tubers are in the right grade band (by checking the weight of every individual tuber) and checking the stored tubers monthly for diseases.

To gather all the predicted and actual timing of events, every page of the weekly plan also has space to allow for comments on how well and timely the planned activities actually occurred. This also includes time and motion studies, and whether or not an event is regarded as a one-off event (Figure 4.6). This information will be used to refine the next year's plan. The various partners ensure that these checks occur and any necessary changes are made as each of the partners is in charge of an area of production. As the founding grower knows the whole plan, he also oversees everything.

Longer-term prices are predicted as best they can be. This information may change the timing of planting of some crops so that they better coincide with the anticipated higher prices. As another check on the pricing structure of their products, every crop item is also costed out using computer-based recording systems. This ensures that any deviations in estimated returns are identified and the reasons for this can then be understood. This method identified that firstly, fruit crops, secondly vegetables and thirdly, the initial flower crops should be replaced by other crops to maximise returns given the constraints they have either imposed themselves or have had imposed on them. These types of financial checks then allow comparison with the long-term goals and whether these need to be revised or whether they are on track.

It should be noted in this Chapter that there are many overlaps between sections. This shows the highly intertwined relationships of all phases of the decision making process.

4.5 Literature cited

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Chapter 5: Framework Evaluation

This Chapter links the findings and analyses of the review of the literature, the broad-based survey, and the in-depth case study, to show a framework of decision-making behaviour, the steps taken in the decision-making process and how they are all interwoven.

5.1 Introduction

Problems start with experiencing a situation (Bawden & Macadam (1983)), and being aware of a problem or situation that you want to change. It should be remembered that there are always many possible versions of the situation, as boundaries and objectives are often difficult to define (Flood & Carson (1988)). Kolb, Rubin, & McIntyre (1974) suggest that effective problem solving proceeds from this first step of problem identification as cyclical process involving three more steps:

a) observation and reflection,
b) conceptualisation and generalisation, and
c) action to validate.

Kolb, Rubin, & McIntyre (1974) have concluded that these steps are identical to the way people naturally learn. Therefore learning can be considered not only to be part of the final step of 'Checking and judgement' identified in the models of Chapters 2 and 3, but also part of all the other steps. Learning is the transformation of environmental experiences into knowledge and then into action that will ultimately result in changes in our relationship with our environment (Kolb (1984)). People usually want to avoid mistakes and exploit opportunities, to better influence or control future events, and the growers interviewed take this stance. Positive reflection plays a big part in their learning behaviours, and is a lifelong process. Many management techniques would have changed if many of the growers in the survey could rewind the clock. The sandersonia grower also had the same philosophy about learning, and extended this through his involvement in a local sandersonia group.

5.2 Problem identification and problem solving

The point in time at which growers perceived they had a problem varied considerably. Many of those growers interviewed in the survey considered problem perception was a "slow realisation" rather than a "bolt of lightning" except for pest and disease incursions. In contrast, the sandersonia grower did not seem to have any major difficulties identifying problems in his operating environment. He is an avid gatherer and processor of information, but even so there were problem situations that he could not solve, because he could not find useful information. This issue was raised with a number of growers interviewed in the survey as well, but was more clearly made by the sandersonia grower. He, for example, was readily able to identify technical difficulties in his operating environment. In these situations he knew the outcome he wanted,

> *"I want to maintain a glasshouse temperature of 25 ^{0}C in the hottest summer days",*

but identifying the technological equipment to do this given the grower's specific operating environment, and implementing it, was the problem:

> *"We know what to do but how do we do it ?".*

This example from the case study shows the convergence and conflict of hard systems and soft systems approaches. Problems of 'hard' systems technologies are often well structured and have quantifiable inputs and relationships based on known laws therefore specific results or solutions can be estimated for given conditions. In the real world though, solutions cannot always be found using the quantifiable 'hard' systems approach. This is because the problems and/or alternative solutions are often poorly structured and have goals and inputs that are more difficult to quantify, can have a variety of conflicting theories associated with them, and have no accepted laws (Flood & Carson (1988); Whittaker (1993)). This scenario typifies a 'soft' systems decision-making environment. In the sandersonia grower's situation the problem was easily quantifiable in financial terms or production units. A problem solution was desired, but achieving it would take on another dimension in terms of limited information and 'what if' scenarios. These 'hard'-'soft' approaches conflicts can also arise between science and management because this is where they interface. However, the sandersonia grower's experience means that he will readily combine solutions from both approaches.

5.3 The importance of information

One of the other key elements to making a good decision is information. The survey revealed that information is vital in making a good decision, but the absolute importance of this was not identified until the case study was carried out. In the survey, information gathering was most important in the 'Consideration of alternatives' phase of the decision-making process. In contrast, information was gathered by the sandersonia grower in all of the steps in the decision-making cycle – during 'Problem identification and prospecting', 'Problem framework and definition', 'Ranking of alternatives', 'Implementation' and during 'Checking and justification'; and affected the time it took to make and implement a decision.

Once growers could see that their knowledge or life experiences were not enough to solve the problem, more 'external' information was required. They had learnt from past learning experiences they needed more information, and to ultimately learn more. Many of the growers interviewed, including the sandersonia grower, found it very difficult to find the information that they needed, and quite often had to rely on their "gut feelings" or carry out their own trials or experiments. This is because they were not willing to risk full implementation of an action without checking first. The type of information they needed was not static. It varied with the problem and as they became more experienced at growing a crop they required more specialised information. The growers used many sources to gather external information; from the Internet; local and international magazines; researchers; consultants; marketers; other growers; to conferences and grower visits. Lively & Nuthall (1983) similarly found that for New Zealand farmers, field days and advisers were significant sources of information, but that radio and TV were not heavily relied on for farming information. Pertinent grower publications were ranked highly by New Zealand sheep farmers as a source of new information along with consultants, but radio, conferences, seminars and market information were not important sources of information (Mendez Lemus (1995)). Even though there seem to be some clear trends in the sources of information used by growers. It is important that they are able to efficiently screen, interpret and apply relevant information, and to learn from trial and error. This can be achieved by learning from making mistakes, learning to carry out their own experiments, or learning to adapt and modify ideas and technology to suit their operating environment. Growers are better at doing some of these activities than others as they operate more effectively at different points in the Kolb cycle.

5.4 Evaluating alternatives and making choices

Making a choice is a complex process, and even though the growers interviewed did not state this, there were choices that they found difficult to make because of their complexity, and the conflict arising between trading off one choice with another. The act of deciding on these alternatives also involves choices as some alternatives are discounted very early on in making a decision. There are rarely single solutions to problems particularly at an innovative or strategic level (Bawden & Macadam (1983)).

There are two types of judgements that growers will make: predictive, in trying to forecast future events; or evaluative, in determining which alternatives to choose (Hogarth (1980)). Unfortunately for cutflower growers these two judgements are interdependent. Determining alternative crops to grow are based on attempting to predict future market potential.

The grower's 'best' choice is made from a list of alternatives. If the alternatives can be isolated they can more readily be weighed up against each other individually and then in tandem with the current operating environment. Unfortunately, even if the 'best' alternative is identified, it may not be selected because it does not fit into the current operating environment. In any production system there are resource and labour constraints as well as short and long term goals to be met, including factors of plant material availability, glasshouse, greenhouse and shadehouse space, labour, harvesting and markets. They all have to gel together, and priorities have to be made in planting and harvesting.

The speed at which the interviewed growers made crop option choices varied considerably from instant decisions to several years of trialling. Many of the growers interviewed in the survey found that deciding on what crops to grow was a major problem. They therefore either jumped into growing a crop with the attitude of "suck it and see", or delayed making a decision, or did crop trials, mainly because they felt it was so hard to make a good judgement. Crop choice was not an important issue for the sandersonia grower, even though he had made very rapid crop changes in the past, and over a reasonable number of crops. This may have been because he was committed to growing sandersonia through its high and low points, whereas most of the other growers grew a range of crops, and thus more readily changed crops. Even so, all growers, including the sandersonia grower were always prospecting for new potential crops.

