Chapter 1

INTRODUCTION

1.1 Introduction

The majority of Australian farmers manage their farms in environments characterised by variability of prices and climate. The financial indicators of the performance of their farms vary over time as a result.

The variability of gross returns to farm production, coupled with commonly long production cycles, suggests fundamental questions about the management of farms in Australia. Arguably the most basic of these questions is: to what extent is control of farm performance available to the manager and what does this imply for the rational allocation of the manager's effort? In this thesis the word control has a precise meaning: influence over behaviour and/or events sufficient to enable the achievement of objectives.

The objective in the thesis is to attempt to answer this question.

Despite the considerable literature concerning farm management, there does not seem to be a paradigm embodied in it which is useful for analysis which might satisfy this objective. The approach adopted herein is one of applying a relevant paradigm from the business management discipline.

The choice of paradigm was based on the assumption that the ability of a manager to make correct decisions about the desired type and level of output delimits his control over organisation performance. That is, the extent to which specific targets for, say, gross returns can be achieved by deliberate management action is bounded fundamentally by the extent to which allocative efficiency can be maximised. The management function directly to do with allocative efficiency, according to the discipline of business

management, is strategic planning. This conceptualisation of planning is therefore the framework for analysis used in this study.

Planning theory, within the business management domain, includes two aspects particularly relevant to this study. One is the hierarchical structure attributed to the set of different plans in any organisation. In this hierarchy strategic plans are identified as the most important due to their relationship with allocative efficiency.

The second relevant aspect is the implications of analysis of environment characteristics as determinants of appropriate general strategies. Inter alia, this analysis indicates that some environments may deny to the manager long run resource allocative efficiency adequate enough to ensure the survival of the organisation.

Given the conceptual framework adopted, the objective of the study can be restated as being: to evaluate the extent to which it appears Australian farmers are able correctly to identify strategies which satisfy their objectives, and to evaluate the implications of this. The focus on strategies related to enterprises is associated with their delimiting effect on performance potential.

The implications of the results of the study may not be particularly useful to a farm manager. If, for example, it is established that control over farm performance is fundamentally and irreducibly variable, suggestions as to how an individual farmer might overcome problems associated with this variability may be non sequiturs. Such a finding would, however, have major implications for the discipline of farm management. Most notably, it would indicate the desirability of a broader perspective being adopted of farm management behaviour and of the farm management environment than currently seems to be the case. This could lead to a substantial enhancement in the real and perceived relevance of farm management research to farm managers.

1.2 Research Strategy

The research strategy adopted has four elements. These are: a theoretical analysis of farm planning using business management perspectives; an evaluation of farm planning techniques; a simulation experiment; and a survey of farmers.

The business management paradigm was applied to farm planning principally to focus the study. The conceptual framework afforded by the paradigm permits identification of the farm management behaviour most closely associated with control of overall farm performance.

Related to this framework is consideration of rationality, control, and of environment analysis. The purpose was to identify the implications for farm planning arising from the application of relevant theory from the business management discipline.

Farm planning techniques were evaluated in terms of their potential to facilitate selection of appropriate strategy. If it is not possible to locate, a priori, relevant weaknesses in the techniques, control of farm performance may not be a problem. If control is low one would expect to be able to identify related limitations in the techniques developed for and/or applied to farm planning.

The nature of uncertainty is pertinent to some aspects of this study, one of which is the way perceptions of uncertain planning parameters might be modelled for use with planning techniques. Another aspect is the area of implications of imperfect control for farm management behaviour. Here, it is necessary to have a considered view about rational responses to uncertainty. For these reasons it was necessary to consider uncertainty and related matters in depth.

The third element in the research strategy was a simulation experiment. The purpose was to assess the effects of price variability on the control of farm performance. The procedure involved a search for preferred strategies.

The fourth element was a small survey which was conducted to identify pertinent aspects of farmer attitudes and behaviour relating to strategic planning and their perceptions of their operating environment. This information was expected to reveal the effects on the sample of farm managers of their first hand experience of their environment.

The results of the four elements of the research were expected to be consistent with each other. The rationale for the research study rests on the logical necessity for this consistency and the possible errors of inference associated with relying on any of the elements alone to address the thesis topic.

Thus, if the simulation experiment indicated that some strategies were more effective than others, the expectation was that at least one planning technique could be identified which would lead to isolation of those strategies. As well, relevant farmer attitudes and strategic planning behaviour were expected to reflect the existence of some strategies which were better than others. Planning theory should also indicate that, given the farm planning environment, preferred strategies can exist.

Throughout the study the unpredictability of non-price determinants of farm performance has been largely ignored. The reasons for this are that its management implications are very complicated and, importantly, its implications for the objective of the thesis are obvious.

Informal and formal insurance, the effect of location on the degree of risk, the possibility of government intervention and lack of data all mean that non-price variability has diverse implications

for control that are difficult to consider comprehensively and satisfactorily.

Variability, and attendant unpredictability of weather, pests and disease, inter alia, can only reduce control. Ignoring on-farm effects of such variability simply implies that the extent of control indicated by consideration of price variability is persistently overstated from the viewpoint of the firm as a whole.

1.3 Thesis Outline

The sequence of coverage of matters referred to above is as follows.

A theoretical treatment of planning is presented in Chapter 2. This treatment draws on business management theory. Prominent in the chapter is clarification of the meaning of control for the purpose of this study, as well as a presentation of the analysis, mentioned previously, which indicates strategic imperatives for environments with particular characteristics.

In Chapter 3 farm planning is discussed within the framework of planning presented in Chapter 2. This chapter is necessitated by the absence of a suitable conceptual framework for farm planning in the existing farm management literature.

In Chapter 4 uncertainty is discussed. The variability of farm planning environments has led to uncertainty receiving considerable analytical attention by farm management researchers. The way uncertainty is represented in planning techniques is likely to be critical to their capacity to reveal better strategies. This chapter evaluates the subjective expected utility approach to the representation of uncertainty since this approach seems to be regarded by most farm management researchers as the state of the art.

A range of farm planning techniques is surveyed in Chapter 5 with the purpose of identifying the capacity they appear to provide potential users to identify better strategies.

In Chapter 6 the simulation experiment is reported. As noted in 1.2, the purpose of this experiment was to try to identify whether preferable strategies existed for the type of farm modelled in the experiment. The belief was that, should preferable strategies seem not to exist, doubts inevitably would follow about the extent of control Australian farmers can exercise over farm performance.

In Chapter 7 the results of the survey of farmers are presented and discussed. The rationale for the survey has been outlined in 1.2. The focus was on pertinent planning behaviour and various perceptions and attitudes related to, or likely to be influenced by, variability in their operating environments.

In the final chapter the various strands of the study are drawn together to assess the findings and their implications. The latter relate to farm management research and practice, and to agricultural policy.

Chapter 2

PLANNING AND CONTROL

2.1 Introduction

One element of this study is the application to farms as firms of relevant theory from the business management discipline. The main purposes are to identify a structure to be used to identify and link the variety of plans which might be made by a farmer, and to identify any pertinent implications arising from the application of planning theory to Australian farms in general.

The structure developed for plans should prove useful for the identification of those plans which are central to the question of control which is the focus of this thesis. The structure should provide, as well, a comparator for conceptualisations of farm planning extant in the farm management literature.

In this chapter a general conceptualisation of planning is presented. The related topics of rationality, control, and environment analysis are considered as well. In subsequent chapters the material in this chapter is applied to the Australian farm and farmer.

2.2 The Planning Function

Planning is often described as a function performed by management in organisations (e.g. Dale 1973). As such it is one of a set of functions all managers inevitably carry out. Other functions in this set are personnel management, determining organisation structure, and control. No manager can avoid performing these functions; their discharge distinguishes managers from non-managers.

2.2.1 Planning definitions

A plan is a 'project, design, intention, way of proceeding' (Pocket Oxford Dictionary 1960, s.v. 'plan') and planning is the making of such things. More precisely, a plan 'may be described as a statement of objectives to be attained in the future and an outline of the steps necessary to reach them' (Dale 1973, 300). Planning may be described as the identification of objectives and the means by which their attainment will be sought. Implicit in this definition of planning is the attachment of some time horizon to objectives, some period within which they are intended to be satisfied.

Plans differ in the objectives they are designed to serve, the operations to which they relate, and the time horizons identified for them. A means of categorising plans is outlined in the next section.

2.2.2 Hierarchies of plans

All organisations have multiple plans which are interconnected. The interconnectedness appears as constraints and/or objectives one plan dictates to another or others. Conventionally, the relations between plans are regarded as creating a hierarchy whereby a higher level plan provides objectives and constraints for lower level plans (Reisch 1971). Higher level plans in the hierarchy depend for effectiveness on that of lower level plans.

The simplest means of identifying the level of a plan in a hierarchy is to identify the source of its objectives. The highest level plan will address objectives held by the owner(s) or senior management of the organisation. Below this level, plans will be designed to serve objectives prescribed, more or less precisely, by higher level plans. The sequence which can be traced out by identifying which plan is guided by which other describes the hierarchy.

A common taxonomy distinguishes strategic plans from tactical plans. Strategic plans are usually defined as the 'broad thrust' an organisation will follow, and tactical plans as the detailed plans designed to achieve the strategy (e.g. Dale 1973).

The distinction between strategy and tactics is a substantive one; the way each type of plan is formulated and implemented is very different. The following differences have been summarised by Steiner and Miner (1977, 23).

Strategy formulation is a continuous process involving irregular decision making provoked by the emergence of new opportunities or threats, new ideas and other irregular stimuli. Tactical planning is commonly determined according to periodic cycles. Strategic planning generally deals with unique situations, whereas tactical planning often refers to repetitive situations. Strategy is developed by the use of information derived from areas of knowledge outside the organisation; tactics are formulated using proportionately greater amounts of internally generated information. Strategy is less detailed and designed to last for longer periods of time than tactics. Tactics are formulated within strategies and are usually much easier to appraise in terms of effectiveness than are strategies. Strategies are plans of the highest importance for any organisation.

It is possible to conceive of the overall plan for an organisation as the 'corporate strategy' (Christensen, Andrews and Bower 1978) or 'master strategy' (Steiner and Miner 1977). Beneath this plan in the hierarchy may be identified a 'marketing strategy', a 'financial strategy' and 'production strategy', for example. Lower in the hierarchy may be various tactical plans appropriate to the various strategies.

It is wasteful of resources to have plans which are not consistent with one another. This is an important reason for proposing the notion that plans should be recognised as forming a

hierarchy. Identification of the subsidiary role of one plan to another is a precursor to devising plans which most efficiently use organisational resources, by applying them to the pursuit of a common set of objectives.

2.2.3 Choice of planning horizon for corporate strategy

The planning horizon for plans varies according to their location in the hierarchy. A plan which is subsidiary to another will be formed for a planning horizon no more distant than that used for the superordinate plan. Often the horizon will be less distant for the subsidiary plan. No planning horizon used is more distant than that for corporate strategy.

The choice of planning horizon determines the extent to which planning parameters, including objectives, may have to be forecasted. Generally, the uncertainty perceived to be associated with parameter values can be expected to be greater the further into the future they are being forecasted. It is appropriate, therefore, for managers to consider the choice of planning horizon carefully.

Corporate strategy, since it is to do with the broad thrust to be pursued, may contain at least two basic elements: the general nature of operations to be undertaken; and the extent to which short term environmental instability will be ignored and not treated as cause for adjustment to operations.

The latter element requires that the planner has some basis for categorising environmental change, as 'short term instability' or a change of longer term significance, as it occurs. One possible basis is his perception of the instability inherent in the environment which, in turn, will be related to his perception of the minimum time frame over which longer term change in the environment can be discerned.

The minimum time frame for detection of change is a determinant of the strategic planning horizon a planner may consider. Contemplation of any less distant horizon may be seen as inappropriate since there is a risk that longer term change in the environment may be masked by short term instability. There is no reason to expect the perceived minimum time frame to be of fixed length over time.

One factor which may influence choice of planning horizon can thus be viewed as the perception the planner has as to the distance into the future he needs to look to be able to identify environmental changes relevant to strategy. This perception may be substantially unaffected by the probable increase in forecast uncertainty associated with increasingly distant planning horizons This uncertainty may influence the nature of strategic alternatives the planner considers, however.

