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An Introduction to  
the Analytic Hierarchy  
Process (AHP) Using  
Super Decisions v2

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# Preface

Since the landmark publication of “Decision Making for Leaders” by Thomas L. Saaty in 1980, there have been several books on the topic. Some of them deal with the theory of the analytic hierarchy process (AHP) and others discuss its applications. The question is whether a new book on AHP is needed and why. The answer is based on our own experience as academic and practitioner of the AHP methodology.

First, AHP appeared as an intuitive and mathematically simple methodology in the field of multi-criteria decision-making in operations research (OR). Because of this, most AHP books assume the reader has basic OR mathematical background. Even books that claim to be extremely simple to understand usually demand from the reader “basic linear algebra and familiarity with vectors” as a prerequisite. Truthfully, these books are very simple to understand if you have the requested mathematical background. However, the problem starts when we try to teach AHP to decision-makers outside the OR field. AHP simplicity suggests that decision-makers from all disciplines can take advantage of the methodology if they can learn it without having to struggle with the mathematical jargon, no matter how simple it can be for an OR professional.

Teaching AHP fundamentals and applications to non-OR students requires a different approach from the one offered by traditional books. Similarly, when explaining and teaching the AHP method to corporate executives, it becomes clear that these professionals are in the best position to take advantage of using the AHP method, but at the same time they lack the time or interest to learn the math behind it. An approach that could provide them with a quick understanding of the method and most importantly, learn it well enough to use it in their business decisions is needed.

This book aims to fill in this need. It provides a quick and intuitive understanding of the methodology using spreadsheet examples and explains in a step-by-step fashion how to use the method using *Super Decisions*, a freely available software developed by the *Creative Decisions Foundation*. The level of math used in this book is at high-school level and we have avoided using

sophisticated terms to make the procedure easy to understand. This book is based on a 15-year experience practicing and teaching AHP to executives and non-OR students and is based on class notes developed for this purpose over time. Because of this, we are also indebted to our AHP students for inspiring us to write this book.

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An Introductory book on the analytic hierarchy process (AHP) would not have been possible without the creation of this methodology. The first author has been blessed with the opportunity to work with and being mentored by the AHP creator himself, Dr. Thomas Saaty, and for this reason he is very grateful. In addition, our work together with Rozann Whitaker in the International Journal and Symposium of the Analytic Hierarchy Process (IJAHp/ISAHP) has been invaluable to make us understand the need to disseminate the “How-To” of AHP to potential practitioners. Also, we thank Heriberto Ortega, a passionate AHP student, who reviewed the examples, and Emily Shawgo who was key for the development of the supplementary material. Finally, without AHP students and practitioners, there would not have been the need and motivation to write anything in the first place and for this reason they deserve credit for bringing this book to life.



# Introduction

Human beings are required to make decisions at individual and collective levels. Initially, the decision-making process was studied as a rational process of analyzing a problem and seeking solutions; however, in recent years it has become clear that human beings are far from making decisions in a rational way, either as an individual or as part of a group.

Psychological studies have found cognitive anomalies or biases experienced by human beings when making decisions (Kahneman 2011). These cognitive biases and the increasing complexity of modern problems make it extremely important to adopt a methodology for making straightforward (easy to use and understand), effective (making the consistent decisions according to our criteria and interests), and safe (proven methodology) decisions.

The analytic hierarchy process (AHP) meets all these requirements and since its appearance in 1980, it has been adopted and used by a large number of institutions all over the world. For these reasons, this is the method that will be presented here for practical decision-making.

There are several books dealing with AHP theory and practice. This book is different in the sense that it intends to provide you with a practical introduction of AHP. In other words, upon reading this book you will be able to start using AHP in practical applications.

## Reference

Kahneman, D. (2011). *Thinking fast and slow*. New York: Farrar, Straus and Giroux.

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## **Part I**

### **Basics**



# Chapter 1

## The Need for Another Decision-Making Methodology

Henry Mintzberg defined three types of management roles: interpersonal, informational, and decisional (1989). Interpersonal refers to the ability of the manager of being a figure head, motivational, and a liaison with the public (e.g., Steve Jobs at Apple). Informational refers to the manager's role as information broker and disseminator. Decisional refers to the power and ability of making decisions.

While Mintzberg argued that different managers have different role abilities, he highlights that managers have the authority and power of committing their organizations to courses of actions that will lead to successful or funnest outcomes. Based on this, being an effective decision-maker is a fundamental skill for managers and leaders alike. In the end, it is the right and wrong decisions that will make the firm succeed or fail. This is quite true not just at the organizational level but also at the individual level.

### 1.1 The Need for Decision-Making Methodologies

The most popular model of decision-making at the individual level was proposed by Simon (1960) and defines decision-making as a process comprising the steps of: intelligence, design, selection and implementation. The stage of *intelligence* is associated with the question: What is the decision we face? The *design* stage allows you to propose alternatives and criteria to evaluate them while the *selection* stage consists of applying the proposed criteria to choose the best alternative(s) to the problem. Finally, the last step is to *implement* the chosen alternative.