The problems that seemed to be solved most quickly by growers taking part in the survey were ones associated with issues such as pest and disease incursions. In contrast, problems associated issues such as irrigation and temperature control and crop culture took the longest for the sandersonia grower, because he often could not identify the means to solve his problem even though he knew the desired outcome. Unlike dropping market prices growers could often change the outcome of problems such as pest and disease incursions, because they knew that if they did not change a situation and rapidly, they could have no crop to sell. Whereas a change in the current or potential financial status of a crop 'in the ground' can be identified but not changed until the end of a growing cycle, because in most cases crop removal would reduce profits even more. In this situation, growers cannot do a great deal about the prices they are likely to get unless they are able to rapidly develop a new marketing strategy.

There are a number of reasons why growers make decisions at a range of speeds:

- their decisions are made based on personal judgements and personality traits, past experiences, how they learn, and their current situation,
- they learn from past experiences on how to approach a new problem, and know what would happen if the problem is not solved,
- the type of problem,
- the quality and quantity of information can either impede or progress the decision-making steps,
- the type of action required to implement the decision.

The models in Chapters 2 and 3 separate 'Alternatives' and 'Choice', but analysis of the data collected in this case study indicates that they are more highly intertwined than initially thought and a model of decision making would be better portrayed if these two phases were joined.

5.5 The role of technologies

The use of more technologies on growers' properties could be considered to be the obvious answer to some to solve problems associated with cutflower growing. The concept of technology (defined in Appendix A5.7), though, seemed difficult for the sandersonia grower to define when asked. It also seemed apparent that it is not a question that had been raised in this grower's mind in relation to his own business even though technology is currently widely discussed in the media. Only a few of the growers interviewed had plans to make more use of technologies. Most of the growers surveyed considered, for example, that there was no point in heating a glasshouse through the winter because the extra returns would not compensate for the extra costs involved. These same growers said that florists did not seem to appreciate the extra cost that had gone into producing such a product, and they would not pay more. From the sandersonia grower's point of view he considers that technological methods are not always the answer, and the "human factor" can override it. This grower also considers that the greenhouse/glasshouse supply industry in New Zealand is not innovative enough for local conditions. In many respects this is not surprising as the New Zealand greenhouse/glasshouse industry is small and potential returns for research and development are limited. Technologies can also include financial or business or production planning packages. A number of growers use some of these technologies, but very few of those who grow a large range of crops use production scheduling and management techniques such as Project Management using Microsoft Project.

In another primary based industry in New Zealand, the dairy industry, no single factor was identified by Parker, Stantiall, Allen, Hurley, Kuiper, Massey, & Rauniyar (1997) as being the reason for adopting a technology, but they identified that widely adopted technologies are generally observable and discrete, whereas business learning techniques are not widely adopted. The perceived overall benefits (financial, time requirements, degree of simplicity, peer pressure, flexibility, risk management and control, and personal satisfaction) all contributed to technology adoption. Feather & Amacher (1994) made similar observations amongst US cropping farmers saying that a lack of producer information regarding both the profitability and the environmental benefits of adopting improved practices may be the reason why widespread adoption of practices has not occurred. They concluded by saying that revising producer perceptions about the cost effectiveness of new farm practices should encourage adoption. Frank (1997) also found that innovations are often developed and marketed individually, but potential clients often adopt relevant innovations in sets. The only common dimension for all innovations was 'social acceptance' associated with environmental stability. The farmers surveyed by Parker *et al.* (1997) also emphasised the vital importance of correctly targeting and packaging a new technology, and obtaining the support of widely respected and leading farmers (or growers) at an early stage in a programme.

5.6 Checking and judgement

The final stage of the model described in Chapters 2 and 3 is 'Checking and judgement'. Checking can only occur effectively if someone has the right experience, and this experience can only be gained with time and hands-on involvement through the learning process and by good judgement, and therefore provides the necessary feedback to learn. Much of the growers' experiences have been gained through trial and error,

> *"We immediately know which ones we can vary from experience",*

the personalities of the growers

> *"I don't intend to make any guesses", "Suck it and see"*

how they learn

> *"I like having all the information", "I should have spread my risks",* and
> *"Learning is more than just observing – it's done by doing"*

and ultimate goals

> *"...I want perfect flowers and perfect tubers..."* and *"I want something to keep me busy"*

These factors will all help to shape their judgement on the success or failure of a past decision choice and influence how the next problem is identified and how it is going to be solved.

There are a number of ways that growers check on their previous decisions. During the active growth cycle of a crop, some growers monitor how their crops are growing to see if they will be on target for harvest, crops are checked for pests and diseases, and the markets are watched for price trends. At the end of the season a crop can be evaluated overall for its performance, and whether it will be grown next year, and when, and if any cultural changes are to be made. If a grower has reservations about a new crop but sees that it may have some potential it is likely to be trialled. During this exercise it will be carefully observed, and decisions will then be made about its future. Therefore, trialling can be used for two reasons: to gather information, or to check.

5.7 Changes to the decision-making model

Analysis of the case study has revealed that the decision-making models developed in Chapters 2 and 3, and shown again in Figure 5.1 would be better represented with a number of modifications.

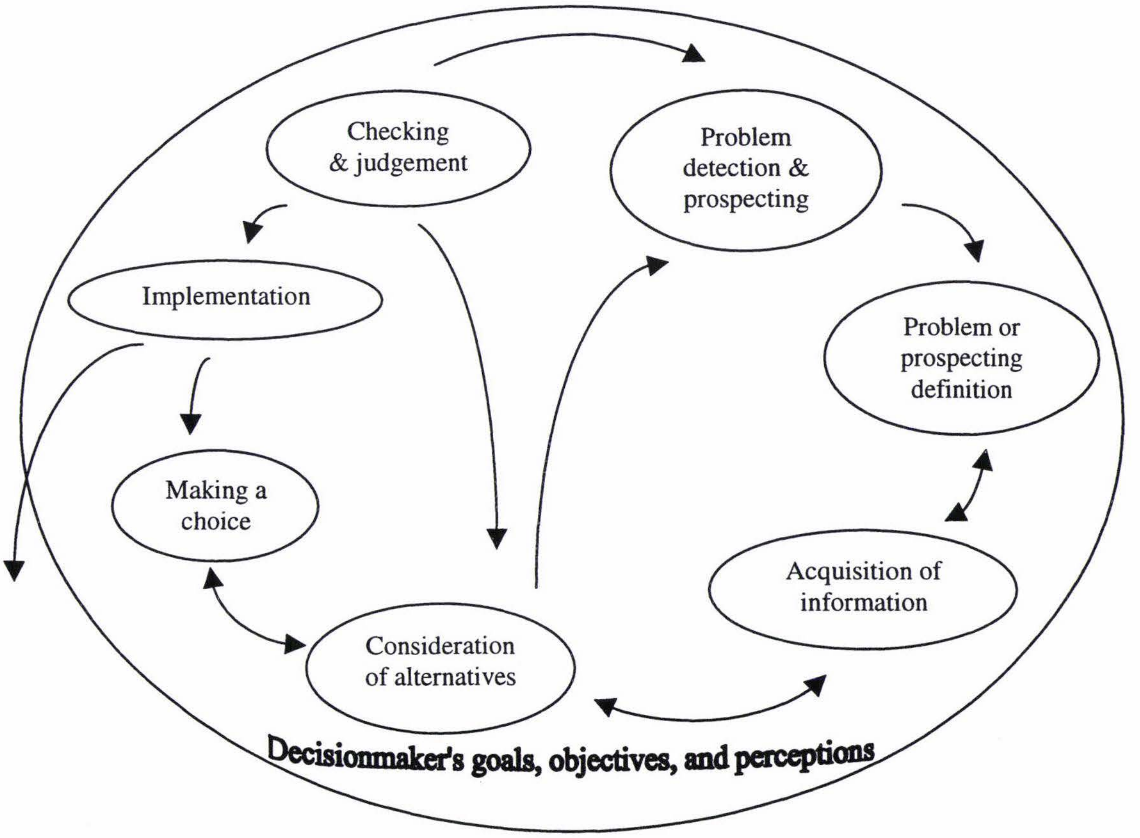

Figure 5.1. Developed decision-making model for primary production systems.

