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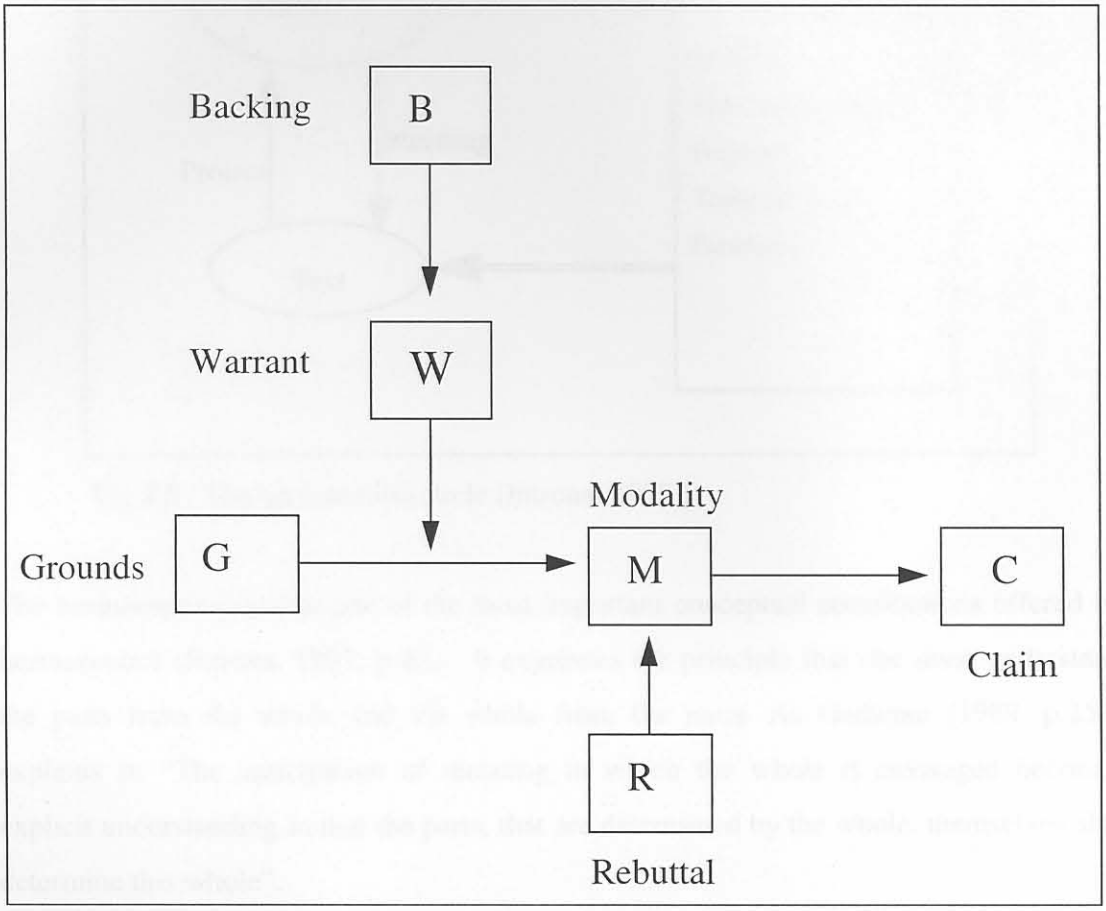

Figure 2.4: *Logical structure of argument* (Toulmin *et al., 1979, p. 78*)

Of particular interest to our study is the fact that distributed cognition is a social activity that takes place through *dialogue*, in a similar way that a decision-making group does. When it works well, individual actions take each other into account in a way that yields a co-ordinated outcome (Boland *et al.*, 1992).

2.7 Hermeneutics and the hermeneutic circle

We have already pointed out the relationship between decision justification, information processing (section 2.1) and information structure (section 2.7). In order to describe the *structure* of the information in question, it is imperative that we understand the concept *information*. Introna (1997),using the work of Heidegger (1962), Gadamer (1989),

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Wittgenstein (1956) and Boland (1983), has extensively explored the concept. He concludes that information has to do with the concepts of meaning, understanding and interpretation. He points out that philosophical hermeneutics as developed by Gadamer (1989), provides a frame for gaining insight into the nature of information. It follows, according to Introna (*op.cit.*), that information is hermeneutic understanding, which according to the hermeneutic circle, is always *projected* (see Figure 2.5). Simply stated, hermeneutics is a theory of interpretation and understanding (Introna, 1997, p 55).

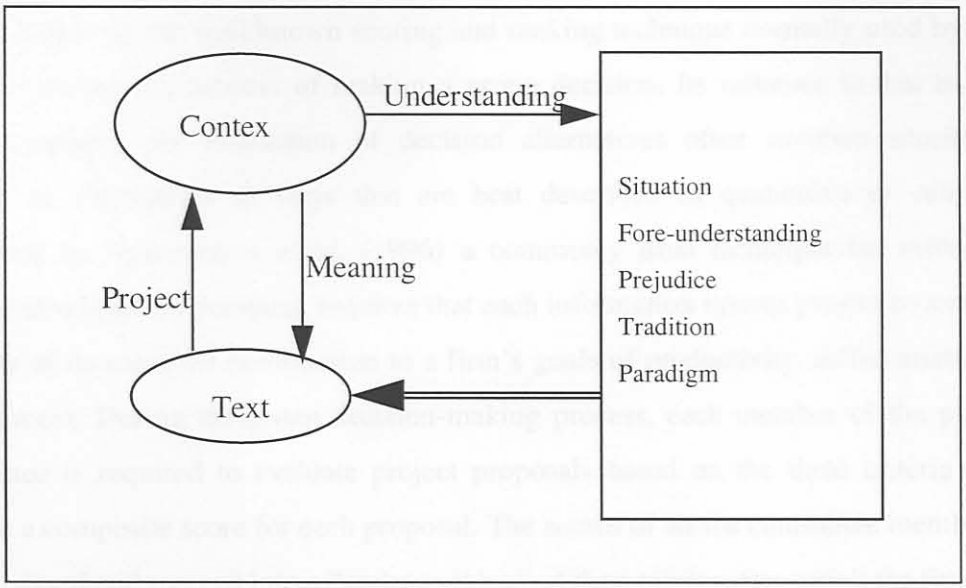

Fig 2.5 : The hermeneutic circle (Introna ,1992)

The hermeneutic circle is one of the most important conceptual contributions offered by hermeneutics (Introna, 1997; p 65). It expresses the principle that one must understand the parts from the whole and the whole from the parts. As Gadamer (1989, p.259) explains it: "The anticipation of meaning in which the whole is envisaged becomes explicit understanding in that the parts, that are determined by the whole, themselves also determine this whole".