The way in which forecast uncertainty may affect strategy depends, in part, on the speed with which operations can be adapted (to maintain their objectives-serving potential) to environmental change. The speed of adaptation is a variable depending on the costs a manager is prepared to bear to adapt. A natural measure of the speed of adaptation is the least cost speed. This is typically tied to production cycles, lead times for changes of the magnitude implied by strategic alternatives, and so on. Another way of viewing speed of adaptation is as the negative of the extent of commitment to a strategy once implemented. This notion of commitment is a summary one used in the management literature to capture the idea that a strategy, indeed any plan, involves investment of resources and that change in strategy involves abandonment of some of that investment. To the extent that change in strategy is forced by unanticipated environmental changes, abandonment implies greater costs.

The greater the uncertainty a planner perceives to be associated with forecasts for planning horizons of appropriate distance, the

more are strategic alternatives likely to be of types which minimise commitment and maximise speed of adaptation.

2.2.4 Criteria for effective planning

It is possible to identify a series of steps which should be taken by a manager if planning is to be effective. That is, if plans are sought which are appropriate to objectives, available resources and the environment in which they must operate, basic activities can be identified which must be undertaken in the process of planning. The appropriateness of the plan(s) adopted in an organisation, assuming effective plan implementation and given the amount and quality of relevant information available to the planner, depends on the adequacy with which these activities are performed.

The steps in planning are:

(i) identification of objectives
(ii) situation analysis
(iii) resource audit
(iv) development of alternative plans
(v) selection of plan
(vi) implementation.

The first step in planning is the identification of objectives relevant to the plan being considered. Objectives are the criteria used to evaluate members of the feasible set of alternative plans. The comprehensiveness and precision with which objectives are understood is fundamental to optimal plan choice.

The next step is often termed 'situation analysis' or 'situation audit' (e.g. Steiner and Miner 1977). It is the activity of appraising current or anticipated organisational achievement in relevant aspects of activity and comparing either with desired achievement. In the case of tactical planning this occurs routinely when the period of a plan expires. With strategic planning, it is

necessitated by the emergence of stimuli which suggest to the planner that plan revision may be appropriate.

Existing and expected characteristics of relevant parts of the environment are also identified in the course of situation analysis.

The purpose of situation analysis is the identification of whether a new plan is necessary, whether a strategy should be continued or whether a tactical plan should be repeated.

If a new plan is deemed to be necessary, the next step is a 'resource audit'. The meaning of this term will be obvious in context, although it is important to note that the audit should include, for some plans, intangible items such as access to finance, and staff skills and morale. Planning for a major development of a new enterprise, for example, may make exceptional demands on finance and on employees. The status of each of these resources would need to be known for effective planning.

Alternative plans are then developed, evaluated against objectives, and a choice of a plan made. It is necessary, as a final step, to implement plans.

The time and care devoted to each of the above steps in planning should be consistent with the importance of the plan. That is, the cost of poor planning to organisational performance will indicate the resources which should be committed, relatively, to the planning process.

2.2.5 Determinants of planning effort

Planning occurs in all organisations. However, the amount of resources allocated to planning varies between organisations. This can mean that managers differ in their coverage of the planning hierarchy and/or in the extent to which they attend to each of the steps in planning for a plan at a given level in the hierarchy.

Such differences can be explained in terms of the benefits, net of costs, that managers perceive to be associated with planning effort related to each aspect of organisational operations. Those managers who commit fewer resources to planning can be assumed to anticipate lower returns to planning than those who commit more resources to planning.

From a business management perspective planning is unavoidable. While resources committed to planning should vary, under this perspective, according to the relationship between costs and benefits associated with planning, it is important that benefits should not be evaluated too casually.

Two factors are pertinent. Firstly, benefits perceived by a manager may be biassed downwards by him for purposes of maintaining his own psychological comfort. For example, failure to identify objectives for some aspect of organisational operations is likely to make planning less valuable, if only because criteria for choice between plans are inevitably less apparent. A failure to identify objectives may result from low self-confidence on the part of the manager (Stoner 1978), and the perceived benefits from planning be biassed downwards by the desire to avoid threats to his self-concept.

The second factor relates to the hierarchical nature of the plans in an organisation. The existence of the hierarchy of plans implies that highest level plans provide key parameters for the identification of allocatively efficient lower level plans. Yet it is higher level plans which are typically the most difficult to formulate, because of their longer planning horizon and greater orientation to the operating environment external to the organisation than is true of lower level plans. Higher level plans are those most likely to have low perceived net benefits associated with their formulation. Their role in the plan hierarchy, however, implies that they should attract deliberate and extensive consideration.

When the net benefits from planning are perceived to be low, the first response should be reconsideration of the objectives judged to be relevant. Low net benefits of planning suggest that the degree to which objectives are attained is inadequately influenced by deliberate variation of plans within the set of alternative feasible plans. If the degree of attainment of objectives is invariant over alternative plans, there is no problem because indifference between plans is appropriate. This is most unlikely to be the case, however.

In the second case where the degree of satisfaction of objectives is plan-dependent, there is a need to reconsider the objectives to which plans are directed. Objectives which are not attainable are meaningless in the context of the planning process. From a business management perspective, planning is cyclic and such reconsideration of objectives is undertaken when necessary; the situation analysis and resource audit, particularly, feed back to modify objectives, as necessary, so that they are attainable.

The business management perspective on planning amounts, in effect, to an assertion that planning, particularly at the level of strategic plans, should be undertaken, and that the planning process includes steps which should increase the benefits to planning effort. The identification of attainable objectives is prominent among these steps.

In the event that it is not possible to identify attainable objectives related to key aspects of organisation performance, such as profit or growth, fundamental issues to do with control arise. A framework for consideration of these is presented in the next section.

2.3 Control

In the business management literature control is identified commonly as a specific function of management which can be distinguished from planning (e.g. Dale 1973). In this section the relationship between planning and control is considered, principally

to permit the use of pertinent aspects of control theory in this study of planning.

2.3.1 Definition of control

Control means directing or restraining. As a management function it refers to the monitoring of actual performance as against planned performance and the exercise of power to correct deviations as and when appropriate. In its most narrow sense, control is the management function of ensuring that plans are implemented and pursued properly.

This narrower meaning has very restricted relevance, however. Its relevance is affected by, inter alia, the extent to which plan implementation and planned performance are causally related. The weaker the connection between plan and plan outcome, the more does control imply changing plans rather than ensuring that plans are being adhered to.

2.3.2 Planning and control compared

A broader definition of control than that above is required for the relationship between planning and control to be defined generally. Otherwise the relationship will vary with situational factors, such as the predictability of planned performance, which could be very difficult to specify.

A definition which is broad but substantive is that control is the continuous identification of appropriate combinations of organisational activity based on observed or forecast relations between an organisation and its environment. The narrow meaning of control is included in this definition because plan implementation (or plan administration) is an organisational activity. When performance is not as expected and this is caused by inadequate adherence to a plan, the control measure required is the commitment of more resources to plan administration/implementation.

The breadth of the definition is achieved by removing the restriction in the earlier definition (2.3.1) that control measures or responses be of the plan administration type. Thus, control is extended to include changes in plans. The focus of attention in the definition is thus organisational performance, without regard to the specific factors affecting the performance.

With control defined thus, any given plan can be viewed as a program or set of activities decided to be appropriate at and for some period of time, in the pursuit of some level of organisational performance. Plans can be characterised as major attempts at control.

The above approach brings, incidentally, some aspects of planning into a new light. For example, the need to plan can be interpreted as a need to limit organisational flexibility. Planning is thus not a valuable activity a priori; it is forced on organisations by lead times in productive activity and the associated requirement to define relatively enduring sets of activities. By implication, plans reduce the capacity of a manager to control performance. They have this effect since they limit the repertoire of activities it is feasible for him to adopt as control measures.

Control is a quite specific form of influence. As defined here, it refers to the capacity to influence events so that objectives are achieved. It is common for control and influence to be used almost synonomously by lay people. Such usage, however, removes a key distinction for managers: that control is to do with the achievement of objectives whereas influence describes a power relationship. Control implies the existence of influence, but the reverse does not apply.

Planning is a substantial event in the continuous process of control, as defined in this section. The extent to which plans contribute to organisational performance will be a function of the

amount of control a manager can exert over performance. As suggested above, plans are reflections of the constraints acting on control. Observations which might be made about the controllability of organisational performance therefore have implications for the maximal benefits associated with planning. A basis for such observations is discussed in the next section.

2.3.3 Limits to control

Ashby (1956) has proposed the law of requisite variety which generally specifies the limits to control. The 'variety' of anything is defined as 'its number of distinguishable elements' (Beer 1966, 147). In a dynamic context 'the elements will be states' (Beer 1966, 251). The law states that, for the achievement of total control over outcomes of interaction of any systems with its environment, the controller must have available variety in the system which is at least identical to the variety in the environment with which he is confronted. If he has less then variety will emerge, potentially, in outcomes. That is, the probability of the objective in question being attained will decline.

One can treat a football game as an example, regarding the manager of team A as the controller. Assume team A is to play team B, which has fifteen members. Team B, like Team A, is a dynamic system; in a game its members can interact to generate alternative moves. This interaction creates the possibility for team B to increase the variety it presents to opponents. If the players could not interact, team B would have a variety of 15. With interaction, the variety will be 15 raised to some power which is determined by the team's training.

The 'law of requisite variety' implies that team A must have 15 members as a precondition for team A to be able to match the variety in team B. With capacity to achieve variety equivalent to that of team B, and a team of 15 members, team A can prevent team B winning. Should team A have only 14 members, there would be a strong expectation that it would lose the game.

In this example, as in the case of any dynamic system, the total variety in a system is a function of the distinguishable elements of the system (in a static sense) and the nature of their interaction. Although, in fact, total system variety is unlikely to be known in most situations, the 'law' has practical relevance. Control over outcomes is a function of the capacity of the control-seeker to create system variety sufficient to match the environmental variety he must offset to achieve desired outcomes.

In a directly competitive situation, like a football game, winning is a matter of presenting variety which the opposing team cannot match. In business planning situations, where outcomes reflect, basically, the match of organisational activity to the preferences of its environment, achieving outcomes is a matter of presenting variety which matches the variety in those preferences and imperatives. This assumes, unexceptionally, that the organisation is basically capable of producing output which is profitable to the organisation because the output is, at times at least, valuable to entities in the environment.

Taking farming as an example and assuming that a given farm has the capacity to achieve a profitable relationship with its operating environment, a farm manager can only control the performance of his organisation to the extent that he can respond to variety in decision parameters which affect the returns to his decisions. Inadequate variety in his repertoire of responses will lead to variety in his performance. A farm manager who has learned, rightly or wrongly, that he cannot achieve requisite variety can be expected to accept as inevitable variations in the performance of his farm. That is, his objectives for plans can be expected to be broad and imprecise. If the farmer's learning is right, one can argue that it would be fruitless for him to believe that performance could not be variable.

The achievement or otherwise of requisite variety by a manager has major implications for planning. The implications for the

selection of reasonable performance objectives have been noted immediately above. Beyond this, however, is the consideration of appropriate strategies for the manager to adopt. That is, in situations where organisational performance can be expected to be variable, on the basis of less than requisite variety being achieved, how should this affect the nature of the highest level plans a manager adopts? This matter is considered generally in 2.6.4, and in relation to farms in 3.3.2.

It should be noted that two characteristics of managers can affect the variety that they face and that they have available to them. On the one hand, a manager who is unaware of some responses he could make to his planning environment obviously has less variety than he possibly could have. On the other hand, uncertainty adds to the variety in the environment. That is, from the point of view of the manager, uncertainty (about the states which are really possible) creates perceived environmental variety which cannot, a priori, be distinguished from the real variety in the environment.

2.4 Rationality

The notion of rationality is pivotal to this thesis. Quite precise concepts of rationality are required if one is to by-pass diverting but, in the context of this thesis, ultimately irrelevant discussion about teleological behaviour.

In this section rationality will be defined in ways which are both non-controversial and useable.

2.4.1 Definition of rationality

Rational is generally defined to mean 'agreeable to reason; not absurd ...; intelligent, sensible' (Simon 1978, 2). In economics it has the more specific meaning of utility maximising behaviour (Simon 1978). Using either definition it is possible to assume that individuals invariably act rationally, although Simon (1978)

contests this assumption in the case of the economic definition. Since the assumption that all action is rational implies that normative studies such as the current one are irrelevant, it is necessary to define rationality in a way that avoids this implication.

