A CONCEPTUAL FRAME FOR EVALUATION OF HIGH LEVEL DECISION SUPPORT

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PREFACE

This Collaborative Paper presents research performed under the auspices of the Interactive Decision Analysis (IDA) Project in the Systems and Decision Sciences Program. The work reported here extends previous methodological studies of the IDA Project on decision support systems to encompass considerations of problem structuring and knowledge representation, which are typically important for strategic planning and support of high level decision makers.

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CONTENTS

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I. INTRODUCTION

High level managers in state administrations and in the executive boards of large companies are, and will continue to be, forced to make decisions in newly-occurring, non-repeated situations where the structure of the problem is, of necessity, initially unclear (e.g. making plans for developing new areas of activity, developing new product mixes, selecting between competing research projects, etc.).

These so-called ill-structured complex decision problems cannot be solved in every case by using traditional "in-house" decision making processes and methods due to:

(a) the *complexity* of the problems, i.e. too many conditions, constraints, and consequences must be simultaneously considered (e.g. lack of resources, market competition, competing interest groups, etc.);

(b) the *uncertainty* related to the objectives and preferences of those concerned, and regarding external conditions, etc.; and

(c) the *lack of available information* connected with the complexity of the problems, the uncertainty, and the problem-solving methods themselves.

The limitations of traditional methods in handling problems with these characteristics often not evident to the decision makers, who are the "problem owners" (Checkland, 1981), so traditional processes and methods are quite often used in ill-defined problem situations. As a consequence, there is no regular demand for the implementation of decision support systems, interactive decision making or methods in strategic decision making. This paper provides the conceptual frame

for a collaborative project seeking some answers to the question of why this is so. The project is based on a contact between IIASA and the Hungarian National Member Organization (the Bureau of Systems Analysis of the Hungarian State Office for Technical Development). Brief details of the organization of the project are given in the Appendix.

Quite a number of decision support models and software packages attempt to provide assistance with the solution of such decision problems, but many of them are not really used by the actual decision makers, for a number of reasons: (i) some of them are too artificial, using models and language that are too abstract, and are difficult for top-level decision makers to understand; (ii) some of the models and methods do not consider the decision makers' own preferences and judgements; and (iii) a number of them are not interactive or cooperative, so that the decision maker and those concerned do not interact during the decision-making process, either with each other or with the decision support system chosen, or (iv) on the contrary, some of the methods demand the active participation of the parties involved in decision making in ways they find inconvenient, though, for example, revealing conveniently hidden assumptions, motivations, etc.

II. DEVELOPMENT OF THE CONCEPTUAL FRAMEWORK

Most DSSs developed and used to date have been constructed for occasional clients. In the future, an increased demand for methods of approaching ill-structured problems can be expected. Two main approaches may be identified.

One approach involves developing methodologies and a conscious awareness of decision-making methods within organizations, so that trained decision makers may experiment with DSSs for structuring ill-defined problems independently of other individual or group decision-making procedures. The other approach involves employing decision analysts from outside the organization concerned to help structure the decision problem and supply the necessary procedures and methods.

For creating a conceptual framework to inform research within this approach of this project the following concepts have been considered to be important.

1. *Requisite Decision Modelling.*

   Phillips (1982) describes the criteria required to develop a requisite decision model as follows: "It is necessary to involve all those who are in some way responsible for aspects of the decision in the development of the requisite model. The process of building the model is iterative and consultative, and when no new intuitions emerge about the problem, the model is considered to

be requisite."

Ensuring requisite decision modelling requires *psychological validation* of the decision method, described by Larichev (1984). In particular, psychological validation requires that the operations prescribed within a system aiding decision making at any level must match the information processing capabilities of the user at that level, and the language he or she employs in exercising these capabilities.

2. The development of *levels of representation of decision problems*, within which the theoretical basis for the problem structuring language and interactive modules are embedded and explicated, together with a portfolio of examples illustrating its practical applications (Humphreys, 1984, 1985).

3. *The roles and motivations of the participants in the decision-making process* as an alternative basis for the selection or design of decision support methods (Vari and Vecsenyi, 1984).