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The circle works as follows:

We *project* significance onto the text, based on the form of life within which we interpret; we then allow the text to inform the tradition, which is the living context from which we seek to understand. In the hermeneutic circle, we continually adjust our point of view, perspective or horizon, always within our tradition and situation, in an effort to fuse these points of view, perspectives or horizons. We do this in order to achieve understanding and in order to maintain a living and current form of life.

The hermeneutic way of structuring and processing information could be a helpful way of sharing understanding and meaning by a group during its decision-making process. The shared understanding and meaning could form a significant part of the justification process.

2.8 The Qualitative Discriminant Process

Ngwenyama *et al.* (1996) developed an interesting way of supporting group decision-making. They call it the Qualitative Discriminant Process (QDP). It is a quasi-rational process, allowing the well known scoring and ranking technique normally used by group members during the process of making a group decision. Its rationale is that in group decision-making, the evaluation of decision alternatives often involves scoring and ranking of alternatives in ways that are best described as qualitative or subjective. According to Ngwenyama *et al.* (1996) a commonly used technique for information systems development planning, requires that each information system project be evaluated in terms of its expected contribution to a firm's goals of productivity, differentiation and management. During the group decision-making process, each member of the planning committee is required to evaluate project proposals based on the three criteria and to provide a composite score for each proposal. The scores of all the committee members are then analysed and merged into a "group ranking" of the projects after which the final

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decision is made. The goal of deriving a composite score for each proposal necessitates the assignment of a numeric score for each criteria, even though some criteria, such as differentiation, have an obvious qualitative/subjective domain. Worse in a group context is the fact that an acceptable "group ranking" is the objective. It is thus necessary that the committee is able to define a "consensus" measure, identify when a satisfactory level of "consensus" has been achieved and to compute a "group" score for each project proposal.

In continuing the rationale for developing the QDP, Ngwenyama *et al.* (1996) argue that many scoring and ranking techniques commonly used in Group Support Systems (GSS) platforms have been criticized in the decision theory literature for their limitations in dealing with the real difficulties of group decision-making, namely:

- Mapping of qualitative evaluations to point estimates in ranking (Goddard,1983; Weber,1987; in Ngwenyama *et al.* (1996))

- The aggregation of individual preferences into a group preference (Kirkwood & Sarin,1985; Dire & Sarin, 1979; in Ngwenyama *et al.* (1996))

- The analysis and use of point estimate data in facilitating group consensus formation (Dutta,1980; Bropan *et al.*, 1992; in Ngwenyama *et al.* (1996)).

Although many relevant advances have been made in voting, fuzzy set, and possibility theories, they have not significantly influenced current GSS development, (Ngwenyama *et al.* (1996)). In their study, Ngwenyama *et al.* proposed a conceptual framework for scoring and ranking that involves a multistage qualitative discriminant process. The framework is informed by voting, fuzzy set and possibility theories. It provides techniques that are better suited to facilitating consensus formation in group activities than currently exist in most GSSs. It offers the following advantages:

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- A clear and simple structured graphical approach to collecting data from users
- Maps qualitative evaluations to numeric estimates
- Allow for vagueness in preference articulation
- Provides support for analyzing data relevant to evaluating consensus formation
- Ease of implementation in manual and computer supported group activities

Like distributed cognition, the qualitative discriminant process provides another classic example of a group decision support process which could easily inform the decision justification process. The difference in the approaches is that distributed cognition is an interpretive process while qualitative discriminant process is a quantitatively informed quasi-rational process. Although our analysis framework is expected to be of an interpretive nature, ideas from both approaches and several other interpretive approaches could easily be borrowed.

2.9 Problem Structuring Methods and Community Operations Research

A fascinating area which also inform this study is a group of frameworks and approaches which are aimed at supporting groups involved in socio-economic development in making decisions. Such frameworks and approaches have been developed and used largely in the United Kingdom and are either collectively classified as issue/problem structuring methods (PSM) or Community Operations Research (COR). For these approaches, *participation* (with its many connotations) by the involved groups in the decision process is central. We use participation here as described by White and Taket (1997), to mean an empowering process which enable local people to do their own analysis, to take command, to take confidence and to make their own decisions. As noted by White and Taket, participatory approaches share the same key features: *flexibility*, *continuous information gathering* at the micro-level, *experimentation* and *iterative learning*. The approaches are spreading rapidly among non-governmental organisations, and to some extent even into government organisations. Strategic Choice Approach developed by

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Friend and Hickling (1987) has recently been used for the first time in South Africa within a community development context.

One could say that in these approaches, it would appear that participation is both a necessary and sufficient condition for decision justification. Processes and structures are legitimized and justified by the fact that groups have participated. A question which could be raised here is whether a group that has participated in a decision-making process would necessarily be able to justify a decision reached by the group.

2.10 Systems thinking, critical systems thinking and decision-making

A detailed study of the link between systems thinking and decision-making can be found in Daellenbach (1994). According to Daellenbach (1994, p.18), from about 1940 on, a number of researchers from various scientific disciplines started to recognize that all things and events, and the experience of them, are parts of larger wholes. He indicates that this does not deny the importance of the individual elementary parts or events, but that the focus shifts from the parts to the wholes - namely to the systems to which the parts belong. This gave rise to a new way of thinking - systems thinking. This new way of thought, has, according to Daellenbach, immediate consequences for decision-making within a systems context, namely that effective action in terms of the system as a whole can only result from the careful study of the complete system, rather than of individual parts or aspects.

The history of systems thinking and how it links up with information systems as we understand and practice it today can be found in Checkland (1999). Checkland argues that systems thinking offers an important insight into the role of information systems, the sequence from data to information to knowledge. He emphasizes that information systems are not created for their own sake. They serve or support people engaged in what for them is meaningful action. When one system is thought of as serving another, it is a

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fundamental principle of systems thinking that in order to think carefully about, and conceptualise the system which provides the support, it is first necessary to define carefully the nature of the system served (Checkland, 1981; Winter et al., 1995). This is necessary because how we see the system served will define what counts as support to it.

