# The evolution of decision-making theories in the context of management

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**Abstract- Individual theories of decision-making have evolved and shaped with respect to the current conditions of the social environment. Many scientific studies are based on individual theories, but there is no comprehensive view of their evolution in the context of the need for their emergence, their logical continuity, understanding of the criticism of previous theories and the innovations of subsequent theories. In the above we see a research gap that we seek to fill with a theoretical study. The main objective of the present paper is to develop a timeline of decision theories in terms of the normative and descriptive direction of their development. The emphasis is on the critical analysis of the theories, their comparison and subsequent synthesis of the findings in the form of a systematic literature search. In the discussion section and in the conclusion of the paper we discuss the importance of decision-making and reasoning as a scientific discipline in the context of ongoing industrialisation. Using a chronological timeline with descriptions, it is illustrated how puzzling ideas opened up space for more complicated ones. In particular, we focus on theories that have the potential to be applied in theory as a tool for the development of managerial thinking or in practice as a tool used to improve managers' decision-making.**

**Keywords – decision-making, management, decision theories**

## I. INTRODUCTION

Humans are the only creatures on the planet who have the privilege of studying their own mental processes. One of the fundamental mental processes of humans is the decision-making process. All mental processes are made up of a complex of related mental phenomenons. Decision-making is a set of mental processes whose purpose is to determine the appropriate goal and course of action in a particular situation. In decision-making we speak of a volitional action, a sequence of steps that lead to the resolution of a conflict situation by selecting one option from among the possible solutions to a given problem. The process of decision-making results in a decision.No organisation can operate without making decisions. Decision-making is a key element of management. Companies have to decide which customer to serve, what technology to invest in, what employee to hire, what product to buy, and so on. Thus, decision-making is an ongoing managerial function that has its place in any other managerial function and activity. In order to understand, subsequently improve and enhance the quality of decision-making processes in management, theories and methods of decision-making have emerged, defined in terms of content through descriptive and prescriptive approaches.Individual theories of decision-making have evolved and shaped with respect to the current conditions of the social environment. Many scientific studies are based on individual theories, but there is no comprehensive view of their evolution in the context of the need for their emergence, their logical continuity, understanding of the criticism of previous theories and the innovations of subsequent theories. In the above we see a research gap that we seek to fill with a theoretical study.

The main objective of the present paper is to develop a timeline of decision theories in terms of the normative and descriptive direction of their development. The emphasis is on the critical analysis of the theories, their comparison and subsequent synthesis of the findings in the form of a systematic literature search. In the discussion section and in the conclusion of the paper, we discuss the relevance of decision-making and inference as a scientific discipline in the context of ongoing industrialization. Using a chronological timeline with descriptions, it is illustrated how basic ideas opened up space for more complicated ones. In particular, we will focus on theories that have the potential to be applied in theory as a tool for the development of managerial thinking or in practice as a tool used to improve the decision-making process of managers.

## I. HISTORY AND EVOLUTION OF DECISION-MAKING

The first ideas about how to make "right choices" can be found many centuries before our era in the form of the wisdom of the philosophers of the time. They can be considered as the first theories or even methods of decision-making. With the development of economics, the first normative theories then emerge. However, the modern era for this field does not begin until the period of the world wars.

### A. *Early decision-making considerations*

The earliest reflections on decision-making can be found in the form of the wisdom of the philosophers of their time. They were both normative and descriptive in nature [1]. The ideas mentioned above do not all directly represent a theory or method of decision making. For example, the emergence of Arabic numerals does not in itself constitute a theory of decision making, but it was a precondition for its emergence and one of the most important milestones. Shortly after the Arabic numerals, algebra emerges, which is directly followed by probability theory.

Some of these ideas build the foundation of current managerial decision theories. Modern decision analysis is also based on Aristotle's idea below. Plato, in turn, emphasized the role of emotion and intuition in decision-making. Occam's razor can be considered as the basis of the very popular "Lean management" or "Agile management" [2]. Today we already apply some of these principles subconsciously and take them as a granted. Early history of decision making:

