THE RISK RANKING TECHNIQUE IN DECISION MAKING

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and

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in

Decision Making

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In order to make this volume available as economically and as rapidly as possible the author's typescript has been reproduced in its original form. This method unfortunately has its typographical limitations but it is hoped that they in no way distract the reader.

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Preface

There have been many excellent proposals for aids to decision making. Most of these proposals tend to deal with only one group of the factors that have to be considered in assessing the acceptability of major high technology projects. In this book we develop a comprehensive approach, known as the Ranking Technique, for the assessment of decision options. The aim being to provide a way of presenting a decision maker with a consistent way of making a comprehensive assessment of all the factors associated with complex decisions. The Ranking Technique we describe, while being based on a thorough and detailed analysis of all the issues involved, presents the results of the analysis in a simple transparent and justifiable way that should be understandable by the lay public not versed in the complexities of the issues involved. In our presentation of the Ranking Technique we attempt to justify the logical basis of the Technique and to describe how it can be applied. Although we illustrate the use of the Ranking Technique by post hoc application to only four major decisions that caused controversy and one fuel resource evaluation we stress the Technique is applicable to all decision making situations. It is our contention that the Technique provides a logical and justifiable approach to the assessment of decision options, which should be useful both to those directly involved in the decision making process and to students of decision making.

The study describes how technical, economic and socio-political factors can be evaluated and their significance integrated to give a comprehensive assessment of the decision options. Appendices to the study describe: the essential features of the Ranking Technique, definition of the terms used in the study, a review of some technical acceptability criteria that have been used and an outline of the essential steps in reactor licensing procedure.

We hope all that read this study will find that it shows ways in which the decision making processes they are associated with can be improved in a rational and logical way.

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Quotations from "The Official Rules",*
Ashley-Perry's fifth statistical axiom:
"The product of an arithmetical computation is the answer to an equation: it is not the solution to a problem."
Thurber's conclusion: "There is no safety in numbers, or in anything else."

Starting from the challenge of the two quotations above this study examines how in reality complex decisions can be made more effectively with the assistance of objective and logical disciplines. The type of decision particularly considered is a final decision about whether or not a project goes ahead. It is assumed the decision maker involved will have overall responsibility for making the decision in a clearly defensible way on the best information available. It is not assumed that the decision maker is an expert in every field involved but it is assumed that he has access to any additional expert opinion that may be required. More specifically the aim of the study is to critically examine the capability of the Risk Ranking Technique for dealing effectively with a variety of complex decision making situations, including decisions related to controversial projects and projects that involve assessing the acceptability of major risks, when every associated factor from technical characteristics to public opinion has to be taken into account. The incentive for developing the Risk Ranking Technique was the need to provide decision makers with a method for making comprehensive assessments in a way that deals consistently with the matrix of factors involved. In developing the technique the aim was to provide decision makers whether at the political or industrial level with a transparent and defensible way of arriving at decisions. Even for smaller decisions in which only a single range of factors need be considered the technique provides a logical structure to the assessment of the options involved. The basis of the Ranking Technique is the comprehensive assessment of all the associated technical, economic and socio-political factors. The Technique, which is described at length in references 1 and 2 and is summarized in Appendix 1, consists of assessing the acceptability of each of the factors involved and scoring the results of the assessment on a scale of 0-4. The higher the score the lower the acceptability, the overall Ranking of acceptability being determined by integrating the scores of the individual factors. The Ranking that an activity is given will provide the decision maker, whether at the regulatory level or the project management level with a yardstick to judge in a consistent way how acceptable the activity is.

By the nature of the circumstances of decision making, decisions often have to be made under conditions when the data about the subject of the decision are sparse and uncertain. Such circumstances are not

*Paul Dickson's "Official Rules", published Arrow Books, London 1981.

unusual in decision making in business or in scientific and technological developments. Unless solutions are found to these problems developments that could be useful to society may be inhibited. To overcome these inherently complex problems several techniques have been proposed. Part of this study is devoted to evaluating the techniques currently available and comparing their efficacy with the Risk Ranking Technique.