Checkland (in Currie and Galliers; 1999) continues to argue that systems thinking, especially "soft" systems thinking, can provide a way of conceptualising the social processes in which, in a particular organisational context, a particular group of people can conceptualise their world and hence the purposeful action they wish to undertake. That provides the basis for ascertaining what informational support is needed by those who undertake that action. According to Checkland, only then does it become appropriate to ask how modern information technology can help to provide that support, and to provide it.

Various researchers in information systems have since followed closely along the lines of systems thinking. Since the development of Soft Systems Methodology (SSM) by Checkland in 1981 (Checkland,1981), talks about "hard" vs. "soft" systems thinking form part of the daily vocabulary in the discipline.

Dahlbom and Mathiassen (1993) describe the hard systems approach as follows:

> "In the hard systems approach we proceed on the assumption that reality is itself an ordered, stable system. Our goal is to find the true representation of the world and from then on our efforts concern the representation rather than the world itself."

The hard systems approach puts heavy emphasis on the internal structure of systems. It is precise, well defined, and quantitative. It is used in situations where it makes sense to take the systems apart, observe them to find the internal structure, measure them, make models of them, and expect them to behave with a predictable degree of regularity. They are deterministic in that given certain input, one can determine what output will be

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delivered. All possible states can also be detected and can be controlled. When using the hard systems thinking to develop systems, the role of the user is very minimal, with consultation done only in the beginning of the process just to obtain the user specifications for the system. The system is then developed according to the given (or rather self-obtained) specifications, and the developers see the user again during implementation of the system. The user is almost totally excluded from the development life cycle. Most decision support systems have been developed using hard systems thinking.

As we have already noted from Checkland's work above, soft systems thinking on the other hand moves from the premise that our world is shaped by our experience of it. We see different things, have different perspectives, and structure the world differently, depending on interests, background, education, and culture. The world we perceive is the world we live in. Our world will change if our perception of it changes, if we develop a new way of looking at it. A system is based on assumptions about the world. Different assumptions give different systems. As a consequence, there are always several perspectives, resulting in different systems, on the same concrete situation. It involve emotions, personal values, attitudes, and shifting expectations. It encompasses a 'personal' rather than a 'technical' attitude. It follows that information systems developed using soft systems thinking involve the system users throughout the development process.

To hard systems thinkers, systems are "out-there", and we build them, change them, and improve them, by engineering. We see them, and believe what we see. To soft systems thinkers, systems are in our minds (mental constructs), "inside-us" (Daellenbach, 1994, p. 22), they are perspectives that we change and improve by being confronted with other perspectives, by getting around in the world and experiencing new things, by learning.

A system is a system inside another, which in turn is a system inside another, etc. All of these systems work together and intertwine to reach or satisfy a specific goal and

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objective. This is known as an open system, according to the father of General Systems Theory, Ludwig von Bertalanffy. Outputs from one system will be the inputs of another and will influence that system in one or the other way. The system is also influenced by certain external factors that come from various places. According to Daellenbach (1994), systems defined for decision-making purposes are always open systems, since by definition the decisions or the decision-making rules are inputs into the system.

Because there are many strands of systems thinking in practice, it became necessary to distinguish them from each other. Based on this and the work of Habermas (1971), Flood (1990) pioneered Critical Systems Thinking, which according to him, consolidates innovative systems thinking changes into a new brand of systems sciences (Flood, R.L in Jackson *et al.*, 1991, p.323). The main idea in Critical Systems Thinking is openness and conciliation between people, and their knowledge and methods. This philosophy is called complementarism. According to Flood, complementarism is the proposition of a meta-science that respects human well-being. It is a meta-science that can co-ordinate other sciences in an informed manner. It harnesses the worth of methods and knowledge according to their strengths and weaknesses.

Jackson (1991) traced the evolution of Critical Systems Thinking and found that it has taken on what he calls five commitments which distinguishes it from other types of systems approaches. These are critical awareness, social awareness, complementarism at the level of methodology, complementarism at the level of theory, and human emancipation.

Critical awareness is concerned with two aspects. The first is the understanding of strengths and weaknesses and also the internal theory behind existing methodologies. This is needed to better understand the internal structure of the different methodologies used for system analysis and in turn be able to apply it only to situations where it is best suited. Secondly, it closely examines the values and assumptions that enter into systems

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inquiry and systems design. It provides tools that are useful in applying critical awareness such as Ulrich's (1983) critical systems heuristics. This is necessary to ensure that a possible design is critically scrutinised and not accepted as the only 'objective' possibility.

Social awareness recognizes social and organisational issues that guide systems intervention, contemplates the social consequences of our intervention, and calls for a free and open debate on the justification of the proposed approach. It involves the organisational and societal 'climate' which determines the popularity of particular systems approaches at particular times.

Complementarism suggests that various strands of system thinking express various rationalities and theoretical positions. These should be respected and their development should be encouraged. It stands for a commitment to the complementary and informed use of the various systems approaches whenever their use is appropriate to the context of specific social conditions and situations. Complementarism should occur at two levels. At the level of methodology, the 'system of systems methodologies' attempts to reveal what is taken for granted in terms of 'systems' and 'participants' in using a specific type of systems methodology. Potential users of systems methodologies could assess the relative strengths and weaknesses of each approach. At the level of theory, different strands of systems thinking stemming from alternative theoretical positions can be presented. According to Jackson, the claim of any one theoretical rationality, whether functionalist, structuralist, interpretive or emancipatory, to absorb all others, must be resisted. Complementarism guides each systems approach on problem types for which its theoretical rationality is appropriate.

Human emancipation aims to ensure the well-being of all individuals involved and the full development of their potentials, and to prevent coercion and the exercising of power that would prevent open and free discussion of the issues. Here, Jackson (1991) alludes to the fact that in certain cases, a democratic culture does not exist in organisations and

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that this in turn inhibits the generation of ideas and the development of personal skills and potential. The use of critical systems thinking tries to prevent this and to encourage the creation of ideas and open discussion of issues.

