THE USV ANNALS OF ECONOMICS AND PUBLIC ADMINISTRATION | VOLUME 18, ISSUE 1(27), 2018

# DECISIONAL MODEL UNDER UNCERTAINITY CONDITIONS

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**Abstract:**
*The notions of risk and uncertainty are the subject of countless studies and specialized papers, being treated by both Romanian and foreign researchers, whose considerations have been taken as reference in the realization of the theoretical and methodological basis of this paper.Unforeseen events influence the present and the future results of businesses, the risk being part of their economic life. In order to have successful businesses, managers need to learn how to manage the risks to which societies are subjected, to understand them, and to prevent them. Starting from the approached subject, the scientific demarche of this paper begins with the identification of a decisional model that highlights the idea that the variability of the results is imprinted, on the one hand, by the decision of the decision-maker and by the eventualities (uncontrollable elements), therefore under uncertainty the result of a decision will have both a part that can be controlled and a part that cannot be controlled.*

**Key word**s: risk, uncertainty, decisional model, distribution of probability decision tree.

**JEL classification:** M41, M49.

## I. INTRODUCTION

"Uncertainty has become a norm for processes taking place in the economy because the information that economic agents need for getting the best results are not available and when are available, they are partially affected by errors or they are incomplete." (Prunea, P., p. 19). In this situation, the behavior of economic agents is marked by uncertainty, and decisions are taken either to accept the risk and to try to treat it, either in the sense of avoiding the risk. The concepts of risk and uncertainty are used in the same way by Ionașcu (Ionascu, I., p. 228) in his approach of presenting how decisions should be made under uncertain conditions (known or not).

## II. THE SHAPE OF A DECISION MODEL

Business activity is influenced by *state variables* and *development variables*, and the ability to adapt and evolve depends on how these variables are handled. The risk is a consequence of the variability of the results, the variability being caused by the random nature of some of the environmental components (competition, natural environment, political environment, social environment, etc.). The decision model should also include the variability of the results, such model being treated in **Figure no. 1.**

The decision model identified bellow highlights that the variability of the results is imprinted on the one hand by the decision-maker decisions and by the eventualities (uncontrollable elements); in other words, under uncertainty conditions the outcome of a decision has both, a controllable part and a part that cannot be controlled.

