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RATIONALITY AND SUBJECTIVITY IN PRELIMINARY ANALYSIS OF ACQUISITION OPTIONS OF TECHNICAL SYSTEMS

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Abstract: *Modeling the acquisition decision and, consequently, managing the capabilities of technical systems involves multiple options that need to be optimized first, based on universal constraints such as time, quality, cost, etc. The criterion of use (private or institutional), according to which analyzes can evolve differently, is also important. Regardless of the way in which these considerations are taken, there is always a difference of approach given by the quantitative and / or qualitative tools used but also by biases, heuristics and mindsets. The article analyzes succinctly, on an example of calculation (based on a matrix used in the theory of decision to evaluate the different alternatives made available, when we have a basic model to be referred to), the universe of these analytical modalities, underlining the idea of making analyzes using a maximum level of objectivity and minimizing as much as possible subjectivism. It has been chosen as a way of applying the field of procurement of technical systems with the possibility of highlighting as many aspects as possible on the decisional criteria. Critical analysis of the robustness of the choices made by the human factor as a rational decision-maker is presented, as it is seen in the classical economic theory, but taking into account the limitations highlighted by modern theories in the fields of psychology and information theory.*

Keywords: option, model, technical system, rationality, subjectivism

1. Introduction

It must be emphasized from the beginning that from the point of view of human behavior, in the decision-making process, a duality (1) full of consequences occurs in the choice of variants, viewed both from an objective perspective (can be considered as a measure of the real knowledge which the decision-maker has, expressed through a ratio between the quantity and quality of the knowledge needed to make the decisions and the knowledge that the decision-maker actually holds) and from a subjective type (the perception that the decision-maker has on his degree of certainty or uncertainty). At the same time, however, the essential role played by experience and intuition in the choices made by decision makers, corroborated with the limits of human reasoning, are factors that have contributed to the increase of interest in intelligent systems based on heuristic processes, whereby even in case of a complex problem, a practically acceptable solution can be obtained in a relatively short time compared to other methods, without guaranteeing the optimal solution [2]. Adding to the fact that, traditionally, in any management study program, bachelor's or master's, we include disciplines on decision theory that present different solutions for some standard organizational issues, with or without the use of dedicated software, we can draw a complete picture to fit the proposed subject. The abundance of decision-making methods, techniques, and instruments gives stakeholders involved in the decision-making process some certainty about choosing a final version to implement for a given problem situation. Is it faultless

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what is being achieved? Are there any other parameters that, while seemingly less relevant, can alter the robustness of a result? What is the final limit of acceptable fragility from the point of view of the consequence of the decision between quantitative and qualitative, objective and subjective, experience and expertise, intuition and emotion, soft and hard?

The Pugh matrix (general design presented in table 1) was developed by Professor Stuart Pugh, head of the Design Division at the University of Strathclyde in Glasgow, currently having a variety of names such as the Pugh method, Pugh analysis, decision matrix method, decision-making matrix, etc. [3].

2. Case study

Table 1 Pugh Matrix – variant

	Basic model	Coefficient of importance	Var. A	Var. B	Var. C	Var. D
Criteria						
1	0	2	+1	-1	0	+1
2	0	4	0	-1	0	+1
3	0	3	+1	+1	+1	0
4	0	5	-1	0	0	+1
5	0	1	+1	0	0	+1

Suppose we decide between four alternatives, A, B, C, D. We already have a model, and we want to know if one of these four models would be better for us. We decide what our criteria are. Our basic point is the model we currently have, so we note this against our criteria. For example, if option A is considered. As far as criterion 1 is concerned, do we think it is better, the same or worse than the basic level? If it is better, we give it a +1, if it is the same, we give it a 0, and if it is worse, we give it a -1. Suppose it is +1. So now we know the number of pluses, the number of minuses and the total score for each alternative, which allows us to make a more rational or objective decision [3]. In this case D is obvious, with three pluses and no minuses. Taking into consideration the percentages for the criteria, we multiply each value of the variants by the coefficient of importance set for each criterion. In order to choose the optimal solution, we collect the values on each column for each variant, and the highest result is the one we choose.

As a practical example, the purchase of some vehicles for a Military Police structure was considered, the criteria for these vehicles being the following: engine capacity (cm3); power (cp); ranging from 0-100 km/h (seconds); maximum torque (N/m); maximum speed (km/h); average consumption (l/100 km); CO2 emission level (g/km); tank volume (liters); free maintenance provided by the selling agency (years); purchase price (euro). The following car-dealers were present at the auction: Audi, Volkswagen, Volvo, BMW with the following models: Audi A6 Facelift 2016; Volkswagen Passat CC 2016; Volvo S90 2016; BMW 5 Series 2016, the features of the auctioned car types being found in the table below.