While Flood and Jackson provide the foundations of critical systems thinking, it is perhaps the work of Midgley (1991) that enhances its relevance to our study. Midgley (1991) explains that being critical about systems expands our understanding of the process of making *boundary judgments* so as to explore the relationship between the boundary judgments, values and ethics. Boundary judgments have to do with accepted knowledge and values. In this sense, accepted knowledge define the values that can emerge, while values adopted will direct the drawing of boundaries that define the knowledge accepted as pertinent. He uses examples to clearly explain what it means to be critical about systems. According to Midgley, being critical about systems means being critical about *defining* system *boundaries* and about *establishing* boundaries *within which* critique can be conducted. Boundary judgments have to be made and it is best to embrace critical flexibility with regard to boundary judgments. The notion of *defining, establishing, making, and critiquing boundary judgments* clearly relates to the process of decision-making. We are made aware that creating boundaries simultaneously casts the 'other' into darkness and that every aspect has its 'other' and being aware of the 'other' is an effective remedy for 'hardening of the boundaries' (Midgley, 1991). There is also the possibility of grey areas in which *marginal* elements lie that are neither fully included in, nor excluded from, the system definition. The concept of 'otherness' could be very helpful in group decision-making as it could assist the group to engage in a *true social dialogue* as discussed earlier.

As illustrated by Midgley (1991) (see Figure 2.6), the system consists of an inner core which contains elements which are within the primary boundary. Then there are elements of the wider system which are recognized as being pertinent to the system but are not explicitly taken into the definition of the system's boundaries. These elements can be

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described as marginal to the boundaries. These marginal elements lie outside the primary boundary but indicate an alternative system boundary, the secondary boundary. Elements lying between these two boundaries are *marginal* to the system.The boundaries need not be tacitly employed, they could be implied or unconsciously given in an analysis. It should be kept in mind that a wider system exists outside the secondary boundary. This system is not really seen as pertinent to the original system. The primary boundary can be retained and marginal elements can be dealt with in relation to it. Alternatively, the primary boundary can be disbanded, then the secondary boundary will become primary due to wider issues which become more important than those narrowly defined in relation to the system boundary (Midgley, 1991). Figure 2.6 captures Midgley's arguments.

According to Midgley, critical systems thinking will prevent an impoverished systems view due to boundaries which have become fixed through the use of tacit knowledge alone, without the benefit of rationally generated theory. The boundaries of accepted knowledge define the values that can emerge. Similarly, the values adopted will direct the drawing of boundaries that define the knowledge accepted as pertinent. This dynamic relationship between what could be seen as *truth* and *rightness* defines critical systems thinking. He introduces a status of sacred (positive) or profane (negative) on marginal elements by suggesting that the choice between boundaries can involve a choice between different ethical concerns. When primary and secondary boundaries carry different ethical implications, tension is set up. Because ethical issues and associated boundary judgments have roots in culture, cultural reactions can set in when ethical tensions arise.

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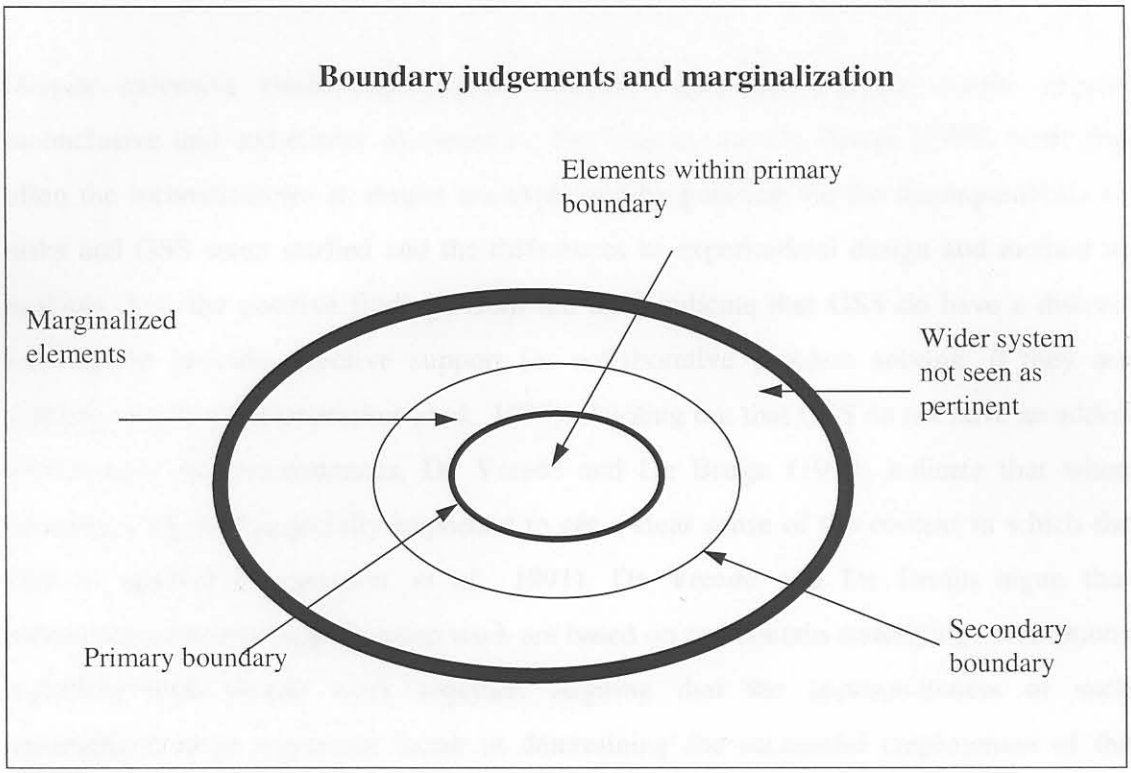

Figure 2.6 : Marginalization. (Midgley in Jackson *et al.*, 1991, p. 398)

These cultural reactions are marginal to boundary definitions and marginal elements come to be characterized as either sacred or profane. Profanity supports the primary boundary by denigrating those elements that are marginal to it. In contrast, sacredness in the margins supports the secondary boundary. In addition to this, ethical tensions give rise to sacredness and profanity and the whole process is overlaid with social ritual. Ritual can be defined as behaviour that contains certain stereotypical elements that involve the symbolic expression of wider social concerns. By observing the presence of ritual, an indication is received as to where sacredness and profanity might lie and hence where ethical conflicts related to marginalization might be found. Midgley warns that life is a dynamic web of boundaries, marginalizations, ethical conflicts and value judgments, and no systems representation can be viewed as an absolute.

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As Daellenbach (1994) puts it, most decision-making occurs within a systems framework. Midgley on the other hand argues that 'critical' and 'systems' are inseparable. It follows that decision-making processes, whether by individuals or groups, would benefit from a better understanding and practice of critical systems thinking. It follows also from Checkland's work that information systems designed and developed within a systems thinking paradigm would be better able to support turbulent decision-making environments, such as instances when decisions have to be justified.