Firstly, the acquisition of information is much more intrinsic in the decision making process than indicated by the two previous models. Information also plays a dominant role in the model developed by Öhlmér, Olson, & Brehmer (1998) and Klein's model cited in Lipshitz (1995),

> *"no step in the* [Klein's] *model can be executed effectively without domain knowledge or experience".*

Therefore changes to the model shown on Chapters 2 and 3 and in Figure 5.1 are suggested to show that 'Information' is part in all phases of the decision-making process. Secondly, 'Problem detection and prospecting' and 'Problem or prospecting definition' are too similar to warrant two categories, therefore they have been combined in a revised model. Thirdly, 'Consideration of alternatives' and 'Making a choice' have also been combined, not only because they are similar actions but because of the higher iterative relationship the two have. This can be seen in Figure 5.1 by the double-arrowed line between the two.

5.8 The new model

The revised model based on the suggested changes in Section 5.7 attempts to better represent the decision-making process and is shown in Figure 5.2. It now shows that 'Information' is a key part of any decision-making process, and can be acquired within the grower's system, from past learning experiences (1), conducting trials, as a result of making other decisions (2), or gathered externally (3). The 'Problem detection, definition, and prospecting' phase is an amalgam of two phases, along with 'Consideration of alternatives and making a choice'.

This model shows no beginning or end point as decision making is a continuous, cyclic and highly iterative process. All of the phases of decision making are interrelated to the other phases. For example, 'Checking and judgement' can occur after 'Implementation' (4), and after 'Consideration of alternatives and making a choice' (5), and may result in reconsidering alternatives and choices made (6). Both 'Checking and judgement' and information gathering can also lead to detection of a problem (7&8). To solve a problem, a situation must be changed, therefore alternative solutions need to be considered and a choice made (9) often by gathering and using stored information (10).

Once a decision choice is made 'Implementation' can occur (11). One of the major findings of this study is that even though growers may know that they want to change a situation, they often do not know the means to do this. Therefore more information is often required (12), or they want to double-check their choice (5) by running trials before implementation (13). It should also be noted that the arrows represent a grower's potential behavioural processes. For a situation to be improved there must be physical changes. These changes occur at two stages in this decision-making model – with acquisition of 'Information' (3) and with 'Implementation' (14), hence the two arrows, to and from the grower's decision-making environment.

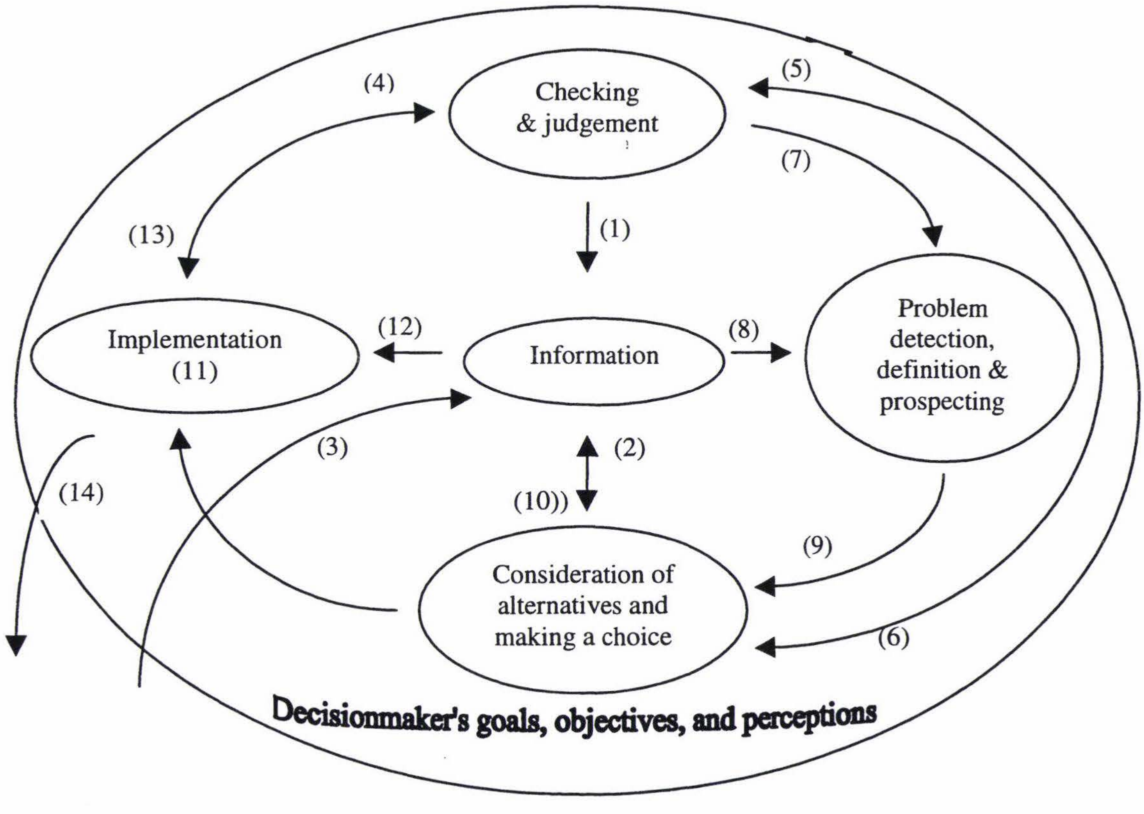

Figure 5.2. Revised view of the decision-making model for cutflower production systems.

5.9 Literature cited

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Chapter 6: Conclusions and Recommendations

6.1 Project overview

The main objectives of this research project were to understand and describe the literature on decision-making behaviour and decision-making models. To achieve this, two decision-making models - a generic model of decision making in primary production systems and a model for cutflower growers, have been proposed and validated. The generic model was developed from the literature review of Chapter 2. A survey of 26 cutflower growers enabled the generic model to be developed into one for cutflower growers (Chapter 3). To validate the cutflower decision-making model, a single case study was conducted (Chapter 4).

6.2 Assessment of the methods used

6.2.1 Data collection

Firstly a survey and then a case study were conducted. Use of these two different but sequential research strategies enabled the qualitative and quantitative data to be used in a complementary fashion. This type of research approach is called a "mixed method" study and is described in detail by Tashakkori & Reddlie (1998). There are strengths and weaknesses to any data collection strategy, and using more than one collection approach permits the researcher to combine the strengths and correct some of the deficiencies of any one source of data (Patton (1987)). The multi-method approach was useful because it added breadth and depth to the study, and overlapping and different data could be collected and analysed. The survey initially provided a broad insight to the decision-making behaviour of cutflower growers who grew a range of crops. The use of the single case study then enabled the research focus to be narrowed to an individual grower's system and specific issues relating to decision making.

Many of the growers were very eager to be interviewed for the telephone survey, in fact some phoned the researcher. When it became evident that no more useful information was likely to be gathered, the researcher was in the embarrassing situation on occasions of having to turn growers away. The survey was a very time consuming exercise for a number of reasons. It was difficult to make contact with some of the growers, and the interviews often ran for longer than the designated 20 minutes. A visit to each of the growers was prohibitive, but a better understanding of their working environment would have been helpful. A telephone survey was more useful than a postal survey because more open and probing questions could be asked, and because of cost and resource requirements. Another advantage of the telephone survey was that the researcher could ensure that the interviews took place in a timely fashion, rather than having to rely on the growers to send back a postal survey. Transcribing did not occur until all the interviews had been conducted. During the interviews the researcher took notes, but it was very difficult to remember all the key points that were mentioned.