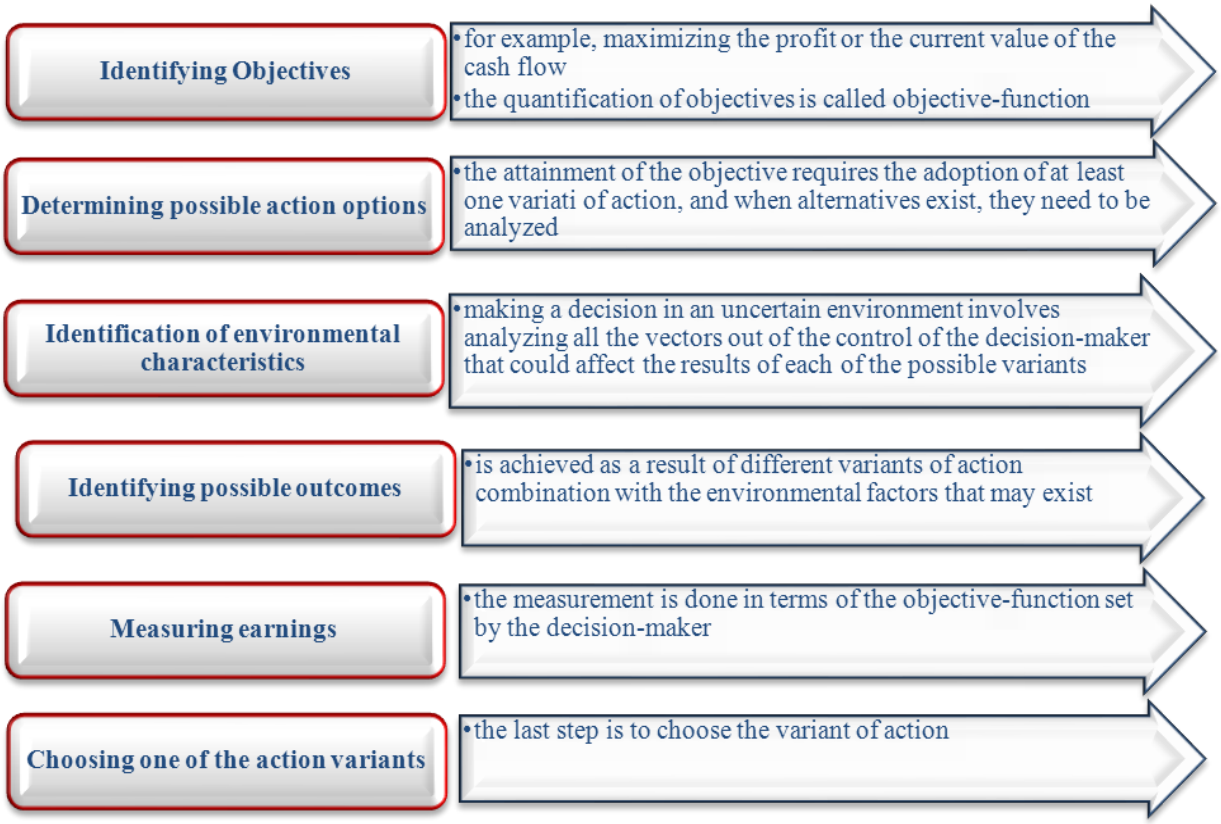


**Figure no. 1. Decisional model under uncertainty**

Source: adapted based on Ionaşcu, I., Filip, A. T., Mihai, S. - *Management control*, Economic Publishing House, 2006

## III. ANALYSIS OF A DECISION MODEL UNDER UNCERTAINTY CONDITIONS

Optimizing decisions under uncertainty conditions is based on the probability theory, probabilities that can be determined objectively or subjectively. In the following part of the paper, I will present a decision model starting from identifying the probability of occurrence of an event, continuing with the analysis of the distribution of probability and the expected value determination, as well as the uncertainty assessment and culminating with the decision tree.

### Probabilities

The frequency of occurrence of an event or of a condition over a certain period of time is referred to*probability of occurrence* in the literature and is usually measured in the range of real numbers [0; 1]. Thus, a probability of 0 signifies the impossibility of producing an event, and a probability of 1 reflects the certainty of the occurrence of that event.

The type of information, the quantity and the degree of confidence in it are factors of influence on choosing a type of probability. If on the basis of facts already known, the probability of action of each resultant factor and of the result corresponding to each event can be quantified, the decision maker will use the objective probability. Instead, if the decision-maker has to rely solely on his/her own knowledge, on his/her own experience, he/she will have to imprint to different factors and result, subjective probabilities. **Figure no. 2** presents the conditions of the decision based on known information and probabilities.