2.11 Group Support Systems research and use

Despite extensive studies undertaken on GSS and their use, the results remain inconclusive and sometimes inconsistent. De Vreede and De Bruijn (1999) posit that often the inconsistencies in results are explained by pointing out the incomparability of tasks and GSS setup studied and the differences in experimental design and method of analysis. Yet, the positive findings from the field indicate that GSS do have a distinct potential to provide effective support for collaborative problem solving, *if* they are skilfully employed (Nunamaker *et al.*, 1997). Pointing out that GSS do not have an added value under all circumstances, De Vreede and De Bruijn (1999) indicate that when studying GSS, it is especially important to get a clear sense of the context in which the GSS is applied (Nunamaker *et al.*, 1991). De Vreede and De Bruijn argue that technologies used to support group work are based on and contain underlying assumptions regarding how people work together. Arguing that the appropriateness of such assumptions is an important factor in determining the successful employment of the technology, they used an action research approach to explore what they called the boundaries of effective GSS application by challenging the basic assumptions built into GSS. They conclude that GSS should be avoided during the separation phase where winners and losers can be identified. Their findings are consistent with various experimental studies that found that GSS application is more successful for creativity tasks than for preference tasks and mixed motive tasks (De Vreede and De Bruijn, 1999).

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A more intriguing kind of research on GSS, the one that seems most relevant to our study, is the one being recently pursued by Briggs *et al.* (2001) using the notion of ***thinkLets.*** According to Briggs *et al.,* one cause of the conflict and ambiguity in GSS research results may be the result of focusing on what they say is a less-than-useful level of abstraction: GSS itself. They argue that in GSS research, the thinkLet may be a more useful unit of comparison than the GSS. A thinkLet, according to the authors, encapsulates three components of a GSS stimulus: *The tool, its configuration, and the script.* They report on having documented about 60 thinkLets that map to seven basic patterns of thinking: Diverge, Converge, Organize, Elaborate, Abstract, Evaluate, and Build Consensus. Each thinkLet creates some unique variation on its basic pattern.

By focusing research on thinkLets, rather than GSS, they predict that field and laboratory research may be more controllable, more replicable, and better able to inform GSS development and use. They note that their field experience shows that thinkLets may be used to create repeatable, predictable patterns of thinking among people making an effort toward a goal. It is our view that the notion of thinkLets relates closely to Toulmin *et al.*'s schema of reasoning as presented earlier. It seems possible that through the relationship between thinkLets and Toulmin *et al.'s* schema, one could better analyse how GSS could be used to support decision-making groups when justification of such decisions become necessary. This will be further pursued in chapters 4 and 5 when the last two of the primary research questions raised in section 2.1 of our study are addressed.

2.12 A new decision-making paradigm for DSS research

A new decision-making paradigm for DSS has been proposed by Courtney (2001). Because the study of GDSS derives from the original DSS, which to a large extent is modelled along the influential work of Simon (1960), this new paradigm for DSS also suggests a new paradigm for GSS, and in particular GDSS. Simon described the decision-making process as consisting of three phases: intelligence, design and choice. Intelligence

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means the need for decision-making activity is identified and the decision-making process is initiated. Design involves the development of alternative ways of solving the problem,

and choice consists of analyzing the alternatives and choosing one for implementation. Based on Simon's model, the first DSS began to appear in the late 1960s and early 1970s (Sprague and Watson, 1986, p.5). Pioneers on DSS research included Gorry and Scott Morton (1971). A mostly used model of the decision-making in a DSS environment is shown in Figure 2.7. Courtney (2001) describes the Figure as follows: the emphasis came to be on model development and problem analysis. Once the problem is recognized, it is defined in terms that facilitate the creation of mathematical models. Alternative solutions are created, and models are then developed to analyse the various alternatives. The choice is then made and implemented as in Simon's description.

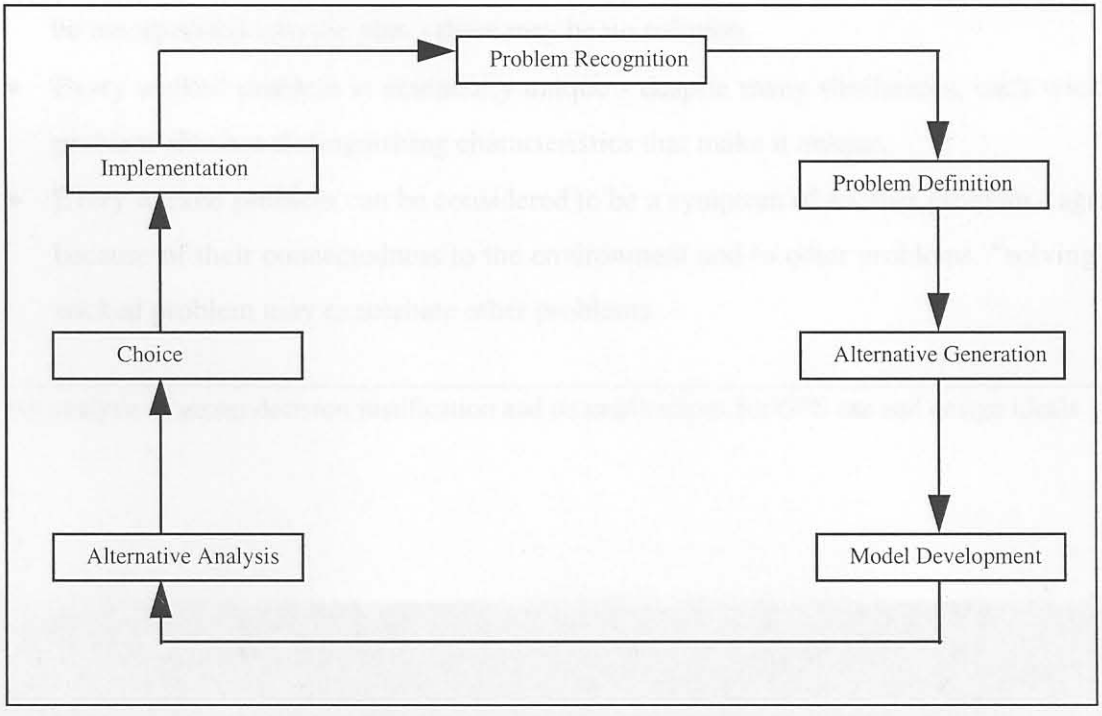

Figure 2.7: The conventional DSS decision-making process (Courtney, 2001)

He indicates that in ill-structured situations, no decision process is this clear-cut. Phases overlap and blend together, and there will be recycling to earlier stages, as more is learned

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about the problem, as solutions do not work out and so forth. In proposing the new paradigm for decision-making, Courtney starts by using the work of Rittel and Webber (1973) to describe DSS decision environments of the 21st century as "wicked". To such "wicked" problems, the classical rational paradigm of science and engineering are not applicable as such problems belong to the open social systems.