Table 1: Early development of decision-making

| Year | Author | Name | Main Idea | Criticism |
|---|---|---|---|---|
| 6th century BC. | **Lao ´C** | *Not acting* | Letting events take their natural course | |
| | **Confucius** | | Decisions should be based on charity, rituals, reciprocity and filial piety. | |
| 5th century BC. | **Athenians** | *Group decision-making* | Decision-making through elections (the birth of democracy) | Tyranny as authoritarian individual decision-making |
| 4th century BC | **Plato** | *Intuitive decision-making* | All perceptible things are derived from eternal archetypes, and it is better to discover them through the soul than through the senses. | Aristotle - empirical decision-making |
| | **Aristotle** | *The basis of the empirical-analytical approach* | An empirical view of knowledge that values information obtained through the senses and deductive reasoning. | Plato - deciding "with the soul" |
| 9th century | **Arab Empire** | *Modern mathematics* | The Hindu-Arabic number system, including zero, spread throughout the Arab empire and stimulated the development of mathematics. | |
| 14th century | **William of Ockham** | *Occam's razor* | The best theory is the simplest one that fits all the evidence. | It is only a useful heuristic not a fact |

Source: own processing based on: *A Brief History of Decision Making. (2006, January 1). Harvard Business Review. https://hbr.org/2006/01/a-brief-history-of-decision-making)*[3]

We could certainly find more ideas shaping decision-making theories in the past, but in the context of management we consider it sufficient to mention the above examples. We can see that from the very beginning this "research" had several competing ideas. This is what makes the study of decision-making extremely interesting even today. A universally valid explanation of decision-making processes does not yet exist and therefore the field of decision-making has a great potential contribution to make to human knowledge from a scientific point of view in the long term.

B. *The development of mathematics and the birth of economics*

More interesting for management science is the period that begins with the development of mathematics and the birth of economics as a science.

Table 2: The period before the emergence of an independent science of decision making

| Year | Author | Name | Main Idea | Criticism |
|---|---|---|---|---|
| 1654 | **Blaise Pascal, Pierre de Fermat** | *Problem of points* | Based on a gambler's question about the "points problem", they developed the concept of calculating probabilities for random events. | Inadequate when considering less idealised situations where it was not possible to give a finite number of equally likely possible outcomes (weather or stock market) |
| 1660 | **Blaise Pascal** | *Pascal's bet* | For the decision-maker, the consequences may be more important than the likelihood of being wrong. | |
| 1738 | **Daniel Bernoulli** | | He laid the foundations of the science of risk by examining random events in terms of how much an individual desires or fears each possible outcome. | |
| 1763 | **Thomas Bayes** | *An Essay on Problem Solving in the Doctrine of Chance (Bayes' Theorem)* | Describes the probability of an event based on prior knowledge of conditions that may be associated with the event. | |
| 1809-1823 | **Jeremy Bentham** | *The principle of utility* | It regards good as that which causes the greatest amount of pleasure and the least amount of pain, and evil as that which causes the greatest pain without pleasure | John Stuart Mill, sharply criticized Bentham's view of human nature, which failed to recognize conscience as a human motive. |

Source: own processing

These authors brought many of the basic principles applied in decision-making and judgement research to the field today. These theories, although they can be classified in the classical period in terms of decision research, were often descriptive in nature. Thus, they took into account that man does not behave as a homoeconomicus but that his judgment and decision-making are influenced by a large number of, sometimes difficult to measure, factors. Pascal's wager is an example of a descriptive theory of decision making. Thomas Bayes is an important author. Bayes' theorem is as important in truth-similarity theory as Newton's equations are to physicists or Pythagoras' theorem is to mathematics. Although the authors of the pre-World War II period brought much insight to the science of decision making, paradoxically the science did not formally exist at that time. Decision making was not studied systematically, there was no institutionalized research, and the results were largely a " side-effect" of the investigations of mathematicians, physicists, theologians, or lawyers [4].

Systematic research in decision making, in the form of the search for new analytical tools for operations research, began ingloriously like many other disciplines during World War II [3,5].

*C. The scientific discipline of judgement and decision-making (JDM)*

The mathematician John Von Neuman started research in the field of decision making with the concept of "expected utility". Expected utility is what results from combining random events with probabilities. We multiply the probability of an outcome against the gains that would accrue to get a value, expected utility, that helps us make decisions [5,6]. Von Neumann based his analysis on the game of poker, in which potential profits can be easily

quantified. For real decisions, it is more complicated. Probabilities are also a problem: If we make decisions under uncertainty, how do we figure out the probabilities?