Table 2 Characteristics of the auctioned car types

Vehicle	Engine Cap.	Power	Acceler.	Torque	Max. speed	Avg. consumption	CO2 Emissions	Tank vol.	Provided maintenance	Price
Audi A6	3000	218	7.1	500	245	8	114	73	10	50
Vw CC	2000	184	8.1	490	240	6	127	60	8	35
Volvo S90	2000	235	7	380	250	5	130	70	15	57
BMW 5-Series	2000	190	7.5	400	235	6	100	66	10	52
Dacia Logan Basic model	1600	75	11	260	165	5	95	55	4	10

According to the theoretical considerations previously presented, the Pugh matrix will look as follows.

Table 3 Pugh matrix for the given example

	Basic model	Coefficient of importance	Audi A6	Vw CC	Volvo S90	BMW 5-Series
Criteria						
Engine capacity	0	2	+2	+1	+1	+1
Power	0	5	+1	+1	+2	+1
Acceleration	0	3	+1	+1	+2	+1
Torque	0	3	+2	+2	+1	+1
Max. speed	0	5	+2	+1	+2	+1
Average consumption	0	2	-2	-2	0	-1
CO2 emissions	0	2	-1	-1	-2	-1
Tank volume	0	1	+2	+1	+2	+1
Provided maintenance	0	3	-1	-1	-2	-1
Price	0	3	-2	-1	-2	-2

After analyzing the characteristics of the auctioned car models, we checked and evaluated each parameter according to the established coefficient of importance, and we would do the final matrix in order to obtain the optimal solution (table 4).

Table 4 Final matrix for the given decisional situation

	Basic model	**Coefficient of importance**	**Audi A6**	**Vw CC**	**Volvo S90**	**BMW 5-Series**
Criteria						
Engine capacity	0	2	+4	+2	+2	+2
Power	0	5	+5	+5	+10	+5
Acceleration	0	3	+3	+3	+6	+3
Torque	0	3	+6	+6	+3	+3
Max. speed	0	5	+10	+5	+10	+5
Average consumption	0	2	-4	-4	0	-2
CO2 emissions	0	2	-2	-2	-4	-2
Tank volume	0	1	+2	+1	+2	+1
Maintenance	0	3	-3	-3	-6	-3
Price	0	3	-6	-3	-6	-6

Following the implementation of the above algorithm, the Volvo S90 (19 points, followed by Audi A6 with 15 points) is the optimal option for the needs of the case study structure. Given that the purchase price/unit of this model is about 60,000 euros, is this a preliminary optimal solution? Are there prejudices or errors that influence the analysis? Are important coefficients sufficient to translate (quantify) the explicit and implicit needs of the beneficiary? How much is reality and how much perception of reality?

It is well known that in the field of technical systems and especially in the case of motor vehicles there are different types, with different utilities and functionalities, with high-tech elements implemented in various measures. As a decision maker in the context of a marketing study or preliminary concept study of a procurement procedure, we inevitably, inherently associate certain levels of characteristics that derive, for example, from mere branding. It is emblematic that German car brands are associated with a certain level of reliability or, equally widely spread in the perception of a possible purchaser, that Japanese vehicles are associated with a high level of constructive implementation of high-tech IT subassemblies. Last but not least, for top luxury cars, top ten rankings made by different companies, professional associations or media specialists for the automotive industry also induce such biases. For example, U.S. bloggers [4] „are buzzing at the imminent arrival of the BMW 1-Series stateside. The car has generated enough Internet sizzle to shame an Apple iGizmo. A great deal of this excitement is created by enthusiasts' idea of what the 1-Series should be– a modern 2002– rather than the car itself (which appears to be a porky hatchback conversion). The 1-Series' association with the "old" 2002 has permanently prejudiced many pistonheads' perception of the product." It is also worthwhile to discuss the neuro-marketing studies to bring about as many benchmarks as possible about the behavior of the human decision maker and the limits of rationality.

Returning to the example of the presented calculation, we highlight the difference of four points between the most favorable option and the option on second place. It is easy to notice that, depending on the different mechanism of assigning coefficients of importance and scoring, the final result may change. What should be considered as additional and objective, and that may prejudice our argument based primarily on figures and calculations, is what is meant to be a program of heuristics and cognitive biases, the first being explained [5] as quick and brief schemes of thought, and the second category, as systematic deviations from what we might call the good interpretation of a subject matter.

3. Conclusions

All managerial activity, as practice and theory, can be summed up, in essence, in a chain of decision-making situations. Although there is a specific decision-making instrumentation tool, the context in which it is applied implies differentiation and the consideration of other factors difficult to quantify algorithmically and mathematically, here also manifesting characteristics of management, as art.

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