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Part I

Introduction

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The scope of decision sciences

1.1 Introduction

The emerging field of decision sciences is concerned with understanding and improving decision making of individuals, groups, and organizations. At issue is not only how decision makers “solve problems,” but also how they came to identify and accept such problems and learn from the results of their actions.

Decision making may be defined as intentional and reflective choice in response to perceived needs. Anthropologists such as Pierre Teilhard de Chardin (1959) consider this ability to reflect and choose as the fundamental characteristic distinguishing man from lower forms of life. While the recognition of this ability may provide the reader with a momentary feeling of superiority, history is also replete with examples of human limitations in decision making. Our purpose in this book is to provide a basis for understanding these limitations as they relate to individual, organizational, and societal decision processes and to use this basis to provide insights as to how such decision processes might be improved.

The dilemmas of choice in the face of an uncertain and complex world have long been the focus of religion, literature, and philosophy. In Western literature, classical epic poems and tragedies depict the gradual evolution of human choice from a metaphorical extension of the will of gods in Homer’s epics to the realm of willful, if not always rational, choice in Euripides’ tragedies. Writers such as Friedrich Nietzsche and Julian Jaynes have described this emergence during the first millennium B.C. from ritual and metaphor to willful action and reflective choice as a matter of the utmost importance in Western culture. People began to view their actions as something beyond the momentary impulses of their current existence to an evolving, connected whole of past, present, and future. The result of this was the view that people could partially affect, and be held responsible for, their choices. It was to be many centuries, however, before the process of reaching such choices was subjected to systematic analysis.

Religion and moral philosophy provided the early foundations for analyzing choice behavior by setting rules for evaluating the motives and

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	DESCRIPTIVE THEORIES	PRESCRIPTIVE THEORIES
Individual	Psychology Marketing Psychiatry Literature	Decision Theory Economics Operations Research Philosophy/Logic
Group	Social Psychology Organizational Behavior Anthropology Sociology	Game Theory Organization Behavior Clinical Psych/Therapy Finance/Economics
Organization	Organization Theory Sociology Industrial Organization Political Science	Planning - Strategy Control Theory/Cybernetics Organization Design Team Theory/Economics
Society	Sociology Anthropology Macro Economics	Legal Philosophy Political Science Social Choice

Figure 1.1. The disciplinary roots of decision sciences

consequences of choice. But it was not until the triumphs of natural science in the seventeenth century that a basis was laid for the systematic investigation of natural phenomena and, much later, of human behavior.

Over the next two centuries, fundamental advances were made in philosophy, economics, biology, psychology, and sociology. Taken together, the result of these studies was a model of the human species as a complicated, evolving organism, embedded in a series of nested social and economic systems. Decision making and choice became areas of immense theoretical and applied interest in many fields. The elaboration and integration of these fields continue. Figure 1.1 lists some of the current disciplines involved in the study of decision sciences today. At the risk of oversimplification, we have divided these fields into two categories of analysis: descriptive and prescriptive. Descriptive analysis refers to how

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people actually make decisions. Prescriptive analysis indicates how decisions should be made according to a set of well-defined criteria. Prescriptive analysis can range from formal axiomatic theories to more informal approaches for aiding decision making. As we shall see, which prescriptive approach one selects for improving the decision process requires understanding the context and descriptive realities of the situation in question.

At the descriptive level, research in the behavioral sciences has increased our understanding of the role of organization and structure on the decision making process. In particular, significant empirical efforts have been undertaken on procedures used by organizations to resolve conflicts and generate solutions between decision makers with different goals and objectives. Political science has addressed similar issues at the level of governmental and bureaucratic decision making. Psychology provides experimental evidence on the limited ability of decision makers to process information and the systematic biases and simplifying decision procedures people employ. Finally, sociology provides a perspective on the nature of information diffusion processes and the role of social norms in the decision-making process.

At the prescriptive level, economics offers a well-developed paradigm for structuring decision making by individuals and firms. At the societal level, an extensive literature is now emerging that provides guidelines for aiding the public choice process. The fields of management science and operations research arose during World War II and thereafter, with an initial emphasis on improving decision making in military and business organizations. A wide range of optimization models has been developed for the purpose of maximizing profits or minimizing costs for part of the firm's operations. In recent years these techniques have been extended to many areas of societal decision making, such as transportation and energy system planning. Finally, the field of information systems is a product of the computer age. Its primary contribution to decision sciences is in the development of interactive computer models, sometimes referred to as decision support systems, which improve decision makers' ability to evaluate complex decision situations.