The assumption that all behaviour is rational is an assumption, in effect, that all behaviour is purposive: every action serves some need or other of the actor. A feature of this assumption is the implicit process whereby one category of objective or purpose becomes relevant in place of another. For example, a businessman who has no idea how to overcome a problem which is denying him achievement of business-related objectives may proceed to get drunk. Getting drunk hardly satisfies the business objectives, but is rational because it assuages, if temporarily, the negative effects on his self-esteem of his inability to achieve his business objectives. Whatever balm alcohol may provide the businessman, it would be unlikely that his inebriation would serve business-related objectives (unless he is a distiller).

Behaviour can be assumed to be invariably rational only if one accepts shifts of the above kind in the relevant objective(s) as appropriate. Such shifts are only acceptable if the global utility function, or entire set of needs, of the individual is germaine to the enquiry. In the example, if the individual's global satisfaction is pertinent, his behaviour is rational. If, however, only his business-related objectives are germane, his behaviour is not rational. It is not necessarily irrational; there may be nothing he can do to overcome his problems. It is definitely not rational, though, since it does not serve business objectives.

In this study rational is defined, in the general sense, as meaning sensible and ends-serving. To specify the pertinent category of objectives, the following taxonomy is adopted:

'...a decision may be called "objectively" rational if <u>in fact</u> it is the correct behavior for maximizing given values in a given situation. It is "subjectively" rational if it maximizes attainment relative to the actual knowledge of the subject. It is "consciously" rational to the degree that the adjustment of means to ends is a conscious process. It is "deliberately" rational to the degree that the adjustment of means to ends has been deliberately brought about. A decision is "organizationally" rational if it is oriented to the organization's goals; it is "personally" rational if it is oriented to the individual's goals'. (Simon 1957, 76-7).

This study is concerned with the identification of farm planning behaviour which is 'subjectively organisationally rational'.

2.4.2 Bounded rationality

Bounded rationality is argued to be inevitable by March and Simon (1958). It arises because 'there are always limitations with respect to knowledge of alternative courses of action, of the relative utility of these alternatives, and of the consequences of these courses of action' (Katz and Kahn 1978, 494). Thus, rationality is bounded when alternatives, relative utilities or consequences are known to a limited extent only.

Decision makers respond to this 'inevitable ignorance' by simplifying problem dimensions (March and Simon 1958, 169). In terms of Simon's taxonomy, bounded rationality implies that there is a high probability that subjective rationality will not be equivalent to objective rationality since 'actual knowledge of the subject' never includes all 'given values in a given situation'. (Simon 1957, 76).

Bounded rationality inevitably provokes the simplification of responses and the simplifications are to some extent unique to each

decision maker. It is inevitable that the personality, attitudes and beliefs of the decision maker will influence these simplifications; the structuring of reality by an individual is influenced by his needs (Berelson and Steiner 1967). There is, therefore, an inevitable intrusion of individual goals, albeit very subtly, as a consequence of the limitations which lead to bounded rationality.

2.4.3 Objectives

Objectives are the explicit, operationalisable aspects of purpose that a manager perceives. They are targets for performance by the organisation. The specificity of objectives is likely to be less the further into the future they are oriented and, by implication, the higher in the plan hierarchy are the plans designed to achieve them.

The values[1] (senior) managers have inevitably influence the way in which objectives are pursued. To this extent values can be viewed as aspects of purpose. Objectives do not, therefore, comprise all relevant aspects of purpose. Very often, values exert influence over the style of organisation behaviour without conflicting with objectives. That is, there often exists a range of possible ways objectives might be pursued equally effectively, and values can carry considerable weight in the criteria used to choose within this range.

When values conflict with objectives, it can occur that the values are served rather than objectives. An example of this arises when senior managers in an organisation resist changing the style of

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[1] Gasson (1973, 524) defines a value as 'a conception of the desirable referring to any aspect of a situation, object or event that has a preferential implication of being good or bad, right or wrong'.

intra-organisational behaviour even though changed circumstances indicate that they should. Instead, organisational objectives are adjusted, by lowering targets for example, so that the familiar style of behaviour can be maintained (Khandwalla 1977). This may be a case of personal rationality displacing organisational rationality.

Whether conflict between objectives and values leading to a change in objectives is organisationally irrational depends on whose values are involved. It seems reasonable to assume that the objectives of the owners of an organisation are those which should form the basis for the evaluation of the rationality of organisational activity. Given this assumption, where ownership and management are fused, the modification of objectives by managers' values does not lead to questions of organisational rationality being displaced; the derivation of objectives for the organisation is irrelevant.

If, on the other hand, ownership and management are separate, the modification of objectives by managers' values may displace organisational rationality. This would be so where the modification of objectives exceeds the discretion owners implicitly allow managers to exercise in the determination of organisational objectives, given those of the owners.

The above reasoning does not conflict with the discussion in 2.4.1. Should values affect business-related objectives to the extent that they are completely displaced by personal objectives, organisational rationality would be threatened regardless of whose values were involved. It should be recognised that such an effect is very hard to imagine in a practical context.

2.4.3.1 Aspiration levels

Research in the behavioural sciences indicates that the objectives individuals seek to satisfy are most accurately viewed as more or less specific target levels for particular outcomes, rather

than a wish to maximise outcome levels (Simon 1959). The target levels are defined as 'aspiration levels' (Simon 1959). They have also been referred to as 'desired achievement or satisficing levels' (Flinn, Jayasuriya and Knight 1980, 37).

Aspiration levels are affected by experienced performance. When performance is less than the aspiration level, for example, that level is revised downward to a level believed by the individual to be attainable. The major factor which explains this process is the need for self-esteem. Self-esteem is central to individual well-being and mental health (Warr and Wall 1975) and persistent failure to achieve performance targets is threatening to self-esteem.

When aspiration levels are exceeded by performance, they tend to be revised upwards. The need for self-esteem generally leads to aspiration levels being set such that they are challenging but feasible (McGuire 1964).

In cases where performance falls short of aspiration levels another response, concurrent with downwards revision of the aspiration level, is for the individual to search for new action alternatives (Simon 1959).

In situations where performance and aspiration levels cannot be aligned, in the long run, the result is 'emotional behavior, and what the psychologists would be inclined to call neurosis' (Simon 1959, 264). This may take the form of apathy or aggression. While apathy or aggression could plainly not be organisationally rational, the features of the planning environment which lead to them may reflect basic control problems which cast into doubt the possibility of rational behaviour insofar as the relevant elements of the objectives are concerned. That is, should apathy exist with respect to objectives which are basic to long run organisation survival, it is possible that long run survival is not something which can be achieved by deliberate action.

2.5 Planning Aids

Planning is an intellectual activity. Anything which might be called a planning aid is external to the mind of the planner. This means that there are two aspects of planning aids to be aware of: the aids themselves; and the relationship, or link, between the intellect of the planner and the aids used. Both aspects are considered in this section.

2.5.1 Definition of planning aids

A planning aid is any technology, not a component of the cognitive processes of a planner, which senses, sorts or manipulates data, and which is potentially utilised by the planner. Examples of planning aids are:

(i) techniques a decision maker may use to handle data externally to his mind (for example: writing out tables of data; calculating optimum values for an equation);

(ii) other people with whom a decision maker may communicate about relevant data;

(iii) techniques others may use to handle data on the decision maker's behalf.

2.5.2 Role of Aids

Planning aids assist planning when they increase the amount or quality of information available to the planner. This they can do by sensing and filtering data (as a formal information system might, for example) or by increasing the information content of data by manipulation and sorting. When the effect of this better information is to increase planner awareness of alternative plans, their consequences and their relative utility, planning aids reduce

the boundedness, or widen the boundaries, of bounded rationality. Planning aids can extend the capacity of the planner to use data logically and purposefully.

Whether planning aids do have this effect in any particular situation is contingent, inter alia, on the extent to which the communication channels between the planning aid and the planner are free from distortion. This is considered in detail in Section 2.5.3.

Planning aids can also possess an educational role. Recurrent use of planning aids by a decision maker can reveal aspects of the functioning of the organisation and/or the environment which may never otherwise have been uncovered. This role is of potentially great importance (Stone and Erickson 1975; Pettit 1977; Debertin, Moore, Jones and Pagoulatos 1981). It can lead to improvement in the decision maker's conceptualisation of the organisation or its environment. The fundamental role in planning of accurate conceptualisations, particularly of the organisation, is so obvious as to warrant no elaboration.

Aids which, for one reason or another, teach a decision maker falsehoods about the organisation or environment are potentially dangerous to the extent that they supplant naive or partial conceptualisations with ones which are wrong.

2.5.3 Rationality and planning aids

The use of planning aids, if they have the potential to induce decision makers to make organisationally irrational plans, is risky. This potential exists wherever: the aid uses an invalid model of the organisation or environment as a framework for data sorting or manipulation; the aid is incorrectly assumed to be using data in ways consistent with decision maker objectives; the information from the aid is misunderstood by the decision maker; the aid fails to have all available relevant data provided to it.

The user of a planning aid which is believed to suffer any of the above deficiencies should be circumspect. The sensitivity of plan choice to possible variations in aid information resulting from such deficiencies should be evaluated if organisation rationality is to be served rather than threatened. Assessment of possible variations in aid information is not always easy, particularly when the aid is mathematically or statistically complex. Assessment will not even be attempted if deficiencies are unrecognised, of course. In Chapter 5 the deficiencies, if any, of some major aids developed for, or adapted to, farm planning needs are identified.

It is appropriate to recall the possibility that subjective and objective organisational rationality may differ. A planning aid may offer objectively organisationally rational plans which are foreign and unacceptable to a planner because the aid has to hand, at all stages of data manipulation, more information than the planner. This is a situation demanding interpretation for the planner by somebody who comprehends the aid. It does not constitute a threat to organisational rationality, except in as much as poor interpretation may cause the planner to reject the (appropriate) information.

2.6 The Planning Environment

In this section characteristics of the planning environment are discussed which seem to affect the appropriateness of strategic plans. A framework of analysis which has strong conceptual links with the 'law of requisite variety' (2.3.3) and which may be used to assess strategy a priori is considered.

2.6.1 The operating/planning environment

The total environment of an organisation is the universe of all systems other than the organisation of interest. A subset of the total environment is relevant to the organisation at any point in time. This subset is the operating environment. When planning is

being undertaken, the operating environment may be called the planning environment.

The systems which populate the operating environment can change over time. New systems can enter the operating environment (for example, the emergence of consumer lobby groups or oil supplier cartels) and existing systems can leave (for example, the exit of the Argentinian cattle industry from the group of beef suppliers to the United States, or the making redundant of a group of intermediaries by a change in technology).

As well as changes in the constitution of the operating environment, changes can occur in the prominence of member systems. Competitors or trade unions may become more active, for example, requiring greater account to be taken of their relationship to the organisation.

Some parts of the total environment are persistently part of the operating environment. However, the parts which vary in prominence in, or membership of, the operating environment deny the possibility of a time-and event-independent description of the operating environment. This is a major source of uncertainty for planners.

2.6.2 Major characteristics of planning environments

A feature of planning environments which is potentially important for planning is their variability. When parts of a planning environment are major determinants of organisational performance and are variable, it may be necessary for a planner to include in his plan(s) elements to deal with the variability. The necessity to do this depends on the predictability of variable parts of the environment.

Although common in the management literature (e.g. Stoner 1978), descriptions of planning environments in absolute terms such as 'stable', 'unstable' or 'turbulent' portend little about the

problems confronting a planner. The predictability of variable parts of the environment is the major factor which affects planning. While it is typically safe to infer some lack of predictability from instability in parts of the environment, it is too casual an inference to be very useful. This is because predictability is partly determined by the planning horizon a planner selects. This in turn may be determined by the length of production cycles and the level of a plan in the plan hierarchy. For different organisations in a given unstable environment, therefore, the importance of instability may be quite different.

The discussion above indicates that the predictability of a given environment can only be described meaningfully with respect to a given organisation at a given point in time. If one is to generalise about the way planning should be approached for a given type of organisation, such as a farm, it would be very useful to be able to characterise environments in terms of their general, base level predictability. That is, a meaningful taxonomy of environments which indicated their maximal predictability, independent of planning horizon, would afford some indications about how planning should reflect the (possibly greater, but not lesser) unpredictability an individual planner would face.

One means of identifying the basic predictability of planning environments has been developed by Emery and Trist (1965). This is discussed in the next section.

2.6.3 Classifying environments according to their predictability

The framework for analysis of environments which follows is based on the analysis of the relationships between component systems in the planning environment. Four 'ideal types' of environment are identified. These are discussed briefly below.