Among the many general texts on decision making, Koutsoyiannis' "Non Price Decisions"[3] and Matthew Miles and Michael Huberman's "Qualitative Data Analysis" are particularly useful.[4] Very practical and direct guides to the subject are given by: Myra Chapman in her "Decision Analysis",[5] Maurice Preston's "Statistical Decision Theory"[6] and Gordon Hilton's "Intermediate Politometrics".[7] The methods they describe are of considerable help in arranging and evaluating complex evidence in a logical way that assists the decision maker to reach a verdict. David Pearce's "Decision Making for Energy Futures", which was based on a study of the Windscale Inquiry for the Social Science Research Council, shows clearly the complex range of factors that have to be considered in government policy decisions.[8]

Like any analytical techniques decision analysis techniques have their limits and should not be used uncritically. It is therefore vital that the suitability of a technique for assessing a particular problem is determined before any value is given to its results. Determination of the suitability of a method includes assessing whether or not relevant data exists and if data exists how exactly they fit the case being examined. In the evaluation of a new or novel process data that precisely fits the specific case is unlikely to be available and any evaluation has to be based on synthetic data. Synthesizing data is a process that by its very nature involves uncertainty. This does not mean a novel process will fail, it simply means it is not known with absolute certainty how successful it will be. The Space Programme illustrates how success can be achieved and the cost that may be involved when there is little relevant data.

The analyst, the techniques used and the stage in a project's life at which the assessment is made all influence the decision making. The changes in the relevance of the results of an assessment that take place with the passage of time can be quite dramatic. Unless the decision is made and implemented in the same instant the need for the decision may change and the relative significance of the associated factors may change.

Judging the efficacy of a decision making process is not simple. One method is to assess how acceptable the decisions proposed are to those affected by them, another method is to assess how successful past decisions made on the basis of a particular decision making process have been. Judging success has, like so many aspects of decision making, many qualitative aspects. But techniques exist to help the making of such judgements. Central to any judgement of the efficacy of decision making techniques is determination of the decision making environment. In this study the Ranking Technique is tested on five major proposals, which have given rise to a certain amount of public

concern. These tests show how effective the Technique can be in predicting the most acceptable decision.

Although the capability of the Ranking Technique is demonstrated on five quite different proposals the examples do not define the limits of the Technique or the most likely users. The Technique is intended mainly for assessing complex decisions where the way account is taken of the whole matrix of technical, economic and socio-political factors has to be clear and defensible. Even though the Technique is designed to deal comprehensively with the whole matrix of factors involved in complex decisions it can be used when the decision is related to just one factor. The decision makers to whom the Technique is likely to be of most interest will be at either a senior political or a senior industrial level and with responsibility for justifying and defending project decisions in terms of the technical content, financial implications or socio-political acceptability.

In the following the analysis of the capability of Ranking Technique as an aid to complex decision making is built up in ten steps. The steps are:

1) The problems of decision making particularly when the decision involves the acceptability of major risks.
2) The relevance of decision analysis techniques currently available.
3) The nature of the Ranking Technique.
4) Evaluation of technical factors for Ranking.
5) Evaluation of economic factors for Ranking.
6) Evaluation of socio-political factors for Ranking.
7) Assessment of the efficacy of the Ranking Technique in five cases.
8) The basis for alternatives to the Ranking Technique in decision making.
9) Guidelines for the use of the Ranking Technique.
10) The overall conclusions suggested and future developments.

Some of the terms used in the study may, in general usage, have several meanings, so to prevent any misunderstanding the meaning attributed to them in this study are specified in Appendix 2.

Chapter 2

The Problems of Decision Making

Decision making takes many forms but the type of decisions that are the main concern of this study are those involving the evaluation of many complex factors, which are difficult to evaluate comprehensively in a uniform and consistent way. It is characteristic of such decisions that they have to be made in a transparently justifiable way and not on the basis of some capricious whim. The importance of transparency being that it allows it to be seen, by all interested parties, that all the relevant technical, economic and moral issues have been considered. Such decisions may arise in companies or at national or international government level. To clarify the types of decision making problems considered first the main types of decision are described and categorised, then the nature of the problems associated with each category of decision are assessed. From this assessment conclusions are drawn about the way the Ranking Technique is most likely to help each type of decision making situation.

Decision making can be described in deceptively simple terms, such as "agreeing the course of action required". Such simple definitions miss many of the important nuances associated with the various parts of the decision making process. For an examination of the various types of decision making process to lay any claim to being thorough it must identify not only the nature of the demands for a decision, the goal of a decision and the consequences of a decision, but also the environment the decision making process has to operate in. The whole environment is often conditioned by the fact that there is a need to be able to show how a particular decision was reached. This need may arise from: those directly involved in decision making, from the people affected by the decision, the general public and out of consideration for those following who must operate future decision making activities.