III. REVIEW OF THE CURRENT STATE OF AVAILABLE DECISION THEORY AND RESEARCH IN REGARD TO STRUCTURING DECISION PROBLEMS

Dina Berkeley and Patrick Humphreys prepared this review during 1981-82 together with an assessment of how the body of published research on "heuristics and biases" uses or misuses this material. The review was published in *Acta Psychologica* under the title "Structuring decision problems and the 'bias heuristic'" (Berkeley & Humphreys, 1982). In that paper, Berkeley & Humphreys identified seven different types of uncertainty which have to be considered in generating a representation of a decision problem, showing how four of these were taken explicitly into account in models within the province of decision theory, viz.:

(i) Uncertainty about the probabilities of outcomes of subsequent events, conditional on what has preceded them in the act-event sequence between immediate acts and consequences;

(ii) Uncertainty about the probabilities of outcomes of subsequent events conditional on the occurrence of other events extraneous to the sequence in (i);

(iii) Uncertainty about how to incorporate prior information (e.g. results of prior sampling, base rate in a reference population) in determining the probability of a subsequent event;

(iv) Uncertainty about how to conceptualize the worth of consequences: assessing a consequence's utility requires the generation of a single number describing its (holistic) worth. When more than one criterion of "worth" is involved, un-

certainty can arise about how to combine these criteria.

Berkeley & Humphreys identified various problems associated with this approach, showing how its adoption has led to deficiencies in the vast majority of research associated with it. Effects identified in that report were availability of tasks, subjects and explanations; representativeness of findings; and anchoring and adjustment of explanations.

It is clear that four lines of development in both theory and methodology is urgently needed if these implications are to be followed up. These three lines concern:

1. The development of problem structuring methods;
2. Specification of knowledge representation in forms appropriate for supporting the operation of these methods;
3. Specification of levels of abstraction in decision making tasks, with each related to (i) level of knowledge representation appropriate for the task, and (ii) an appropriate level of responsibility in an organizational context.

These three lines of development are intimately interrelated, as described below.

IV. LEVELS OF REPRESENTATION OF DECISION PROBLEMS

Developing problem structuring calculi led to awareness that all decision making calculi need to be embedded within a framework of qualitatively distinct levels of knowledge representation (Humphreys & Berkeley, 1983). The paper on Handling uncertainty: Levels of representation of decision problems (Humphreys & Berkeley, 1984a) gives a detailed account of the characteristics of five levels of representation within decision problems. It describes relations between the levels, requirements for decision support at each level, and implications of the multi-level scheme for supporting organizational decision making.

Achieving requisite decision modelling (Phillips, 1982; 1984) in any particular situation may require that three remaining types of uncertainty are also resolved. Humphreys and Berkeley (1982) identified these as:

(v) Procedural uncertainty, i.e. "uncertainty concerning means to handle or process the decision, e.g. specifiying relevant uncertainties, what information to seek and where, how to invent alternatives and assess consequences, etc." (Hogarth, Michaud & Mery, 1980);

(vi) Uncertainty about how the decision maker will feel, and wish to act, having arrived at a subsequent act choice point after intervening events have unfolded in real time;

(vii) Uncertainty about the extent one possesses agency for inducing changes in the probabilities of subsequent events (conditional on acts yet to be taken, as in (i) above) through being able to alter relations between stages of the world (Savage, 1954).

All these three types of uncertainty are usually present in ill-structured decision making situations, the focus of this project. Resolving these uncertainties implies in practice temporarily "fixing" the way in which a decision problem is located. Difficulties in resolving uncertainties in doing this were described and the need for a problem structuring calculus was identified to articulate this process.

The alternative "heuristics and biases" approach to the study of human decision making was contrasted as imposing structure, assuming common understanding. This latter approach was shown to involve (i) the "naturalization" of the small world in which the decision problem is located, and (ii) the utilization of normative models as "ideal types", leading to the use of the "bias" argument in discussing subjects' performance in decision tasks.

The key advantage of the "levels" framework is that it permits integration across levels: results of operations at a higher level define the constraints at lower levels. Moreover these levels of problem representation mirror Jaques' (1976) account of levels of abstraction of organizational roles, from shop and office floor (level 1) to managing director (level 5). A comparison of the levels within Jaques' scheme and requirement for effective decision support at each level is summarized in Table 1 (reprinted from Humphreys, 1984). We consider the findings from this comparison to be of crucial importance for the design and implementation of multilevel decision support systems (DSSs).