The first type, called the placid, randomised environment is one in which 'goals and noxiants ('goods' and 'bads') are relatively

unchanging in themselves and randomly distributed' (Emery and Trist 1965, 246). This environment is placid because it is neutral with respect to system survival or death; there is no intention in the environment to foster or threaten a system. The randomness in the environment prohibits learning by any system in it.

This first type of environment is 'largely theoretical' (Emery, Emery, Caldwell and Crombie 1977, 6) and system evolution from such environments 'most unlikely' (Emery et al 1977, 6). Its existence is proposed for the sake of completeness in the categories Emery and Trist developed.

The second type, called a placid, clustered environment differs from the first in that goals and noxiants are no longer randomly distributed. The ways goals and noxiants are related can be learned by systems in this kind of environment. Though they are related, the goals and noxiants appear placidly in that systems in the environment do not react to the actions of other systems. 'Most of the collecting, hunting and early agricultural societies appeared to have lived in such environments' (Emery et al 1977, 7).

The third type of environment, called disturbed, reactive, differs from the second only in that it contains two or more systems of the same kind. The presence of competitors (for resources and/or markets, for example) removes the placidness from the environment; other systems respond to a system's behaviour. In addition to learning about the environment, attempting to assess the kinds of reactions competitors will exhibit to one's own activities in the environment becomes appropriate. The behaviours of other similar systems create goals and noxiants.

The fourth type of environment is called turbulent field. This type, in addition to the characteristics of 'disturbed, reactive' environments, is one where dynamism arises 'from processes set off in the environment itself' (Emery et al 1977, 9). These processes are set off by the actions of large systems, or groups of related

systems. In addition to the dynamism which emerges as similar systems compete for satisfaction of goals, non-competing systems in the environment react to the actions of the group of competing systems thereby creating dynamism which is less predictable than that of 'disturbed, reactive' environments.

Examples of dynamism are noted in the following quotation (Emery et al 1977, 10):

> 'when institutions and organisations are large enough and powerful enough, their efforts at producing planned changes in the environment can trigger off social processes of which they had no fore-warning, in areas they never even thought to consider and with results they had certainly not calculated on. Massive efforts at planned change like President Johnson's War on Poverty just seep away in the sand; minor miscalculations, like the Watergate burglary, spread like wildfire to paralyse the political life of a nation and overthrow a president'.

Emery and Trist (1965) cite three major factors which lead to a transition from a 'disturbed, reactive' to a 'turbulent field' environment. These are:

(i) the sheer size, and associated magnitude of effect on the environment, of organisations or linked sets of them.

(ii) increasing interdependence of types of systems, such as between economic and social types.

(iii) increasing reliance on new information and technology as a source of competitive advantage. This leads inevitably to increasing rates of change in the environment.

There are two major, qualitative changes incorporated in the taxonomy Emery and Trist (1965) developed. One is the evolution of environments, from one containing no similar systems, to a situation of similar systems, to an environment populated with large and powerful similar systems.

The other change is the evolution of environment responsiveness to systems. From indifference to systems, environments may evolve to display a reaction to system activity. Initially this is no more than the response of competing systems. Ultimately, other systems, not directly competing, react to system activity.

The two types of change are obviously related. Associated also is the predictability of the operating environments for a given system. The environment is most predictable when it is of the 'placid, clustered' type, less predictable when it is 'disturbed, reactive', and significantly unpredictable when it is 'placid, randomised' or 'turbulent field'.

A principal virtue of the above approach to categorising environments is that it identifies a causal structure for the predictability of environments. This enables one to escape the potential trap of describing an environment incorrectly on the basis of how it appears to an observer inside one system. Specifically, uncertainty a manager perceives may be a reflection of incomplete learning in a 'placid, clustered' environment; a reflection of inability to predict competitive action in a 'disturbed, reactive' environment, or a reflection of endemic change in a 'turbulent field' environment. Which it is is important for the manager. Appropriate responses to uncertainty depend on its real source. It would be as inappropriate to 'throw one's hands in the air' in a 'placid, clustered' environment as it would be to strive to learn about the potential variability of a 'turbulent field'.

2.6.4 Planning in alternative possible environments

Emery and Trist (1965) drew inferences for management from their taxonomy of environmental types (2.6.3). These inferences are based on the fundamental predictability of the environment, and the consequent predictability of the results of management action. The key to their inferences is reflected in the proposition by Beer (1966, 265), that 'a vital capability of a viable system is (in some sense hard to define) the ability to forecast'.

In 'placid, randomised' environments strategy and tactics have no meaningful distinction. The best any system can do is respond to immediate goals and noxiants. The randomness in the environment prevents the effective orientation of behaviour to opportunities or threats which are not immediate.

The clustering in the second type of environment permits learning and a strategic orientation. Indeed a strategic approach is required. 'To pursue a goal under its nose may lead [an organisation] into parts of the [environment] fraught with danger, while avoidance of an immediately difficult issue may lead it away from potentially rewarding areas. In the clustered environment the relevant objective is that of 'optimal location', some positions being discernible as potentially richer than others' (Emery and Trist 1965, 247).

In 'disturbed, reactive' environments the behaviour of competitors needs to be monitored and anticipated. The environment is not placid and strategy should be appropriate to the possible effects of competitor activity on goals and noxiants. 'This gives particular relevance to strategies of absorption and parasitism. It can also give rise to situations in which stability can be obtained only by a certain coming-to-terms between competitors, whether enterprises, interest groups or governments. One has to know when not to fight to the death' (Emery and Trist 1965, 248).

In 'turbulent field' environments the unpredictability of goals and noxiants is such that there is no strategic or tactical approach any individual system can adopt which will promote its survival in the long-run. 'The forms of strategic planning and collusion that aided survival in 'disturbed reactive' environments would be no more adequate than tactics alone would be in 'placid, clustered' environments' (Emery et al 1977, 11). Emery and Trist argue that the unpredictability in 'turbulent field' environments has to be reduced for managers to be able to exercise control over the performance of their organisations. They suggest that a reduction can only be achieved by managers of non-competing organisations adopting values and ideals which 'have overriding significance for all members of the [environment]' (Emery and Trist 1965, 252). This adoption of shared values is required, it has been argued, 'between dissimilar organisations whose fates are basically positively correlated' (Emery et al 1977, 121).

The effect of the adoption of values is the transformation of 'turbulent field' environments into 'placid, clustered' or 'disturbed reactive' environments. This occurs as a result of managers of organisations deliberately restricting their set of alternative actions in accordance with the shared values. Emery et al (1977) instance international communications as a process around which such value sharing has occurred.

Emery and Trist are asserting that 'turbulent field' environments are unmanageable; any system survives in them solely on the basis of good luck. Rational action in such environments is, by implication, that directed to changing the environment to a type with which systems can cope. These propositions can be regarded as testable hypotheses. Moreover, they are hypotheses which are central to this thesis (see Chapter 6).

The type of analysis Emery and Trist have conducted is unique. The inferences they have drawn for appropriate system activity from their analysis of environments is likewise unique; other theorists

have not proposed that environments may exist in which individual organisations cannot be made to survive. It is not the validity or credibility of the analysis Emery and Trist have carried out which is most relevant here. The critical issue is whether pertinent aspects of their work conforms with reality in Australian agriculture. This is considered subsequently (see Chapter 6).

If the Emery and Trist analysis is valid, the implications for planning are apparent, in broad terms at least: type of environment implies the appropriate orientation to planning.

It is possible to imagine operating environments which have elements of a 'placid, clustered' kind and elements of a 'turbulent field' kind. For example, the demand for an organisation's output may be highly variable but the input supply aspects of the environment quite stable and placid. The question arises as to how the overall environment should be classified, as one type or the other, or neither.

Rhenman (1973), criticising the analysis by Emery and Trist, has argued that environments tend to contain characteristics of all four ideal environments as defined. By implication, it is difficult to draw practical inferences for strategic behaviour from the analysis of a given environment. That is, what approach to the environment is appropriate when the environment is composed of some mix of ideal types? This argument serves to emphasise the coarse nature of the Emery and Trist analysis. Importantly, it also indicates the need to consider possible criteria for selection of appropriate strategic responses to environments which are a blend of ideal types.

The importance of any element of the environment to a manager depends on the extent to which the value which that element takes affects the outcome of his plan(s). Using the 'law of requisite variety', the importance of any element can be said to depend on the significance of the variety in outcomes implied by variety in that element, given the variety in manager response.

Among a set of elements of the environment which are equally 'important', a 'turbulent' element will dominate other types in dictating appropriate strategy. One can go further and suggest that any element of the environment which is of substantial importance, and is 'turbulent', will dominate other types. This may hold even when other elements are of greater importance. That is, if an element can affect plan outcomes to the extent that, for example, net profit could be made negative, and if that element can be characterisied as 'turbulent', strategy should be determined to cope principally with that element.

Such domination of 'turbulent fields', among other types of important elements of an environment, in implying strategy is a result of the proliferation of variety in turbulent fields, and the asserted inability of any manager to offset that variety. 'Turbulent fields' are environments where variety proliferates and changes in ways which deny the possibility of achieving any variety in response which even approaches 'requisite variety'. Thus, where some element of the environment is a 'turbulent field' and has substantial importance, the strategy adopted to cope with that element plays a primary role in determining organisational performance.

While the use terms of like 'substantial importance' reflects the coarseness of the concepts being used here, it is not likely to prove difficult in a practical setting to determine whether some element of the environment can be so described. When such an element is a 'turbulent field', a strategy is required which is designed to achieve the sharing of values by systems in the environment, given the Emery and Trist analysis. Plans will still be required for output, input acquisition and internal functioning, in the hope of survival, but there is no optimal orientation to adopt in making these plans. Luck will dictate their relevance, and thus their potential effectiveness, although the more technically efficiently they are pursued the greater will be the achievement of this potential. In the medium term, however, technical efficiency will have little, if any, effect on survival.

Any mix of 'types' within one environment can be analysed similarly; that 'substantially important' element which implies greatest unpredictability in the environment should dictate the character of corporate strategy. Therefore, assuming that 'placid, randomised' environments do not exist, the order of dominance would be 'turbulent fields' followed by 'disturbed reactive'. Thus, the strategic orientation appropriate to 'placid, clustered' environments would only be appropriate when all 'substantially important' elements of the environment were 'placid, clustered' in nature.

2.7 Concluding Comments

In this chapter concepts basic to this thesis have been considered. Planning, rationality, control and planning aids have been defined and discussed. As well, an approach to categorising system environments has been presented and some consideration given to the implications for planning of the existence of alternative types of environments.

One objective in this chapter was to develop a basis for conceptualising planning and planning environments such that appropriate approaches to planning can be inferred from analysis of planning environments. That is, a theory of planning was sought which would enable an analyst to evaluate a priori what would and would not constitute rational approaches to planning, given a planning environment. Such a theory would allow an analyst to escape the inappropriate advocacy of planning activity and planning aids which might otherwise occur.

The analysis of Emery and Trist (1965), outlined in this chapter, is focused explicitly on the question of which general type of strategic response is appropriate for different types of environment. The implications of this analysis to mixed environments was considered finally.

Chapter 3

FARM PLANNING

3.1 Introduction

In this chapter the general conceptualisation of planning developed in the previous chapter is applied to farms. The purpose in doing this is to provide a theoretical basis against which actual and recommended farm planning practice can be evaluated.

3.2 The Farm Planning Function

In this section the conventional theoretical view of farm planning, more or less explicit in the relevant literature, is presented. This is followed by a contrasting perspective which flows from the application of concepts developed in 2.2 and 2.3.

3.2.1 Conventional perspectives

Farm planning is seldom defined in any literature (an exception is Johl and Kapur 1973). How the majority of theorists interpret 'farm planning' can only be inferred, therefore, from the way and contexts in which the phrase is used.

Two features of the use of the phrase 'farm planning' are notable. Firstly, farm planning is often used synonomously with planning. That is, the adjective 'farm' connotes nothing more than that planning of some activity or another is being discussed with relation to farms. This is to be expected.

The second feature is that nowhere is there a thorough conceptualisation of the planning function on farms. Strategy and tactics, and hierarchies of plans receive scant attention. No theory of planning has been developed or utilised. 'Whole farm planning' is used in the literature (Trebeck and Hardaker 1972;

Anderson, Dillon and Hardaker 1977) but the phrase does not mean planning which is as comprehensive as it would seem to indicate. Rather, 'whole farm planning' refers to the resolution simultaneously of '(1) which enterprises to adopt on the farm, (2) what method of production to employ in each enterprise, and (3) what amount of resources to allocate to each enterprise' (Anderson et al 1977, 195).