This model, as well as other similar models, assumes individuals are rational information processors that seek to maximize the benefits of their decisions (economic behavior); however, these assumptions have been strongly questioned in recent years (Camerer 1994). Experiments in cognitive psychology have shown that individuals are easy victims of a series of cognitive biases such as the phenomenon of framing (changing the way a decision is framed—e.g., as a win or a loss—makes

individuals change their opinions), anchoring (the individual's decision is influenced by what piece of information is shown first), and many other cognitive biases (Kahneman 2011).

For example, if two investment projects are presented to a group of people, one where there is the probability of losing 20 % of the investment and another in which there is 80 % chance of making a profit; people prefer to invest in the second project, although both have the same risk (20 % probability of losing and 80 % winning). This is an example of the phenomenon of preference based on the frame of reference (framing). In general, humans feel more inclined to proposals that are presented in positive terms (e.g., earnings) rather than those that are presented in negative terms (e.g., losses).

In other studies, it has been found that if a group of individuals is asked to estimate the following product:  $2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9$  and another group composed of individuals of similar age, education, etc., are asked to estimate the product  $9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2$ ; the first group estimates systematically lower results than the second group. This is because people are influenced by the first numbers shown. This phenomenon is called anchoring; somehow the person's estimate is defined or "anchored" by what is shown first.

In other words, these studies prove that human beings are not cold and calculating information processors. The fact that individuals may choose alternatives independently of their economic benefits does not speak well of the individuals in their role as *homo economicus*.<sup>1</sup>

Unfortunately, these cognitive biases do not simply occur as isolated cases, but their constant influence on financial, political, social, and professional decisions has been demonstrated (Piattelli-Palmerini 1994). For example, in 1982, McNeil, Sox, and Tversky subjected a select group of doctors in the United States to a test. Using real clinical data; these researchers showed that doctors were so prone to make mistakes based on the decision's frame of reference (framing error) as anyone else. If doctors were informed that there was a 7 % expected mortality for people undergoing a certain surgery, they hesitated to recommend it; if on the other hand, they were told there was a 93 % chance of survival to the operation, they were more inclined to recommend the surgery to their patients.

If this happens with medical professionals, what can you expect from the rest of us? While there are several famous cases of fatally flawed individual decisions, decisions at group level have not fared much better. At the group level, disastrous decisions such as the invasion of the Bay of Pigs under President Kennedy or the madness of investments in Internet companies have been also attributed to problems associated with decision-making cognitive biases. Undoubtedly, there is a need for decision-making methodologies that can help to minimize biases and increase the likelihood of making effective decisions.

---

<sup>1</sup>An amusing discussion of how people can make irrational decisions is provided by Dan Ariely in *Predictably Irrational: The Hidden Forces that Shape Our Decisions*. Harper Perennial.



One of the reasons for the interest in working in groups in modern organizations is precisely the possibility of minimizing cognitive biases and to obtain group participation's synergy; however, this has not proven to be the ultimate solution to the problems of decision-making. Organizational psychology has shown that as part of a group, individuals are also exposed to a number of problems that hinder group decision-making (Forsyth 2013). Among these group cognitive biases, we can mention *groupthinking*, consisting of the individual's desire not to act (or decide) different than what seems the consensus in the group (Janis 1972). Another group bias is caused by *power unbalance* which makes the members of the group with less power and influence try not to antagonize those of greater power in the group, etc.

## 1.2 Decision-Making Methodologies

Perhaps the best known method for decision-making, described by Benjamin Franklin in a letter to Joseph Priestley, is the called Pros and Cons list. In this method, the problem is clearly stated, alternative possible solutions are proposed, and the pros and cons of each are established. Then, according to the importance of each PRO/CON factor and how it can be traded with the others (for example, the benefit/satisfaction provided by a specific PRO may be canceled out by the cost/pain of two specific CONS), the best alternative is determined based on the net result of this PRO/CON trading.

This method is, despite its limitations, a great improvement over simply following one's intuition to make a decision. The advantages of this method (and the majority of decision-making methods in general) are that it allows; first, the structuring of a problem that at first glance may not seem possible to structure; and second, allows sharing the decision criteria with others to get more ideas and opinions. The above method works well for simple problems but has the disadvantage of not being able to accurately quantify the relative importance of each factor to be traded. Moreover, the process is complicated when the number of alternatives and factors becomes very large. A better method is needed.

There are several methods of decision-making but most require specific training in areas such as economics, operations research, probability, etc. However, what is needed is a methodology that can be applied in a more natural way by decision-makers.

The analytic hierarchy process (AHP) developed by Professor Thomas Saaty in 1980 allows for structuring the decision hierarchically (to reduce its complexity) and show relationships between objectives (or criteria) and the possible alternatives. Perhaps the biggest advantage of this method is that it allows the inclusion of intangibles such as experience, subjective preferences and intuition, in a logical and structured way.

The popularity of this method has increased since its implementation as computer software in the mid-1980s and the development of group decision support