

Chapter 5

COMMUNICATIONS

5.1 Introduction

Independent of the level of externalisation of the information - decision process, wherever the transition between internal and external processes occurs, the transmission of data/information/recommendation/decisions across this interface can be viewed as an act of communication. The efficiency with which these acts of communication occur can be considered one of the limiting factors determining the efficiency of the overall information - decision process. Further, there is evidence to suggest that factors impacting on the efficiency of communication may also impact on both the selection of data for inclusion in the decision data set and the perception of data/information reliability.

Without exploring in detail the whole of the published work in the domain of communication theories, this chapter attempts to draw from such literature some points considered by the author as cogent to consideration of communication in the context of management information systems and decision structures described previously.

The process of communication has been generally considered to be composed of the following steps: a) the construction of a message by the source; b) the transmission of that message along a channel; and c) interpretation of that transmission by the recipient. In addition to the consideration of these components of a unidirectional modelling of communication, it appears relevant to examine the impact of feedback loops and factors influencing producers' perceptions of source and channel reliability.

As with the difficulty experienced in the differentiation of "data" and "information" (see Section 4.2.1), the literature in general is often quite ambiguous in the differentiation of sources and channels, especially in the area of descriptive studies of farmers' sources of information. To illustrate this problem, consider the question as to whether the "source" of meat market reports on the Australian Broadcasting Corporation's (ABC) "NSW Country Hour" is in fact the Country Hour itself or the NSW

Meat Industry Authority, who are the generators of the original data. Most descriptive studies have attributed "source" status to such radio programmes as well as many rural papers. The question's significance lies in two areas. First, should the channel either modify the message or exhibit strong influences on farmers' perceptions of reliability, the channel can be said to exhibit the characteristics of a "source". Second, the types of message and the message formats transmitted by the alternate channels (radio, printed material, journals, papers or magazines or electronic data transfer), and the capacity for feedback, are individually constrained by physical and cultural characteristics of particular channels.

Within this chapter no attempt has been made to provide a structured differentiation of source and channel. Rather, the approach has been to attempt to view both from the perspective of the producer. The producer is held to be confronted by a continuum ranging from identifiable sources of market information (data), such as recorders of actual auction prices for wool, to the intermediate position of Stock and Station Agents who act as both channel and source by virtue of their interpretation, condensation and modification of both market data and market intelligence, while at the other extreme there is the fax or computer modem which exhibits the sole function of a communication channel.

The following examines briefly the concepts of communication, the sources identified as significant to primary producers, some characteristics of message encoding relevant to the communication of market information, the common communication channels utilised in agriculture and producers' decoding of messages. The chapter concludes with a limited consideration of the factors impacting on the perceptions of source and channel reliability.

5.2 Communication theory

The classical mathematical information theories, with their engineering heritage, have inspired a great deal of work concentrating on the efficiency, in terms of both the rate and the quality, of data transmission. In essence, the source is viewed as generating information when an occurrence is reported in a stochastic environment, with the efficiency of transmission being considered in terms of statistical quality of the transmission channels (Dretske 1983). This classic information theory is seen by Glen

(1980) as a "theory of communication" concerned mainly with rate and quality of a transmitted commodity "information".

The shortcomings of the classic information theory were also recognised by Lee and Nicholson (1973, p.921) who commented that

In short we do not have an acceptable 'theory of information'.
Communication-based information theory leads to a 'quantity-of -
information theory' which is useful in dealing with information
transmission as a technical problem but is of doubtful value when
dealing with the semantic or effectiveness problem of information
transfer.

In an attempt to define a more holistic view of information theory, with special reference to decision making in a small enterprise, Glen (1980, p. 35) suggested that "a) the 'meaning' of information as generated by a data user, and b) measurement, storage, and transmission of data within a business system." will impact on the utilisation of data/information in a business environment. Within Glen's view of the overall communication process, the originator (source) of a data transmission is assigned the following tasks: "a) selection of data, b) determination of meaning to be conveyed, c) encoding of sign to be understood by the recipient, d) selection of an appropriate channel for communication, e) actual communication via the selected channel" (Glen 1980, p. 91). The responsibility of the data user, post reception, is seen as "1) decode the language used to transmit data, 2) derive meaning from a decoded message, 3) convert the meaning derived into information and reduce data user uncertainty, 4) respond to new information generated by matching information against a determined problem" (Glen 1980 p. 94)

This holistic approach to the study of communication which, whilst less amenable to objective analysis, is considered to be more in line with the tenor of this dissertation. Hence, the following sections are couched in a similar vein to Glen's (1980) modeling of communication, with much of the work reviewed being descriptive in nature.

5.3 Sources

Primary producers during the course of their business activities are required to gain

information on a vast range of subjects and to make numerous and diverse observations of both the physical and financial environment in which they operate. Johnson (1979) suggested that farm managers require access to over 200 individual categories of information, noting that many problems, although superficially price-related, also involved questions relating to technological change, institutional change and various human factors. Johnson's (1979, p. 87) work led to the following comment, which is indicative of the scope of information utilised by farmers and of the deficiencies of current expectations modeling techniques.

..... in forming price expectations, farmers utilise a wide range of information having to do with technology, institutional arrangements, political events and attitudes, consumer behaviour, military operations, etc. Their models are much more complex than the simple lag or distributed lag models ...

Thus, even within the restricted category of market information there is a need to acquire data and information from numerous sources such as markets, marketing boards, processors, distributors, manufacturers, semi-official agencies and government departments, as well as from farmers themselves (Barnard 1975).

These observations indicate that the MISs (whether such systems be considered in a formal structured sense or are considered to be a conglomeration of the somewhat adhoc structures currently operating) servicing agriculture will be both expansive in nature and dependent on a large number of data/information sources. This presents the producer with the problem of how to efficiently communicate with such an array of sources.

From observations of current practice it is possible to detect a funnelling of information to the producer. Such structures as rural weekly papers, statutory authority market reporting services and State Departments of Agriculture extension services perform much of the data sourcing and interpretation which is beyond the economic capacity of the atomistic producer. These structures, because of their characteristic of being at the interface between producers and the environment external to the particular enterprise, are most commonly viewed as sources rather than communication channels.

Two features appear significant in understanding who farmers consider to be sources of information. First, farmers will differentiate between potential sources on the basis of the type of information being sought (Bardsley 1982, Schnitkey et al. 1992). This source/information type (problem type) interaction is seen in Lively and Nuthal's (1983) work, where advisers and consultants are reported to rank highly as providers of financial information but rate poorly as providers of market information. Second, the rapid changes in the fields of communication technology, analysis and institutional change experienced in recent years have resulted in corresponding changes in both source identification and source ranking by farmers. Alterations to information flows arising from the demise of open cash markets and increased vertical co-ordination, cited by Sporleder (1983), are indicative of such changes.

Yet, how ever broad the field of information sources, producers appear to limit the number of sources actually contacted, with Bardsley (1982) reporting that, while it was common for producers to utilise more than one source of information, no producer was observed using more than three sources of information on any one question. The motivation for this reduced search pattern is normally attributed to the economic constraints faced by individual producers. However, it could be interesting to speculate on the contribution that constraints on integration (inferencing) capacities and the avoidance of message ambiguity (different sources - different messages) make to such behaviour.

Several studies (Bock 1976, Halls 1977, Bardsley 1982) have revealed characteristic patterns of source utilisation by farmers, with interactions between source, information, format and decision type being observed, suggesting that the observed source selection (elimination) is far from haphazard.

In a study of Victorian beef producers, Halls (1977) ranked the following sources of market information, in order of importance to growers: 1) agent or broker, 2) attend sales personally, 3) media reports of prices at Newmarket, 4) media reports of prices at local centres, 5) other sources, 6) meat processors and 7) other farmers. Similarly, based on a survey of a wide range of Australian primary producers engaged in various enterprises, Bock (1976) noted the predominance of newspapers and magazines as sources of market information. In ranking sources on the basis of producers' perceptions of their ability to provide specific information, Bock (1976) (Table 5.1) also observed

that, within the arena of market information, a sources/information type interaction similar to that reported by Bardsley (1982) and Schnitkey et al. (1992) exists.

Apart from this decision type (marketing, production or consumption) influence on source selection the scope of the decisions can also be expected to impact on source numbers and source selection. Level 1 decisions would be expected to rely on a far smaller data set than, say, level 3 decisions (Humphreys and Berkeley 1983) hence limiting the need to consult widely. Similarly, programmed decisions (marketing of lambs already on hand) as opposed to unstructured or one-off decisions (purchase of new property) can be expected to be dependent on a far more limited number of sources. The former is typified by the dependence of producers on local agents for short-term market information, a situation which is normally not challenged until there is a disruption to the decision programming. With decisions of a unique nature, source use varies with the stage of adoption, type of adopter, the complexity of the practice and timeliness of the practice (McArthur 1977).

Table 5.1

Rank Order of Major Sources of Market Information

Type of Market Information	Rank Order						
	Farm Newsp.	Radio	Daily Newsp.	Agent	TV	Other Farmer	Other*
Prices at local sale centre	5	2	3.5	1	-	3.5	6
Prices at major sale centre	2	1	3	4	-	-	-
Processors or contract sales	1	3	5	2	-	4	-
Prices at international markets	1	2	3	-	-	-	-
Future price trends	1	2	3.5	3.5	-	-	-
Future demand trends in Australia	1	2	3	4	-	-	-
Future supply trends in Australia	1	2	3	-	-	-	-
Overseas demand	1	2	3	-	-	-	-
Overseas supply	1	2	3	-	-	-	-
Farm production costs	1	6	4.5	2	-	3	4.5
Weather reports	1	6	4.5	2	-	3	4.5
Aust. Gov. agric. policies	1	2.5	2.5	-	4	-	-
Marketing Board policies	1	2	3	-	-	-	-
Foreign agric policies	1	2.5	2.5	-	-	-	-

*This category consists mainly of personal observation, rural publications (e.g. B.A.E. reports), and Government bodies and organisations (e.g. State Departments of Agriculture, Marketing Boards).

Note (i) Sources with less than 5% of responses have not been ranked.

Source: Bock 1976, p. 24

5.3.1 Search

Glen's 1980 description of the responsibilities of both originator (source) and data users, engaged in an act of communication, assumes a compulsory reception of the message by the data users, as their initial responsibility is to decode the message. This view, whilst adequate where a structured MIS has been imposed on all parties, appears to be deficient as a description of current agricultural practices. It is certainly a view which is in conflict with Bardsley's (1982) call to move from a reactive model of producers to the recognition of the producer as an active participant in the communication process. As, first, most data/information sources accessed by producers can be described as passive in that they await enquiries from producers rather than force-feed producers with information, even those organisations that transmit information directly to individuals (e.g. the monthly mailing of "Wool Monitor" to all registered wool producers) can not assume that the information will be received (that is read or listened to). Second, at the interface between the farm enterprise and the external environment the producer has the option to engage or not in communication with any particular source, such that message reception can be considered to be initiated by the producer.