The first step towards identifying the various types of decision is to identify the essential elements of the environment that may surround any decision making process. In reference 9 a model of the environment of policy making was proposed and that model is used as the foundation for the model of the environment of the decision making process used in this study, as the processes are closely related. The decision making environment is seen as just one part of the universal environment set which includes all real and transcendental systems sets. Transcendental systems sets are those sets outside present knowledge, so only real systems sets are relevant to this discussion. Real system sets include: designed physical system sets, human activity system sets, designed abstract system sets and social and cultural systems sets. Designed physical system sets embrace all the inanimate products of man's activity such as machines and factories. Human activity systems are defined as all systems that exist as a result of human endeavour like cities, political systems and computer systems. Designed abstract system sets represent the knowledge man has developed. Social and cultural system sets in some way overlap

the human activity systems sets and the designed abstract systems sets. The elements of the real systems set most relevant to the decision making process are shown diagrammatically in a simplified form in Figure 1. One variable the figure does not show is time. The influence of time is ubiquitous it influences impartially both the explained and the explanatory variables in the argument. Time has to be allowed for in the assessment of each variable.

Each of the elements identified represents a complete group of relevant factors so that taken together the elements define all the factors that make up the environment surrounding the decision making process. The significance of any factor may vary with time. For example, in a major project the importance of financial resources is different at the conceptual stage when the demand for funding is low compared with the construction stage when the demand for funding is real and can be very significant even in national terms. Table 1 summarizes the ways the environment surrounding a decision may change with time. Attention is particularly drawn to the fact that with the passage of time the need for a decision may either increase or decrease.

TABLE 1 SUMMARY OF CHANGES POSSIBLE WITH TIME IN THE DECISION MAKING ENVIRONMENT

DECISION VARIABLE	CHANGES THAT MAY OCCUR WITH THE PASSAGE OF TIME
KNOWLEDGE	Improved knowledge may show action no longer required or must be modified
RESOURCE REQUIREMENT	Demand for resources in terms of material, finance or manpower may be different to that originally predicted.
REQUIREMENT FOR DECISION	Demand for decision and action may increase or decrease

The need for a decision can, with some justification, be described as being generated by various elements in the environment surrounding the decision making process. For this study the decision making process is defined as: the interaction between elements within the decision making set that result in determination of how demands that arise can be most acceptably satisfied with the resources available. This concept of decision making being an interaction between the related elements of a set is illustrated in Figure 2, which shows the decision making process being a continuum lasting from the emergence of the demand to the satisfaction of the demand. During the time of the decision making process the significance of the various variables involved may change. In a decision involving a scientific or technological development the changes that have to be allowed for in knowledge may be quite dramatic.