In reality, it is not so straightforward to categorize a theory as descriptive or prescriptive. Psychology has been primarily concerned with characterizing individuals' information-processing abilities and identifying systematic biases through field studies and controlled laboratory experiments (descriptive analyses). Based on this understanding of human behavior, there has been research by psychologists in trying to correct these biases (prescriptive analyses). Until recently, research in economics focused almost exclusively on the development and application of models of choice as to how individuals and firms should behave (prescriptive

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analysis). Today more attention is being given to understanding the impact that imperfect information and misprocessing of data have on the final choices of individuals and the performance of markets (descriptive analysis).

Utilizing concepts from these disciplines, we view the field of decision sciences as integrating descriptive analysis with prescriptive recommendations. Descriptive analysis provides insights on the values, beliefs, and choice processes actually used by decision makers. Prescriptive analysis helps to clarify values and beliefs and suggests ways of improving decision processes using criteria from rational models of choice, such as expected utility theory, as guidelines. The basic framework of this book for integrating descriptive and prescriptive analysis is described at the end of this chapter. We first consider some of the important organizational and technological factors that have affected decision making in industrial societies and then illustrate the problems of interest in this book with some examples.

1.2 **Historical developments**

It is instructive to consider from a historical perspective why the study of decision making has become increasingly important. The reasons are evident. During the two centuries since the industrial revolution, goods and services available in the market have grown exponentially in variety and complexity. Revolutionary changes in transportation and communication have made economies, both national and international, more tightly interconnected. The workplace has become the realm of science and electronics in place of the manual arts and crafts of two centuries ago. The buildings we live and work in are filled with a bewildering array of labor-saving innovations, which are wonderful when they function properly, and which remind us of an earlier, simpler age when they don't. When one considers all of this, it is clear that the pace of life has quickened. There has been a tremendous increase in the complexity and frequency of decisions confronting individuals and organizations as they seek to understand and cope with their social and economic environment.

Consider individual decision making. Two centuries ago, most decisions revolved around one's survival and associated daily family activities (excluding a few aristocrats who had other concerns). The situation is vastly different now. Today's teenager is already making decisions on complicated consumer items such as cars and computers that were not even invented a century ago. The price of all this is longer educational preparation for life and a much deeper division of jobs and expertise once maturity is reached. Thus, as Alvin Toffler has pointed out, our personal lives have become exceedingly more complex in terms of the choices we must make and, at the same time, our educational and professional lives

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have become narrower as we attempt to stay abreast of at least one of the myriad occupational specialties responsible for supporting our lives.

There have been both positive and negative consequences of these changes at the individual level. Very few would gainsay the importance of the increases in the quality of life and level of goods available to the average person today relative to his predecessors of a century ago. On the other hand, the dizzying pace of associated choice activity and the specialization in education and jobs associated with today's high technology organizations have also caused a deep feeling of loss of control and alienation among many members of modern society. The post-World War II mobile society and the liberation of women have had their impact on the family and have exacerbated the feeling of being alone in a world that one cannot control. Leaving the nuclear family and living in a society that can be wiped out in a nuclear war has created its own set of tensions.

One interesting development of this felt alienation has been a growth of interest in group choice processes as a means of sharing responsibility for these complicated decisions and partially recapturing the emotional support that the family provided in the past. The number of community, social, and economic groups supporting individual interests has grown astronomically over the past century as individuals have attempted to gain a sense of identity and control over their destinies through banding together with like-minded others. Interestingly, although these groups have provided support to individuals, the sheer number of such groups has immensely complicated the social and political processes attempting to balance individual interests in setting public policy.

The recent controversy in different states on the abortion issue stimulated by the Supreme Court decision is one of many examples of the importance of groups in rallying around certain positions and making a political impact. Mancur Olson (1965) has described the increasingly complex problem of dealing with such special interest groups as a major impediment to national economic growth and social consensus. Thus, some of the steps taken by individuals to cope with increased choice complexity have had far-reaching effects on decision making at the group and societal levels as well.