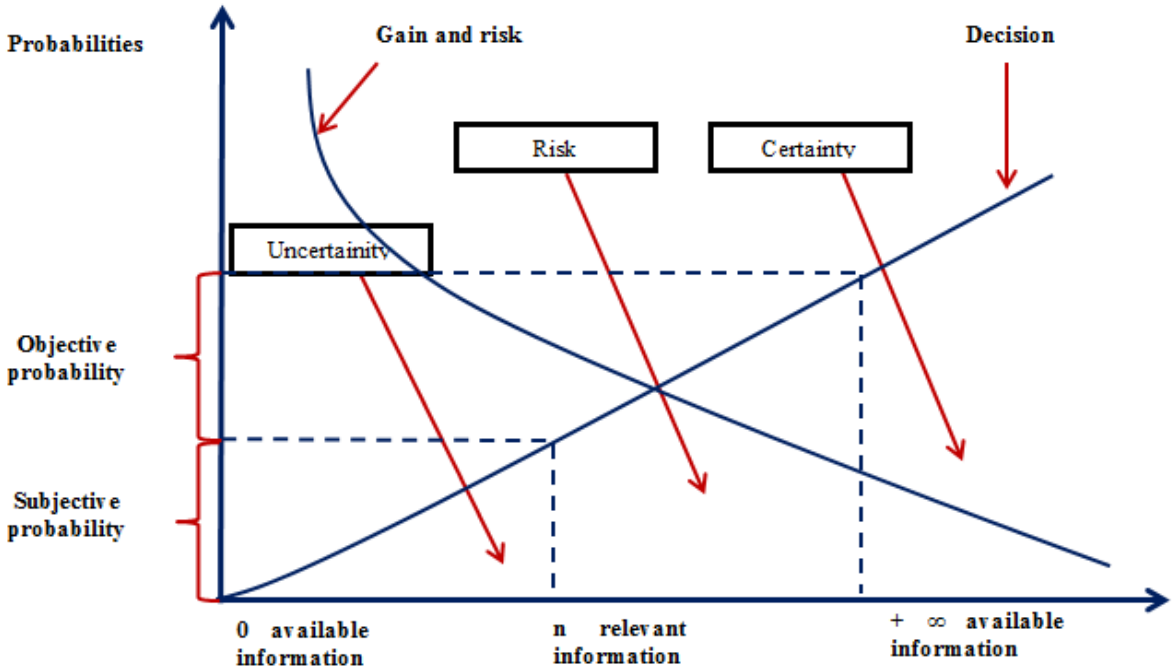


**Figure no. 2. Conditions of the decision**

Source: adapted based on Duran, C. D., - *Aspecte privind evaluarea riscului ca sursă a deciziei la nivelul firmei*, Editura Politehnică 2007, p. 68.

## Distribution of probability and the expected value

"The presentation of distribution of probability for each action variant can prove to be very useful in the decision making process, since this distribution reflects the degree of uncertainty of each alternative. The distribution of probabilities allows the manager to consider not only the possible profits they promise, but also the degree of uncertainty that accompanies each of these profits. "(Ionașcu, Filip, Mihai, p. 230)

For example, I will present the following situation inspired by the work of Ionascu I, Filip, A. and Mihai S. - *Management control*, according to which the manager of SC Alfa SRL has the resources to choose between the implementation of two services: *the exchange car* and the *direct reception*, and the market research for each service led to the following results on the distribution of probability for obtaining a profit, as shown in **Table 1**.

**Table no. 1. Distribution of probability**

| A – exchange car service | | | B – direct reception service | | |
|---|---|---|---|---|---|
| **Result** | **Estimated probability** | **Weighted value** | **Result** | **Estimated probability** | **Weighted value** |
| **(1)** | (2) | (3)=(1)*(2) | **(1)** | (2) | (3)=(1)*(2) |
| **Profit 5.000** | 0,45 | 2.250 | **Profit 4.500** | 0,5 | 2.250 |
| **Profit 6.000** | 0,25 | 1.500 | **Profit 6.000** | 0,2 | 1.200 |
| **Profit 7.000** | 0,15 | 1.050 | **Profit 8.000** | 0,2 | 1.600 |
| **Profit 8.000** | 0,15 | 1.200 | **Profit 10.000** | 0,1 | 1.000 |
| **TOTAL** | 1 | Expected value = 6.000 | **TOTAL** | 1 | Expected value = 6.050 |

The distribution of probability allows to the manager of SC Alfa SRL to conclude that: for service A - the *exchange car* has a probability of 0.45 to obtain profits of 5.000 u.m., or there is a probability of 0.45 to obtain profits of less than 5.000 u.m., therefore a probability of 0.55 to obtain profits greater than 5.000 u.m.

**The expected value**

The expected value is also called the expected benefit and is determined by weighing each expected profit level with the probability attached to it and gathering the results obtained. From the previous table it can be seen that the expected values that those services can generate are 6.000 u.m. for service A - *exchange car* and 6.050 u.m for service B - *direct reception*. Depending on the expected value, service B proves to be more profitable. The decision based on the expected value has a major inconvenience, namely is important to consider that the expected value expresses the average result that would be obtained if a particular variant of action is chosen several times.

**Uncertainity assessment**

If the decision in an uncertain context would be based on the expected value methodology, thanin the present casewould be chosen the development of B service - *direct reception*. In the case in which a third service C- *tires hotel* comes into the equation,about which is known the data presented in Table 2.