Decision aiding software tools with capabilities at the first three levels are comparatively well developed. These comprise level 1 systems aiming at providing "best assessments" (e.g. most management information systems, systems for eliciting and calibrating probability assessments), level 2 systems exploring hypotheses rather than reporting "facts" (e.g. most expert systems) and level 3 systems capable of capturing and editing the structure of an aspect of a problem. We identified a complete absence in practical applications of DSS possessing the ability of to work with the decision maker's own problem structuring language in linking to appropriate level 3 systems; ability to determine the bounds of a problem through scenario generation). The problem here is not simply a failure of automated DSS

TABLE 1: Comparison of Demand characteristics of tasks facing personnel having responsibilities at a given organisational level with structuring capabilities required in representing decision problems at that level

(characteristics of levels 8 to 10 can, in theory, be ascertained by extrapolation from levels 3 to 5 respectively)

	Level number	Organisational level in employment hierarchy.	Time span inherent in problem representation at given level.	Demand characteristics of tasks facing personnel with responsibility at given level	Structuring capabilities required in representing decision problems at given level (decision support must also include capabilities at all lower levels).	Number of existing DSS incorporating support formalised at given level.
Socio-cultural decision making: goal-closed small worlds structured within cultures (in theory, up to level 10).	7	Chairman M/D of corporate group; head of large government department.	20-50 years	Anticipation of changes in sociological, technological, demographic and political developments; leading corporate strategic development to meet them.	Isomorphic with level 2, except can conduct sensitivity analysis, simulating changes in level 5 representations; assessing their impact within cultural structure.	None
	6	Corporate group/ sector executive.	10-20 years	Co-ordination of social and theoretical systems; translation of corporate strategic development into business direction.	Isomorphic with level 1, except each node is now a level 5 problem representation within fixed cultural structure.	None
Individual decision making under uncertainty: uncertainties and preferences structured within goal-closed small worlds.	5	Corporate subsidiary/ enterprise managing director	5-10 years	Problem not dealt with in context set wholly from above; can modify boundaries of business within policy i.e. define work system.	Articulation of principles for conditional (goal) closing of an open system, and/or re-opening of a conditionally closed system (e.g. through scenario generation).	None
	4	General management, (of e.g. development, production *or* sales, within work system).	2-5 years	Detachment from specific cases, seeing them representative examples of issues calling for development of a system.	Selecting/interfacing capability between structural types (requires use of problem structuring language).	Very few (prototypes)
	3	Department Managerial/ principal specialist.	1-2 years	Control of trend of tasks and problems arising. Extrapolation from trend to ways of formulating problems.	Re-structuring capability within single fixed structural type (e.g. attribute generation in multi-attribute model).	A few
	2	Front-line managerial/ professional.	3 months to 1 year	*Formal operational*, can anticipate changes in tasks due to any *one* of: demand, object, production resource, pathway, or pathway resource.	Manipulation of data on one variable at a time within fixed structure (e.g. sensitivity analysis).	Many
	1	Shop and office floor.	less than 3 months	*Concrete operational* limited to tasks concretely and physcially at hand.	Estimation of values at nodes within fixed structure (e.g. information retrieval system).	Many

Abstracted from E. Jaques: *Free Enterprise, Fair Employment* [32].

design at higher levels. Humphreys & Berkeley (1984) conclude:

> "It is not actually advisable to attempt to formalize level 5 scenario generation techniques and level 4 problem structuring languages into automated decision support systems. At level 5, decision makers' scenarios need to be explored rather than fitted into formal structures. At level 4 it is better to develop techniques for the psychological validation of the decision maker's own problem structuring language than to try to invent a universal problem structuring language that will have to be taught from scratch to high level decision makers." (p. 30)

These findings point towards the following two-fold research strategy:

1. To assemble and standardize specifications on the elements of a library of problem structuring methods, each method being programmed as a complete software module implementing a level 3 problem structuring calculus and supporting level 2 and level 1 procedures. The appropriate specification of the contents of any library of this type held by a particular decision aiding/decision analysis group or institution will depend upon the types of decision problems to be handled with its support).