Given this view, it is suggested that factors influencing producers' search activities will be significant in the determination of sources and the type of information utilised in any decision process.

Davis and Olson (1985) identified four means by which information may be gained. These included research, authority, intuition and experience. Here, we are concerned with the patterns of producers' attempts to gain information from authority.

In general, informational search can be described as either focused on the alternatives or on attributes (Svenson 1979). Alternative-focused search can be expected at higher levels of decision abstraction while attribute search is expected to dominate where the level of decision abstraction and the associated decision structures involve choice mechanisms based on attribute maximisation. From the area of general open decision research, Englander and Tyszka (1980) have observed four basic patterns of search: parallel examination; narrowing down the number of alternatives; confirmation seeking; and satisficing. The patterns are described in the following terms.

- 1) Parallel examination is a strategy resulting in a low variability percentage and two relatively high thoroughness indices. The strategy of parallel examination may be accomplished either through asking questions according to particular attributes or to particular alternatives, or in a mixed way. In all cases the strategy implies a thorough investigation of all alternatives.
- 2) Narrowing down is a strategy with moderate thoroughness indices of which the index for the chosen alternative is usually the higher one. The strategy implies that subjects first examine almost all alternatives; in the next stage some alternatives are eliminated, and the remaining are further examined.
- 3) Confirmation seeking involves various alternatives being examined with a similar number of questions, but the questions are different for different alternatives. This suggests that the subjects questioned according to a predetermined image, just to confirm that image.
- 4) Satisficing is a pattern of information seeking characterised by a very high thoroughness index for the chosen alternative and quite low thoroughness indices for the rejected alternatives. (Englander and Tyszka 1980, p. 174)

To this point in time the potentially interesting field of study into the interactions between search pattern, level of problem abstraction and decision structures adopted in agriculture remains an area in which very little work has been undertaken. However, from normative economics it has been predicted that the effort expended in search by producers will be governed by the opportunity cost of search (McCall 1970), a very difficult concept to apply in practice. There is ample evidence from experimental work (Nakajima 1988) to suggest that individuals seek to reduce their mental effort by selectively examining information within a decision world and that, as the total amount of information available increases, the proportion of that information examined actually decreases. This incentive to reduce search appears to be to a large extent independent of potential economic gains, as illustrated by Hall's (1977) observation that beef producers with large numbers of stock for sale did not refer to any more sources of market information on average than their contemporaries with smaller numbers.

5.3.2 Source characteristics

The question of source characteristics is considered significant in the discussion of the role of market information to Australian primary producers for a number of reasons. First, it has been shown that differences in sources can influence the producers' perceptions of data and information reliability. This area will be covered in greater depth in a following section. Second, observations of the current conglomeration of market reporting and commentary services indicate that many structures, especially those operated by Governments and SMAs, are significantly removed from the market economy and, as such, react in a manner at variance to that contemplated or assumed in the more traditional, corporate-context MIS theories. In fact, many of the structures provide information or data to primary producers as a by-product or are directed to do so by Government in an attempt to rectify a perceived market failure.

The continuing movement away from the traditional open cry market towards a more vertically integrated trading structure has raised questions of private ownership of information and the public's right to know, along with market efficiency considerations (Bonnen 1975, Smith 1965). Walker (1990) suggests that, even within agribusiness, different organisational goals can become a barrier to efficient information transfer.

The involvement of government or semi-governmental bodies in the provision of market information has been justified on a number of grounds. An example of the rationale used is provide in the Rural Policy Green Paper (1974).

The provision by government of information on market prices, trends and developments is basic to any policy to improve market efficiency and to make the agricultural sector more market orientated. Such information will not only help farm producers but others in the marketing processing and distribution chain, where it will tend to make competition more effective by reducing market power based on information. As well as providing economies of scale in the collection, analysis and distribution of both domestic and overseas information, governments are in a better position to be able to supply the information and analyses in a neutral way, free of direct commercial interest. (p.158)

Kohls and Downey (1972) further justify the public collection and dissemination of agricultural market information, at least in the USA context, on the grounds of negation of the bargaining advantage enjoyed by larger firms, an advantage seen to be derived from their superior information facilities.

However, some commentaries on such actions suggest that these functions may not be totally benign. First, governments themselves require substantial economic information relating to agricultural production and market prospects for their own budgeting and planning purposes (Harris, Crawford and Gruen 1974). Second, Bonnen (1975) has noted that bureaucracies tend to develop substantial vested interests in existing concepts and measurement procedures, leading to a perceived ownership of data which hinders subsequent access. Third, Richardson (1979) notes the potential conflict of interests that arise where statutory boards, in order to behave in a commercial manner, may suppress market information that may be of value to primary producers.

This intervention of non-commercial bodies in the field of information provision to farmers has often been held to have significantly distorted the agricultural information market. Whilst this situation is seen to be changing as input supply companies enter the area of information transfer as a response to deregulation (Hudson 1990), the predominance of non-commercial bodies or commercial organisations (agents, chemical companies, etc), who view market information provision as a "service" or "loss leader", results in a very corrupted market. This may be significant in so much as the absence of a price mechanism prevents any communication of producers' evaluation of the quality and appropriateness of the services provided. (Question: Could ABARE maintain its forecasting activities on the revenues derived from the sale of its forecasts to producers?)

The capacity of producers to actively influence the quality and type of information provision is further complicated by the previously-mentioned problem of the differentiation of source and channels. Through the modification of messages and original data formats, "sources" such as agents, radio programmes and newspapers obscure from the producer's view the performances of particular originators of data and information. The common reporting of "point" forecasts by journalists in the absence of verbal qualifications originally issued in conjunction with such forecasts is illustrative of this problem. This can not only be misleading, it can also impact on the producer's perception

of the originators of the information, especially if the latter is specifically referenced in the report. Such communication breakdown can often be attributed to message modification or to problems with message encoding. The factors influencing such acts having been discussed in 4.2.5.

5.4 Encoding and decoding

Glen's (1980, p. 91) model of communication places the responsibility for "determination of meaning to be conveyed" and the "encoding of signs to be understood by the recipient" firmly on the shoulders of the originator of the message. Efficient encoding of a message requires of the message originator various attributes: an ability to compose a message, an understanding of the recipient's data demands, their decoding capacity and their capacity to comprehend the decoded message.

Given that the nature of the communication task will change, from the simple clinical communication of data required where a producer is interacting with a simple data base through to the tasks associated with communication between producer and MISs, it can be expected that the nature of, and the problems associated with, efficient encoding and decoding will change. Further, the encoding and decoding tasks can be expected to be influenced by the level of problem abstraction and associated decision structures as well as the communication channel utilised. For example, the use of radio prevents any visual encoding of messages.

Consider the difference in the communication tasks associated with fulfilling the "data" needs of decision structures which entail a level of problem abstraction that encompasses multiple variables and a recognition of the risk/uncertainty dichotomy (as defined in 2.4.1), whilst being reliant on an external MIS, as opposed to a simplistic decision structure requiring only point estimates of a single variable observed directly by the decision maker. In the former case, apart from the cognitive constraints on the verbal and numerical encoding and decoding of probabilities discussed in 3.4, the functional problems associated with encoding/decoding in the operation of information/decision structures which require the intervention of humans at various points can be seen to originate in at least two areas. The first area of concern is seen in Simons and Newell's (1971, p. 157) observations that

Information comes to the human problem solver principally in the form of statements in natural language and visual displays. For information to be exchanged between these external sources and the mind, it must be encoded and decoded.

An additional pertinent observation is that nobody has yet been able to describe the language utilised by humans for the internal representation of information or data (Simons and Newell 1971).

Budescu, Weinberg and Wallsten (1988, p.281) describe the second problem area in the following way.

The numerous decision models that assume numerical representation of uncertainty are in sharp contrast with the fact that people generally prefer to express their beliefs by means of natural language.

Erev and Cohen (1990, p. 2) use the phrase "communication mode preference (CMP) paradox" to describe the disparity between a natural human preference to encode messages verbally and the decision maker's preference for numerically encoded messages, a paradox which is seen to be even more perplexing given the differing findings relating to the decision making efficiency of both forms of communication. These authors found no difference in the efficiency of the verbal and the numerical assessments of probabilities (Erev and Cohen 1990). Alternatively, Budescu, Weinberg and Wallsten (1988) state, in summation of a series of laboratory experiments, that numerical judgements consistently and significantly out-performed verbal probability judgements and that, whilst both forms produced internally consistent scales, communication of probabilities based on numerical encoding consistently resulted in smaller errors of recipient comprehension of actual probabilities. Yet, Zimmer (1983) comments on the apparent superiority of the verbal mode at least in relation to the reduction of "conservatism" in the integration of new information, suggesting that

These results clearly indicate that verbal responses together with a visible record induces near optimal, or Bayesian, performance in the subjects. (p. 177)

Whilst the work conducted to this point in time on the efficient communication of probabilities is in itself inconclusive, the communication of uncertainty about probability estimates or, for that matter, prediction in general appears to be restricted to verbalisation. Kahneman and Tversky (1982, p.149) note the role of uncertainty assertions such as "I estimate that...", or sometimes "I think that..." and the assumption of uncertainty surrounding comparative statements such as "I think that the price of gold will be higher by 50% in six months than it is today". Such convenience or rounded numerical statements assume a variance around their literal point estimate interpretation (see 3.4).

This dominant form of encoding (verbalisation) of higher moments of uncertainty represents a significant problem in the communication of data for use in decision structures reliant on the formal application of probability theory, as even such verbalisation of subjective probabilities seldom conforms to the laws of probability theory (Kahneman and Tversky 1982).

Hence, a decision structure which attains a level of abstraction of the decision world inclusive of either of the concepts of risk, or which embodies acknowledgement of uncertainty about probability estimates, yet is itself dependent on a choice mechanism constrained by the rules of probability theory, can be expected to be confronted with significant communication problems.

These encoding/decoding problems arising from the need to alter the form of probability representation in the original data (objective or subjective) to its representation in the message, its internal representation and the representation required by the decision structure can be expected to exist not only in an information/decision system reliant on data/information from external sources, but in any decision structure which requires the cognitive processing of data. This communication problem becomes even more complicated if Kahneman and Tversky's (1982) concept of the variants of uncertainty (see 2.4.1) is included in the conceptualisation of the decision world.

The significance of this representational disparity problem extends beyond the questions of communication efficiency in that the inducement of informational ambiguity can, in itself, influence the selection of decision strategies (see Beach and Mitchell

(1978) cited in 2.3.4).

