Chapter 2

Solving Decision Problems

"So I deliberated, read up on the problem, went methodically through several libraries, pored over all sorts of ancient tomes, until one day I found the answer... ."

2.1 Chapter Content

This chapter presents the decision process scheme, its principal phases and also introduces the generic idea of decision problem solving. The idea of the scheme is to repeat the principal phases of the process in cycles, till the DM concludes that among variants identified in the decision process, one variant can be regarded, in his/her opinion, as the most preferred variant.

2.2   The Decision Process Scheme

As said before, the decision process ends up when the most pre-
ferred variant is selected.

The following four generic phases can be distinguished in any
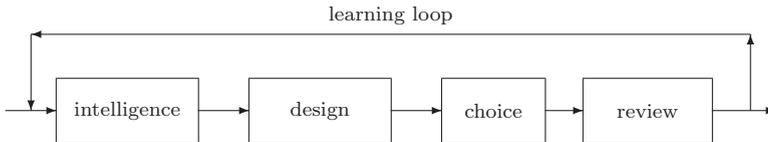decision process[1]:

Figure 2.1 Four phases of the decision making process

– intelligence (1),
– design (2),
– choice (3),
– review (4).

These four phases are closed in the loop called the *learning loop*.

The scheme of the decision process is graphically represented
in Fig. 2.1. In contrast to algorithms, the scheme does not have
a clearly defined stopping rule. The decision process is stopped
when the DM finds it is expedient. We refer here to decision
makers which are free to make their choices without any external
ties, as it is the case where the decision process is not formalized
by any set of rules.

A good example of a non-formalized process is planning one's
professional career. On the other extreme, the process of selecting
the most preferred offers in public tenders is, as a rule, highly
formalized.

Below, we shall be concerned only with processes for which no
formal rules or ties are imposed.

In the intelligence phase (1), the DM specifies the aims and
scope of the decision problem.

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[1] The scheme presented here draws from works of Herbert Simon, the
American economist and sociologist, the laureate of the Turing Prize in 1975
and the Nobel Prize in 1978.

In the design phase (2), the DM (occasionally supported by some analytical staff) specifies a model of the problem consisting of: the decision space X, the set of decision variants X_0, and the list of criteria $f_1, \ldots, f_k$.

By variant enumeration (partial or complete) in the choice phase (3), a variant which is regarded by the DM as the most preferred is selected. Enumeration is performed within the model specified in the design phase (2).

The selection of the most preferred variant in the choice phase (3) can be made automatically, i.e. by an algorithm, or by the DM in a sequence of $DM \Leftrightarrow model$ interactions.

Until now no universal method for automatic selection of the most preferred variant has been proposed. Nowadays, in the majority of cases, the most preferred variant is selected in the interactive manner which works as follows. The DM valuates a sequence of variants in turn. By this, some of his/her partial preferences become explicit. Mechanisms for the derivation of subsequent variants account for those explicit preferences and, presumably, more and more preferred variants are derived.

Variant derivation mechanisms make use of the model specified in the design phase (2). The selection process in the choice phase (3) ends up when the DM is convinced that one of valuated variants satisfies him/her more than any other. That variant is considered the most preferred variant.

The adequacy of the most preferred variant selected in the choice phase (3) to the decision problem under consideration is verified in the review phase (4). In other words, this variant is confronted with the reality of the decision making context. That variant can turn out to be inadequate (nonrealistic, not admissible) because not all circumstances (limits, bounds, conditions, constraints) have been recognized or taken into account in the intelligence phase (1) and in consequence, the model specified in the design phase (2) inadequately represents the problem. This is the stage of the decision making process, where the DM can recognize the existence or significance of such circumstances (the DM *learns*).

If the variant selected in the choice phase (3) is inadequate, the whole sequence of phases (1)–(4) is to be repeated.

2.3   Sum-Up

In this chapter, we have introduced the decision process scheme which is used in subsequent chapters.

The choice phase (3) of the decision process is computationally the most intensive. Usually, in this phase it is necessary to employ some formal (algorithmic, mathematical) tools, and those in turn call for the use of computers and specific software. Such tools are introduced in Chaps. 4 and 8.

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