   A major technical objective for the collaborative work within this project will thus be best to research a framework for a catalogue of specifications of decision problem structuring methods and software, for publication by IIASA. This catalogue will be invaluable for DSS researchers, developers and implementers, as it will provide a unique and comprehensive information resource when specifying, assessing and interfacing interactive decision aiding methods which have the capability to serve as elements in decision problems and structuring libraries of the type outlined above.

2. Research is essential which will provide the basis for the development, validation and implementation in practice of DSS providing effective support at higher levels (i.e. level 4 and above) where it is essential to support the natural problem structuring languages used by decision makers and by skilled decision analysts working interactively with them.

V. ROLES AND MOTIVATIONS IN THE DECISION MAKING PROCESS

In designing and using new decision analytic methods, not only the characteristics of the decision problem, but also the roles and motivations of the participants in the decision-making process need to be considered.

Decision making in an organisational context implies a process with several actors. As a basis for understanding the motivations and problems of individuals as members of organisations Vari and Vecsenyi (1984) have found it useful to investigate their roles in comparison with those of other participants in the decision making process. The principle roles that they identified in their previous studies (Humphreys, Vari, Vecsenyi, 1982; Vari, Vecsenyi, 1983) are those of *decision makers, proposers, experts, and participants primarily concerned with implementation.*

1. *The decision makers* have executive power to define the use of outputs of the decision making.
2. *The proposers* have power to make recommendations to the decision makers.
3. *The experts'* function is to supply inputs to the currently modelled problem structure.
4. *Those concerned with implementation* play an active role in the realisation of the accepted solution. In situations where a decision support system or decision aiding techniques are applied two further roles can be defined. These are:
5. *The client* who initiates the decision support.
6. *The consultants or decision analysts* who advise on methods of problem representation and decision making procedures. They are in a position to facilitate the collaboration of the parties involved, the communication of the results, etc.

Another related approach to the identification of roles of participants was described by Checkland (1981) from a systems analysis perspective. Checkland identified the following roles:

1. *Client*: He who wants to know or do something and commissions the study. The implication is that he can cause something to happen as a result of the study.
2. Decision taker: The role player in a human activity system who can alter its content (its activities) and the arrangements within the systems (subsystems) and who can decide resource allocation within the system.

3. Problem owner: He who has a feeling of unease about a situation, either a sense of mismatch between 'what is' and 'what might be' or a vague feeling that things could be better and who wishes something were done about it. The problem owner may not be able to define what he would regard as a 'solution', and may not be able to articulate the feeling of unease in any precise way.
4. Problem solver: A person or persons anxious to bring about improvement in a problem situation.

Despite the apparent similarities, some differences are also obvious. The most important point is that in Checkland's system the differentiating factor is the actors' role as related to the *problem content*. In our case, however, it is the role played in the *decision making/problem solving* process. From the point of view of our assumptions about supporting *decision making activities* the latter approach seems to be more reasonable.

Vari and Vecsenyi came to the conclusion that the decision aiding methods should support the whole decision making process rather than supporting only the device itself in the way suggested by traditional decision theory. They argue that decision making in organizational contexts comprises not only a series of activities and attitudes to the problem content and to the decision making process.

According to the findings of Vari and Vecsenyi, most of the motivational factors can be traced to the desire for *controlling (through understanding and influencing) the three phases of the decision making process*, i.e. gaining or maintaining control over (i) *the planning of the decision* (problem structuring, analysing and proposal formulating), (ii) *the choice process* and (iii) the *implementation* of the decision.

One of the most frequent motivating factors for the decision makers in applying decision support methods is to increase their *control of the decision making*. As pointed out by Pfeiffer (1981), the control of the decision making is one of the main sources of power in organisations. In selecting a method which can provide adequate decision support we consider here the decision maker as a client. In this case the analyst (consultant) should help him to increase the control over the decision making. A more profound analysis of this factor will, however, call attention to the need for distinguishing between control over the different phases of the decision making process.

The decision maker's *control over the planning* is maximal when all the steps are taken by himself (e.g. definition of goals, options, outcomes, criteria, tradeoffs, evaluations of options and the aggregation of data through decision rules,

etc.). This implies a situation charcterised as *individual* decision making within an organisational context. Larichev (1984) calls this "holistic choice" in contrast to cases in which the decision maker has not enough expertise or information for estimating the alternative solutions on his own.