Turning now to the consideration of the selection of the means of communication and the associated constraints on the encoding and decoding of information, the initial step is seen to require a recognition of the limitations that each communication format places on the transmission of various stimuli. Humans receive messages from their surrounding environment in the form of visual, auditory, tactile, taste and olfactory stimuli. In general, the communication between producers and the market environment is dominated by visual and auditory stimuli. However, tactile stimuli (subjective appraisal of wool strength), taste (sampling of fruit) and olfactory stimuli (differentiation of coloured wool and urine stain in wool) are still in evidence in the generation of market data. As such, it is considered important to note the need for calibration of visual and verbal descriptors with tactile and olfactory stimuli. Note that a producer attending a wool sale, confronted with an objective measurement of staple strength (in N/Ktex), will normally take a staple from the display box and apply a manual (tactile) strength test. Similarly, a fruit producer may smell or taste produce at a sale to assess quality in an attempt to calibrate reported quality grades and realised prices.

However, it is widely recognised that the bulk of market information transfer is dependent on the visual and auditory stimulation of the target. Visual stimulation may be in the form of pictures, the written word (which itself can be considered as encoding of verbal communication), numerical symbols (raw data, statistically summarised data, arithmetic means, coefficients of variation, maximum value and range (Chervany and Dickson 1974)) and graphical summations of the latter. Auditory stimulation of targets is, to all intents, restricted to the verbalisation of the message.

In commentary on the current provision of market information/data in Australian livestock industries, Weeks (1991) made the following statements and provided an associated recommendation of the efficient combination of encoding techniques.

There is a dearth of market information. If anything this has to be condensed and presented in a more appropriate fashion.

(p. 4)

and

The following information is required for each (export) market:

1) Ideally export prices should be stated and graphed which represent

the actual return to the exporter by excluding the exchange rate and freight costs.

- 2) co-located with the graph there should be 3 actual prices- this week - last week - this time last year.
 - 3) A brief comment on why the export price is so and a best guess of what future trends will be.
 - 4) A best guess statement about whether the market is being demand led or supply driven.
 - 5) Volume of exports.
 - 6) Effects of exchange rate movements on demand and price
- (p. 12)

As with the verbal and numerical encoding and decoding of probabilities and the associated "communication mode preference (CMP) paradox" (Erev and Cohen 1990), the relative efficiency of verbal, graphical and tabular encoding of data is a subject of debate. Davis and Olson (1985) observed that there was no positive correlation between the use of graphs and the quality of decisions, noting that graphs encourage decision maker's to look at relative trends and induce significant bias through: choice of scale; choice of graphic; choice of size; and colour. Zmud (1979, p. 971), though, states that

Graphical reports have been shown to result in better performance than tabular reports and were preferred when compared with tabular or bar chart reports. Colour-coded graphics have improved performance, a single multi-line graph resulted in better performance than multiple single-line graphs, and format improvements were observed to be positively associated with increased MIS usage.

Message encoding, in report format inclusive of verbal and numerical components, has the potential to induce in a recipient a message focused on total volumes and individual discrete amounts (Davis and Olson 1985).

In the absence of a definitive advantage attributable to any particular form of encoding it is not surprising that most market reporting services resort to a hybrid encoding of messages similar to that described by Weeks (1991) above.

5.4.1 Internal representation

The product of decoding of such market information messages or, for that matter, the decoding of messages from decision support systems is taken to be the target's internal representation of the message received. The complementarity of this internal representation and the original concepts which the originator of the message wished to convey provides the basic measure of communication efficiency. However, this presumes a commonality of conceptual representation, a particularly questionable assumption, as evidenced by Dillon's (1971) observation that farmers often had no formal concept of probability.

The examination of producers' internal conceptualisation and storage of market information ultimately relies on: first, noting how prices and yields are verbalised; second, by discerning how the statements about price and yields are grouped into classes; and finally, noting the relationship between the classes. This process is of course based on the assumption that verbalisation of concepts is in fact a true expression of their internal representation.

A number of observations by various authors gives some insight to these internal processes.

Rounded or convenient prices were reported by producers more frequently than other prices. (Williams 1953, p. 361)

and

Farmers were reported as encoding price information in both qualitative form (good, bad, etc) or in a quantitative form. (Ortiz 1980, p. 181)

With regard to the internal representation of probabilities

There are indications in these studies, as well as others, that individuals do not trust, do not understand, or simply do not much use precise probability estimates. Crude characterisation of likelihoods are used to exclude certain possibilities from entering the decision calculus. (March 1987, p. 411)

These observations are consistent with anecdotal evidence that, when producers are told that lambs are being sold at \$25 per head, they often verbalise such information as being a "poor", "average" or "good price".

The internalisation of information producing such exemplars is seen by Ortiz (1980) to be a function of an automatic notation of the repetitiveness of events as well as its spatial and temporal connection with other events along with the notation of semantic associations. Richardson and Carthy (1989) provide an extensive review of the models of the mechanisms by which data or observations are internalised to form concepts and by which events are categorised. Such models belong to one of two major classes of such models, namely 'strength' models and 'distance' models.

From this review, and on the basis of experimental work, Richardson and Carthy (1989) concludes that

..... subjects tend to use relations among variables in a category of objects to make predictions about other variables. This in turn indicates that such categories are stored or represented in the form of such relations rather than as information about independent variables. If this is the case, it suggests a great capacity for predictability from partial information. (p. 93)

They note, though,

Of course, none of this excludes the possibility of independent-cue information being encoded in addition to, or instead of, relational information, in certain circumstances. (p. 97)

5.5 Communication channels

Both Smith (1965) and Glen (1980) recognised the role of the message initiator in the selection of the communication media. Currently the channels available for selection in Australian agriculture include: rural press, direct mailing, fax, radio, and television (Weeks 1991), along with the emerging dissemination technologies of video-text,

teletext, computerised data bases and decision aiding models (Sporleder 1983). The selection of a communication channel from this group appears to be influenced by a number of factors associated with the various media formats and the information itself.

Those wishing to communicate information which can be characterised as a "public good" (a good which is nonrival and non-exclusionary) (Streeter 1988) can be expected to be able to make far greater use of "free to air" (radio, tv) and the general press than those who are required to generate an economic return from the information held. In general, the costs associated with exclusion and the limited marginal returns from the provision of market information to an additional producer combine to place most market information in the "public good" class and hence allow the utilisation of open access media. However, the greater the analytical content of the material and or the shorter its period of relevance, the greater the "private good" nature of the information. The latter type of information is restricted to communication via channels on which a charge can be levied, as illustrated by the general publication of wool market indicators and commentary in contrast to the availability by subscription of ABARE's "Agricultural Commodity Notes" or the operation of "video-text" services. Hence, as the level of externalisation of the information - decision process increases the need to extract a return from the communication of information to the decision maker increases.

Significant in the selection of communication media appear to be the criteria by which the performance of the message initiator is measured. The performance of organisations which primarily deal in public information and are funded through communal funds (AWC, AMLC, MIA, etc) is, in general, subjectively evaluated in terms of the public's perception of the volume of the work they produce. This can be expected to bias their selection of communication channels towards the utilisation of mass access media.

However, if the measurement of the efficiency of communication is to include the consideration of the level of learning induced in the recipient, channel selection needs to address the questions of data integration capabilities and feedback capacity. Some channels can facilitate learning to a greater extent than others, as seen in the ability of communication channels utilising computer graphics to aid in multidimensional functional learning tasks (Hoffman, Earle and Slovic 1981) (see 3.6.2). Further, channels which allow a two-way communication enable producers to question the sources ("the what if?" game) and by such processes generate greater knowledge of their decision

environment, as noted in Doluschitz and Schmisser's (1998) description of the interaction between decision makers and Expert Systems.

Data integration is further aided by the utilisation of channels such as print and "Viewdata" which exhibit the advantageous characteristic of allowing "the user to take as much time as necessary to absorb specific pieces of information and to allow review of the information at a later date" (Lively and Nuthal 1983, p. 4). This can be contrasted with Bock's (1976a, p. 3) description of radio as "non-static, low-involvement medium" in which, since it "cannot be referred back to if a piece of information is missed, detailed price quotes would appear to be inappropriate", making it an inappropriate medium for the transfer of detail.

However, alternative channels, such as printed material, suffer from production lags which impact on the timeliness of information. This has resulted in the transmission of short term market information (current prices at major sale centres) being dominated by radio, while information on overseas, national, state, and local level market issues are covered in different publications (Sheahan 1979).

Apart from channel efficiency considerations, other factors appear to impact on channel selection (message routing) and message summarisation. From the study of organisational MISs, Huber (1982, p. 142) makes the following observations.

Six variables that seem to affect the routing and transmission of organisational information: (1) cost of communicating; (2) work-load of the message sending unit; (3) message relevance; (4) repercussions from communicating 'bad news'; (5) relative power and status of the sender and receiver; and (6) frequency of previous communications.

There is some anecdotal evidence to support the view that these comments are applicable to the information structures observed in agriculture. The repercussions of bad news may contribute to modification of market signals by agents. The summation of positive movements in cattle markets, as reported by Stock and Station Agents, is said to yield a figure far in excess of the actual market at the end of the period observed (John Carter 1992 MIA, personal communication) indicating that the reward/repercussion influence is at least observable. Similarly, the traditional communication of market

reports at the end of the "Country Hour" can certainly be related to the question of frequency of previous communications.

5.6 Perceptions of source/channel reliability

McArthur (1977 p. 275) reports that there is a "high variability in farmers' perception of the credibility of various information sources." This variation in farmers' perceptions of source characteristics is seen in the favourable/unfavourable assessments attributed to particular sources, or groups of sources, by farmers and the attachment of varying levels of importance to different sources of information (Webster 1979). This results in the characteristic nomination, by producers, of sources that are used extensively as opposed to sources which are used sparingly by farmers (Bardsley 1982).

However, acquisition of information from a source does not necessarily predetermine the actual use of the information. Use may actually depend on perceived characteristics of the source and the usefulness of the information provided (Halls 1977). Such variations in producers' perceptions of different sources have been shown to be significant in the make-up of the data sets entering into a decision process (Bock 1976).

Yet, the significance of producers' perceptions of information sources goes far beyond the simple composition of the data set, in so much as complexity of inference in real-world settings requires issues of reliability and ambiguity associated with differential source reliability; varying numbers of reports per source; and the interdependence of sources to be dealt with in the formation of expectations (Einhorn and Hogarth 1985).

Lively and Nuthal (1983) agree with the view that the reputation of a system (source) for usefulness, reliability, and credibility is the ultimate determinant of the use of the system, suggesting that the information provided by the system plays the most important role in establishing this reputation. This reasoned causality, however, misses a significant number of the influences on producers' perceptions of source usefulness, reliability, and credibility and may lead to the eccentric's dilemma of being right without an audience.

To move past this simplistic information quality/perception of source approach, Bock(1976), Bardsley (1982), and Munro and Fisher (1982) all have applied

"Personal Construct Theory" and the associated investigative technique of "Role Construct Repertory Tests" (REP Grids) to the analysis of the ways in which producers perceive sources of information. Amongst a group of Victorian beef producers, Bock (1976) observed significant relationships between property size, education level, "variance" (a measure of the individual's cognitive complexity) and information source use. To the extent that it is possible to aggregate the idiosyncratic constructs used to evaluate information sources, the following constructs (Table 5.2) were shown to be significant in producers' perceptions of information sources (Bock 1978).