Breaking the case study interview into time periods revolving around two sessions on each of two days a week apart was beneficial for the researcher and the interviewee. The relatively short time period made it easier to remember the previous interviews, and the grower was able to do a few odd jobs and reflect on what had been said. It also gave the researcher a chance to review the information that had been gathered. A lot of data was gathered. Later it was obvious that much more data than necessary had been collected, but this was part of the learning process of the researcher. The volume of data made it difficult to handle, but this was helped immensely by having it all transcribed very quickly and accurately.

6.2.2 Data organisation and analysis

There are several ways that the information in Chapters 3 and 4 could have been categorised by:

- decision type as shown in Figure 4.4,
- the activities described in Figure 6.1,
- using the types of decisions defined by Kay & Edwards (1994),
- using the phases of the decision-making models.

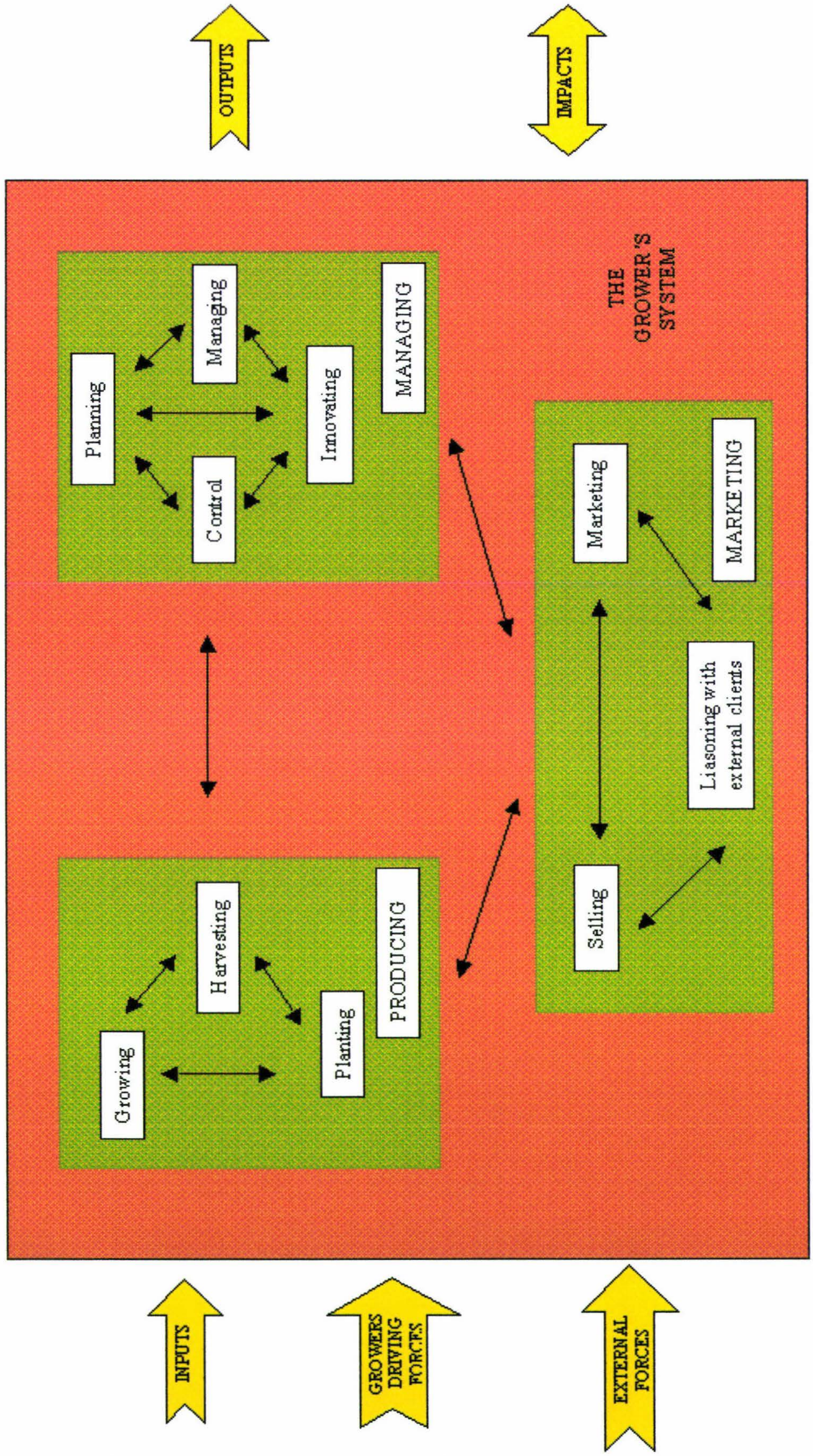

Figure 6.1. The grower's system. (Adapted from Bawden and Macadam, 1983).

Decisions in a management context can be classified as operational, tactical or strategic. Kast & Rosenzweig (1985) for example state that problem solving techniques for operational decisions have a 'computational' focus based on 'optimising',

> *"Anything that is making money will have priority over others that are not making money",*

whilst those involved with the more unstructured strategic situations tend to be 'judgementally' focussed with objectives of 'satisficing',

> *"We'd go through thick and thin as long as there's going to be a thick again".*

Furthermore, Kast & Rosenzweig (1985) state that operational decisions tend to be protected from environmental changes and are therefore relatively stable and deterministic while innovations, which are at the very interface with the environment, are dynamic and stochastic. These classifications seem to be quite clear cut and convenient for those who have defined them, the academics and analysts, but it is not always clear which operational decisions actually fit into each category.

Even though there is a good understanding of each of these management contexts in which decisions are made and problems solved, they often co-exist in the grower's decision-making environment so the pure form often becomes blurry. This occurs in two ways. Firstly, making decisions that have two management component types, for example, changing a crop grown or its timing, can be defined as any management type depending on the reasons for making the decision and the situation in which it is made. Secondly, it results when a decision of one type quickly evolves into another management type. For example, in making a strategic decision to buy a glasshouse the sandersonia grower had to make a number of operational and tactical decisions at a later time. It was decided to buy a second-hand glasshouse and move it onto the property when they first bought the land.

> *"I wouldn't recommend anyone to do that ever because those old glasshouses have got insufficient ventilation"..."the moment we started using the house for sandersonias it was up to 40-odd ^{0}C... so we took the sides completely out and replaced them with wind-up sides and took half the roof out and put the winged plastic vents on top...it's far more controllable...".*

Decisions that the grower may make to solve operational problems can also have both short-term and long-term consequences. If plants are in desperate need of water, the short-term solution is to identify they are dry, and then water them accordingly. The long-term solution is to implement a better way to either identify when they need or may need watering through monitoring, and/or change the watering delivery system to a more automated one. These changes in decision types occur because many problem decisions often occur in a combination of two or more management contexts and can determine the timeframe in which the grower identifies the problem and undertakes to solve it. This has readily been exemplified in this case study.

The second way to describe decisions made by the grower is by company activity. In this company there are three main components of management: production, managing, and marketing (Figure 6.1). Within each of these components and between the components are intertwined sub-activities, many of which are dependent on each other. The grower's driving forces, as well as external forces, (the weather, supply and demand, and the value of the New Zealand dollar), and his resources will all influence activities in each of these components and their sub components, and thus product timing, quality and volume outputs of the system. It is evident that changing one part of the system will have repercussions throughout the rest of that system (Bawden & Macadam (1983)). For example production volumes will affect other production-oriented activities as well as marketing the product and managing the operation.