This type of individual decision making occurs relatively rarely in organisational contexts, and generally in small-scale problems. The complexity of organisational problems makes it necessary for the decision maker to invite experts to supplement the information lacking for the decision. Experts are employed most frequently for giving assessments about events and outcomes, while the definition of the preference structure is likely to remain under the decision maker's control. This is what Larichev calls "criteria-experts choice". This, however, implies a decrease in the decision maker's control over the planning, and a wider range of possibilities for them to supervise the proposals based on questioning the experts' judgements.

The decision maker's control over the planning is minimal when the decision maker does not participate in it at all. In this case, only experts are involved. However, in using the *results* of this kind of decision support the decision maker has maximal free dom since either (i) no proposal will have been put forward by the experts, due to lack of information about the decision maker's preferences or (ii) there will have been a proposal reflecting the expert's preferences. Such cases often occur in practice.

As far as the *control over the choice* is concerned, the situation is quite different. Lock (1983) pointed out that "it is remarkably difficult for a manager in a supposedly 'rational' role to argue against a supposedly rationally derived solution to a decision problem". Consequently, the more involved is the decision maker in the planning process, the more uncomfortable he will feel about revising these results which are opposed to his intuitions.

Beside desire for control over the planning process or over the choice, the third most important factor motivating the decision maker's use of decision aids is desire for the *control over the implementation process*. For the decision maker, it is important in this phase (i) to understand the opinions and the future behaviour of those concerned with the implementation, and (ii) to ensure that the prescribed solutions are accepted.

Understanding and considering the opinions of those concerned with the implementation of a decision may obviously increase the chance of selecting a feasible solution. One way of ensuring this is to use decision support methods which involve the stakeholders' full participation. Facilitating discussions and the partici-

pation in the formulation of the proposal may ensure the participants' *internalisation* of the solution.

Another way of promoting acceptance does not necessarily involve the participation of those concerned with the implementation in the whole decision making process. It suffices to explain to them the final proposal which may possibly have been produced with the aid of contributions from experts and analysts as well as from institutions of high status. In this case the acceptance of the results can be promoted through a second well known psychological mechanism for adjustment, i.e. the *identification* of those concerned with the implementation with the persons who generated the solution.

In summary, it must be emphasized that different motivations can usually be served by different methods which - if applied simultaneously - can complement each other, but can be contradictory as well. Given awareness of such conflicting requirements, a decision analyst or DSS designer has to decide in each particular case (i) which actor in which role on which level with which motivations should be served, (ii) which activities in the decision making process should be aided, and (iii) which methods and related computer-based software modules if any should be applied as an aid to each activity.

VI. CASE STUDIES ORGANIZED WITHIN THE CONCEPTUAL FRAME IN REAL WORLD HIGH LEVEL DECISION MAKING

Testing the relevance of the conceptual frameworks described above requires a real world decision making laboratory for their successful implementation. By this we mean a facility where the actual decision makers can meet to work together on the actual decision problem they are currently facing supported by decision analysts and decision aiding systems. In aiding decision making dictates above level 3, the presence of a specialist decision analyst is essential, and problem formulation and solution at these levels requires the use of group processes which cannot be formalized into automated systems. However, to be effective, high level decision making must include appropriate support at all lower levels, implemented here through the selection of appropriate decision aiding systems from a library of problem structuring methods. The nature of the research we have described requires also that key aspects of the interactions between the decision makers, decision analysts and decision aiding systems must also be monitored in forming an evaluation of the use of any particular decision aiding technique on DSS. However, this monitoring process must never become intrusive or appear restrictive to the decision makers while working on the problem for real rather than acting as "sub-

jects" or guinea pigs, trying to handle what would quickly become toy problems. Decision conferences provide a 'natural laboratory' in which the problem solving process can be studied, while still meeting the requirements set out above.

The research plan for the IIASA collaborative project on Evaluation of Decision Support Systems provides for the participants in this collaboration to develop case studies on their own development and application of decision support systems and decision aiding methods, making use of the conceptual framework we have outlined above in ways appropriate for each case. The review and revisions in the light of the insight gained and comments made in subsequent group discussions of meetings of all the major participants in the project, the revised case studies will form chapters within a book on *Experiences in DSS construction for Problem Structuring* to be published through IIASA. The book will also contain an initial chapter providing a general introduction and survey, and a chapter identifying implications for development and application of decision aiding techniques and decision support systems.