According to Courtney, 10 properties of wicked problems are listed by Rittel and Webber:

- There is no definitive formulation of wicked problems - formulating the problem *is* the problem.
- Wicked problems have no stopping rule - planners stop, not because they have "the" answer, but because they are out of time, money, patience or because the answer is "good enough"
- Solutions to wicked problems are not true or false, but good or bad - values are inherently a large part of the problem and values employed vary among stakeholders.
- There is no immediate or ultimate test of a solution to a wicked problem - solutions to wicked problems, because they are so inextricably bound to their environments, generate "waves of consequences over extended - virtually unbound - period of time."
- Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly - and consequently, solutions cannot be undone.
- Wicked problems do not have a numerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan - there may be *no* solution.
- Every wicked problem is essentially unique - despite many similarities, each wicked problem also has distinguishing characteristics that make it unique.
- Every wicked problem can be considered to be a symptom of another problem - again, because of their connectedness to the environment and to other problems, "solving" a wicked problem may exacerbate other problems.

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- The existence of discrepancy [between actual and desired states of affair] can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution - the choice is the one most plausible to the decision maker.
- The planner has no right to be wrong - scientists may formulate hypotheses that are later refuted, but planners seek to improve some aspect of the world. *"The planner who works with open systems is caught up in the ambiguity of their causal webs."*

Noting that globalization will lead to more wicked problems, Courtney laments that methods are desperately needed to help with making effective decisions in such situations. He indicates that while models and knowledge-based DSS exist, more powerful tools are required and points out that especially GSS can help with such problems. He calls for a broader perspective in terms of DSS research. Courtney does not stop at lamenting. Using the work of Churchman (1971), Mitroff and Linstone (1993), he discusses DSS and knowledge management in Singerian organisations and sets the stage for a new decision-making paradigms for DSS. A new decision style as exhibited by Singerian organisations and Unbounded Systems Thinking (UST) of Mitroff and Linstone is proposed by Courtney. Churchman's work on "the design of inquiring systems" is based on the work of five influential western philosophers, Leibniz, Locke, Kant, Hegel and Singer. A summary of the "inquiring organisations" derived by Courtney from this work can be seen in Table 2.1.

Courtney starts by considering the nature of knowledge and knowledge management and its relationship to decision-making in organisations. He presents Churchman's (1971) view of knowledge - knowledge as a collection, an activity or a potential. When viewed as an activity, "Knowledge is a vital force, which makes an enormous difference in the world" (Churchman, 1971, p. 10). It implies that the ability to act is pragmatic in the sense that it implies that someone knows how to do something correctly. Yet, a person does not have knowledge only when acting. A database analyst knows how to normalize a databases even when she is asleep. Thus knowledge can be viewed as the potential for

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action. Yet, "To be knowledgeable, one must be able to adjust behaviour to changing circumstances"(Churchman, 1971, p. 11). Thus being knowledgeable implies not only how to perform an act correctly, but also how to learn as circumstances change, which according to Courtney (2001) is an essential ability in today's dynamic environments. He continue to discuss other forms of knowledge and knowledge management aspects for which we refer an interested reader to Courtney (*op. cit.*).

Of particular relevance to our study is Courtney's discussion of the interpretive perspective of knowledge creation, which is founded on the belief that social reality is socially constructed, and attention is directed to interpretation, distributed cognition, communication, and social processes. Knowing and knowledge are inseparable from action, as in the Churchmanian view described above. Courtney describes knowledge both as action and object - that is as both procedural and declarative. Organisational knowledge is viewed as existing in a "collective mind," developed through interpretation, communication, and shared meanings. Organisational knowledge is in a constant state of flux as new experiences are evaluated and shared. According to Courtney (*op cit.*), knowledge management in this environment consists of fostering communication between individuals, sharing and enriching interpretations, and co-ordinating actions. Courtney posits that a collective culture must be created in such organisations to permit effective communication and sharing of knowledge. Such a culture in the context of this study is equivalent to what we have earlier described as the *decision justification social practice*. Such a culture need cannot just develop, but needs to be collectively created and practised.

Courtney proceeds from this knowledge management perspectives and presents a notion of inquiring organisations, which he defines as learning organisations patterned after Churchman's (1971) inquiring systems. He presents what he calls the five flavours of inquiring organisations: Leibnizian, Lockean, Kantian, Hegelian, and Singerian, each based on the philosophies of their respective namesakes. According to Courtney, the

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orgainizations may be entire enterprises, or possibly even social systems, but more likely would be units within an enterprise. They could also be temporary groups or teams established to resolve a decision problem. Following Mitroff and Linstone (1993), who called the decision styles of Leibnizian and Lockean as "old style", Kantian and Hegelian as "complex thinking" and arguing for the need of a "new thinking" as exhibited by Singerian organisations, Courtney uses their Unbounded Systems Thinking (UST) to propose a new decision-making paradigm for DSS. This new decision-making paradigm can be seen pictorially in Figure 2.8. The new paradigm derives from the "five flavours" of Churchman (1971) and Mintroff and Linstone's (*op cit.*) Unbounded Systems Thinking (UST). A brief description of each type of organisation and its decision-making and knowledge management styles is given next, followed by the UST and finally the new decision-making paradigm for DSS proposed by Courtney.