The constructs are formatted such that sources considered to be to the left of the statement (construct) are viewed more favourably than those to the right.

Table 5.2

Significant Constructs for Information Source Evaluation

Having practical knowledge	_____	Give theoretical advice
Concerned with on-farm production	_____	Concerned with off-farm marketing
Provide general farm management advice	_____	Give market reports
Advice on how to to produce requirements	_____	Give advice on what the market requirements are

Other constructs, developed by Bock (1978) were shown to be of little importance in the evaluation of market information sources (Table 5.3).

Table 5.3

Less Significant Constructs for Information Source Evaluation

Reliable market information	_____	Unreliable market information
Experienced in marketing	_____	Not experienced in marketing
Broad viewpoint	_____	Narrow or specialised outlook
Concerned with quality of product	_____	Just interested in seling meat
Trust advice	_____	Do not trust advice
Personal, active relationship	_____	Passive relationship

Similar results were obtained by Eardsley (1982) in a study of Wimmera Region wheat growers. These growers are reported to consider the following as key requirements of information sources (production information): to be practical; to be technically knowledgeable about practice; and have local knowledge, whilst providing unbiased, visible results to enable comparisons.

Caution, however, is required in the extrapolation of such results as Munro and Fisher (1982) observed considerable regional and cross-commodity variations in both producers' perceptions of market information sources and source utilisation.

5.7 Summary

The consideration of the constraints on efficient communication of data/information and the factors influencing the effectiveness of information transfer, within this chapter, suggests that in the "real world" whilst data/information may be abundant in the economic environment the producer may be operating with sub-optimal data sets, due to communication breakdown.

As with the previous chapter, the emphasis has been on the delineation of the constraints within the particular part of the decision process (in this case the process of communication) which can be seen to potentially influence the appropriateness of the decision makers' data/information set. The following chapter draws together, in a model, the constraints identified along the chain of events leading to decisions at varying levels of cognitive complexity.

Chapter 6

MARKET INFORMATION AND THE DECISION PROCESS6.1 Introduction

The structure of this thesis has, within Chapters 2, 3 and 4, followed the approach of establishing the characteristics of the demand for decision information, consideration of the mechanisms by which the demand may be met and identification of the constraints upon the meeting of that demand. The relativity of the subject matter in each chapter can be seen in Figure 6.1, which is based on Humphreys and Berkeley's 1983 modeling of the interfaces between the decision process, the decision maker's semantic memory and the decision environment. For the purpose of this dissertation it has been convenient to introduce an interface, absent in Humphreys and Berkeley's 1983 model, between data held in semantic memory and expectations formation.

The nature of the demand for information associated with various decision structures has been described in Chapter 2. Variation in the demand for information associated with particular decision structures has been described in terms of the change to an idealised data set. Both volume and cognitive complexity of the data set has been shown to be linked to the level of problem conceptualisation.

To aid in the categorisation of the data sets described, Humphreys and Berkeley's 1983 multi-level scheme for the conceptualisation of decision problems has been used to form the basis of a "decision structure" taxonomy.

Chapter 2 concluded with a brief discussion of the concepts of risk and their associated descriptors. The conceptualisation of risk can be seen to run in parallel with the decision taxonomy previously described, with various descriptors of risk being admissible to the data sets of particular decision structures.

The acquisition and storage of data along with the subsequent processes involved with expectation formation were the subject matter of Chapter 3.

In this chapter the penultimate process involved with the completion of the requisite data sets was reviewed. The majority of the chapter dealt with processes that occur within the cognitive memory of the producer, including stimulus differentiation, memorialising, environmental modeling and data integration techniques. The literature reviewed in this chapter provided various insights into the mechanisms involved in data acquisition, storage and processing. It also highlighted some of the constraints on these processes.

The role and characteristics of heuristics was discussed, as was cue saliency and utilisation. The chapter concluded with discussion of data encoding, decoding and storage formats, search motivation and search patterns along with a discussion of human learning capacities in a stochastic environment.

The processes and constraints on the generation, transformation and communication of data to the producer, formed the subject matter of Chapter 4. These processes and constraints were, in general, external to the individual producer's cognitive processes.

Generalised information systems theory provided the basic structure for a holistic view of this part of the data processing chain. Discussion of the function and process of data bases, management information systems, decision support systems and expert systems not only aided in the description of the data processing chain. It also provided the continuum along which the externalisation (removal from producers' cognitive activity) can be traced.

The impact of data summation via data series and efficiency ratios on data quality and volume has also been discussed.

The chapter concluded with a discussion of the techniques and accuracy of market forecasting along with some consideration of the producers' confidence in forecasts. Such activities were seen to be an example of the externalisation of part of the data processing chain, in this case the cognitive activities associated with market modeling and data integration.

Figure 6.1

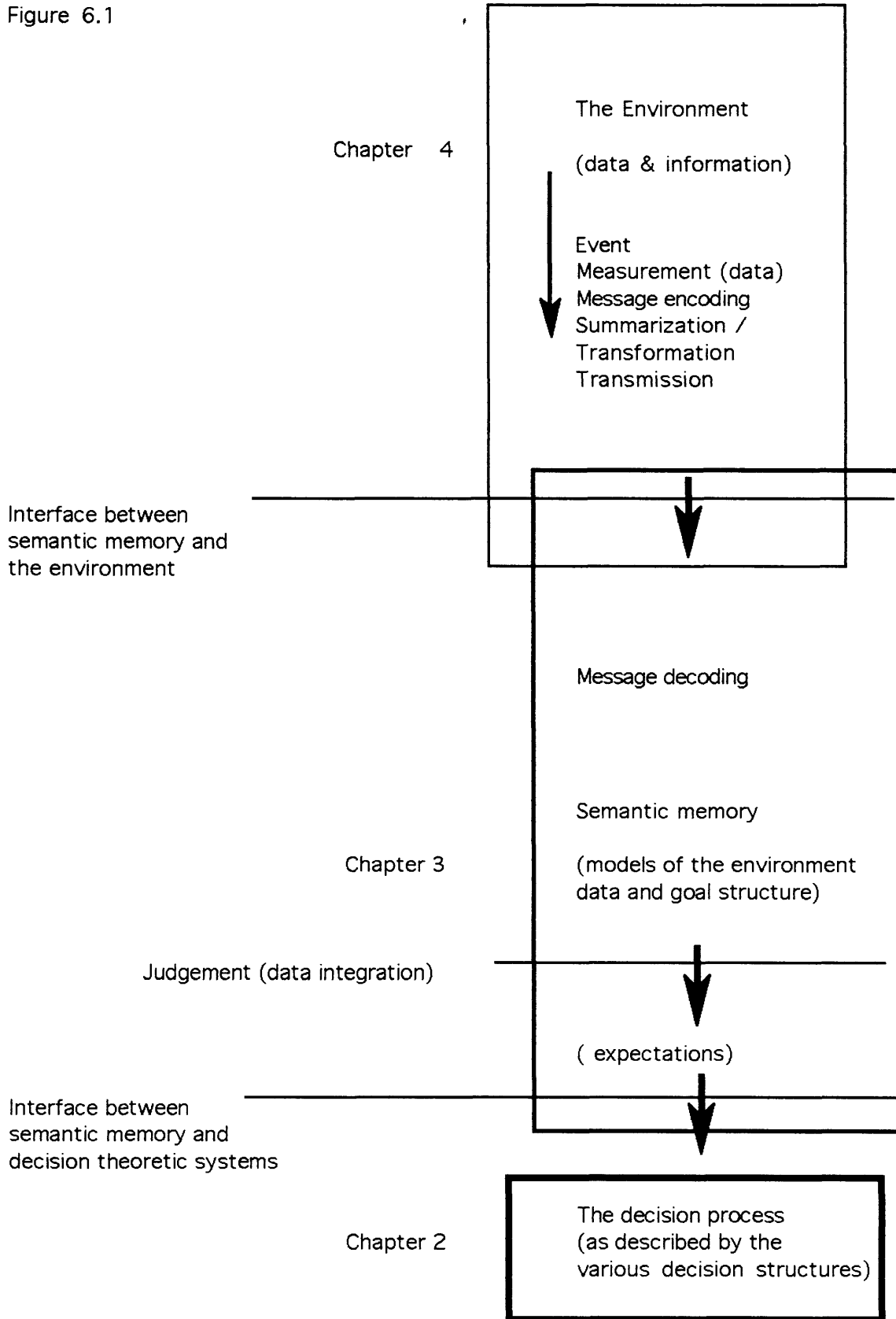


Figure 6.1 The Environment - Memory - Decision Process Interfaces (adapted from Humphreys, 1983)

The fifth chapter of this dissertation dealt with the concepts and constraints associated with the process of communication. In respect of the degree of externalisation of the data processing chain, ultimately the producer must communicate with his or her economic environment.

The efficiency with which this communication occurs can have a major impact on both the volume and quality of data/information available to the producer. Factors such as source selectivity, message encoding and channel selection have been shown to play a major role in determining the efficiency of communication (Barnard 1975, Bock 1976 and Glen 1980).

From these preceding chapters it can be seen that there is a vast array of factors that may ultimately influence the make-up of the economic data set available to the producer.

These observations suggest a need to move away from the classical agricultural economics approaches to decision making, as the formulation of theoretically "correct" decision structures contributes little to producers' welfare if it is likely that the required data sets are unavailable. While descriptive models of decision making, being derived from the analysis of a particular decision environment, are of little use in aiding producers' decision making in a changing environment.

The challenge is to develop a holistic model of producers' decision environments that can accommodate the numerous factors described previously whilst being able to contribute to the discussion of both prescriptive and descriptive approaches to modeling agricultural decision making.

From a prescriptive stance, the constraining factors identified only become important when they adversely influence the completion of a data set, predetermined by the selection of a given decision structure. Such an approach to the analysis of environmental factors influencing the fulfilling of a preordained data set will subsequently be referred to as the "demand approach".

However, Waller and Mitchell (1984, p. 397) observe that

An important theme in research on behavioral decision making is that

decision behavior is largely contingent on characteristics of the task and context.

Where the selection of a decision structure is constrained by the availability of adequate data, the producer is viewed as exhibiting contingent behaviour. This approach to the selection of decision structures will subsequently be referred to as the "contingency approach". Figure 6.2 portrays this fundamental divergence of these approaches.