These same effects are also evident in organizational decision making. Two centuries ago, all but a few governmental organizations were small in size with only rudimentary administrative and accounting procedures. The industrial revolution, starting in England in the late eighteenth century and spreading like wildfire to Europe and the United States, changed all of this. First, factories were built to house the newly developing mass production technologies. New energy sources were developed to power these complexes. Organizational and management innovations were designed to cope with the increasing size and complexity of these factories.

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The economies of scale available through these new manufacturing technologies provided incentives to develop wider markets. New transportation modes, both rail and shipping, made this possible, and brought with them at the end of the nineteenth century the beginnings of the large geographically dispersed firms that have grown into today's conglomerates.

Alfred Chandler (1977) has called this transformation from small, family-centered business units to multinational giants the substitution of Adam Smith's "invisible hand" of the marketplace by the "visible hand" of internal organization. Chandler ascribes this substitution to the fact that the complex products we have come to rely on in modern society require much larger production and service organizations than the simpler products of former times. These large organizations also imply immense problems in coordinating and controlling organizational decision making, and in designing the incentive and information systems that support such decision making.

At the societal level there has been a radical change in the role that government has played in our lives in the past fifty years. Prior to that time individuals and firms operated in a relatively laissez-faire environment with the government collecting taxes to support a relatively small bureaucracy and military activities, and with firms occasionally prosecuted for violating antitrust regulations. Today there are a number of federal and state agencies that are involved in information provision and regulation to protect us against health, safety, and environmental risks. Financial risks are mitigated through unemployment insurance and government-subsidized health care. How much risk we are willing to tolerate is a subject of considerable controversy. There is a price to pay for zero risk. The challenge is to frame the problem so people can see what the trade-offs are.

This brief historical sketch points out the vastly changed role of consumers, organizations, and social institutions over the past two centuries. A primary goal of this book is to understand the implications of these changes for decision making, both descriptively and prescriptively.

1.3 **Framework of the book**

The preceding discussion illustrates the broad scope and importance of decision sciences. In this section we wish to outline briefly the framework this book follows in addressing these issues.

1.3.1 *Key aspects of decision making*

Figure 1.2 depicts two major areas of interest with respect to the decision-making process. The box at the top, labeled procedural and technological

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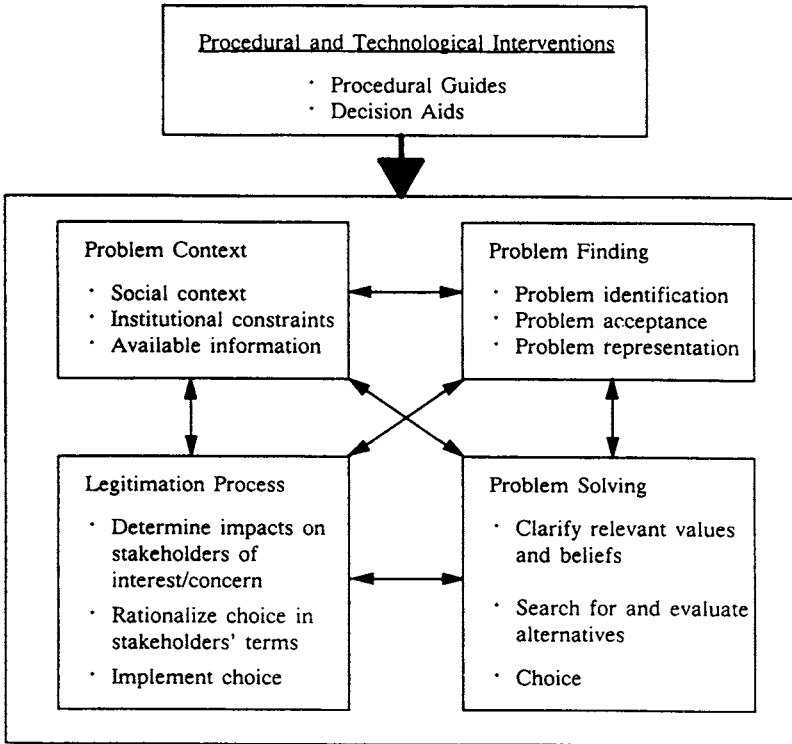


Figure 1.2. Aspects of decision making

interventions, encompasses prescriptive measures to guide and improve the decision-making process. Such interventions may be as simple as check lists and may extend to sophisticated decision support systems using advanced information technology, quantitative models, and data base management techniques.