'Whole farming planning' does not, it appears, extend to matters such as farm firm growth, degree of short term production flexibility, financial plans, strategy designed to cope with variability in output or income, or employment plans. That is, various aspects of farm management which are not intrinsically related to enterprise plans are excluded from 'whole farm planning'. Some of those listed would probably appear as objectives or constraints for enterprise plans. Where they appear as objectives they provide strong evidence of the existence of a higher order plan, somehow not included in the notion of 'whole farm planning'. 'Whole farm planning' seems to be partial.

The focus of attention in the literature has tended to be on planning techniques (aids), as evidenced by the reviews presented by Anderson (1972 and 1974), McInerney (1971), Nix (1969), Reisch (1971) and Throsby (1974). There seem to be no links, in this respect, between farm management and the discipline of business management. The business management literature has long reflected an interest in a broad, comprehensive view of planning as a management function (e.g. Fayol 1925).

Appeals made for researchers in the farm management area to, in effect, adopt a broader perspective on planning and related matters (Wallace and Burr 1963; Johnson 1971) have apparently had little impact. The rarity of definitions of farm planning is perhaps the most compelling (mute) testimony to the absence of theoretical attention to the planning function on farms.

3.2.2 A comprehensive approach

The application to a farming context of the propositions about planning in Chapter 2 has clear implications for the meaning of 'farm planning'. According to those propositions, farm planning is the identification of objectives for a farm and of the means by which they will be achieved. This process can be expected to relate to a hierarchy of plans, wherein the highest level plan (corporate strategy) is that which is most directly and comprehensively concerned with the selection of strategies appropriate to objectives, resources available and the operating environment. All other plans in the hierarchy should, according to this approach, be consistent with corporate strategy and with each other.

Planning the corporate strategy for a farm would involve the identification of objectives as a first step. These may include matters such as income aspirations, leisure preferences, minimum acceptable financial independence, preferences for future involvement of offspring with the farm, aesthetic preferences, and so on. Also relevant could be preferences related to external controls on production and marketing, cooperative activity with peers, and relative preferences for alternative enterprises which may be produced on the farm.

The concept of planning suggests that a situation analysis should be carried out to provide a prognosis for the satisfaction of objectives should existing plans continue. Inter alia, this would involve an assessment of future environments over various time horizons.

A resource audit would indicate the production capabilities of the farm. This would reflect land types, management and worker abilities, financial resources, climate, and the availability of other inputs. The variability in the amount, quality or availability of these resources is also pertinent. For control purposes, the availability and reliability of information could also be evaluated.

Alternative corporate strategies would state the basic farm posture with respect to the environment. They would reflect the amount of control a farmer perceives he has both over pertinent aspects of farm operation and over the satisfaction of objectives. They would imply the relative emphasis a farmer will place on the various managerial actions he will perform. They would include decisions about the stability or flexibility of farm productive activities (such as enterprise mix), the degree to which possible enterprise diversification will be pursued, the extent to which financial loans will be used, the status of long term growth as a short term objective, and so on.

The 'superior' status of corporate strategy as a plan implies that it should be sufficiently comprehensive to provide all relevant guides and criteria to all other plans the farmer makes. This requires that corporate strategy contain decisions, particularly, on the short run (or tactical) flexibility in activity to be maintained, normally, around the long-run (strategic) posture. This will often be manifest in statements of policy with respect to short term opportunistic action.

Strategy should also contain provisions for its own revision. Actual or anticipated overall farm performance would be compared to performance targets and, depending on tolerances set for acceptable deviations from them, a review of strategy might be initiated. Corporate strategy would imply the permissible deviations from targets for performance of all lower level plans.

The strategy chosen only becomes relevant when it is implemented. As suggested in 2.2.2., strategy should not be contradicted at any stage by lower level plans. Lower level plans, such as enterprise mix plans, should serve the corporate strategy of the farm.

It is by no means essential that farmers decide corporate strategy explicitly and formally. Many organisations in other

sectors of the economy do not have formal statements of corporate strategy. Management of any organisation as though it has a strategy is, however, desirable. It is desirable for the reason that any plan is desirable: to inhibit organisationally irrational behaviour by deliberately addressing the question of how the environment indicates the organisation should employ its resources if objectives are to be satisfied.

The formalism and structured nature of the approach to farm planning described above seems to be inconsistent with the general character of farming life and farm management in Australia. Indeed, it is probably inconsistent in appearance with the character of management in the majority of firms in Australia. Proponents of the concept of planning characteristically respond to suggestions that they seem to be promoting excessive formalism by noting the abstract nature of their approach and the axiomatic rationality of thought prior to action. They state (e.g. Steiner and Miner 1977) that planning procedures should be tailored to individual organisations such that the procedures suit its 'style'. They emphasise, though, the importance of distinguishing, conceptually, long term from short term plans, of thorough contemplation of the appropriate relationship for a manager to seek between the operating environment and operations of his organisation, and of the net benefits which accrue to managers who move away from intuitive, informal approaches to planning and towards more structured, formal approaches.

Whether or not a formal model of planning, generally accepted in the management literature, appears relevant to an organisation, such as a farm, is a question relating to the degree of control its manager(s) can profitably exercise over organisation performance. That is, the logic underlying the model is not affected by actual or perceived planning practice.

Whether Australian farmers appear to have corporate strategies and, if they do, what they reveal about farmers' perceptions of appropriate strategic postures for them are matters addressed in Chapter 7.

3.3 Application of a Comprehensive Approach to Farm Planning

In this section the approach to analysis of planning environments presented in Chapter 2 is applied to farms. It will be recalled that this approach affords a means of categorising operating environments and the drawing of specific inferences therefrom with respect to appropriate corporate strategies and organisational structures.

The application of the approach provides an image of rational farm planning with which farmer practice and recommended approaches to planning can be compared.

3.3.1 The Australian farm planning environment

A variety of types of environment (see 2.6.3) comprise the Australian farm planning environment. This variety is discussed here in terms of concepts presented in 2.6.3 and 2.6.4

While other elements in farm planning environments may have transitory importance, climate, input costs and output prices are persistently important. Variability in any of these elements affect farm financial performance directly.

Climate seems to be substantially a 'placid, clustered' element in the environment. It is as yet not well understood and cannot be forecasted very far into the future in detail. The lack of understanding of the weather system means that climate should be regarded as, effectively, a 'placid, randomised' element in the planning environment.

Input costs are generally neither highly variable nor unpredictable. Occasional shocks occur, such as the effects on the costs of oil-based products of the behaviour of the Organisation of Petroleum Exporting Countries (OPEC). These are relatively infrequent and their immediate, unpredicted effects usually

restricted to items representing a small component of total farm input costs. Input costs can be described as a 'placid, clustered' element in the planning environment.

Output prices are quite variable and quite unpredictable (see Chapter 6). Factors influencing output prices are diverse. They range from the effects of the adoption by the European Economic Community of the Common Agricultural Policy, to the effects of the attempted embargo on wheat sales to the Union of Soviet Socialist Republics in response to events in Afghanistan, to significant changes in farm output levels domestically and abroad. The diversity of factors and unpredictability of the impact on output prices of some of them, indicates that output prices should be regarded as being (formed by) a 'turbulent field' element in the environment.

The 'turbulence' reflected in output prices has many sources, but two seem to predominate. These are fluctuations in output nationally and internationally, and the effects of government policy action nationally and internationally. Output fluctuations are commonly the result of climatic factors. Government policy may be a response to any one of a number of factors. While one might hope that a better understanding of climate would eventually enable timely forecasting of supply, it would be naive to expect to be ever able to model policy making, and its consequences for output prices, to a useful extent. This is the essence of 'turbulent fields'; the (output price) environment is subject to significant change, the nature and timing of which is variable.

In 2.6.4 the argument was advanced that, when a 'turbulent field' is the character of an important element in the planning environment, that element dominates the environment. That is, the presence of a 'turbulent field' element indicates that an organisational response appropriate to a 'turbulent field' is required, regardless of the nature of other elements in the environment. What this argument implies for Australian farmers is considered in the next section.

3.3.2 Appropriate planning foci

Given the above, and following Emery and Trist (1965), appropriate farm corporate strategy in Australia would be the pursuit of relationships, involving the sharing of values, with other organisations/systems in the environment. The objective of this strategy would be to reduce the magnitude or unpredictability of change in the environment. The strategy would be one designed to change the planning environment of Australian farms and, as sharing of values is involved, that of other organisations/systems whose performance is linked with that of Australian farms (2.6.4).

A thorough consideration of the detail of such a strategy is beyond the scope of this study. The salient implication of the argued requirement for such a strategy is that on-farm plans for enterprise mix and the like are peripheral to the performance of any given farm in the long run. The strategy said to be needed is one that will change the planning environment to one in which individual farmers can exercise meaningful control over the financial performance of their farms.

Casting this argument into control theory terms (2.3.3), the premise is that the gap between variety in the environment and variety in farmer response is so great as to render on-farm behaviour practically irrelevant to the determination of absolute levels of financial performance. To moderate this situation, it is necessary for variety in the environment to be reduced. Value sharing, which might be caricatured (but not characterised) as collusion, is argued to be the only available mechanism by which this might be achieved. A strategy to achieve value sharing and a sufficient reduction in environmental variety thereby would enable farmers to exercise control over financial performance. Until this is achieved, on-farm activity, and plans dealing with it, is appropriate to the planning environment only occasionally and fortuitously.

Specifically, attempts by farmers to maximise financial performance by planning enterprise combinations on the basis of expected future environments may be organisationally irrational in the long run. Since such planning, or variants of it, is a common objective to which sophisticated farm planning techniques are directed, doubts about the rationality of using such techniques to this end are also encouraged by the reasoning above.

The implication of the above for the appropriate emphasis of management activity on-farm is that operational efficiency should be the planning focus. Operational efficiency is something over which farmers can exercise considerable influence and which affects profitability.

Within the enterprise mix and development constraint set of a farm, the factor that most affects financial performance is the capacity to minimise average total costs. The 'placid, clustered' character of input costs indicates that minimisation of average total costs is a meaningful objective, given the planning environment. That is, the above analysis implies that allocative efficiency is not deliberately attainable. Consequently, planning related to on-farm behaviour should be focused on maximising operational efficiency for the chosen enterprise mix and emphasis within that mix, both of which are likely to be inappropriate choices for the relevant price regime. The strategic rationale for this cost minimisation objective is that its attainment contributes to maximising the capacity of the farm firm to tolerate variety in gross income.

Research in Australia tends to support the last point. Technical efficiency emerges as a key determinant of farm profitability (Christiansen 1974; Kingma 1982). Net equity held by farm owners, which can be regarded as a measure of capacity to tolerate fluctuations in financial performance, has been found to be critical to farm survival in Australia (Christiansen 1974; Kingma 1982) and the U.S.A. (Richardson and Condra 1981). Kingma, Paul and

Backhouse (1983, 30) note that 'for most farms debts greater than [20 percent of total capital] could jeopardise the long-run viability of the property'.

From a business management point of view the implications of the Emery and Trist approach are rather dismal. They indicate that the organisationally rational focus for planning of on-farm behaviour is the maximisation of resilience to the consequences of inevitable allocative inefficiency (and climatic and pest/disease variability). These implications contrast sharply with the persistent emphasis on allocative efficiency, jointly with operational efficiency, in the farm planning literature (e.g. Barnard and Nix 1979).

3.4 Conclusion

In this chapter a comprehensive approach to the conceptualisation of farm planning has been presented, together with strategic implications of the suggested characterisation of the Australian farm planning environment.

Formal planning models point to the importance of highest level plans, termed strategies, being made on the basis of careful analysis of the planning environment. The work of Emery and Trist (1965) provides a form of environmental analysis which appears to offer sensible strategy prescriptions for a variety of planning environments.

Application of the work of Emery and Trist seems to imply that:

(i) given uncertainty relating to characteristics of the Australian farm planning environment, farm strategy directed to farm adaptation to key elements of that environment is inappropriate, and

(ii) appropriate strategy would be directed to reducing the unpredictability of the planning environment.

In Chapter 6 the first of these implications is examined in detail. In Chapter 7 actual farmer planning behaviour is examined, using a formal planning framework and considering the implications above.

In Chapter 4 uncertainty as a construct is examined, with the purpose of identifying the extent to which it can be dealt with in formal farm planning techniques. The capacity to accommodate uncertainty in the planning environment in planning techniques must be inadequate if the implications of the Emery and Trist work are to obtain.