According to Kay & Edwards (1994) there is yet another way to group decisions made in agriculture and horticulture. These are *what* to produce, *how* to produce, and *how much* to produce. Cutflower growers also have to make decisions about *when* to produce. The growers interviewed can readily identify all of these problem types. This insight into problem solving or decision making is the one that many growers interviewed talked of. Many have grown a range of cutflower crops, they have had to learn how to grow each of them and improve their volumes and quality. They have also learnt the dynamics of supply and demand, and when the markets require certain products. In some situations income continued to decrease until the grower actually became aware of the problem or could not bear it any more. This situation has been described before. For example, Frank (1997) states that growers will adopt innovations that will arrest a decline. On several occasions a problem had been identified but had been put into the "too hard basket" because, for a number of reasons, the decision maker could not find the information to solve the problem or the technical equipment and/or skills to fix it.

The fourth method of categorising the data collected was by the phases in decision making. This was the approach taken in this study because it most clearly validated and extended the concepts of decision-making from Chapter 2 initially and then Chapter 3, even though all of the structures described above could have been used to describe the data collected.

Because of the volume of data, the initial phases of data organisation and analysis were difficult and time consuming. To organise the data gathered from the survey, answers were collated by question so the trends and quantitative data could be identified, and then analysed according to the headings of the generic model described in Chapter 2. This was a helpful process. A similar method was used to organise the data gathered from the case study. Data were collated into the predetermined categories as laid out in the decision-making models described in Chapters 2 and 3 then analysed.

The process of breaking up can cause information about the relationships to be lost (Dey (1993)). Elements that are connected through interaction need not be similar (Dey (1993)), in fact it is the differences that indicate the possible links and relationships - one cannot exist without the other. Even though the collation approach used was beneficial, use of one of the computer programmes such as NUDIST that categorises data based on rules may have been quicker. Such a system, though, would have had its limitations based on the operator's ability to be able to clearly place the data in one (the best) category, as they could have fitted into several categories. NUDIST also looses relationships between data items.

Analysis of the data collected from both the survey and the case study took a behavioural approach, because it ensured that the form of the research questions, "what", "how" and "why" would be best answered. Scrutiny of the headings used in the models, and classification of the data indicates that the approach to data organisation and analysis generally worked well together, but several modifications to the models described in Chapters 2 and 3 were identified that would enhance the decision-making model.

6.3 Conclusions

The decision-making behaviour of cutflower growers, along with agriculturalists and other horticulturists is best described the *"individual differences approach"*, one of the five accepted schools of thought describing decision-making. Cutflower growers have been identified as a highly diverse group of people, but they all have very similar decision-making drivers – their goals, values and beliefs. All decision makers behave in a different manner and timeframe depending on their own personal drivers, their experience, the nature of the existing environment, and each decision is dependent on information and the way the decision maker prefers to learn. This environment has often been found to be complex and highly uncertain, and a cutflower grower is often involved in making a large number of simultaneous decisions.

Problem detection is basic to problem solving. If a problem is not identified there will be no change to a situation. The speed with which cutflower growers identify a problem is highly variable, depending on their skills and experience, and the nature of the problem they encounter and the quality and quantity of the information available tothem. Identification of a problem does not imply that growers are able to solve it. This can occur with two problem types: what to grow, and in solving a technical difficulty. With both these types of situations growers know the desired outcome, but identifying the means to do this given the grower's specific operating environment, and implementing it, can be the problem. It also does not presume that growers know why they need to adopt a course of action - they just do it, by using some or all of the steps described in Figure 5.2.

Growers consider information is critical to help them solve their problems in all phases of the decision-making process. This is one of the most difficult aspects of decision making as the information is often not obtainable (either not existing, undetectable, incomplete, or in the wrong form (either too detailed or not detailed enough)). One way that growers can commonly overcome a lack of information is by relying on their 'gut feelings'. Improved technologies are not always considered to be of benefit to growers, as the "human factor" can override them, or they are not perceived to be cost-effective.

The findings of the literature review suggested that a new generic model on decision-making should be developed. The seven step generic model, incorporating the most relevant features of all the models reviewed, was supported by the findings of a survey. From the data, a decision-making model of cutflower growers was also developed. Later, findings of a case study generally supported the two earlier developed decision-making models, but three modifications are suggested. Firstly, the case study revealed that information gathering plays a far more important part in the decision-making process than initially thought, as it is used in all phases of decision making and affects the time taken to make a decision. Secondly, considerable overlaps were identified in several phases of the model ('Problem detection and prospecting' and 'Problem framework and definition'; and 'Consideration of alternatives' and 'Making a choice') and have been merged. Thirdly, the role of the inter-relationships between a number of the phases has been emphasized more to show the highly iterative and cyclic nature of decision making.

Overall, this latest version of the model shows a number of key differences to the models described in the literature:

- It shows the cyclic and iterative interrelationships of the decision-making phases, and the seamless process of decision-making,
- All decision-making phases are highly dependent on a number of factors including: the goals, aspirations and preferences of the decision maker; the way they learn; external factors which influence their views of and actions in the real and complex world; the degree of risk and the timeframes in which decisions must be made; and the nature of the problem, or prospecting needed,
- Prospecting has been identified as being an important trigger in making a decision, particularly in relation to new crop choices,
- It shows decisions can be made under all degrees of uncertainty and risk, and decisions can be made over a range of decision types, whether they are operational, tactical or strategic.

Information is the key to enhancing production systems. For any type of information to be of use to growers it must be relevant, timely and in an appropriate form. To increase the chances of this occurring, information providers (analysts, scientists, educationalists and suppliers) must realise the complex, uncertain and risky environment that growers operate in. For some groups of information providers this will be difficult to do because their daily operating environments are much more stable. Therefore, information providers must learn to understand and allow for the variety and complexities of grower's goals in a dynamic operating environment. Information and technology must be delivered in the most appropriate form, and providers must also understand how and why the grower requires the information and what will enhance uptake. This will only come about through understanding growers and their decision-making behaviour, and teasing out the key drivers of it, and this research project is a step toward enhancing this understanding.

6.4 Further research

Based on the findings and conclusions of this study programme there are three research areas that would further enhance cutflower production systems:

1. Growers must make decisions under uncertainty and risk particularly on *when* and *what* crops they grow. Growers are concerned at the lack of market and forecasting information relating to consumer requirements and fashion trends, and prices, especially for exported crops, where large distances, language barriers and multi-tiered marketing structures make acquiring market intelligence difficult. Therefore, methods of improving the availability of current market information, and methods to improve market intelligence need to be developed.

2. If the New Zealand cutflower industry is to become strongly market-driven, growers must increase the level of technology they use, so they are able to meet consumers' demands of supply, rather than supplying product when it suits the grower. Therefore, research on understanding and improving the cost-effectiveness of technology would be a major advantage to the industry.

3. Better monitoring systems are required by cutflower growers to define which crops are best for them to grow, and when to crop them. Therefore, research on identifying and implementing the best recording methods is also suggested.

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Appendix 1: Key Models Of Decision Making

	Subprocess			
Phase	Searching & Paying Attention	Planning	Evaluating& Choosing	Bearing Responsibility
Problem Detection	Information scanning Paying attention	______	Consequence evaluation, Problem?	Checking the choice
Problem Definition	Information search Finding options	______	Consequence evaluation, Choose options to study	Checking the choice
Analysis & Choice	Information search	Planning	Consequence evaluation, Choice of option	Checking the choice
Implementation	Information search Clues to outcomes	______	Consequence evaluation, Choice of corrective action(s)	Bearing responsibility for final outcome, Feed forward information

Figure A1.1. A revised conceptual model of the decision making process. (Source: Öhlmér, Olson, & Brehmer (1998)).