**Table no. 2. Distribution of probability – service C**

| **Service C** – *tires hotel* | | |
|---|---|---|
| **Result** | **Estimated probability** | **Weighted value** |
| (1) | (2) | (3)=(1)*(2) |
| Loss 1.000 | 0,5 | -500 |
| Profit 14.000 | 0,5 | 7.000 |
| **TOTAL** | **1** | **Expected value = 6.500** |

The expected value of service C - *tires hotel* is higher than service B - *direct reception*, which is why, according to the expected value methodology, service C should be implemented. However, given that the probability of loss is equal to the probability of winning, it is unlikely that the manager chooses service C. The degree of uncertainty is higher for service C than for service B and the application of the expected value method in isolation can lead to wrong decisions.

As Ionaşcu, I., Filip, A.T., Mihai, S., asserts in the work *Management Control*, we subscribe to the conclusion that besides the interest shown to the expected value, the managers are also interested on the degree of uncertainty (variability) of the possible results. Conventionally, the measurement of dispersion within the distribution of probability is accomplished by standard deviation, by applying the following formula:

$$\theta = \sqrt{\sum_{x=1}^{n} (A_x - \bar{A})^2 \times p_x}$$

Where: $A_x$ = each profit level

$\bar{A}$ = the expected value (average value)

$p_x$ = the probability attached to each result

n = total number of possibilities

$\theta$ = standard deviation

For Services A and B, the results are shown in Table 3.

**Table no. 3. Calculation of the standard deviation for services A and B**

| A – exchange care service | | | | | | B – direct reception service | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Profit** | **Expected value** | **Dev. from the expected value** | **Dev. square** | **Prob.** | **Weighted value** | **Profit** | **Expected value** | **Dev. from the expected value** | **Dev. square** | **Prob.** | **Weighted value** |
| **(1)** | **(2)** | **(3)=(1)-(2)** | **(4)=(3)$^2$** | **(5)** | **(6)=(4)*(5)** | **(1)** | **(2)** | **(3)=(1)-(2)** | **(4)=(3)$^2$** | **(5)** | **(6)=(4)*(5)** |
| 5.000 | 6.000 | -1.000 | 1.000.000 | 0,45 | 450.000 | 4.500 | 6.050 | -1.550 | 2.402.500 | 0,5 | 1.201.250 |
| 6.000 | 6.000 | 0 | 0 | 0,25 | 0 | 6.000 | 6.050 | -50 | 2.500 | 0,2 | 500 |
| 7.000 | 6.000 | 1.000 | 1.000.000 | 0,15 | 150.000 | 8.000 | 6.050 | 1.950 | 3.802.500 | 0,2 | 760.500 |
| 8.000 | 6.000 | 2.000 | 4.000.000 | 0,15 | 600.000 | 10.000 | 6.050 | 3.950 | 15.602.500 | 0,1 | 1.560.250 |
| **TOTAL** | | | | | **1.200.000** | **TOTAL** | | | | | **3.522.500** |
| **Standard deviation** | | | | | **1.095,44** | **Standard deviation** | | | | | **1.876,83** |
| **Expected value** | | | | | **6.000** | **Expected value** | | | | | **6.050** |
| **Coefficient of variation** | | | | | **0,183** | **Coefficient of variation** | | | | | **0,31** |

Comparing the standard deviations of two services with different expected values does not bring an informational plus in the decision making process, but if a derived indicator would be introduced into the equation, for example the coefficient of variation, calculated as the ratio between the standard deviation and the expected value. The variation coefficient for service A is 0.183, and for service B it is 0.310, which indicates that service A is less risky.

"The judgments developed so far has, only, highlighted the fact that there is no powerful tool to help hierarchize projects according to the degree of risk they are incorporating. Elements such as the expected value, the standard deviation or the coefficient of variation can be used only to present the characteristics of the different variants of action, but they only present in vague form information about the distribution of probabilities, thus hiding to the decision-maker the true/relevant part of the information. "(Ionascu, Filip, Mihai, p. 234)

## The decision tree

When more than one random variable is involved in the decision-making process, it is recommended to use the decision tree, an analysis tool to inventory all possible variants and possible outcomes.

The decision tree is a scheme showing the variants of action and possible outcomes for each variant. Designed to capture all action variants, the decision tree is a useful tool in the managers attempt to show their distribution of probability.