Chapter 4

UNCERTAINTY

4.1 Introduction

Uncertainty is the bane of decision making and planning. It exists where, for whatever reason, an individual has doubt. Uncertainty can exist with respect to each of the steps in planning (2.2.3). Consequently, the way an individual deals with uncertainty bears directly on the rationality of his behaviour. In a deterministic environment, the extent to which behaviour serves well-specified objectives is readily identified. In stochastic environments, which evoke uncertainty, it is much more difficult to identify rational behaviour, since rationality is then contingent partly on the way uncertainty is accommodated.

Assessment of the rationality of behaviour, which is one purpose of this study, must therefore be preceded by an analysis of uncertainty. Another purpose of this study, the evaluation of aids to planning, likewise requires careful consideration of uncertainty. For both purposes it is necessary to identify the structure of uncertainty. Should it seem that uncertainty may have alternative structures, it is possible that the rationality of a response to it may be conditional on the existence of particular structures.

Indications that uncertainty may have alternative structures arise from the material presented in Chapter 2 in relation to analysis of environments. There it was suggested that different environments can be distinguished qualitatively and that one effect of their differences is that uncertainty has causes which vary from one environment to another (2.6.3). As well, the distinction made by Knight (1933) between risk and uncertainty, although disputed

(by, for example, Anderson, Dillon and Hardaker et al 1977), indicates that the question of alternative structures is real.

In this chapter uncertainty is analysed to establish whether distinct structures do in fact exist. The specific relevance of this analysis to the overall study is twofold. On the one hand, the material from Chapter 2 referred to above has relevance to major questions in this study. As suggested above, the existence of only one structure to uncertainty would be inconsistent with the implications of that material. One purpose of the analysis in this chapter is to confirm or deny these implications.

Related to this, the second purpose of the chapter is to evaluate the feasibility of measuring uncertainty. Of specific interest is the use of such measurement as input to formal planning aids. Should uncertainty be structurally heterogeneous but measurable, the implications for strategy of the material in Chapters 2 and 3 must be invalid. That is, while different environments may lead to different structures of uncertainty, if these are invariably measurable, strategy need not be directly implied by type of environment. If uncertainty is heterogeneous and not completely measurable, the implications cannot be rejected on these grounds. Moreover, the usefulness of planning aids which use some measure of uncertainty would be called into question if comprehensive measurement is not possible. As well, the rationality of a farmer using formal representations of his uncertainty for planning purposes would be doubtful.

4.2 Aspects of Belief

Action which is the result of decision making is predicated on information. Information may be available to a decision maker as attitudes, values, opinion, belief or knowledge. Values have been defined in Chapter 2. Belief can be defined as 'the epistemic attitude of holding a proposition p to be true where there is some degree of evidence, though not conclusive evidence, for the truth of p' (Speake 1979, s.v. 'belief'). Belief that (some proposition) p

obtains does not entail the truth of p, but does require some evidence. Opinion is belief without evidence.

An attitude is '... an organised predisposition to think, feel, perceive, and behave toward a referent or cognitive object ... [and] ... is an enduring structure of beliefs that predisposes the individual to behave selectively toward attitude referents. A referent is a category, class, or set of phenomena ...' (Kerlinger 1973, 495-6).

Knowledge is not defined easily (Ayer 1956; Speake 1979, s.v. 'knowledge') but the essence of its meaning is captured by recognizing that it requires, inter alia, belief in, and the truth of, a proposition.

A feeling of uncertainty indicates that knowledge (or valid certainty) is absent. Since the use made of evidence is bound up with rationality, belief appears to be the most relevant construct, of those referred to above, to use in the investigation of uncertainty.

4.2.1 Models of reality

Each person's model of the real world is the result of cognitive activity, including perception. The processes whereby reality is mapped onto the human mind are not independent of preferences, aspirations and hopes. The model of reality each person has reflects tendencies to select, distort, interpret and forget data in subjectively rational ways. The model, far from being an approximation, is '...fantastically different from the "real" world' (Simon 1959, 272; see also Taylor 1975).

The distortions in the model individuals have of the real world are the result of a variety of processes. Two principal processes, selectivity and cognitive dissonance reduction, are explained below to clarify and expand upon Simon's observation (above).

Individuals are typically surrounded by stimuli too numerous to notice and perceive simultaneously. To make sense of the mass of potential information embodied in those stimuli people only pay attention to some of the stimuli at any given moment. The selection of stimuli receiving attention is purposive and non-random. That is, stimuli are generally ignored when they do not offer information perceived to be relevant by and to an individual (Britt 1978).

The information derived or inferred from stimuli is also subject to selective processes. 'Selective perceiving implies that a receiver [of a message] will accept what he wants to perceive, and this depends on his past experiences and beliefs as well as his present situation or state of mind' (Britt 1978, 106). Selective perception thus defines both choice among stimuli which are being attended and attribution of meaning to those stimuli which are chosen to be perceived. Cognitive dissonance becomes very pertinent in this process.

Cognitive dissonance exists 'whenever an individual simultaneously holds two cognitions (ideas, beliefs, opinions) which are psychologically inconsistent' (Aronson 1973, 310). 'Psychologically inconsistent' does not necessarily mean logically inconsistent. Aronson (1973) suggests that a useful way to appreciate the notion of psychological inconsistency is to view it as a case of a cognition leading to an expectation which is confounded by another cognition. This expectation may or may not be logical.

'Since the occurrence of dissonance is presumed to be unpleasant, individuals strive to reduce it by adding 'consonant' cognitions or by changing one or both cognitions to make them 'fit together' better - i.e. so that they become more consonant with each other' (Aronson 1973, 310). One means of reducing dissonance is to distort reality in the process of perception.

Where erroneous models of reality lead to behavioural mistakes, one might expect an individual to correct his model. This can

occur but is not inevitable; such mistakes are themselves dissonance increasing and may be dealt with in other ways (for example, by mis-diagnosis of the cause of the mistake).

4.2.2 Confidence

From the definition presented above it is apparent that belief can refer to any proposition referring to the past, present or future. Various degrees of confidence can associate with belief. A person with very high confidence in a belief may describe such belief as knowledge (c.f. 4.2). Very low confidence belief would approximate opinion. Confidence of belief is conceptually equivalent to intensity of belief, a phrase used to define subjective probabilities (see 4.3.5).

4.3 Belief Constructs

Belief has been defined in a way which encompasses all cognitions which are relevant to planning. Rational use of beliefs in decision aids requires that relevant beliefs are modelled accurately, and exhaustively, in decision aids.

In the following sections constructs are presented with a view to using them to model belief in decision making contexts. The constructs parallel closely constructs used in decision theory.

4.3.1 Environments and states of nature

'Environments' in decision theory are all the relevant uncontrollable elements of a decision situation. Possible environments are also commonly described by decision theorists (e.g. Starr 1971) as 'states of nature', a description which emphasizes their exogenous nature.

In this thesis, state of nature is used to denote specific alternative values of relevant uncontrollable parameters. The values are those which a decision maker contemplates as

possibilities. Environment is used, in a generic sense, to refer to all truly possible states of nature. Thus, a decision maker with a perfect understanding of the processes in a stochastic environment (as generally defined) which determine the values of relevant parameters should be able to identify all truly possible states of nature. Less than perfect understanding of the environment may cause identified states of nature to comprise a subset of the environment. That is, some possible states of nature may not be identified. Those that are may even include some states of nature which are not in fact possible.

The distinction drawn here between states of nature and environment is useful for two reasons. Firstly, the conventional meaning of environment is preserved in essence. That is, environment connotes, not merely possible future states of nature, but a notion of the general character of processes within the environment as well (see 2.6.3). The definition of environment links states of nature with the common meaning of environment. This enables environment to be discussed meaningfully in decision theoretic and other contexts.

Secondly, the distinction enables consideration separately of the form and content of apparent randomness in an environment (Beer 1966, 369). If state of nature and environment are defined as equivalent constructs, contemplation of the nature of the processes determining states of nature is constrained to language pertinent to states of nature. This constraint has implications for measuring belief about the environment (4.3.6) and for describing the environment for the purpose of considering strategy (2.6.3).

4.3.2 Results, outcomes and payoffs

'Results', 'outcomes' or 'payoffs' are the consequences of decision maker action or inaction. Outcomes may be composed of a sequence of events such as a level of physical achievement implying a level of gross earnings implying, in turn, a level of achievement of some ultimate objective. There is no virtue in decomposing such

sequences into components unless uncontrollables appear to influence linkages between the various components of the sequence. If the latter is the case, we might expect either a range of outcomes to associate with a state of nature as specified, or states of nature influencing linkages between outcomes to be specified.

Outcomes must be measured in terms of decision maker objectives if they are to be maximally informative. In fact, to be maximally informative, they must be measured in terms of those objectives which will be operant at the time of their achievement. This can be an awkward requirement if objectives are unstable over time (Alexander 1975). Treating alternative objectives as different states of nature is, conceptually at least, one way of accommodating this difficulty. The nature of the environment (that is, all possible objectives) may pose a problem (see 4.4.2.).

4.3.3 Strategies and actions

'Strategies' or 'actions' are substantive alternative system behaviours a decision maker may contemplate initiating. A strategy may or may not be composed of a temporal sequence of activities whereby, for example, control or re-planning is contemplated as an activity contingent on future events (see 2.3.2).

Strategies (or actions) include all the controllable factors in the decision situation. They are plans. They are reflections of beliefs about feasible alternative ways a system may proceed.

4.3.4 Risk and uncertainty

Thus far various components of a decision situation have been defined about which a decision maker may have beliefs. These have been the controllable aspects of a decision situation, and possible outcomes of the interaction of these aspects.

'Risk' and 'uncertainty' relate to the nature of belief in a decision situation. Risk has been defined variously in decision

theory as being a special class of uncertainty (Knight 1933) or as being effectively identical to uncertainty (Savage 1954). Knight (1933) identified risky situations as those where the probability distribution of a set of states of nature was known objectively, from general principles or experience. Uncertainty Knight (1933) defined as pertaining when the probability of states of nature could only be known (or believed) subjectively, there being insufficient grounds for deriving objective probabilities.

The subjectivist school argues (see Anderson et al 1977) that the derivation of so called objective probabilities is predicated on a necessarily subjective assumption that the structure underlying past relative frequencies of appearance of states of nature, or the general principles used to derive probabilities, will persist into the future. Since the assumption underlying the application of the probabilities for the future is subjective it is not valid, it is argued, to label such probabilities as objective. The argument is analogous to the point made earlier (in 4.2) that certain belief can be wrong, coupled with a suggestion that we cannot know the future.

The subjectivist argument has considerable force and is accepted in this thesis. It is appropriate, however, to consider the logical impact of this point of view on Knight's dichotomy between risk and uncertainty. The specification of objective probabilities implies confident belief that all possible relevant future states of nature have been identified. In terms of the discussion of environments (4.3.1) this belief is of some interest and can be distinguished from beliefs relating to the possibility of particular states of nature. That is, belief as to which states of nature are possible is conceptually distinguishable from belief about one's understanding of the environment (see 4.3.6). The subjectivist argument concerning objective probability does no damage to the importance of the distinction between belief about the environment and belief about states of nature.

Uncertainty has two elements potentially: uncertainty as to what some relevant set contains; and uncertainty as to the

possibility of each member of the set becoming manifest. The potential existence of two elements has major implications for the measurement of uncertainty. This is considered in 4.4.3.

4.3.5 Probability and expectations

Expectations are attitudes about the future (Kelley and Scheewe 1975) and refer to states of nature or outcomes as defined. Probabilities, in decision theory, are feelings of the likelihood of some state of nature or outcome occurring.

Subjective probability is defined as 'the degree of belief ... an individual has about a proposition' (Anderson et al 1977, 18), and 'the degree of uncertainty concerned' (Moore and Thomas 1976, 45). As defined, probability and confidence are identical.

Questions concerning the beliefs to which probability relates, the technology of assessment and the use of probability in decision theory are considered subsequently.

4.3.6 Ambiguity

'Ambiguity' has emerged in the literature as a construct which, at least superficially, indicates that probability may not be a comprehensive measure of 'degree of belief'. Particularly, it indicates that probability does not equate with confidence.

Ambiguity has been defined as 'a quality giving rise to the amount, type, reliability and 'unanimity' of information, and giving rise to one's degree of 'confidence' in an estimate of relative likelihoods' (Ellsberg 1961, 657). To assist consideration of ambiguity and for subsequent discussion, the various relevant objects of belief are defined as follows (see Wright 1983):

(a) chance belief is a belief that a state of nature may occur;

(b) stability belief is a belief about the chance or probability that a state of nature will occur, is stable over time, and is predictable as a result;

(c) set belief is a belief that one knows the environment. That is, a belief that one has exhaustively specified the states of nature that are truly possible.