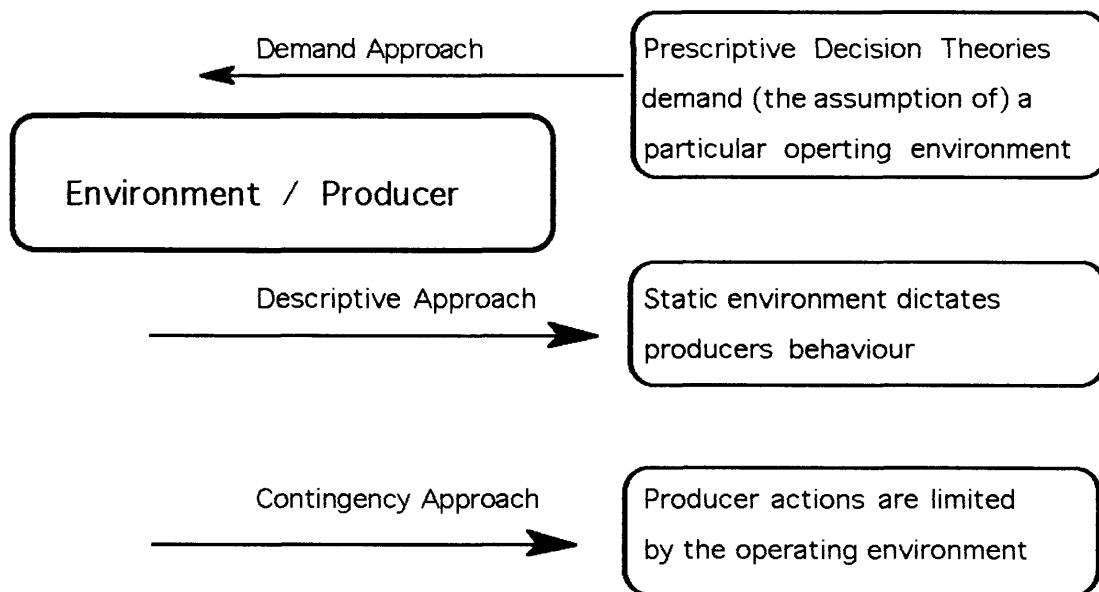


Figure 6.2 Approaches to Decision Environment Analysis

The intent of this chapter is to develop a holistic model, based on this contingency approach, to assist in the understanding of primary producers' information acquisition, data processing, decisional behaviour and the identification of impediments or aids to the efficient utilisation of data/information in the information/decision process.

Such a model should also facilitate the understanding of the environmental factors influencing the degree to which primary producers move from non-analytical (heuristic) decision making towards analytical (structured) decision making.

It is suggested that until the framework for such a holistic evaluation is available it is impossible to make valid suggestions aimed at the improvement of on-farm delivery of

market information. Here, the assumption is that the improvement of decision making is dependent on an "increase" in decision structuring and the subsequent reduction in the heuristic nature of agricultural decision making. That is, it is expected that producers will become more efficient in the utilisation of market information as the decision environment allows movement away from non-analytical (heuristic) decision making through to unaided analytical and finally to aided analytic decision making.

Again, it is necessary to stress the emphasis of this analysis on information relating to market uncertainty and medium term decisions.

6.2 A Contingency Model of Market Information Utilisation in Agricultural Decision Making

Four domains are held to be of interest in developing an understanding of the utilisation of information in decision making. These domains are "the environment", being the closed world in which the economic agent operates, the agent's "semantic memory", essentially the agent's knowledge and models of their particular environment, the agent's "expectations" of future states of the environment and the "decision structures" employed by the agent (see Figure 6.3). As with any information describing the decision maker's environment, for market data/information to be of use it must pass between these various layers.

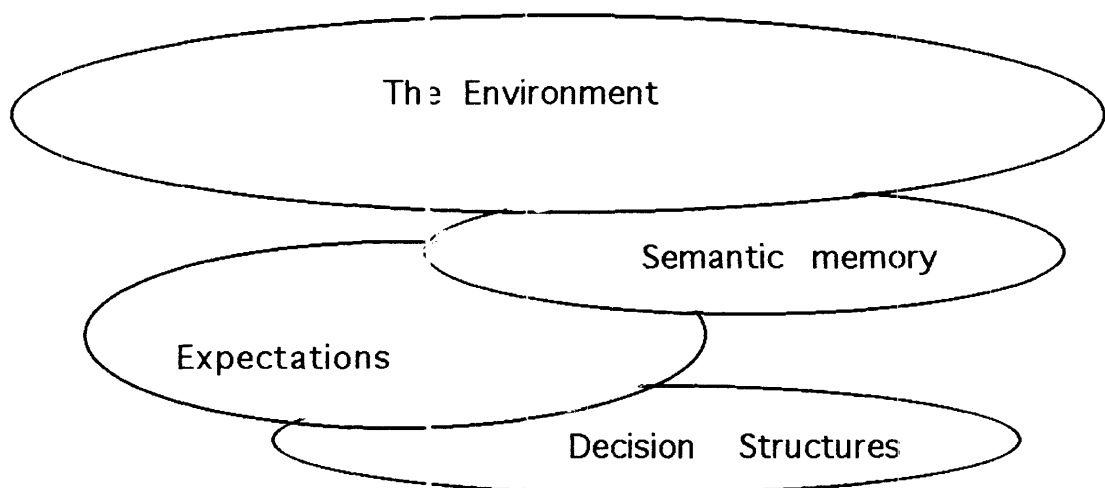


Figure 6.3 Data, Information and Expectations Domains

Given this structure it is possible to describe a number of basic "conceptual elements" which are held to influence the transmission of data/information across the regional interfaces, such that the filling of the data set required for a particular decision structure is contingent upon the expression of these conceptual elements at an appropriate level.

The expression of these conceptual elements is, in the main, continuous or polytomous, rather than dichotomous, in nature and quite inter-related in both concept and action. This complexity makes it practically impossible to construct a matrix of the information/decision environment which would be traceable to any degree. Hence, the approach adopted here has been to describe a series of conceptual elements which are held to influence the degree of problem structuring and the level of information utilisation.

The conceptual elements are seen both to be associated with a particular domain or the interface between domains. For example, the elements of a producer's decision world associated with the function of communication, e.g. sources and communication channels (AMLC, ABARE, press and radio), are parts of the environment which influence the transmission of data across the interface between the environment and semantic memory domains.

The conceptual elements are presented in the model, overlaying examples of their manifestation in the realm of agricultural decision making. However, it is not the intent of the model to slavishly record every contextual variation that may be seen to influence the information/decision process. Rather, the intent is to provide a framework with which researchers and practitioners in the field may approach the analysis of information transfer.

6.2.1 The Environment

Within the context of this model the environment is considered to be the totality of the stimuli that alert the producers to the closed world in which they operate. The producers' decision world can be considered to be a sub-set of these stimuli which impact on the decision maker's semantic memory and expectations. Until these stimuli are constrained within a coherent conceptual structure they must appear as random signals of no intrinsic value. Hence, the initial step is to establish a conceptual basis for the

collection and reporting of data.

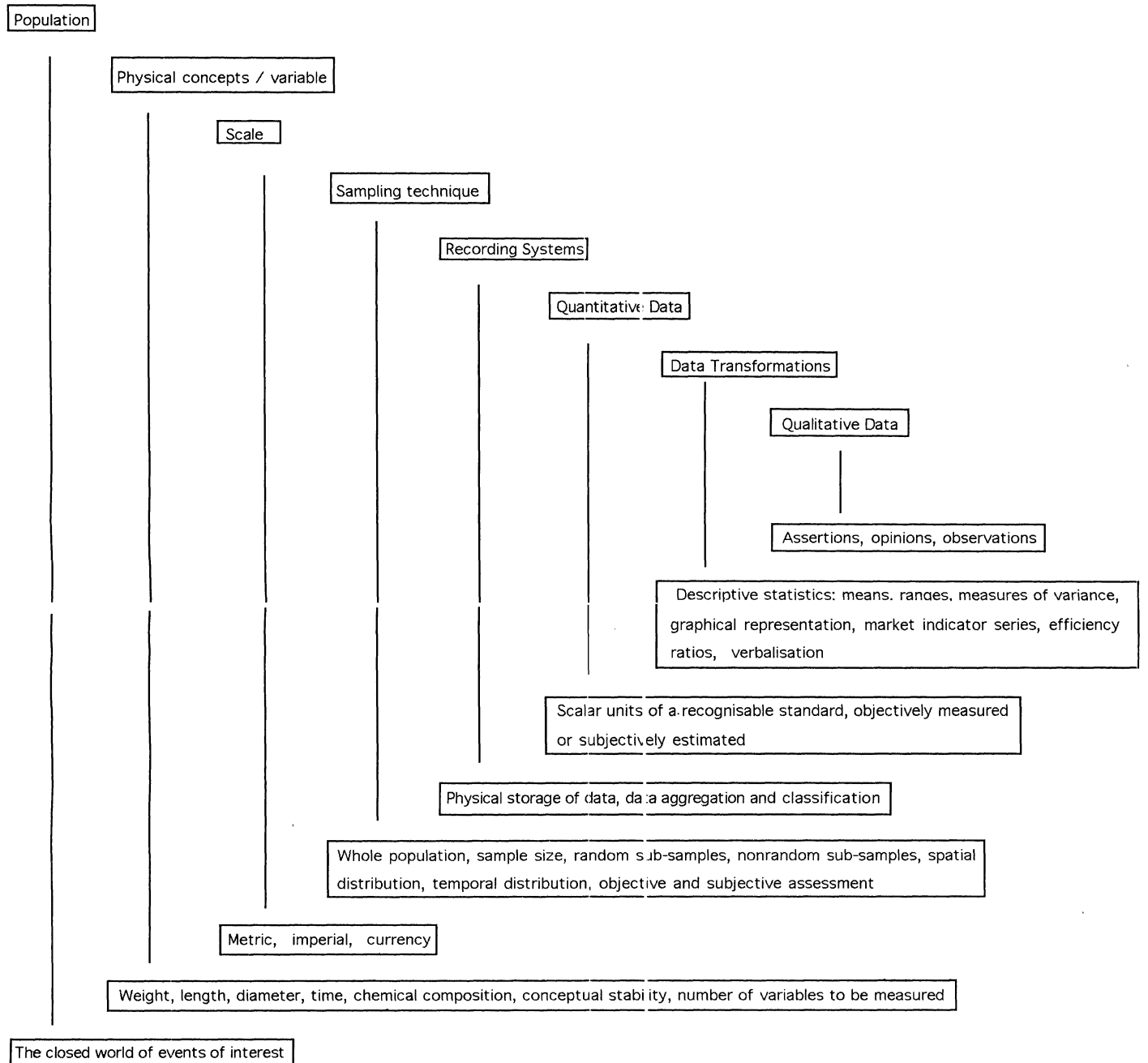
Concepts of data

Problem conceptualisation at any particular level will mandate an equivalent level of data abstraction. However, underlying any data series there are a number of conceptual requirements necessary to establish the validity of the data and its efficient transmission, these conceptual requirements and their manifestations are shown in Figure 6.4.