A decision tree can be built on the following example:

*The manager of SC Beta SRL analyzes the possibility of introducing a new service on the market, the costs amounting to 500.000 RON, with the possibility of 0.80 of the implementation to be successful and 0.20 to fail. If implementation succeeds, the service can be confirmed on the market:*

- *as a very good service, bringing a profit of 1.500.000 u.m., probability 0.35;*
- *as an average service, bringing a profit of 400.000 u.m., probability 0.45;*
- *as a fiasco, the service implementation generating a loss of 25.000 u.m, probability 0.20;*

*Each estimate is made after considering the initial cost of 100.000 u.m.*

The decision tree can be projected as in **Figure no. 3.**

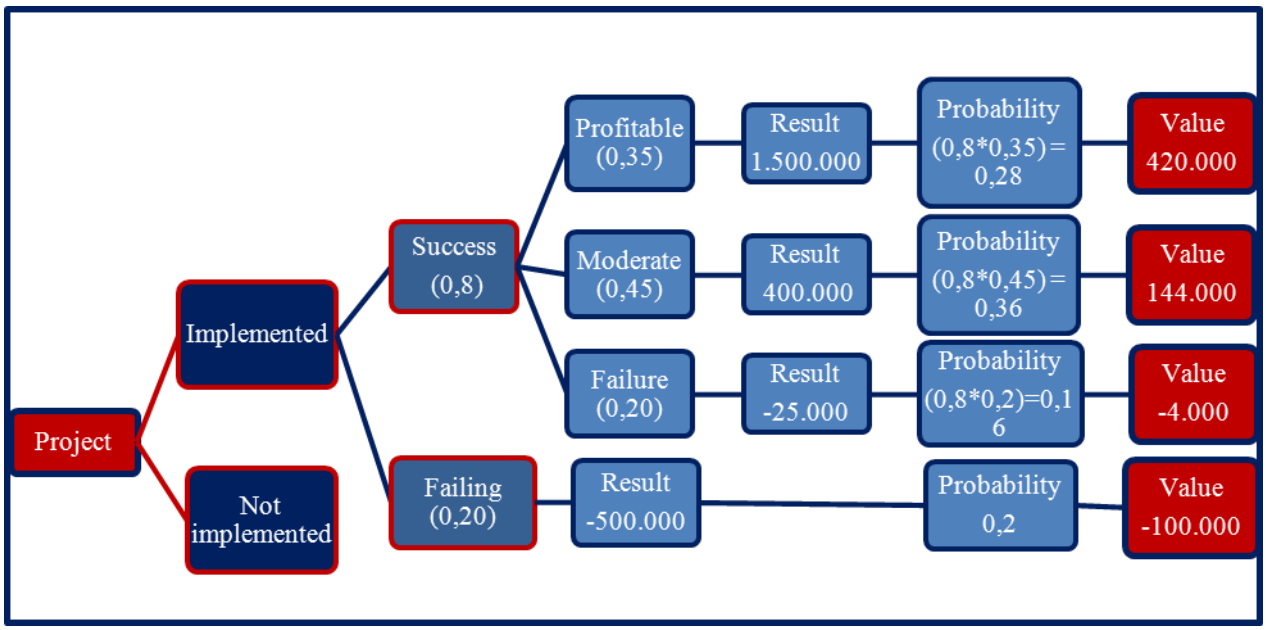


**Figure no. 3.Decision tree**
Source: personal elaboration

From the previous figure it can be seen that "the probability that two events occur simultaneously is equal to the product of the probabilities that the two events will occur separately." (Ionaşcu, Filip, Mihai, p. 236)

Due to the fact that this instrument uses the expected values, to the decision tree it can be brought the same reproaches that have been brought to the other instruments. This instrument, however, has the advantage of retaining all the alternatives for action and possible outcomes, as well as the interferences between them. Another great advantage is providing the distribution of probabilities when multiple combinations of alternatives and events are possible.

***Attitude towards risk***

Faced with the need to make risk decisions, besides assessing uncertainty, the attitude to risk of each individual is equally important.

The ideal situation would be where, under the conditions of a minimum risk, maximum results are achieved, but unfortunately the economic reality shows that higher results are achieved when there is a high risk; therefore there is a direct proportional relation between risk and profitability.