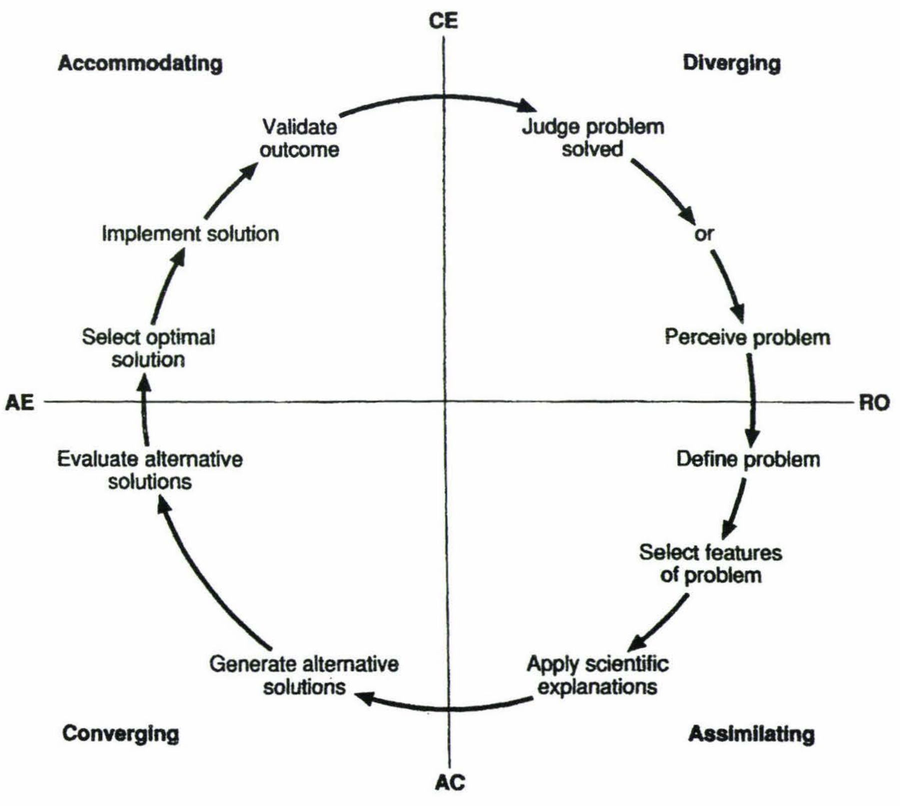

Figure A1.2. The process of applied science inquiry developed by Bawden and Macadam. (Source: Wilson and Morren (1990)).

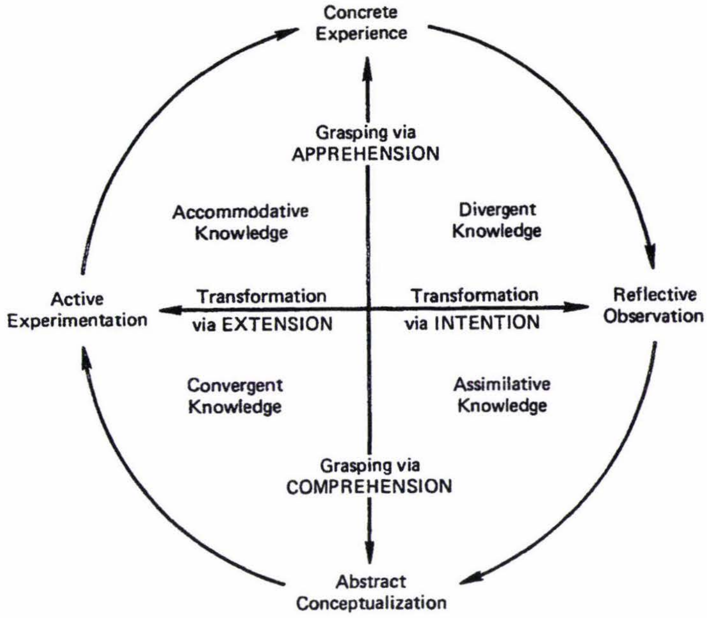

Figure A1.3. Structural dimensions underlying the process of experimental learning and the resulting basic knowledge forms. (Source: Kolb (1984)).

A1.1 Literature cited

Öhlmér, B., Olson, K., & Brehmer, B. (1998). Understanding Farmer's Decision Making Processes And Improving Managerial Assistance. *Agricultural Economics* vol. 18, 272-290.

Kolb, D.A. (1984). *Experimental Learning; Experience As The Source Of Learning And Development.* Prentice Hall, New York, USA.

Wilson, K., & Morren, G.E.B. Jr. (1990). *Systems Approaches For Improvement In Agriculture And Resource Management.* Macmillan Publishing Company, New York, USA.

Appendix 2: Survey Questions

- Hi, it's JC there. I sent you a letter several weeks ago asking if you would be happy to participate in a telephone survey I am conducting. Just to refresh your memory, this survey is designed to develop an understanding of how you make decisions and choices on your business, and how you encounter and solve problems in your business activities, so that I can be better equipped to help you better. All the information that I gather from you will remain anonymous.
- Now, are you still happy to participate in this telephone survey ?
- Are you personally happy to answer the questions ?
- The questions should take about 20 mins to go through, so is now a convenient time ?
- Do you mind if I tape this conversation ? Beep every 15 seconds...*(No, any particular reason, I will be happy to send you a copy of the tape, if that would alleviate any fears that you might have.*
- You might assume that I may already know some of the answers to the questions, but I would still like to formally ask them as part of this exercise. I have tried to ask questions that are not commercially sensitive, but if you feel that any are, please let me know.

1. When and why did you start out in floriculture commercially ?
2. Did you start off full-time or part-time ? Why ?
3. Has this now changed ? When did this happen ? Why ? *Any intention of becoming full-time ?*
4. What were you doing before you started/ are you still doing this now ?
5. How long did it take to make up your mind from when you first thought of getting into floriculture commercially until you actually took the plunge ?
6. What general steps did you take to realise this ?
7. Did you talk to any one about getting started ? *Who ? (new/old info ?)*

8. What are your current main horticultural activities ? What is the main one ?
9. What did you do when you first started out commercially ?
10. Have things changed now? How ? Why take this approach ?

11. How many crops or cultivars are you currently growing/handling ? How long have you been growing these for ? *How do these tie in with your other floricultural activities ?*
12. How often have you changed your crops/cultivars/activities since you first started ?
13. One at a time or as a suite of crops/cultivars/activities ?
14. Why have you taken this approach ? *spread risk/profit, was this the case when you started growing ?*
15. What has made you change crops/cultivars in the past ? *can't solve problem ?*
16. Do you plan changes to the crops/cultivars your grow some time in advance ? *or more on an ad hoc basis ? Timeframe, Room for rapid changes ?*
17. Why ?
18. How did you decide on growing/being involved in your current crops ? *Your idea or came from somewhere else ? New/old Info ? start with a range and whittle down or validate decision ?*
19. How does this method differ from the decisions you made on your first crop(s)/activities ?
20. How long did it take to decide on growing these crops/cultivars/activities ? Why ? *Does it vary with crop or year ? Cf 1st crop ?*
21. Did you set a list of criteria that had to be met in choosing these crop(s)/cultivars/ activities ?
22. In finally deciding on your crop(s)/cultivars did you stick to your criteria ?
23. Why ? *more info, changed criteria ?*
24. What would make you change these crop(s)/cultivars ?
25. Have you made any major changes in your operation over the last 2 years ?
26. How did this (these) come about ?
27. Do you harvest your crops when you would ideally like to do so ? *(deliberate or out of control)*
28. How do you do this OR do you want to achieve this ?
29. How could you achieve this ? *glasshouse/shade house*

30. What types of problems have you had in the last year and how have you tried to solve them? *(in/out of your control) ?*
31. If you have more than one problem, how do you sort out which one to solve first?
32. What things would make solving these problems easier ? *information* ?