In a perfect world, where information was freely available and based solely on objectively measured criteria, all questions relating to the adequacy of data sets for particular decision structures would fall within the ambit of "Information Theory". However, in reality we need to deal with data generation and communication costs which motivate the application of (optimisation - satisficing) techniques such as the subjective estimation of objectively derived criteria (for example, liveweight, fat scores and crimp in wool) or numerous data transformations which, to varying degrees suppress the richness of the original data. To illustrate the latter, consider the value of the traditional wool market indicator to an individual trying to estimate the value of 22 micron wool, relative to the value of the 22 micron indicator, itself a component of the former. The traditional wool market indicator, being a weighted average of prices for wool across a range of microns and types, inclusive of 22 micron types, will, by its aggregation of prices across all micron ranges, camouflage the more specific market information.

Any attempt to quantify the constraints on the utilisation of a particular decision structure or to design an information system for producers will not only need to consider such satisficing techniques. It will also need to address the fundamental questions of population, variable definition, sampling, recording and data transformation. The latter may occur either within the data generating organisation or within the communication channel. For example, scaling, verbalisation or statistical summation of data, in a format at odds with the demands of a particular decision structure, could be expected to increase the cognitive load associated with the utilisation of the decision structure. This additional load may be of such significance as to ultimately bar the use of the decision structure.

Figure 6.4 Concepts of Data



Similarly, where a stochastic market is being reported the selection of the form of the most appropriate descriptive statistic will be influenced by the concept of risk in the decision structure to be used, the producer's conceptualisation of risk and the producer's cognitive inferencing capacities.

Concepts and descriptors of risk

At the first level of problem abstraction, the relevant data set is composed of point estimates under the assumption of perfect certainty, effectively negating the consideration of risk and associated descriptors of risk.

However, the stochastic nature of agriculture is such that anybody wishing to provide comprehensive management data for primary producers will be required to address a series of questions relating to the definition, measurement and communication of market variability.

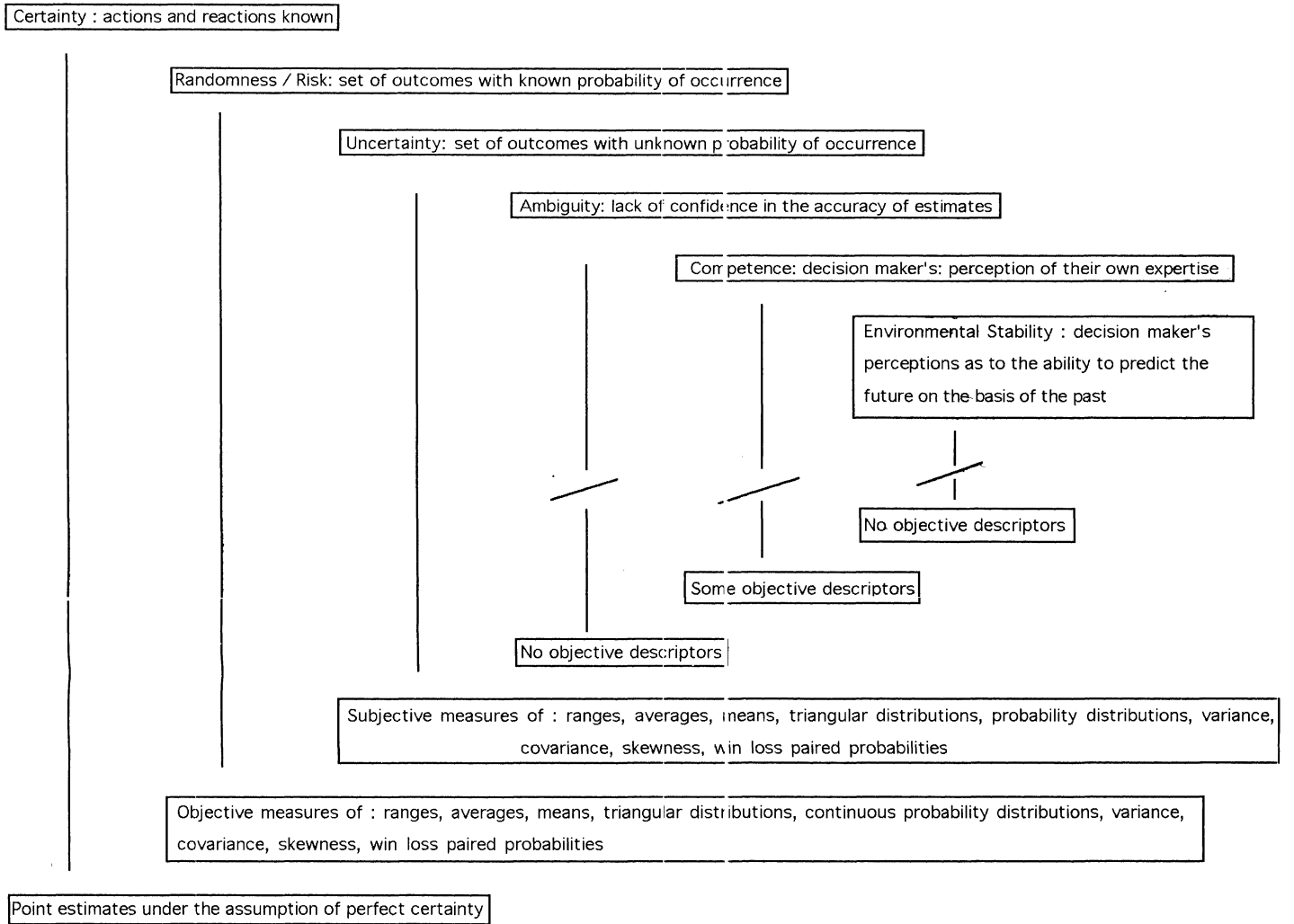
Given that higher levels of problem abstraction allow the admissibility of the concepts of certainty, risk, uncertainty, ambiguity and competence, it is appropriate to view the capacities of the various concepts of and descriptors of risk/uncertainty. For, unless there are adequate descriptors of such concepts readily available to producers, the formal structuring of decisions at these higher levels becomes impossible.

The various concepts and their associated measures are detailed in Figure 6.5. Here the risk/uncertainty dichotomy, as defined by Bullock and Logan (1969), has been maintained, with the significant difference between measures of risk and measures of uncertainty being that the latter are derived through subjective estimation. The underlying conceptual basis remains the same, the reversion to subjective estimation being viewed as a form of satisficing. In terms of the data concepts defined in Figure 6.4 these measures of uncertainty and risk would be termed quantitative data.

The levels of ambiguity that producers associate with measures of risk and uncertainty will be influenced by their perceptions of the adequacy of the physical concepts, variable, scale, sampling techniques, recording systems and data

Figure 6.5

Concepts and Descriptors of Risk



transformations used. Further in the case of uncertainty measures, their perceptions of the expertise of those making the subjective estimates can be expected to influence the level of ambiguity associated with such measures.

The lack of any widely accepted, scalar expressions of confidence, ambiguity and the completeness of a decision maker's understanding of the appropriate decision inhibits the generation of any data series relating to such concepts. As such, this inability to provide measures complying with the appropriate data concepts acts as a bar to the operationalisation of decision structures at the fourth and fifth level of problem conceptualisation.

At the lower levels of problem conceptualisation a producer with access to data describing the range of prices expected to be received for fat lambs but deprived of information on the likely distribution of such prices within the range will be constrained to application of level two decision structures. The availability of the latter, though, would enable the producer to employ decision structures from a higher level of conceptualisation, such as stochastic computerised activity budgeting. However, this will be contingent on the producer understanding the appropriate concepts of risk, having access to such decision-structuring aids and there being a suitable communication system to convey such data to the producer.

Concepts of communication

In the majority of agricultural situations the generation of market data or information is external to the decision maker's semantic memory. The study of the efficiency of this transfer of data/information from the environment to the decision maker's semantic memory requires the investigator to employ a number of concepts derived from communications theory and schema theory. A selection of these concepts, and their expression in an agricultural context, is presented in Figure 6.6.

Breakdowns in the communication process may be viewed as reducing the efficiency of decision making. However, where inefficiencies in the communication process can be shown to limit the comprehensiveness of the data set available to the producer or to alter the level of confidence that producers place in the

data/information available to them, the selection of decision structures, itself, can be contingent upon the communication process.

The constraints of communication channel capacity and channel efficiency place an upper limit on the data flows to primary producers. Apart from these mechanistic measures, source characteristics, producer-imposed limitations on sources contacted and selectivity between sources will influence the ultimate make-up of the data set utilised by producers. Other factors influencing the efficiency of communication, including producers' search characteristics, message modification or corruption during encoding and the decoding, the communication mode preference paradox, variations in internal representations, message routing, perception of source and channel reliability and the public versus private ownership of information question, have also been shown to be of significance (Beyth-Maron 1982, Kahneman and Tversky 1982, March and Schapira 1987, Williams 1953).

The significance of communication constraints on the fulfilling of requisite data sets for the various levels of decision structuring can be illustrated through the consideration of the communication of market risk at differing levels of risk conceptualisation.

A daily occurrence in Australian agriculture is the reporting, by radio, of the "Eastern", the "Western" and the "National Wool Market Indicators". These indices, along with their component micron indices, are derived from a structure which entails the majority of the data concepts discussed earlier. That is, there is a set population (sales catalogue), physical concepts (price per unit weight clean wool), scale (dollars Australian, kilograms), sampling technique, recording system, a predetermined data aggregation process (index computation structure) and a degree of subjective assessment (J. J. Skillecorn and Associates 1992). However, due mainly to time constraints the message conveyed via radio is normally truncated to the global "national" and the locally appropriate "eastern" or "western" regional indices, under the implicit assumption of certainty.

Producers attempting to formulate a point estimate of the value of their clip for incorporation into, say, a cash flow budget on the basis of the information contained

in these broad indices, will need to derive price estimates specific to each individual's average clip micron and yield at the very least. To undertake this inferencing process the producers must have formed some view of the relationship between the market index and the price they would expect for the wool in their clip.