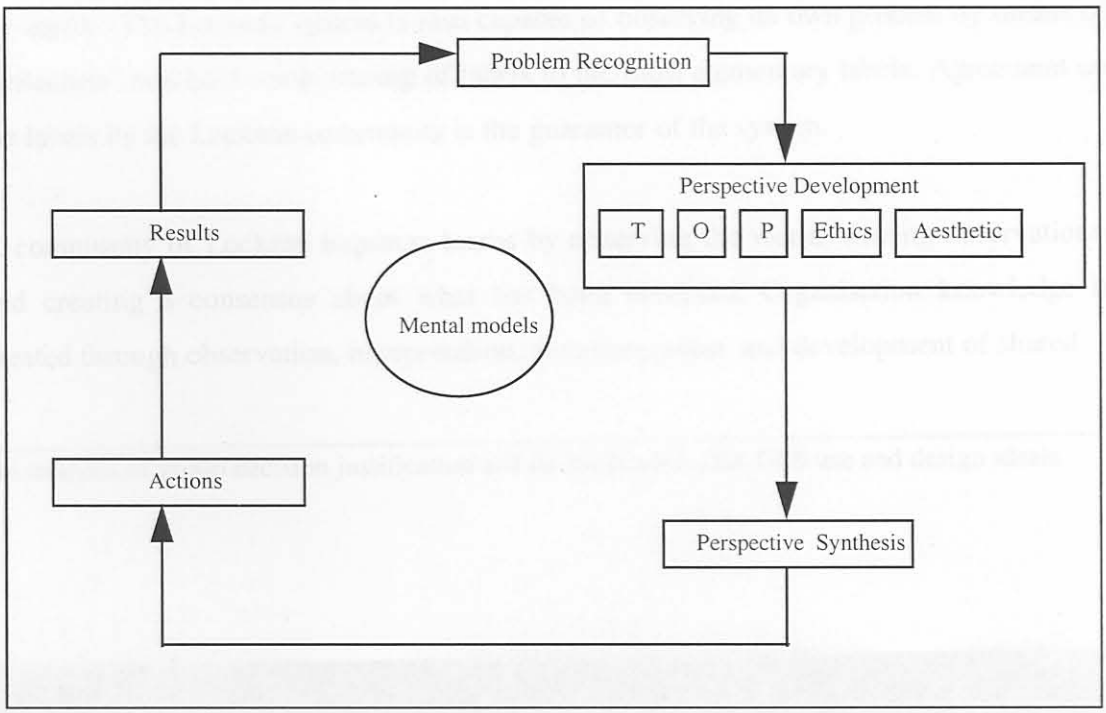

Figure 2.8: A new decision-making paradigm for DSS (Courtney, 2001)

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The Leibnizian Organisation

A Leibnizian inquiring system is a closed system with a set of built-in elementary axioms that are used along with formal logic to generate more general fact nets or tautologies. The fact nets are created by identifying hypotheses, each new hypothesis being tested to ensure that it could be derived from, and is consistent with, the basic axioms. Once so verified, the hypothesis becomes a new fact within the system. The guarantor of the system is the internal consistency and comprehensiveness of the generated facts.

The Leibnizian organisation creates knowledge by using formal logic and mathematical analysis to make inferences about cause and effect relationships. Decision-making procedures in Leibnizian organisations exhibits a strict, formal bureaucratic, "by the book" approach. Mitroff and Linstone (1993) call this the analytic-deductive approach to decision-making, an approach which is only suited to well structured, simple problems; but entirely unsuited to the unstructured domains found in DSS arena (Courtney, 2001).

The Lockean Organisation

Mitroff and Linstone (1993) refer to Lockean inquiring systems as being inductive and consensual. Empirical information, gathered from external observations, is used inductively to build a representation of the world. Elementary observations form the input to the Lockean inquirer which has a basic set of labels (or properties) which it assigns to the inputs. The Lockean system is also capable of observing its own process by means of "reflection" and backwards tracing of labels to the most elementary labels. Agreement on the labels by the Lockean community is the guarantor of the system.

A community of Lockean inquirers learns by observing the world, sharing observations, and creating a consensus about what has been observed. Organisation knowledge is created through observation, interpretation, communication, and development of shared

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meanings. The organisation's culture or subculture (a Lockean community) must be supportive of this kind of environment. The decision style is group-oriented and open. The primary knowledge management tools in Locken organisations are repositories, such as datawarehouses, for storing observations, datamining for analyzing observations, and groupware tools, such as electronic meeting software and e-mail, for facilitating the communication process, and the development of shared meaning (Courtney, 2001).

The Kantian organisation

The Kantian system is a mixture of the Leibnitzian and Lockian approaches in the sense that it contains both theoretical and empirical components. The empirical component is capable of receiving inputs, so the system is open. It generates hypotheses on the basis of inputs received. A clock and kinematic system are used to record the time and space of inputs received. The theoretical component allows an input to be subjected to different interpretations. This occurs because the Kantian theoretical component maintains alternative models of the world (alternative world views). Representations and interpretations are based on causal connections maintained in the models. The theoretical component contains a model building constituent, which constructs Leibnizian fact nets. It tests the alternatives by determining the best "fit" for the data, and the guarantor in this approach is the degree of model/data agreement. The use of alternative models permits, for example, one piece of economic data to be interpreted differently by different econometric models (e.g., competing models proposed by different political parties). Additionally, an "executive routine" turns the Kantian models on and off and can examine their outputs in terms of the degree of satisfaction with their interpretations. Thus, if a model is not producing satisfactory results it can be turned off, while those which are more successful proceed.

According to Courtney, the decision style of the Kantian organisation is to encourage the development of multiple interpretations of a set of data. It is both empirical and

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theoretical in its approach. Courtney (2001) notes that the perspectives tend to be very analytically based, however somewhat akin to combining the Lockean and Leibnizian approaches, but relying heavily on analytical methods for interpreting the data. Mitroff and Linstone (1993) believe this approach is suitable for problems of moderate complexity. The knowledge management system of the Kantian approach, is according to Courtney, closest to that of the functional view. It is based on the belief that problems can be modelled analytically. There is little or no emphasis placed on human interpretation of the problem, nor of human involvement. The problems is attacked strictly from a technical perspective. Courtney says that this approach requires knowledge management software capable of maintaining data about the problem and supporting the development of alternative types of models that attempt to explain the data.

The Hegelian organisation

Hegelian systems function on the premise that greater enlightenment results from the conflict of ideas. The Hegelian dialectic is comprised of three major players. The first player begins the dialectic with a strong conviction about a fundamental thesis. This player or subject, besides holding a strong belief in the thesis, constructs a view of the world in such a way that information, when interpreted through this world view, maximizes support for the thesis. The second player is an observer of the first subject. The observer generates an opposing conviction to the original thesis. In fact, the observer is "passionately dedicated to destruction of the first subject's conviction" (Churchman, 1971, p. 173). The final player in the Hegelian dialectic is a "bigger" mind and an opposition to the conflict between the thesis and the antithesis. This "bigger" mind synthesizes a new (larger) view of the world which absorbs the thesis/antithesis conflict. Synthesis generated by the objective "bigger" mind acts as guarantor of the system. Objectivity is based on a kind of interconnection of observers (Churchman, 1971, p. 149). They promise that "the movement from thesis-antithesis to synthesis is a soaring to greater heights, to self-awareness, more completeness, betterment, progress" (Churchman, 1971, p. 186).