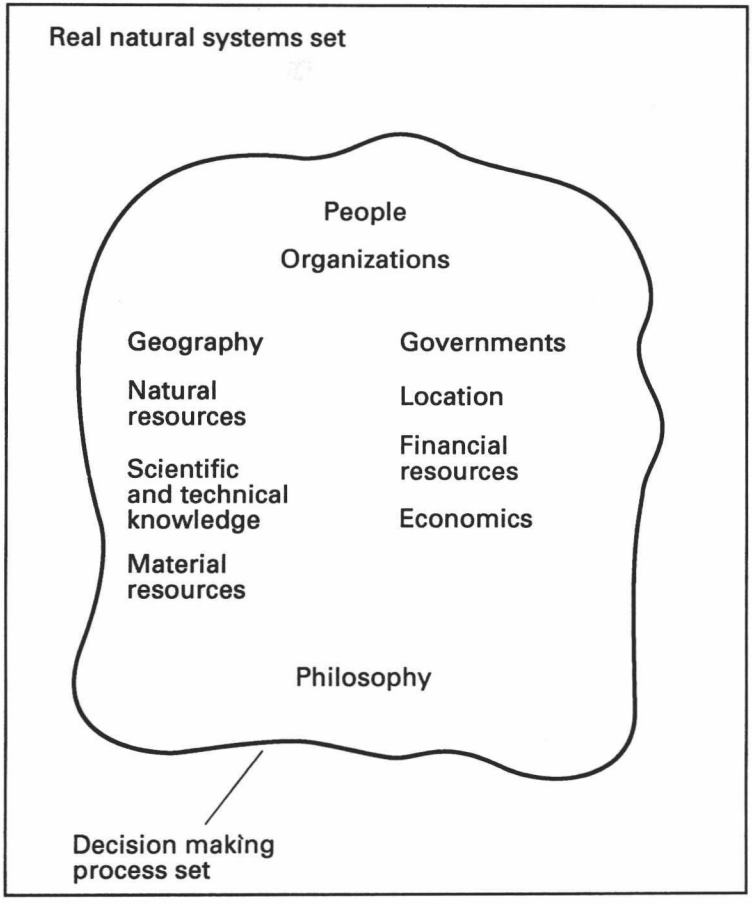

Fig 1 Elements of the real systems set relevant to the decision making process set

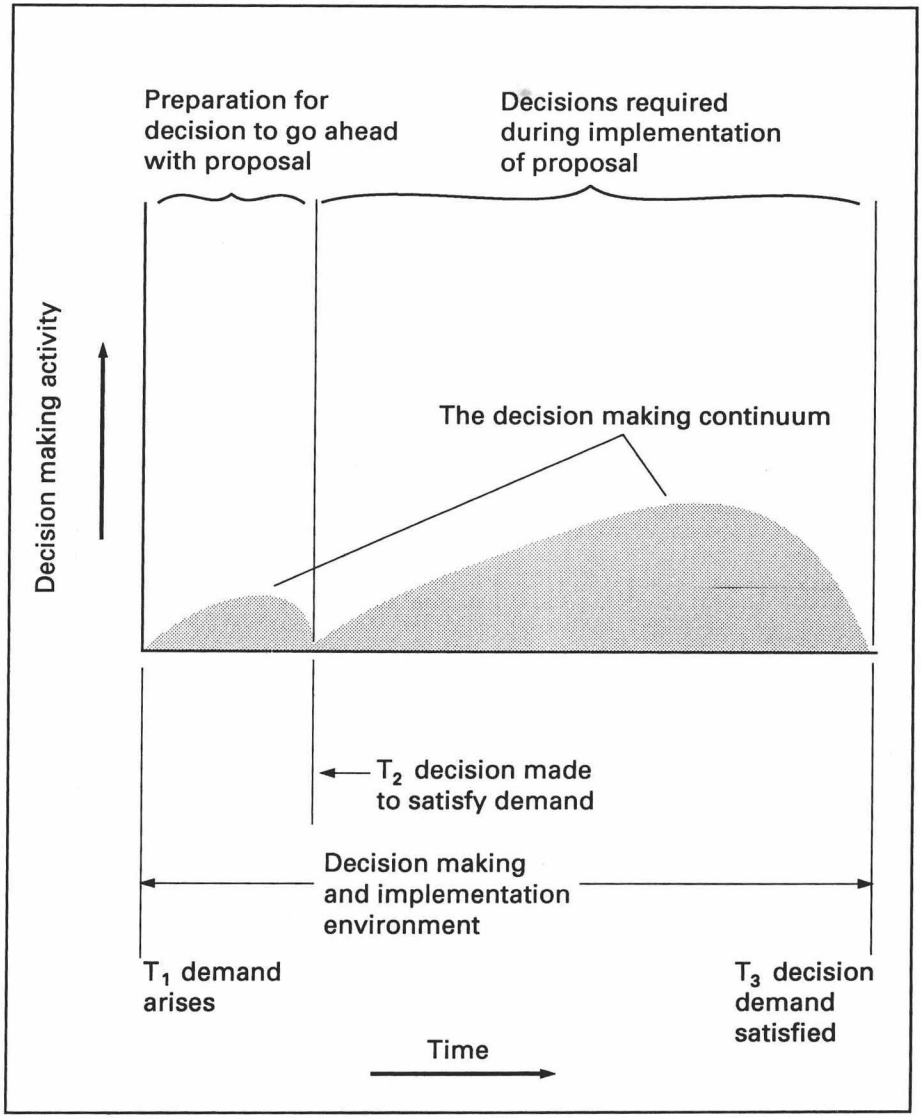

Fig 2 Decision making continuum