The literature identifies three attitudes to risk:

- risk aversion;
- risk indifference;
- risk preference;

This segmentation of individual's attitude demonstrates that decisions taken under uncertainty depend largely on the managers' attitude to the risk.

The model of making decisions under uncertainty is far from being perfect, a series of criticsbeing presented in **Figure no. 4.**

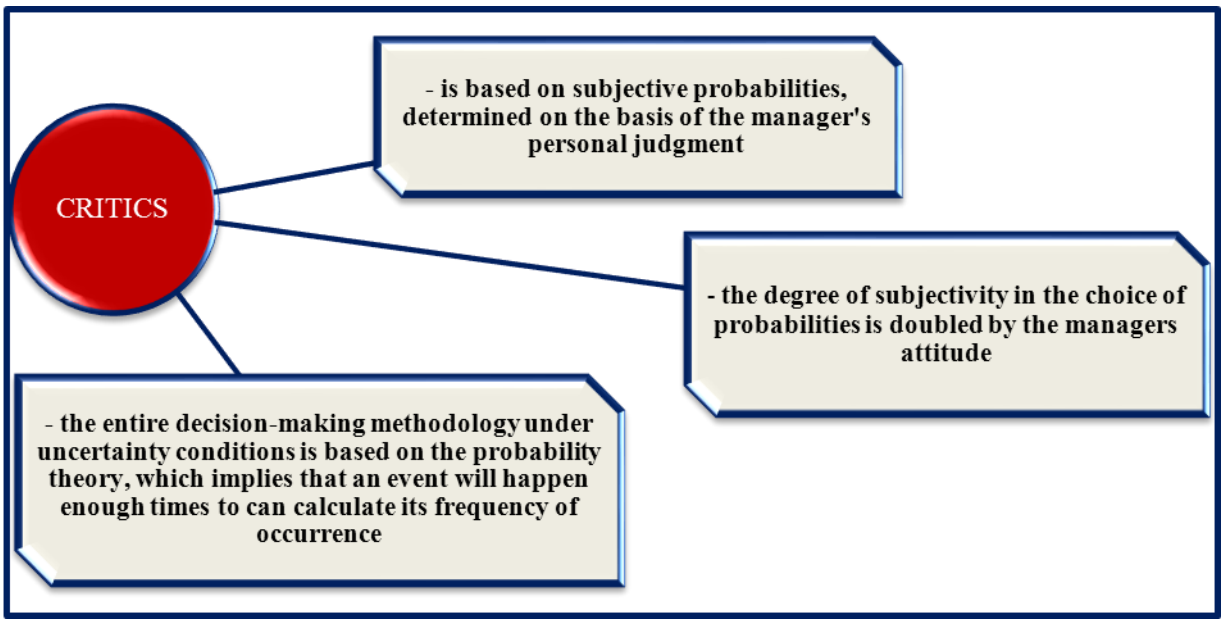


**Figure no. 4. Critics brought to the decision model under uncertainty conditions**
Source: personal elaboration

The statistical-mathematical tool has only the role in assisting decision-making within an uncertain environment. The use of risk and uncertainty optimization techniques provides managers the possibility to consciously take risks, selecting them according to their effects, by the consequences that these risks might pose if they were to occur. (Mandru, Begu, p. 81)

## IV. CONCLUSIONS

The success of a decision is indispensable connected to taking risks, therefore making the best decision in known circumstances is very important. It is recommendedto take into account, in the use of uncertainty-making techniques, the economic and financial situation of the concerned enterprise: profitability, turnover, liquidity ratios, its market position etc. Thus, as much as the company is in a more stable economic and financial situation, the higher risks are possible to be taken, with the possibility of higher earnings, but it is necessary to have compensation resources in case of failure.

As a first conclusion, the idea is that risks are inevitable in business, and because each activity is unique, the risks are different from one activity to another, from one group of companies to another. The degree of success of an enterprise has its source in the way the risks were controlled.

Risk is a multidimensional concept whose values cannot be reduced to one element, a number, and for each enterprise it is very important to determine a considered acceptable level of the investment risk that the company is willing to assume.

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