33. What types of problems did you have in the first year of growing ?
34. How did you solve them ? Would you try to solve the same types of problems in the same way now ?

35. What do you consider to be the major bottlenecks to your product in the value chain?
36. Have you tried to solve any of these bottlenecks and why these ones ?
37. What would make solving these bottlenecks a quicker or earlier process ?

38. What types of recording and/or accountancy systems do you have at present ?
39. What does it/they actually do ?
40. How long have you had it (them) ?
41. Why didn't you use one earlier ? Did you consider it ?
42. Are you happy with how it works ?

43. Have you got a picture of where you'll be in 5 years ?
44. How have you developed that picture ? *terms expressed in business, financial and physical.*
45. How will you get there ? *break into short & long term goals -strategic, tactical, operational 6 months, 2 years, 10 years ? types of decisions ?*

46. What would you have done differently from when you started growing until now ?
47. Why ?

48. Would you like a copy of the summarised results of this survey or the transcript ?
49. Would you be happy if I contacted you again to clarify any points you have made, or to ask you a few more questions ?

Appendix 3: Case Study Questions

For some case study topics, there is a rich theoretical framework. For others, descriptive theory may be best to use, but for others there is only a poor theoretical framework. This case study, is based on the use of technology by sandersonia growers, where there is no conceptual framework or hypothesis, and is likely to assume the characteristic of being an "exploratory" study. It gives me, the investigator, an opportunity to observe and analyse a phenomenon previously inaccessible to scientific investigation.

The purpose of this case study is:

- to define the term "technology" in the grower's eyes
- determine what types of technology they currently use and why
- what types of technology they have used in the past and why?
- how have they used it?
- what types of technology they intend to use in the future and why?
- How would they use it?
- What types of technology they would like to use in the future and why
- a SWOT analysis of the current technology used
- a SWOT analysis of technology they could use in the future

Before the visit

Complete preparations:

- email dates and times of visits
- permission to tape
- send a copy of the objectives and questions
- confidentially issues

First Interview

Background

1. What is your background since you left school?
2. Why did you get into floriculture?
3. Why did you start growing sandersonia?

4. Why did you choose Nelson?
5. Why did you choose this property
6. What facilities did the property have when you bought it?
7. Did you make any changes to it, and if yes, what were they? Over what timeframe? Why this period of time?
8. How do you describe your business at present
9. Flower growing/bulb growing and/or other activities (% of business)
10. How many crops and cultivars grown – nos produced or areas of each, % of business?
11. Do you treat all cultivars of a species the same?
12. Area under glass/plastic and shade?
13. Number of full-time staff?
14. What skills do they have that are pertinent to the business?
15. Number of part-time staff – when are they employed?
16. What skills do they have that are pertinent to the business?

Annual production planning

17. What crops are you currently growing?
18. How long have you been growing this current suit of crops for?
19. How did you make your decisions to choose them?
20. Over what timeframe were the decisions made?
21. How soon were they implemented?
22. Have you stopped growing any crops?
23. Why did you stop growing them?
24. Has this influenced the way you make decisions on selection of other new crops?
25. What times of the year do you plant, grow and harvest each of your crops?
26. Does any one of them have priority over the other crops? ...especially if there is a bottleneck.
27. How do you plan all the activities based on the various phases of your crop's growth and development?
28. What do you use to help you do this?
29. When do you do this?
30. How do you implement all the activities based on the various phases of plant growth and development?

31. Do you record any of these details?
32. Do you refer to them, and if so why?
33. What checks and controls do you have in place to make sure everything is on track? (fitting all the crops in, past records, what if growing a new crop, using a different growing technique or new environment?)
34. Do you have a long and short term business plan?
35. What time frame(s) does it cover?
36. If you have one how do you go about defining it?
37. How often do you update it?

Sandersonia

38. Earlier we established the types of sandersonia crops you grow and when. What is the routine you go through for production of a sandersonia flower crop and sandersonia tuber crop? (soil and tuber preparation, beds, location, planting, watering, spraying, harvesting etc)
39. Does this change with the time of the year?
40. From year to year?
41. What is your definition of crop quality?
42. What factors influence the timing and quality of sandersonia flower and tuber crops?
43. How do you mitigate the negative aspects of these factors?
44. Are there any other activities you would like to perform to mitigate the negative aspects of these factors?
45. How do you decide whether you are going to grow a flower crop or a tuber crop?
46. When do you decide whether you are going to grow a flower crop or a tuber crop?
47. How do you decide how you are going to market your crop?
48. Does it differ on the time of the year the crop is produced or whether it is a tuber or flower crop?
49. When do you decide where you are going to market your flower crop or a tuber crop?

Second Interview

50. Technology
51. What is your definition of technology? *(Should I give my definition afterwards?)*
52. Current technologies used in growing sandersonia

53. What technologies do you use in your current operation? *(don't know if I like this question – how does information fit into this)*
54. Growing *(heating, lighting, automatic watering moisture probes, humidity, g/h climate control, alarms, computer (does what?)*
55. Harvesting and handling *(machinery for cleaning, weighing, grading, packing)*
56. Storage *(cool chain?)*
57. Transportation *(cool chain?)*
58. QA systems

Past technologies

59. What technologies did you use in your first year of growing *(sandersonia?)*
60. Why has this changed?
61. What did you base these decisions on?
62. How did you discover these technologies?
63. Did you talk to anyone about implementing these new technologies?
64. How did you implement these new technologies
65. What are the strengths and weaknesses of these technologies?
66. What are opportunities of these technologies?
67. Are there any threats in using these technologies?
68. Were they "off the shelf" technologies or "customised" technologies?
69. Were they NZ designed or built technologies or imported ones?
70. What type of customer and/or service support does the supplying company provide?
71. Are you happy with this?
72. Why?

New technologies

73. Do you have any technological problems in your current operation?
74. Why is this the case?
75. Are you able to do anything about it/them?
76. What types of technology are you most interested in for your business now?
77. Why?
78. Would you like to use any new technologies?
79. What are they?
80. How and why have you identified these?

81. Are you going to implement any of them in the short and medium term?
82. What do you base your decisions of implementing them on? *(what it does, price, returns, short/long term, labour etc)*
83. Why not the other ones?
84. Is practical technology keeping up with your needs and requirements?
85. Why and how?
86. How do you keep up with technological developments that are occurring?
87. Where should the ideas for new technological developments come from?
88. Who should pay for the initial development costs?

Gathering information

89. When do you gather information? (*specific tasks/generally)*
90. When do you use this information?
91. How do you store information you have gathered?
92. How do you use this information?
93. Where do you gather it from?

Sources of information

94. Are you happy with all your sources of information?
95. Why?
96. Are you happy with the information you generally seek?
97. Why?
98. What types of accurate information are easy to obtain?
99. What types of accurate information are difficult to obtain?
100. How do you solve these difficulties?
101. How do you rank these sources of information (generally good, bad, variable, not applicable) in helping you with your business activities and why?
    - NZ magazines
    - Overseas magazines
    - Newspapers
    - Radio
    - NZ Scientific publications
    - NZ Scientific publications
    - NZ Grower articles
    - Overseas Grower articles
    - NZ Conferences
    - NZ Conferences
    - General fielddays
    - Specific crop fielddays

- Talking to your business partners
- Talking to your family and friends
- Talking to other growers
- Consultants
- Scientists
- Exporters
- Local marketers
- Your customers
- The end consumers
- Florists
- Bulb brokers
- MAF
- Education personnel
- Horticultural suppliers

102. What form of information best suits you in terms of usefulness?

Forecasting

103. Do you make predictions for crop harvesting times, expected prices and demand, and your crop quality?
104. How do you make these predictions?
105. How accurate do you consider you are?
106. What would be of additional help for you to make these predictions?

Experimenting

107. Do you conduct your own experiments?
108. Why do you do this?
109. What types of activities do these involve?
110. How do you design them?