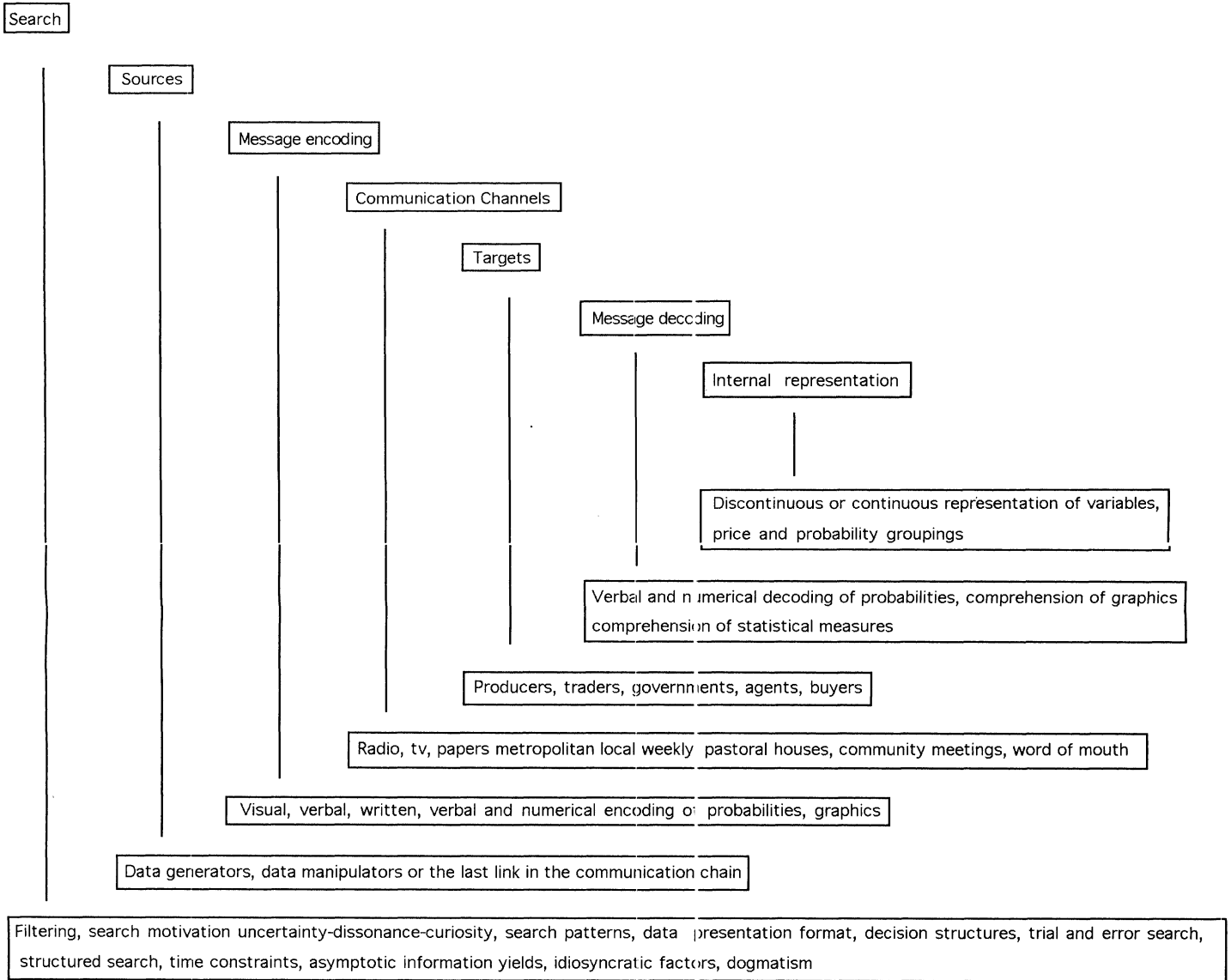
However, should the producer wish to formulate an estimate of market uncertainty for inclusion in decision structures of a higher level of conceptualisation, he or she will need not only to establish the index/micron/yield/price relationship but be able to recall from memory the time series (range and distribution) of index quotations for a specific period.

An information provider wishing to reduce the cognitive effort involved in both these situations, may move away from the constraints of radio as a communication channel to a more visual medium (press, tv), where the graphical representation of individual micron indices and the global index over an extended period becomes possible.

The aiding of inferencing by such techniques opens up a series of questions related to producers' message decoding and data absorption capacities, the internal representation of their market environment and integration techniques that fall within the domains of semantic memory and expectation formation.

Figure 6.6

Concepts of Communication



6.2.2 Semantic memory

An understanding of the clientele's cognitive capacities, data transformation and the correlation between market expectations formed by producers and actual market outcomes may seem rather esoteric to a market information service, funded independently and whose value is subjectively measured in terms of column inches published. However, if we are interested in improving the ultimate utility of market information, or if we take a holistic view of the subject area, processes relating to data/information absorption, internal representation, integration and their influence on the cognitive efficiency of information transfer become of major importance.

Human capabilities

Australian agriculture is characterised by a low level of on-farm computerisation and relatively limited human resources at the atomistic production unit level. This leads to a managerial process significantly dependent upon the innate capacities of individual owner/operators.

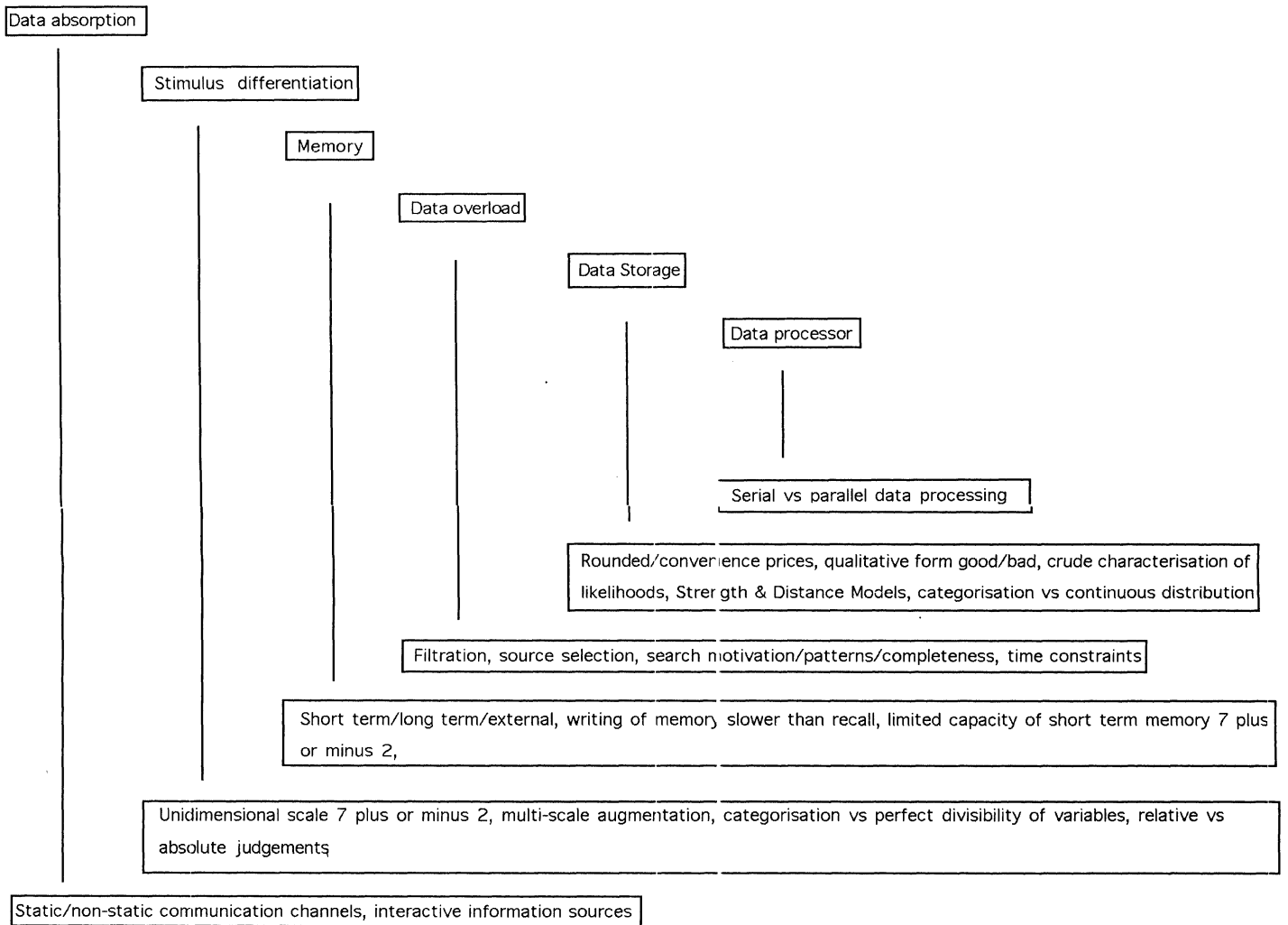
The fields of psychology and communications research have generated a number of concepts (presented in Figure 6.7) that should aid in the understanding of the constraints on humanity in the acquisition of data/information.

These concepts and their contextual expressions, noted in Figure 6.7, can be seen to have a broad influence over both the ultimate selection of an appropriate decision structure and the efficiency of data/information transfer between the environment and expectation formation (inferencing procedures).

The rate of data absorption and the ultimate data storage capacity (in memory, both short- and long-term) will place an upper limit on the data available for expectation formation, while limitation on the rate at which data can be written into long term memory will result in a reversion to static communication channels (printed material) where significant volumes of data are required to be accessed.

Figure 6.7

Concepts of Humanity



Similarly, the disparity between a decision structure that involves the assumption of perfect divisibility in variables and the predominance of rounded/convenience prices or the storage of prices in a qualitative format could be expected to impose an added cognitive strain on the decision maker. Here again the importance of a holistic view is evident in that communication efficiency can be seen to be influenced by message format and its correlation to internal representation, which in turn will influence the selection of inferencing and decision structures.

6.2.3 Concepts of inferencing

Under the structure proposed here, inferencing or the integration of data/information is, to an extent, viewed as a separate unidirectional cognitive activity. This approach, of course, could be justifiably criticised on the grounds that expectation formation appears to be concurrent with data/information acquisition and that decision making involves a significant degree of feedback.

However, as with the discussion of communication concepts, the simplifying assumptions of linearity and temporal segregation are a significant aid in the crystallisation of concepts in an otherwise amorphous field of endeavour.

The concepts considered to be of significance in the analysis of human activities involving data integration include features of human cognitive ability, various models of judgement and expectation formation, factors influencing cue salience and utilisation, idiosyncratic factors and the ability of humans to learn in a stochastic environment (see Figure 6.8).

In discussing the influence of integrative capacity on decision making it is necessary to clarify the functional role of the judgemental process. For example, the formation of expectations as to the current market value of a commodity and the prediction of commodity prices one or two years in the future can be expected to exhibit major differences.

Where producers are presented with a raft of "real time" quantitative data (e.g. wool market quotes) they will need to establish a view as to the "lot quotations/index/

micron/yield/type/price" relationship to derive an estimate of the current value of their clip. In this situation producers, cognisant of the constraints on the accuracy and efficiency of communication of either quantitative or qualitative data and/or inaccuracy in the estimation of qualitative data, will need to adopt nonlinear relationships as inferencing structures. Fore example acknowledged inaccuracy in price quotations may require the inclusion of a measure of probability of the real price description around the quotation in the inferencing structure. Failure to do so will result in inefficient inferencing, possibly leading to the application of heuristics and an increase in ambiguity associated with the derived predictions.

The conceptualisation of this class of relationships can be expected to vary as the producers' concepts of market variability change, as the forecasting horizon increases and as producers move from a deterministic to a stochastic modeling of their environment.

In the aiding of expectation formation an information supplier must not only develop an understanding of the inferencing techniques being used but also the constraints on the efficient application of those techniques. For those who assume that producers attempt to make "rational" judgements, consistent behavioural deviations from the normatively correct "statistical man" become significant constraints on the effective application of higher-level decision structures. Such deviations are seen to arise through misperception, misaggregation and effects such as the base rate fallacy and the artifact hypothesis.