The answer is provided by the ideas of Bayesian statistics (most of them not the work of the English Reverend Thomas Bayes, but of the French mathematician Pierre-Simon Laplace) developed in the 1930s. Leonard Jimmie Savage's The Foundations of Statistics (1954) laid down rules for changing probability estimation in the context of newly acquired information [7]. Another important "fruit" of this new way of thinking is portfolio selection theory, formulated by Harry Markowitz in 1952. He advised investors on how to estimate both the expected return on a stock and the probability that their estimate was wrong [8]. Markowitz was awarded the Nobel Prize for this in 1990.

The initial phase dates from 1954-1972 and three main themes in particular came to the fore, which are still part of research today: uncertainty and probability theory, decision-making under risk and utility theory, strategic decision-making and game theory [9]. The broader field of decision analysis began to take shape in 1957 when mathematician Howard Raiffa arrived at Harvard with a joint appointment in the Business School and the Department of Statistics. He soon found himself teaching a course in statistics for business students with Robert Schlaifer, a classics expert and quick learner who had been teaching just about everything that was needed at HBS in the postwar years. Both concluded that the standard statistical fare of regressions and P-values were not that useful to future business leaders, so they adopted a Bayesian approach. Soon they were teaching more decision-making than statistics. Raiff's decision trees, which students used to calculate the expected value of the various paths available to them, became a foundation at HBS and other business schools that have emulated this approach [5].

Bayesian judgments represent an update of the a priori probability to the aposteriori one. It is a kind of probabilistic judgement, considered normatively adequate and rational. However, criticisms of authors investigating decision making descriptively arise. Ward Edwards considered the main reason for the failure of solvers of the above tasks to be their inability to properly group and combine data in the computation and revision of their beliefs, and he also labeled people as conservative information processors. Further, the field has also been addressed by authors Tversky and Kahneman, Kleiter, and Gigerenzer and Ulrich Hoffrage[10].

An important author who has contributed to research on descriptive approaches to decision making is Simon [11], whose concept is called bounded rationality. The essence is that people do not always behave rationally, but rather function in ways that do not maximize utility or operate with limited information processing capacity. Lee points out that the notion of bounded rationality can be interpreted as rational choice within computational constraints[12]. Testing this phenomenon has subsequently been explored in recent years by Zenko, Ekkekakis and Kavetsos[14,15].

The second period, from 1972 continued until 1986 and many important ideas of researchers and authors were born. In addition to the normative and descriptive approaches to decision-making, a third category emerged - prescriptive. Attention was drawn to human rationality, where author L. J. Cohen asked whether human irrationality could be experimentally demonstrated[15]. Also characteristic of this period is the research program on biases and heuristics by Kahneman and Tversky [16]. The topic of overconfidence in probabilistic judgments was also brought to the fore by Lichtenstein and Fischhoff[17]. This author has also addressed the hindsight bias, the implications of which are relevant to various domains of everyday life. In this period, 1982, the aforementioned author Fischhoff began to dedicate himself to the issue of debiasing, and his research was continued by Keren, who pointed out that the ability to overcome cognitive biases is limited [19,20].

The following years 1986-2002 can be considered as the next significant period. The most influential work in this direction is Busemeyer and Townsend's work on decision theory [20], where they present a dynamic cognitive approach to decision making in uncertain environments. This theory adopts a sequential sampling process to explain such disparate decision phenomena as violation of stochastic dominance. The topic of the dynamic nature of the world, especially the decision maker's uncertainty in his future preferences, is also addressed by March [21]. Also important at this time was the work of Hsee[23,24], where he discusses the explanation of preferences in the case of joint and separate evaluations of alternatives. Intrinsic to the research of the authors [25,26]of this period was the affective behaviour of humans.

## II. DISCUSSION

Nowadays, JDM research is the subject of many scientific disciplines; normative directions have formed the basis of artificial intelligence, expert diagnostic systems, data analysis and others. Descriptive directions, on the other hand, have provided the basis for neuroscience, psychology and psychiatry or sociology. As the environment changes, new challenges come but we also gain new tools to overcome them. The still young scientific discipline is made up of a large number of fragments obtained through experimental research that form a mosaic of human decision-making processes. What are the current trends in managerial decision-making and what is the relevance of the above-mentioned, nowadays, so to speak, classical theories in the context of the current state of the world?