VII. A SUPPORTING CATALOGUE OF METHODS FOR DECISION PROBLEM STRUCTURING

A supporting aim of this aspect of the research within the frame is to assemble a catalogue of specifications of methods which could be implemented as modules in a library of problem-structuring methods, for two purposes: (i) to increase the frequency with which high-level decision makers utilize the available problem-structuring methods in the solution of ill-defined decision problems, and (ii) to generate DSSs that can help the analyst or consultant to structure novel problems in such a way that the decision maker is able to function effectively.

This catalogue will be published through IIASA as an information resource for DSS developers and decision analysts. The entries in the catalogue will be based on self-report by the method developers in response to a questionnaire developed in a form consistent with the of this paper. This means that members of the project team for the collaborative research and IIASA will not be able to take responsibility for the accuracy of the descriptions in the catalogue. Instead, the catalogue will serve to increase awareness of potential methods and to establish liaisons between method developers and method users.

Ideally, methods included in this catalogue (and software implementing them) will meet the requirement that they have capabilities at each of the following levels:

Level 3: restructuring capability within a particular structural variant or "frame" (establishing new criteria)

Level 2: assessing judgement on a variable within a fixed structure (e.g. "what if" models)

Level 1: judgement within fixed structure (e.g. with information retrieval service)

Crucial objectives which must be achieved in assembling any decision problem structuring library consist of knowing how to specify characteristics of modules included in, or required for inclusion within the library at each of these three levels. Existing modules which might be included in the library also need to be assessed in terms of their capabilities at each of these levels, identifying strengths and weaknesses, and possibilities for future development.

The catalogue will also contain guidelines specifying the characteristics of modules which could potentially be included in an appropriately specified library. These guidelines should enable an applications requirement to be intersected with modules appropriately specified.

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APPENDIX: IIASA COLLABORATIVE PROJECT ON EVALUATION OF DECISION SUPPORT SYSTEMS

A. ORGANISATION OF THE PROJECT

The IIASA collaborative project on Evaluation of Decision Support systems is designed to provide a constructive framework for international collaboration between researchers of the East and West. It is based on a contract between IIASA and the Hungarian National member organization, the Bureau of Systems Analysis of the Hungarian State Office for Technical Development.

This contract provides support for the international collaboration involved in the work described below. Participants in the project have arranged to fund the components of the work carried out in their own institutions, (development and preparation of case studies, compiling the catalogue, etc.) through project supported separately within their institutions. The responsibility for arranging the national components of the work lies with these individual institutions and not with IIASA.

This project attempts to provide a framework for designing and selecting decision support systems (DSSs) for structuring ill-defined decision problems based on a cross-cultural comparative study evaluating DSSs in different countries. The international network of the project was created with the participation of the following collaborative groups in Hungary, UK, USA and USSR.

In the Soviet Union at VNIISI, Professor O. Larichev, Dr. H. Moskovich and their colleagues are working on application and development of multidimensional scaling and semi-ordering methods in decision-making, and on the psychological validation of DSSs.

In the UK at the LSE, P. Humphreys, L. Phillips, S. Wooler and their colleagues are developing an applying interactive decision aiding method which provides effective support for decision making at all levels. Lower level support modules have been programmed as interactive software, while higher level support relies upon analysis of decision makers natural problem structuring language and the use of decision conferencing techniques. At the Manchester Business School, Professor A. McCosh is using DSS software modules in strategic planning applications.

In the USA, Professor D. Gustafson at the University of Wisconsin and W. Cats-Baril at the University of Vermont are developing several decision aids, implementing an analysis where the computer would guide people into thinking

about how they would plan for implementation efforts.

In Hungary at the Bureau for Systems Analysis (OMFB REI), A. Vari, Z. Paprika and J. Vecsenyi are investigating the conditions under which to use new decision technology in ill-defined decisions finds successful applications.

The groups identified above have agreed to carry out collaborative research through IIASA in the collection, development, field testing, and publication of details of decision support methods and associated guidelines, as a contribution to the solution of strategic decision problems by top-level decision makers.