The second and larger box in Figure 1.2 indicates the major features of decision making. Problem context refers to the social, institutional, and informational environment of the decision process. This is important in determining who may be affected, who has power, what information is available to decision makers and affected stakeholders, and, possibly, the values and beliefs evoked by the problem context in question.

Problem finding is the activity associated with identifying that a decision opportunity exists for a particular decision maker. It also involves the process by which the problem is accepted as within the decision-making purview or responsibility of the decision makers. Finally, problem finding gives rise to a representation of the problem, including some

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elemental notions of the source and structure of the problem identified and criteria for when the problem will have been resolved. Problem finding involves tracing the perceived source of the problem to the needs, values, and beliefs that the decision maker brings to bear in defining the problem as a decision or choice opportunity.

Problem solving is the activity associated with taking action or choice so as to resolve well-formulated problems. This involves articulating relevant values and beliefs, finding appropriate alternatives for choice, evaluating these, and choosing one that seems to resolve the perceived problem or choice situation.

The legitimation process is the final activity associated with decision making. It consists of determining the impacts of potential choice outcomes on stakeholders outside the decision-making body in question and rationalizing the decision makers' preferred choice in these stakeholders' terms. The importance of legitimation processes has been increasingly realized by political scientists and sociologists as an important ingredient of choice. Essentially, the necessity of legitimation focuses the decision makers' attention *ex ante* on constraints and values of individuals who may be affected by certain alternatives. To the extent that the decision maker cares about these stakeholders, possibly because they have the power to constrain the present or future choices if dealt with callously, the anticipation of legitimating a decision outcome can have strong effects on choice.

1.3.2 Fundamental issues

In addition to these categories in isolation, there are many interactive effects between each category. We have just dealt with one such interaction between legitimation and problem solving. Other interactions are easily imagined, and we shall be exploring these in some depth in this book. Without going into detail here, we can point to several issues raised by this interactive view of the several components of decision-making and problem-solving activity. We wish to highlight three fundamental issues at this point, which guide the presentation of much of the material in this book.

1. Linking descriptive and prescriptive analysis. A central theme of this book is that sound prescription must begin with good description. We take the view that all phases of the decision-making process in Figure 1.2 must be first understood before they can be improved. As an example of what we have in mind, it should be clear that different context and legitimation processes may trigger different problem-finding and problem-

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solving procedures for a given decision-making body. Consider the decision of whether to buy a new foreign car or an American car. The same decision may be made in very different ways depending on whether it must be legitimated to others as contrasted with being simply enacted by the decision maker with only his own conscience to bear witness to the validity of his choice. It is therefore important to describe clearly the actual nature of problem context and legitimation processes in understanding and improving choice processes.

A second reason for good descriptive analysis is to provide an operational basis for prescription. It is one thing to observe that a decision outcome is faulty. It is another to know the cause, and this is where descriptive theories are crucial. By modeling the decision process, and understanding its foibles and biases, we are often able to pinpoint the cause of faulty decision making. This may then allow a direct intervention, through procedural constraints or decision aids, in correcting the situation.

2. Recognizing abilities and limitations. Given that descriptive analysis is important, the next step is to adopt the proper perspective on how to view the fundamental actor in decision making, the decision maker. The view we adopt in this book, supported by considerable recent research in psychology and sociology, is that humans have many limitations and biases and that these provide the key to understanding what they will do in choice situations. To put it simply, people do not have immense memory, perceptual abilities, or information-processing abilities. When confronted with tasks that require such faculties, they must therefore adopt certain heuristics or shortcuts. Understanding the resulting consequences for the outcome of these tasks is then a key aspect of descriptive analysis. Such an understanding must clearly rest on a realistic assessment of the cognitive abilities of decision makers. It also provides interesting implications for the nature of appropriate prescriptive interventions in alleviating task overloads on decision makers' cognitive faculties.

Human emotions are also important in understanding decision making. Consider problem acceptance, for example. It is a widely held view that a major reason that many choice situations are resolved in favor of doing nothing (the celebrated status quo solution) is fear. Accepting a problem implies accepting responsibility for resolving the resulting choice dilemma. This can be a very threatening experience, especially if the results of the decision-making activity are publicly announced. Other emotional factors, such as love, hate, regret, and disappointment, may also be seen as very important to understanding choice processes in many problem contexts.