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The decision style of the Hegelian organisation is based on conflict. Decision makers encourage the development of opposing viewpoints on how to resolve a decision problem. Debate between parties holding the opposing views is encouraged. The decision is forged from the two views in such a way that the problem is not only solved, but also completely dissolved. Courtney notes that Mitroff and Linstone (1993) have found this to be an effective approach to surfacing assumptions in strategic planning problems, leading to more effective plans. The knowledge to be managed in this environment consists of the information that the thesis and antithesis attempt to interpret, the thesis and antithesis themselves, the debate and the synthesis. Courtney sees Groupware designed to support negotiation and arbitration as well suited for this approach, along with repositories holding the data being debated, document management software, and analysis tools for developing points to support either the thesis or antithesis.

The Singerian Organisation

Two basic premises guide Singerian inquiry (Churchman, 1971, pp. 189-191). The first premise establishes a system of measures that specify steps to be followed in resolving disagreements among members of a community. Measures can be transformed and compared where appropriate. The measure of performance is the degree to which differences among group members' opinions can be resolved by the measuring system. A key feature of the measuring system is its ability to replicate its results to ensure consistency.

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Table 2.1: Summary of inquiring systems characteristics (Courtney, 2001)

	Leibniz	Locke	Kant	Hegel	Singer
Decision-making style	Formal Analytical Bureaucratic	Open Communicative Consensual	Open Analytical Multi-model	Conflictual	Teleological Cooperative Ethical
Knowledge perspective/ mode	Functional Combination	Interpretive Socialization	Functional Combination	Critical Socialization-Externalization	Interpretive-Critical Socialization-Externalization
Knowledge creation process	Induction Mathematical analysis Formal Logic	Deduction Observation Classification Communication	Mathematical analysis Multiple models Choose best	Construct theses, antitheses Dialectic Synthesis	Strategy of disagreement Sweeping-in Multiple perspectives
Information technology	Math models DSS Expert systems Document management	Repositories Groupware Networks	Databases Model management systems	Repositories Negotiation systems	Groupware Networks Repositories Document management

The second principle guiding Singerian inquiry is the strategy of agreement (Churchman, 1979, p. 199). Disagreement may occur for various reasons, including the different training and background of observers and inadequate explanatory models. When models fail to explain a phenomenon, new variables and laws are "swept in" to provide guidance and overcome inconsistencies. Yet, disagreement is encouraged in Singerian inquiry. It is through disagreement that world views come to be improved. Complacency is avoided by continuously challenging system knowledge. Singerian inquiry provides the capability to choose among a system of measures to create insight and build knowledge. A simplistic optimism drives the community toward continuous improvement of measures. However,

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the generation of knowledge can move the community away from reality and towards its own form of illusion if not carefully monitored.

Courtney indicates that it is difficult to discuss the Singerian organisation separately from Mitroff and Linstones' (1993) Unbounded Systems Thinking (UST) as they are closely related. His new decision-making paradigm is based on both. At the core of the UST is, according to Courtney, the development of multiple perspectives, a critical aspect of which is open, honest and effective dialogue among all relevant stakeholders in the problem involved. From the literature already alluded to in this chapter, it seems to us that Courtney's new decision-making paradigm for DSS could inform the theoretical framework of our study, the finer details of which are discussed in chapter 4. Figure 2.8 shows only a schematic representation of the new decision-making paradigm for DSS.

2.13 Conclusions from the literature review

We mentioned in the introduction that we are interested in an enhanced understanding of the group decision-making process and the potential benefits this process could obtain through the introduction of the concept of justification. We raised four primary research questions in section 2.1 and pointed out that in addition to this enhanced understanding, we are also interested in finding out what its implications are with respect to the use and design ideals of group decision support systems. This establishes the *purpose* of the research.

The literature reveals to us that although the concept of justification has been noted since the beginning of modern science, as demonstrated by the Cartesian inquirer, it has either been ignored or assumed. Other than Descartes' philosophical arguments on the concept, we have found only five instances where the concept and its potential benefits were explored (De Hoog & Van der Wittenboer, 1985; Hagafors & Brehmer, 1983; Bacharach, Bamberger and Mundell, 1995; Toulmin, Rieke and Janik, 1979, and Ulrich ,1987. In the case of Toulmin *et al.*, we have seen that the need for justification has to be established

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first, while Giddens' (1984) structuration theory simply assumes it. We have also noted that the much referenced Simon's (1960) model of rational decision-making, which informs the development of decision support systems and much of the management science literature, also did not pay any attention to the concept of decision justification. We find this surprising as much of science as we know and practice it today, is based on the Cartesian model of rationality, which requires and encompasses the concept of justification. We take the position well articulated by Bacharach *et al.* (1995) that underlying every human decision-making is the anticipation of post-decision anxiety and the decision maker's consequent need to reduce it. It follows from this that the need for decision justification cannot be socio-psychologically optional and that until we understand the underlying logics of decision justification, the "black box" in decision theory is likely to remain quite large.

Moving from this position, the literature presents us with two opportunities. The first is the recent work by Courtney (2001) on a new decision-making paradigm for DSS. This new paradigm would enable us to incorporate and integrate the concept of decision justification into a solid theoretical framework of mainstream decision theory. This would enable us to address the first two of our primary research questions. The second opportunity is that presented by Briggs *et al.* (2001) on thinkLets. It is our view that the notion of thinkLets relates closely to Toulmin's schema of reasoning as presented earlier. It seems possible that through the relationship between thinkLets and Toulmin *et al.*'s schema, one could better analyse how GSS could be designed and used to support decision-making groups when justification of such decisions become necessary. This will enable us to address the last two of the primary research questions.

We see Toulmin *et al.'s* schema of reasoning as the potential link between the two sets of research questions, through systems thinking, structuration theory, the UST and thinkLets. The rest of the literature cited here will assist us in responding to secondary questions to be raised in the next and subsequent chapters.

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The literature is also indicative of possible research methodologies which could be pursued in a study of this nature. We explore such methodologies and their rationale and arrive at a choice of our research method in the next chapter.