The researchers from LSE, OMFB-REI and VNIISI have previously made comparative analysis of the Application of Decision Support Systems in R and D Decisions, as part of IIASA's Management and Technology Area, Task 2: 1981-1983; this work is described in a series of IIASA Collaborative Papers and the analysis is summarized in a book developed from the IFIP WG8.3 Working Conference on *Processes and Tools for Decision Support*, held at IIASA in 1982 (Humphreys, Vari and Vecsenyi, 1982; Humphreys et al., 1983).

B. OBJECTIVES AND SCOPE OF THE PROJECT

The project on Evaluation of Decision Support Systems is a continuation and development of (i) the IIASA project on Comparative Analysis of the Application of decision Support Systems in R and D decisions: 1981-1983; and of (ii) the research activities of members of the international network of the collaborative group in Hungary, UK, USA, USSR concerning the use of decision theory and methodology in organizational context.

Based on the apparent increasing demand for using decision support systems in solving complex decision problems and also on the accumulated experiences in decision analysis and DSSs development the following objectives will be achieved:

1. Reviewing of methods for supporting the structuring and solving of ill-defined unique decision problems. The methods will include both those that can be used by the decision makers independently of external consultants and those designed for use by decision analysts working together with the decision makers.
2. Providing a framework for designing and selecting decision support systems (DSSs) for structuring ill-defined decision problems.

3. Providing a basis for a cross-cultural comparative study on experiences in problem solving DSSs construction and application in different countries through an international network of collaborating groups.

C. EXPECTED FINAL RESULTS

At the end of the project the final results will be published through IIASA and probably through other publishing channels. The published results will comprise:

1. A book of experiences on DSS construction for problem structuring comprising an introductory chapter on frameworks useful in DSS construction and application, an international series of case studies developed by the participants in this project, and a final summary chapter making comparisons across the case studies (methodological, cultural, results) and pointing towards the development of theory DSS for problem structuring.
2. A comprehensive review of those methods (existing software implementing those methods which provide a resource basis for decision problem structuring libraries. This will be supported by a catalogue of methods and guidelines for their selection and use in practical applications.

D. PHASES OF THE PROJECT

The program of the project consists of a preparatory phase, followed by a main phase ending on 31 December 1985. It comprises a total of 15 tasks.

In the *preparatory phase* a conceptual frame for the project will be formulated and the infrastructure of the international collaboration will be established for the main phase. The preparatory phase was completed at a task force meeting in Budapest, 11-13 February 1985.

In the *main phase*, researchers are studying the history of the solution of a group of decision problems throughout their various stages: recognition of the problem situation, calling for decision analysis, selection of a problem-solving procedure, definition and structuring of the problem within the natural language of the participants in the decision making process and through to recording the problem, representation actually used as a basis for describing procedures (interviewing the decision analysts, the choice and use of confidential questionnaires with the participants, and so forth).

This means that approaching the problem by monitoring the decision structuring phenomenon as a whole. Based on the recording, coding and analysis of the information gathered, models supporting ill-structured decision situations in an organizational context can be further developed. The case studies will be developed through discussion and comparative analysis within the group of participants with a view to future publication. New theoretical findings will need to be developed through this work, and these will form a major feature of the book to be written summarizing the results of the case studies.

E. TASKS OF THE PROJECT

1. Planning meeting for the project.
2. Establishing the infrastructure of the project.
3. Creating the conceptual framework of the project.
4. Pilot recording and analysis by each participant of use of an interactive decision aiding method or DSS, meeting the criteria outlined above and preparing a case study for the task-force meeting.
5. Organizing the February 1985 task-force meeting.
6. Finalizing the questionnaire and guidelines for (i) the decision problem structuring method catalogue, (ii) case study book and comparative analysis.
7. Forming the specification of a decision structuring program catalogue, based upon method-developer self-reports to the specifications questionnaire.
8. Conducting (by individual participants) decision analyses using decision aiding or decision support methods including the selection and use of modules identified in 7.
9. Elaborating the experiences raised through the decision analyses carried out in 8.
10. Exchanging case studies within the network, and providing feedback to analysts, facilitated through a meeting of the project team in Helsinki, August 1985.
11. Evolving a framework for reviewing and describing the case studies with emphasis on the role of problem structuring language and its role within decision analysis.

12. Revising and completing the specification of the decision problem structuring method catalogue.

13. Completing the case study book and comparative study. The schedule of the tasks is shown in Table 2.

Table 2. Schedule for the tasks of the project.