Appendix 4: Sandersonia And Calla Production Timeframes

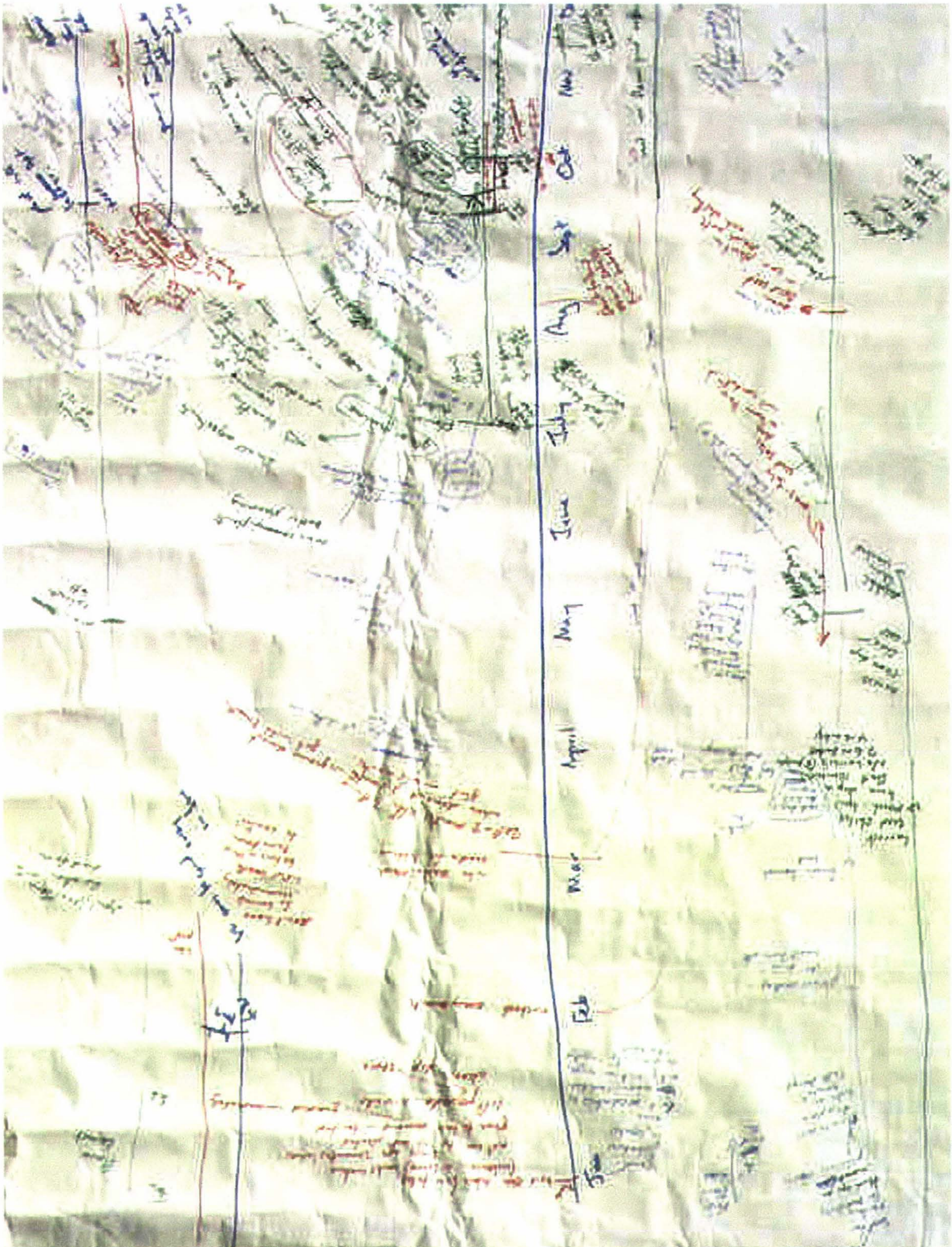

Figure. A4.2. Plan of all the production activities of sandersonia and callas.

Appendix 5: Glossary Of Terms

A5.1 Hard Systems

This approach is used for tackling problems *real-world* which has a defined objective or desired end result often based on quantifiable inputs and outputs (Checkland (1981)).

A5.2 Soft systems

This approach is used to learn new information by tackling *real-world* problems in which known to be desired end results are not always clear. And seek to answer the following questions (Checkland (1993)):

- What are the special characteristics of this kind of system ?
- Can the system be improved, modified or designed ?
- If so, how ?

A5.3 Satisficing

The process whereby a feasible but sub-optimal plan is produced rather than an optimal but non-feasible plan (Ackoff and Sasienieni (1968) cited in Keen & Morton (1978)).

A5.4 Heuristics

Rules of thumb that give solutions that are good enough most of the time. There is often a compromise between the demands of solving a problem for the decision maker and the capabilities and commitment of the decision maker (Keen & Morton, 1978).

A5.4 Decision types

A5.5.1 Operational decisions

Includes pest and disease management, irrigation and glasshouse control. Minimum judgement is required for these decisions as the tasks, goals and resources have already been defined. Problems of this nature are quite often identified by visual stimuli by the grower, for example, seeing dry plants or diseased plants. The problem is often quickly resolved through the grower relying on his past experiences with the crop and maybe by using his experience with the problem in the past. These observational skills can only be learnt with time, often after many plants have suffered the worst fate.

A5.5.2 Tactical decisions

A mixture of planning and controlling, and relates to choices on obtaining and using resources once per cropping season and include harvesting and distribution of the crop. This type of decision choice is well planned by the grower, as the company plans it at least a year in advance down to a week timeframe and for who will be doing what.

A5.5.3 Strategic decisions

Can involve deciding on the company's objectives, changes in direction and attaining the resources to meet objectives. Such decisions are mainly orientated towards planning with time frames from 1 to 10-20 years. These include decisions about constructing new greenhouses, developing new marketing channels, and introducing new products.

A5.6 Technical

Practical applications rather than abstract thinking (The Collins Concise Dictionary (1988))

A5.7 Technology

Technology can mean different things to different people. This is no more apparent than shown by the definitions of three groups of workshop participants (Parker, Stantiall, Allen, Hurley, Kuiper, Massey, & Rauniyar (1997)). Farmers defined "a technology" as an idea; the industry group defined "a technology" as a method) process / idea / information / equipment) to achieve an end with a known purpose; while researchers and academics defined "a technology" as a definable idea / concept / knowledge /innovation / tool. Bawden & Macadam (1983) define technology another way. They consider it relates to the taking of effective action, and as such they believe that management is technology.

The grower's first thoughts on the definition of technology were

> *"...scientific advancements or scientific research. So it's information that's usually scientifically based, in a nutshell"* and
> *"...it's basically given to us in written form because that's the only way it can be easily disseminated to us, but it is both information and any advancements at all that usually are scientifically based...But it is hard to define in exact terms."*

A5.8 Literature cited

Bawden, R., & Macadam, R.D. (1983). *Problem Solving In Agricultural Systems - Innovations At Hawkesbury.* Paper presented at the Biennial Conference of Principals/Directors of Agricultural and Horticultural Colleges of the South West Pacific, Adelaide, Australia, May 1983.

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Keen, P.G.W., & Morton, M.S.S. (1978). *Decision Support Systems: An Organisational Perspective.* Addison-Wesley Publishing Company, Inc., Massachusetts, USA.

Parker, W.J., Stantiall, J.D., Allen, W., Hurley, E.M., Kuiper, D., Massey, C., & Rauniyar, G. (1997). *Report on a Dairy Industry Exchange Forum.* Massey University, Palmerston North, New Zealand, 25-26 June 1997.

Appendix 5: Glossary Of Terms

The Collins Concise Dictionary Of The English Language (1988). (Hanks, P ed.). Collins, London, UK.