An easily noticeable trend is the availability of data. In various examples from both the public and private spheres, we see endless amounts of data travelling back and forth through information systems, automatically processed, sorted and even interpreted. So let's put Big Data in the hands of managers in front of the concept of bounded rationality. A classic concept cited in thousands of papers, one of the pillars of all known decision theory. One of the barriers to rationality cited by Simon was the information void. Based on the idea of bounded rationality, the decision maker resorts to satisfactory solutions instead of optimal solutions due to lack of data, because of information void. A very recent study by Pittenger et al. [26] provides an answer. Based on a survey, it finds that while data is ubiquitous, the quality, utility and value of data are inconsistent and remain constraints on managerial decision making. These findings suggest that satisficing behavior can and does exist also in the age of data in our hands[26].

According to Di Fiore [27], there are three main reasons why judgement will remain a focal point of management and leadership practice in the years to come. First, qualitative judgement is the last reserve of humanity in the decision-making process. Creativity, emotional understanding, and pure imagination are things at which humans excel, and the availability of vast amounts of additional data or AI will not disprove this fact. Second, as the cost of prediction falls, the demand for judgement will increase. AI is a predictive technology, so the cost of prediction will get cheaper over time. This means replacing other input factors (human skills) with cheaper and better technology for collecting data and making predictions. At the same time, however, the value of and demand for complementary factors, such as more decisions to be made for more frequent insights and forecasts, will increase. This in turn will lead to more demand for the application of judgment and emotional understanding (provided by people) in making these decisions. Third, as data prediction technologies become more widespread, judgment needs to become more prevalent. Big Data and AI technologies will provide managers and employees with accurate data and predictions at their fingertips. These technologies leverage distributed IT architectures that enable employees across organizations to make the right decisions in a timely manner. Distributed data will enable and require the distribution of decision-making authority based on judgment.

The importance of good judgement and decision-making is thus likely to increase. The only thing that is changing are the underlying themes given by the environment. However, the basis for the study of decision-making will always be, among other things, the basic theories and ideas mentioned above, which perform the same function in management education as the periodic table of the elements in chemistry, Newton's laws in physics, or the Roman law in the law sciences. They provide us with the necessary basis for thinking about more complex problems in the field. The better the foundation one builds, the more solidly the top of one's efforts stands.

## III. CONCLUSIONS

The main objective of the present paper was to develop a timeline of decision theories in terms of the normative and descriptive direction of their development. On the basis of a critical analysis of individual theories, their comparison and subsequent synthesis of knowledge, we can conclude that the basic ideas opened the space for more complicated ones, that even today we can apply known theories from the past in managerial thinking, and that some of the long-acquired knowledge forms the basis of today's theories. The science of decision-making and reasoning as it has developed today has overlapped into a large number of disciplines that are gaining in importance.

In the current period, decision-making processes are being shaped by the fourth industrial revolution. Some authors are inclined to the view that analysis, automation or adherence to well-defined steps in decision-making processes are indeed necessary in today's information age and are paramount in the context of the Industry 4.0 era. On the other hand, it must be stressed that behavioural economics, its knowledge and conscious incorporation into decision-making are integral to achieving an efficient rational process. Awareness of the fact that we can fall into one of the psychological traps, the knowledge that the action of different types of emotions can significantly influence our decision-making, can significantly improve the quality of our decision-making processes. Thanks to the rapid development of computer technology and the availability of rich software support, rational approaches to decision making are leading to a renewed understanding of their importance and also to a change in their understanding. There is an emerging tendency to bring into the decision-making process the involvement of all stakeholders, collective judgement, the ability to learn from the evolution of a situation or openness to feedback. The understanding of the decision-making process is thus shifting from its traditional conception to a new understanding that incorporates these factors[28].

The problem of normative and descriptive theories in decision making has been addressed by many scholars who highlight the positives of one or the other side of decision-making methods. In any situation, whether it is normal decision making or decision making in crisis conditions and also in times of technological advancement, it is not possible to overemphasize only one side of decision making. Developments are leading to an integration of the two in the form of a direction that has no name yet, but implies a synergy of rational decision-making and critical thinking and reasoning in the context of descriptive theories[28]. Given the importance of decision-making and its related

theories in both theoretical and practical terms, we consider the knowledge and understanding of the evolution of decision-making theories to be significant and beneficial for improving managers' decision-making.