Ambiguity, as defined, can be regarded as low 'stability belief' or 'set belief'. This ambiguity arouses doubts about specific probabilities which may be attached to 'chance beliefs'. For example, if an individual is pressed by somebody to state the probability that it will rain one week hence, ambiguity will cause the former to feel uncomfortable in some sense. The discomfort could be described as dissonance where a cognition 'I am predicting the future with some degree of confidence' is dissonant with another cognition 'I really feel that I have very little idea about the future with regard to rain'. (For other examples see Hall 1975).

The manner in which probability (related to 'chance belief') should be used in any decision aid will depend on the degree to which it can be accepted as a comprehensive measure of relevant belief. Doubt persists in the literature as to whether probabilities can be identified in a way which accommodates ambiguity, or as a component of belief, or its impact on relevant confidence.

On one hand authors such as Georgescu-Roegen (1966; 1971) reject the feasibility of capturing, in probability-type measures, all the relevant uncertainty a decision maker feels. Georgescu-Roegen (1966, 275) proposes that good judgement, which can only be identified ex post, is 'the only means by which we can respond to living without divine knowledge in an uncertain world'. He asserts that although 'to many this may sound very discouraging, ... the opposite view, that good judgement is an obsolete concept in an era of panlogistic models is patently delusive' (1966, 275).

On the other hand are authors like Raiffa (1968) who assert that ambiguity can and should be eliminated by re-elicitation of probability. (The probability measure so obtained is conventionally defined as 'prior probability'. Since theorists argue that it can encompass ambiguity, prior probability should not be regarded as equivalent to 'chance belief' measures here, although most definitions of prior probability (e.g. Anderson et al 1977, 5) encourage such a view).

The removal of ambiguity, if it is achieved by re-elicitation, is achieved by encouraging the decision maker to contemplate the possible occurrence of a greater number of states of nature than he did when he initially established his best possible estimate of the situation.

There are several grounds on which the Raiffa approach may fail. Increasing the number of members of the set of possible occurrences (to eliminate low 'set belief') may require the inclusion of a number of members so great as to render the association of a probability with each of them meaningless. Such an increase may require, as well, an extensive amount of contemplation by the decision maker of an array of possible sequences of events. The attachment of probabilities to the members of a set enlarged in this way could involve a discounting of 'chance belief' assessment. This would result from the mixing of 'set belief' and 'chance belief' in the one probability figure. (Shackle 1952, 113ff addresses this problem).

Ambiguity arising from low 'stability belief' is not addressed at all by the Raiffa approach. A belief that chance is unstable is commonly the quintessence of uncertainty about the future. That this belief can be accommodated by altering set composition or switching probability about among set members is inconceivable. At best an array of alternative probability scenarios will be created, which will form a set and hence beg the question of relevant 'set belief' (or 'probabilities of probabilities', after Borch 1975)

which Raiffa seeks to treat by the very process generating the begged question.

A final problem is that the specification of the decision maker's best possible estimate addresses only 'chance belief'. The ambiguity problem is concerned with how much confidence a decision maker has in his best possible estimate.

In this section the construct 'ambiguity' has been considered, together with means by which decision theorists argue it can be eliminated, or at least incorporated in measures of uncertainty. On balance, elimination of ambiguity by such means does not seem possible.

4.3.7 An alternative treatment of ambiguity

There are few options for the way that 'set belief' and 'stability belief' can be treated if one rejects the argument that both can be measured by 'chance' probabilities. One approach is to distinguish formally between the components of ambiguity, as defined, and consider the kinds of decision aids which may be appropriate in the presence of different mixes of these components. This approach challenges, implicitly, the assumption commonly made by decision theorists that the relevance of decision theory is not bounded by the nature of uncertainty (e.g. Anderson et al 1977).

Starr (1971) argues that relevant approaches to decision making are defined by the nature of forecasts which can be made. Forecasts depend on what is knowable about environments. Starr (1971) categorises 'knowability' in terms of knowledge about relevant states of nature (i.e. 'set belief') and knowledge about the stability of probabilities of states of nature (i.e. 'stability belief'). The former knowledge he defines as ambiguity; the latter as stability. (Starr's 'ambiguity' is thus a subset of ambiguity as previously defined).

By classifying environments as (being perceived to be) 'ambiguous' or 'non-ambiguous', and 'stable' or 'unstable' a matrix of four possible states of knowledge can be described and Starr (1971, 140ff) argues for the appropriateness of various decision making approaches in each cell of the matrix. One aspect of Starr's argument which is relevant here is that decision theory is argued to be appropriate only in situations of 'stable non-ambiguity', which are the equivalent to situations of Knightian risk (see also the discussion of uncertainty and information in Kaufmann 1968). That is, where Knightian uncertainty (ambiguity as defined by Ellsberg) exists, 'chance belief' probabilities are inadequate as bases for rational decision making.

4.3.8 Ambiguity, probability and belief

Probability as a construct seems to be a useful representation of 'chance belief'. Ambiguity seems to be a useful construct which captures situations of beliefs about beliefs which typify Knightian uncertainty. That is, where an individual lacks confidence about believed 'chance' probabilities, because of low 'set belief' or 'stability belief' or both, it does not seem to be valid to force a merger of the various categories of belief into a single set of prior probabilities as Menz (1976) has argued, for example.

Ambiguity is something which needs to be accommodated explicitly in decision making. Decisions made unaided can be expected to be influenced by all relevant beliefs, as should decision aids proposed as comprehensive aids to decision making. Should ambiguity exist and not be considered in a decision aid, that aid is operating with some subset only of relevant beliefs.

Ambiguity is rather more than an artefact of poor identification of 'chance belief'. The implications for planning of the possible presence of ambiguity in decision making situations are considered in 4.5.

4.4 Representations of Belief

Belief needs to be represented in situations where decision aids are to be used to assist a decision maker. Which belief about what aspect of a decision situation is relevant may vary with different kinds of decision aids. It is possible nevertheless to discuss general means, independent of aids, for representing constructs dealing with belief.

The purpose in considering representations of belief in this section is to assess their validity and reliability. Consideration of the validity of the way in which they are used in decision aids occurs in Chapter 5.

Each of the constructs identified in 4.3 (environment, action, outcomes and uncertainty) may need to be represented in a decision aid, and each is considered separately below.

4.4.1 Environment representation

Environment has been defined in 4.3.1 and discussed at length in Chapter 2. Its representation cannot be considered independently from the discussion in Chapter 2. It is important to note, however, that much of the analysis in Chapter 2 relates to matters of uncertainty about the environment, and its sources. In this section it is the representation of environments, rather than uncertainty, which is considered.

The suggestion was made in Chapter 2 that it is often possible to define states of nature in terms of critical parameters. Product prices, rainfall, yield of output or credit availability may be summary relevant definitions of complex states of nature. When such definitions are to be used, representing states of nature is a relatively straightforward procedure. Different prices, rainfall distributions or intensities, yield possibilities and amounts of loan monies available are examples of different states of nature.

The aspect of environment representation likely to prove most difficult is the identification of relevant states of nature. This is an aspect which will tend to become more prominent the higher in the plan hierarchy is the plan a decision serves, since such plans are normally designed to cope with more distant futures than lower level plans.

4.4.2 Outcome representation; utility

The only characteristics of outcomes which are of interest to a decision maker are those which relate to objectives. Potentially, each outcome has quite a long list of such characteristics.

To enable outcomes to be evaluated comparatively it is desirable to transform (beliefs about) their concordance with objectives into a standard unit of measure. Utility, or valence, is one such measure. Definition of utility in terms of satisfaction or happiness is not necessary; it is a standard measure of concordance of outcomes with objectives and is a positive transformation of concordance.

An extensive literature exists concerning means of identifying and representing utility (see Anderson et al 1977). For outcomes with manifold relevant characteristics the task of attributing a single-valued evaluation or rating to them is more difficult than for outcomes with only one relevant characteristic. It is critical for valid measurement that all relevant characteristics are recognised by the decision maker.

Since outcomes occur in the future, it is possible that a decision maker may not be confident about the utility of some characteristics of some outcomes (March 1978). Uncertainty about utility may include an element of ambiguity as defined in 4.3.6. Where this is the case, it is necessary to be able to incorporate ambiguity in the representation of utility for use in a decision aid. Otherwise, a relevant aspect of belief would be omitted from formal consideration.

4.4.3 Uncertainty representation

Uncertainty has been disaggregated above into beliefs concerned with 'chance', 'stability' and 'sets'. The objects to which it relates may be actions, states of nature, outcomes or utilities. Frequently the measurement of uncertainty is related to states of nature and to 'chance belief' (e.g. Anderson et al 1977). The appropriateness of this emphasis on environmental uncertainty is considered below, following discussion of the process of measuring uncertainty.

4.4.3.1 Chance belief

Probability is defined (above) as a measure of the degree of belief (or one minus the uncertainty) that (some proposition) p will prevail. It is doubtful that individuals use probability intuitively in a numerical form as a guide to day-to-day decision making. One should expect belief to be used, however, and the quantification of it by some technique based on the probability construct would not seem to be logically objectionable provided it can be done validly. The quantification of belief is often referred to as 'probability elicitation' (e.g. Anderson et al 1977). 'Elicitation' implies that individuals actually have quantified belief and have probability numbers in their minds somewhere and that one is engaged in a process of drawing them out. It would be more accurate perhaps to describe the process as one of 'probability attribution'.

Much attention has been paid in the literature to methods of 'eliciting' probabilities (e.g. Stael von Holstein 1970, Anderson et al 1977). There are some, like Georgescu-Roegen (1958), who reject the possibility that all expectancy can be described meaningfully by real numbers, such as probabilities.

The technology of probability elicitation is not an area to be explored here. The importance for rational action of validity and reliability in such measures of belief is apparent, and one must

view as the first priority in the development of decision aids the identification of a means of measuring belief which is unbiased.

It is important to note that belief includes all of the prior effects of dissonance-reducing cognitive activity and other selective cognitive activity arising from the need to simplify and structure data from the real world. That is, belief may be influenced by systematic cognitive activity which renders reality acceptable in terms of values, attitudes, aspirations, and, possibly, the realisation that the ability to manipulate any but a small amount of information is limited (by bounded rationality). This personally rational cognitive activity leads to a conundrum: how should a decision analyst respond to the likely distortions embodied in belief?

A specific instance of such systematic cognitive activity is the following.

People who are uncomfortable with uncertainty tend to adjust probabilities. That is, where a state of nature would otherwise have a middle-order probability attached to it, such people change probabilities to very high <u>or</u> very low levels (Kogan and Wallach 1964). An explanation for this may be found in the notion of cognitive dissonance (4.2.1). People who feel threatened in some sense by uncertainty will experience a rise in cognitive dissonance when required to act in a context of uncertainty. One way to reduce this dissonance is to distort their model of reality. By increasing the probability of a state of nature, they lessen the perceived uncertainty. Alternatively they may lower their probability thus raising the perceived uncertainty. This is a pre-outcome rationalisation for possibly incorrect behaviour. The information a decision maker has, including beliefs, is data 'processed' in personally rational ways. The 'processing' may achieve both the reduction of cognitive dissonance and cognitive effort and an acceptable success rate attaching to decisions resulting from the (cognitive) use of data in such ways (Henry 1958; Kahneman and Tversky 1974).

Thus 'deviations of subjective from objective probability seem reliable, systematic, and difficult to eliminate. Apparently, people replace the laws of chance by heuristics, which sometimes yield reasonable estimates and quite often do not' (Kahneman and Tversky 1974, 25). For example one heuristic used by people is representativeness whereby probability is evaluated according to 'the degree to which [an uncertain event] ... is: (i) similar in essential properties to its parent population; and (ii) reflects the salient features of the process by which it is generated' (Kahneman and Tversky 1974, 26) rather than to the principles of probability theory.

A problem which raises similar questions to the above is the finding (de Zeeuw and Wagenaar 1974, 79) that subjective probabilities do not always sum to unity. De Finetti argued that, while inconsistencies such as this may interest psychologists, for the purposes of aiding decisions 'the most instructive and fruitful approach is to request a person to correct and improve his assessment through a careful comparison and revision for coherence and reasonableness' (de Finetti 1974, 17; emphasis added). Stael von Holstein (1970) adopted a similar view, suggesting that inconsistencies must mean that the individual's judgement is not in agreement with the probabilities elicited. Inconsistencies are 'mistakes or strange evaluations' (de Finetti 1974, 18).