Concepts of Integration

Human cognitive ability

Bayesian judgement / rational expectations

Bayesian conservatism

Regressionists to approach modeling of human judgement

Cue salience and utilisation

Idiosyncratic influences

Learning

Hypothesis testing confirmatory/nugatory, cue pairing distraction-facilitative effect, feedback patterns, functional learning, probability learning, cognitive control, cognitive feedback, noise & equipotentiality

Over confidence, confirmatory data selection, avoidance of nugatory data, cognitive characteristics perceptive/receptive - systematic/intuitive individuals

Primacy, negation, multiple variables, redundancy, format compatibility, sequential/simultaneous presentation

Lens model, Integration theory, weighted average model, contrast surprise model of updating beliefs, anchoring and adjustment, heuristics, selection of inferencing techniques-response requirement-uncertainty type

Misperception; misaggregation, base rate fallacy, artifact hypothesis

The normatively correct statistical man

Cognitive styles, cognitive schemata, stochastic/deterministic modeling of the environment, preference for causality over probabilistic reasoning
linearity assumption, configularity

However, whilst the stochastic modeling of the environment is the normative standard, Brehmer's (1980) work indicates that humans exhibit a strong propensity for deterministic modeling of the environment.

For those that wish to aid producers in expectation formation, on the assumption that the producers are in fact forming linear and nonlinear models of the environment, questions relating to the number of cues, configurality, cue saliency, direction of evidence and idiosyncratic influences become important.

Finally, in an ongoing relationship an information supplier will be interested in the producer's ability to learn. Whether expectations are formed via the application of normatively correct statistical methods through to the application of various heuristics, problems with noise and equipotentiality have been shown to constrain improvement (Hammond and Summers 1972), whilst the move away from standard stimulus-response-outcome feedback patterns to more cognitive feedback has been shown to improve judgemental learning.

6.2.4 Problem conceptualisation, decision structures and data requirements

The actual selection of a particular decision structure can be seen as a function of the level of problem conceptualisation, where the level of problem abstraction desired dictates the application of a particular class of decision structure; the demand approach. Alternatively, the decision maker's selection of decision structure can be viewed as being contingent upon the availability of data/information and the associated expectations within semantic memory, to complete a requisite data set; the contingency approach. The differentiation of the demand versus the contingency approach to the selection of decision structures and the consequential definition of the data set can be seen in Figure 6.2.

Here the level of cognitive complexity applied to a particular problem is described using Humphrey and Berkeley's (1983) decision taxonomy. This taxonomy has provided the conceptual framework on which a classification of various decision structures, both normative and descriptive, has been developed. Agriculture-specific examples of decision structures applicable at levels one, two and three of the taxonomy have been identified. At the fourth level of problem conceptualisation, which deals with the description and selection, of appropriate problem representations, only generalised

models of decision strategy selection were located. At the fifth level of problem abstraction it was impossible to identify any applicable calculus.

Each classification of decision structures can be seen to require data sets of increasing cognitive complexity. For simplicity of presentation, examples of the additional elements, over and above the elements of the data set required to support decision structures of a lower level, are noted for each classification. Thus, the full data set for a particular classification will be inclusive of data associated with lower level decision structures and problem conceptualization.

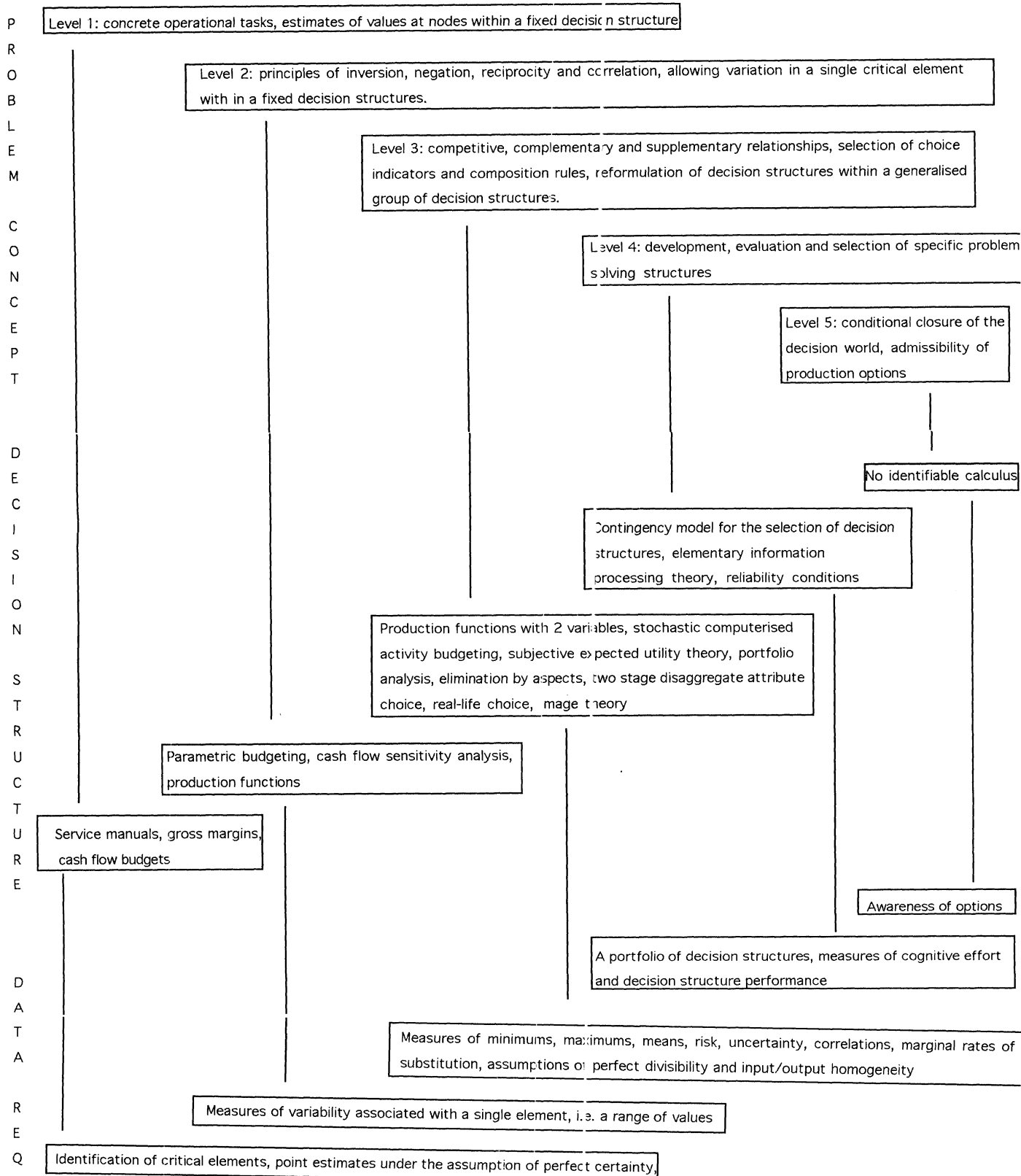
Reviewing a decision environment in a contingency model an investigator would move from the bottom of Figure 6.9, having established the nature of the data set available to the producer, through to the consideration of the decision structures which the producer may apply, then finally to the question of the level of problem conceptualisation.

In the deterministic or demand mode the investigator establishes the level of problem conceptualisation, designs an appropriate decision structure then searches for the right environmental/producer combinations to allow the application of the decision structure.

The accommodation of both the contingency approach to decision structure selection and the demand approach to the delineation of data sets in Figure 6.9 enables a singular point of reference for those who wish to predict producers' decisional behaviour and those who wish to design information systems for producers utilising particular decision structures. To illustrate, an information provider wishing to service a producer who utilises portfolio theory will be required to provide measures of the variance of returns on individual enterprises and the correlation of returns between the various feasible enterprises or provide, at the very least, the data required to producers with the capacity to calculate these measures. Alternatively, an investigator who is unable to identify any measures of variability in the producer's decision world or their set of expectations, could expect that any decision structuring would be restricted to heuristics or structures associated with the first level of problem conceptualisation (i.e. gross margins and cash flow budgets).

Figure 6.9

Problem Conceptualisation, Decision Structures and Data Requirements



6.3 Contingent Behaviour

The concept of actual task related behaviour being both constrained by environmental factors and exhibiting characteristics which describe a continuum from fully analytical to heuristic behaviours has been described in a number of fields.

Hammond (1980, 1981, 1986) developed a theory of cognition which recognises cognitive behaviour, in influencing tasks, ranging from intuition through to fully analytical (rational) thinking. The actual form of thinking (cognitive activity) employed is held to be influenced by the characteristics of the task involved.

Similarly, in the field of organisational structuring research contingency theories have been developed (Chandler 1962, Woodward 1965, Perrow 1967, Blau 1970, Pugh and Hickson 1976).

Donaldson (1995, p. 32) provides the following summation of these theories.

"Each of the main structural contingency theories identifies a contingency factor (or set of kindred factors) and delineates which organization structure is needed in order to operate effectively at each level of that contingency factor."

From this limited review of the literature it can be seen that the contingency approach described in Figure 6.2 is by no means novel in its description of behaviour along a continuum being influenced by environmental factors and of the appropriateness of behaviour being determined by those factors. Apart from this partial theoretical validation, by analogy with other fields of endeavour, some indication of the applicability of the contingency approach to information provision and decision making in agriculture is provided in the following chapters.

6.4 Summary

The model proposed delineates a series of conceptual constraints on the completion of the requisite data sets for a variety of agricultural decision aid/structures applicable at various levels of problem conceptualisation. Figures 6.4, 6.5, 6.6, 6.7 and 6.8 present

the fundamental conceptual basis, and some manifestations, of concepts relating to: data, risk and risk descriptors, communication, human capacity and data integration, respectively. The contingency approach (see Figure 6.2) to the understanding of producers' decisional behaviour suggests that the producers' environment will, through limitations on the observed expression of all or some of these conceptual elements, constrain behaviour.

Alternatively, Figure 6.9 can be viewed in a prescriptive or demand approach (see Figure 6.2), as establishing the data demand for a predetermined level of problem conceptualisation or a previously selected decision aid/structure. Such an approach will require the development of a decision world in which the concepts presented in Figures 6.4, 6.5, 6.6, 6.7 and 6.8 are at levels appropriate to the selected decision aid/structure or the desired level of problem conceptualisation.

The applicability of the contingency approach to agricultural information provision can be seen in two applications of the model presented in Chapter 7. In providing some limited validation of the "Contingency Model of Market Information Utilisation in Agricultural Decision Making" the approach adopted has been to demonstrate its potential in the understanding of producers' information acquisition and decision related behaviour, while in Chapter 8 work describing a group of producers' decision environment and their observed decision behaviour is reviewed using the contingency approach.