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## REFERENCES

[1] N. Suhonen, "Normative and descriptive theories of decision making under risk: A short review," 2007.
[2] G. D. Putnik and Z. Putnik, "Lean vs agile in the context of complexity management in organizations," *The Learning Organization*, 2012.
[3] L. Buchanan and A. O Connell, "A brief history of decision making," *Harvard business review*, vol.84, no. 1, p.32, 2006.
[4] V. Bačová, "ROZHODOVANIE A USUDZOVANIE," p.210, 2010.
[5] J. Fox, "From 'economic man' to behavioral economics," *Harvard Business Review*, vol.93, no. 5, pp.78–85, 2015.
[6] J. Von Neumann and O. Morgenstern, "Theory of games and economic behavior, 2nd rev," 1947.
[7] L. J. Savage, The foundations of statistics. Courier Corporation, 1972.
[8] M. E. Mangram, "A simplified perspective of the Markowitz portfolio theory," *Global journal of business research*, vol.7, no. 1, pp.59–70, 2013.
[9] G. Keren and G. Wu, Eds., The Wiley Blackwell Handbook of Judgment and Decision Making: Keren/The Wiley Blackwell Handbook of Judgment and Decision Making. John Wiley & Sons, Ltd, Chichester, UK, 2015.
[10] V. Bačová, "Rozhodovanie a usudzovanie II," *Oblasti a koncepcie. Bratislava, Ústav experimentálnej psychológie SAV*, 2011.
[11] H. A. Simon, "Rational decision making in business organizations," *The American economic review*, vol.69, no. 4, pp.493–513, 1979.
[12] C. Lee, "Bounded rationality and the emergence of simplicity amidst complexity," *Journal of Economic Surveys*, vol.25, no. 3, pp.507–526, 2011.
[13] Z. Zenko, C. J. Berman, and J. D. O'Brien, "HEURISTICS, BIASES, AND BOUNDED RATIONALITY," *Motivation and Self-regulation in Sport and Exercise*, p.41, 2021.
[14] Z. Zenko, P. Ekkekakis, and G. Kavetsos, "Changing minds: Bounded rationality and heuristic processes in exercise-related judgments and choices.," *Sport, Exercise, and Performance Psychology*, vol.5, no. 4, p.337, 2016.
[15] L. J. Cohen, "Can human irrationality be experimentally demonstrated?," *Behavioral and Brain Sciences*, vol.4, no. 3, pp.317–331, 1981.
[16] A. Tversky and D. Kahneman, "Judgment under uncertainty: Heuristics and biases," *science*, vol.185, no. 4157, pp.1124–1131, 1974.
[17] S. Lichtenstein and B. Fischhoff, "Do those who know more also know more about how much they know?," *Organizational behavior and human performance*, vol.20, no. 2, pp.159–183, 1977.
[18] B. Fischoff, "Debiasing," DECISION RESEARCH EUGENE OR, 1981.
[19] G. Keren, "Cognitive aids and debiasing methods: can cognitive pills cure cognitive ills?," in Advances in psychology, vol.68, Elsevier, 1990, pp.523–552.
[20] J. R. Busemeyer and J. T. Townsend, "Decision field theory: a dynamic-cognitive approach to decision making in an uncertain environment.," *Psychological review*, vol.100, no. 3, p.432, 1993.
[21] D. E. Bell, H. Raiffa, and A. Tversky, Decision Making: Descriptive, Normative, and Prescriptive Interactions. Cambridge University Press, 1988.
[22] C. K. Hsee, "Elastic justification: How unjustifiable factors influence judgments," *Organizational Behavior and Human Decision Processes*, vol.66, no. 1, pp.122–129, 1996.
[23] C. K. Hsee, "The evaluability hypothesis: An explanation for preference reversals between joint and separate evaluations of alternatives," *Organizational behavior and human decision processes*, vol.67, no. 3, pp.247–257, 1996.
[24] D. E. Bell, "Regret in Decision Making under Uncertainty," *Operations Research*, vol.30, no. 5, pp.961–981, 1982.
[25] B. A. Mellers, A. Schwartz, K. Ho, and I. Ritov, "Decision Affect Theory: Emotional Reactions to the Outcomes of Risky Options," *Psychol Sci*, vol.8, no. 6, pp.423–429, Nov. 1997.
[26] L. M. Pittenger, A. M. Glassman, S. Mumbower, D. M. Merritt, and D. Bollenback, "Bounded Rationality: Managerial Decision-Making and Data," *Journal of Computer Information Systems*, vol.0, no. 0, pp.1–14, Sep. 2022.
[27] A. Di Fiore, "AI and the democratisation of judgement and decision-making," LSE Business Review, 15-Jan-2018.
[28] D. Puhovichova and N. Jankelova, "Changes of human resource management in the context of impact of the fourth industrial revolution," *Industry 4.0*, vol.5, no. 3, pp.138–141, 2020.