In the context of uncertainty representation, the question raised by bias in the formation of probabilities (i.e. belief) and by inconsistency in elicited probability distributions is: to what extent is an effort to correct such distortions justified? The 'correction' in question is the adjustment of subjective probabilities (expressions of degrees of belief) to personal probabilities (expressions of degrees of belief which are coherent or self-consistent). The latter are probabilities 'as conceived by an ideal rational person' (de Zeeuw and Wagenaar 1974, 76).

De Finetti (1974) is correct in arguing that differences between subjective and personal probabilities are of greatest interest to

psychologists seeking to explain decisions rather than necessarily aid them. There remains the question, however, as to the extent of cognitive 'massaging' of real world data. If probabilities are assumed to be unbiased in ways which permit their use to calculate things like expected value or expected utility (see Chapter 5), cognitive distortion, related systematically to preferences of various kinds, poses a fundamental threat. The most clear example of this threat comes from findings that probabilities are influenced positively by the attractiveness of outcomes associated with environments (Irwin 1953, Edwards 1955).

The problem can be characterised as a situation where data, presumed to be raw for some decision aid, has very likely been processed already in ways dictated by the data handling facilities developed in the absence of access to decision aids. It is difficult to identify ways such probabilities might be truly and completely 'corrected'. Striving to make them coherent or self-consistent would appear to amount to treatment of only some possible symptoms of data massaging.

The possible existence of purposively distorted probabilities indicates that 'chance belief' may not always be represented validly as the entity it is assumed to be. This would appear to be one reason for emphasising the need to identify additional measures of uncertainty. The more extensively uncertainty is probed by an analyst, and the less any single measure, such as 'chance belief', is relied upon as <u>the</u> measure, the more should one expect information concerning a decision maker's beliefs about the future to be revealed.

4.4.3.2 <u>Ambiguity</u>

The representation of ambiguity has received much less attention than that of 'chance' probabilities (Winkler 1972, Borch 1975). Ambiguity can be characterised as a higher order probability over 'chance' probabilities. Menz (1976, 12) argued that 'if the legitimacy of second order probabilities is admitted, then there is no logical reason for not evaluating second order probabilities with third order and so on'. This is true and impels the conclusion (not

that 'chance' probabilities can and should capture all relevant uncertainty, as Menz argues but) that probability is not a useful construct for the assessment of 'set belief' or 'stability belief'. That is, while 'chance belief' may be measured as probabilities of states of nature, ambiguity cannot be so measured without initiating an infinite regress.

The state of the art of the representation of ambiguity is, and is likely to remain, such that one can only identify whether it exists, and not to what extent it exists. Shackle (1952) sought to address the problems ambiguity posed, although he nowhere used the term ambiguity. Ultimately he seemed to fail since he proposed as a solution only a special case of subjective expected utility theory. (see Edwards, 1961).

4.4.3.3 Actions, outcomes and utility

Uncertainty concerning actions, outcomes and utility has, like ambiguity, received relatively little attention. In the case of actions this is reasonable since a decision problem can be said to exist only when there is a choice to be made between or among alternative actions. There can hardly be uncertainty about such alternatives; there may be ignorance of other possible actions but that does not constitute uncertainty. Any uncertainty about alternatives reflects insufficient contemplation of belief by the decision maker.

Since outcomes are the results of interactions between action and environment it is logically appropriate to attribute all uncertainty about outcomes to uncertainty about environments. If, for example, outcomes are perceived to be uncertain because a decision maker is unsure about labour productivity within his organisation, labour productivity can be treated as a set of possible states of nature. Uncertainty about outcomes is addressed by the requirement that all relevant states of nature should be identified if one seeks to specify a decision problem comprehensively. It is pertinent to note, in this context, the

statement by Kurtz (1974, 395) that 'the random variations in labour and managerial performance is a fundamental endogenous uncertainty [created within the system] which is probably the most important uncertainty in any social system'.

Uncertainty about utility is not so easily incorporated into assessment procedures. The more distant in time decision outcomes are from the time of decision, and the more changeable an organisation's environment, the greater is the likelihood that relevant objectives will change.

Objectives can be disaggregated into long term objectives, which relate to higher level plans in the plan hierarchy, and to short term or tactical objectives unique to a particular decision, in the sense that they may change for the next such decision. Any plan related to action in the near future is likely to be based on both types of objective. This is a consequence of the hierarchical nature of plans (2.2.2). The utility of an outcome in the near future (or short term) is potentially a function of the satisfaction of short term objectives (such as the achievement of some level of cash flow) and of long term objectives (such as the repayment of loans).

It would appear unlikely that a decision maker would be uncertain as to his short term objectives, and the related utility associated with outcomes. It is quite possible, however, that he may be uncertain about long term objectives and about the related utility of short term outcomes. That is, a decision maker may be certain what his long term objectives are at the moment of planning but have some doubts about their stability over time. Alternatively, he may be uncertain what his long term objectives are at the moment of planning. In either case, it may be difficult for him to evaluate the utility of alternative short term outcomes.

Related to the above problem, Rosenhead, Elton and Gupta (1972, 419) define <u>robustness</u> as 'a measure of the useful flexibility maintained by a decision'. It is the number of plans, currently

thought of as good or acceptable, as a fraction of the total number of good or acceptable plans, still attainable in the future following a current decision. 'Plans' is the summary term for sequences of decisions, in this context.

Identifying the immediate decision alternatives that have maximal 'robustness' requires contemplation of alternative plans which requires, in turn, the specification of some planning horizon. 'The choice of planning horizon is necessarily a compromise between increasing complexity and uncertainty on the one hand, and inadequate cohesion [among decisions] and lack of preparedness on the other' (Rosenhead et al 1972, 427). That is, the more distant the planning horizon the more will short term plans be oriented to long term objectives, but the more difficult will it be to plan.

The possible importance of utility uncertainty is indicated by the fact that pursuit of 'robustness' may lead to decisions which do not have the highest value with respect to short term objectives. 'Flexibility is normally achieved only at a cost' (Rosenhead et al 1972, 427).

There is some correspondence between the notion of 'robustness' and fuzzy approaches to decision making. The latter are considered in the next section.

4.4.4 Fuzzy approaches to representation

Fuzzy-set theory, developed by Zadeh (1965) and Goguen (1967), has been applied to decision aids in an attempt to represent vagueness decision makers may feel about aspects of belief (Roy, 1977; Watson, Weiss and Donnell, 1979). '<u>Vagueness</u> is meant to be a conceptual problem arising out of the discrepancy between the logical form of a concept and its empirical manifestation' (Mattesich 1978, 123). This discrepancy may arise in decision making contexts when precise numbers (empirical manifestations) are sought as measures of belief (the concept). 'Imprecision' is a term

used, in decision making contexts, synonomously with 'vagueness' (Watson et al 1979).

In terms of the taxonomy presented in 4.3.6, vagueness or imprecision may relate either to 'chance belief' or 'stability belief', depending on the source of the imprecision. Imprecision reflects a situation where a decision maker does not hold 'chance belief' which can be validly represented by any precise (probability) figure. This may be a result of low 'stability belief' and/or the fact that 'chance belief' is, relative to precise figures, fundamentally vague; that is, the decision maker perceives zones of probability rather than a discrete probability for the focal objects of belief. A significant point to be made in this context is that 'imprecision and uncertainty are distinct qualities, which ought to be modeled in different ways' (Watson et al 1979, 2; see 4.3.6).

The distinction between imprecision and uncertainty can be explained with reference to two notions. These are mental categorisation of data and beliefs about beliefs (see 4.3.6). Uncertainty refers to a perception that two or more hypotheses are credible alternative descriptions of reality. Imprecision refers to the inability of an individual to attach unique probabilities to the chance of an hypothesis being confirmed.

Imprecision may be an artefact of the effort to measure chance with unique numbers. An individual may not mentally categorise degrees of perceived chance with sufficient fineness or detail to permit valid representation by a unique number (see 4.4.3.1).

Alternatively, imprecision may reflect a belief that the quality of 'chance belief' denies the validity of representation of 'chance beliefs' by unique numbers. This is one manifestation of what has been defined (in 4.3.6) as ambiguity, which has been argued (in 4.3.6) to require representation separately from 'chance belief'.

Fuzzy approaches to decision making do seem to offer ways of representing 'the imprecision which surrounds the probabilities and

utilities used in most decision analyses, while retaining the benefits of structure and consistency which the decision-analytic paradigm provides' (Watson et al 1979, 2). The 'cost' of these approaches is that the information yielded by techniques using these representations is also fuzzy. Preferred strategies are indicated, not necessarily very clearly, rather than optimal strategies being identified. The implication of fuzzy approaches is that the quality of information available from decision makers is often insufficient to allow the legitimate identification of optima (see 2.6.2).

Fuzzy approaches cannot be used to deal as well with low 'set belief' as they can with low 'stability belief'. The feeling a decision maker may have that a state of nature, which he does not anticipate, may eventuate, cannot be captured by any attempt to represent beliefs which is based on his expectations. This is most obviously the case when a decision maker suspects that he may not even have contemplated a particular relevant state of nature. This has been described as a problem of unknown unknowns (Newhouse 1982). It is also the case, though, when states of nature have been contemplated and rejected as possible futures without absolute confidence that they will not eventuate.

Overall it seems that fuzzy-set theoretic approaches to representing uncertainty are consistent with an important argument developed in 4.3.6, that it is not appropriate to strive to represent ambiguity in 'chance' probabilities.

4.5 Uncertainty and Planning

Planning is basically a combination of information gathering and decision making. Decisions are made at a number of steps in the planning process. The selection of a plan (2.2.3) plainly involves choice. Other steps which may have a decision making component are situation analysis and the development of alternative plans.

Situation analysis is undertaken, in part, to provide information so that the decision can be made as to whether a new

plan or plans are required. The development of alternative plans requires a decision about the extent of search for alternatives. Uncertainty related to each of these decisions can be considerable. In the case of the decision to plan or not, uncertainty is often associated with the trend value of stochastic variables. That is, how should one distinguish information from noise in values of variables? In the case of search decisions, uncertainty typically relates to the value of search.

In both cases 'ambiguity' may be a significant component of uncertainty. To the extent that 'ambiguity' is difficult to measure, and given that the decisions referred to precede the selection of plans, uncertainty may have major implications for planning beyond those associated with a single decision problem. That is, a single planning effort potentially involves a series of decisions. There are several relevant parts of the environment and uncertainty can arise with regard to each part. The implications of this for techniques advanced as aids to planning are considered in the next chapter.

4.6 Conclusion

In this chapter uncertainty has been characterised as belief. Three relevant objects of belief have been identified, utilising constructs adopted principally in decision theory and related areas of enquiry. Those objects are the chance of a state of nature occurring ('chance belief'), the possibility that some state(s) have been omitted erroneously from the set of possible states ('set belief'), and the posibility that the chance of occurrence is unpredictably unstable through time ('stability belief').

Matters related to the measurement of belief have been canvassed and an argument put that there are serious impediments to measurement. Decision theorists, while inevitably concerned with the measurement of belief, have avoided these impediments. This they have done by denying their existence generally.

The argument presented in this chapter is contrary to the conventional wisdom among decision theorists. The fundamental point of departure from that wisdom is the claim here that uncertainty is heterogeneous in ways which are inconsistent with the assumption that prior probability is a valid construct in all decision making contexts. This heterogeneity is to do with the form of uncertainty; decision theorists focus on its content, effectively denying the relevance of differences in form. In this, decision theorists are in distinct conflict with analyses of the kind made by Emery and Trist (1965).

It should be noted that decision theorists are identified in this chapter solely because they are the group which most clearly assumes the validity of prior probability as a measure of relevant uncertainty. All theorists and researchers who share that assumption are subject to the observations made about decision theorists in this chapter.

The analysis of belief in this chapter, and the implications of that analysis, is not tested empirically in any direct way in this study. The purpose of the chapter in the wider context of the study was to present an analysis which achieved basically one objective. This was to identify any problems in the measurement of uncertainty. Given the suggestions in Chapter 2 that environments can be categorised as different according to their sources of variety, measurement problems should exist. It appears that they may indeed exist and not be readily soluble.

The implications of the analysis for existing farm planning techniques are considered in the next chapter. In terms of the implications of the Emery and Trist analysis reported in Chapter 2, the problems associated with the measurement of uncertainty seem to be consistent.