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DECISION-MAKING ALGORITHM FOR OPTIMIZATION OF RESEARCH RESULTS COMMERCIALIZATION PROCESS IN UNIVERSITY "POLITEHNICA" FROM BUCHAREST

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Abstract: *: Universities and public research organizations are confronted today with the imperious necessity of contributing much more to technology transfer processes and applicative research results commercialization. In this respect, a decision-making algorithm is needed to be in place, following different models, depending on their mission and the strategic objectives, the entrepreneurial oriented one being today the most challenging one. The present paper takes into account the money allocation for activities done by a Technology Transfer Office (TTO), i.e. the one from University "POLITEHNICA" from Bucharest (UPB), the revenues obtained by UPB through research results commercialization, and, by adapting Laplace & Hurwitz decision-making strategies, taking into account uncertainty conditions, and a data analysis procedure, we offered recommendations about "increasing-decreasing-keeping the same" money allocation for TTO, in different scenarios of similar "increasing-decreasing-keeping the same" "gross profit" coming from research results commercialization, implying different expertise ("technology push", "market pull" and "start-up") in estimation of this profit evolution, with two sets of "degree of confidence" (Cases 1 & 2). We proved that the developed Laplace & Hurwitz models are very sensitive, referring to the estimated values of "gross profit" taken into calculation by different experts, depending on alternatives for money allocation for TTO, and on the presumed three scenarios of research results commercialization efficiency.*

Key words: *Decision-making, Uncertainty conditions, Research commercialization, Technology push, Market pull, Start-up*

1. INTRODUCTION

There are numerous models for technology / knowledge transfer, several sets of "key" performance indicators used in studies / analyses and how these elements are integrated in the synthetic reporting sheets / rankings, made in the field of innovation and competitiveness, at European level and worldwide.

In the case of universities and public research organizations, one model explicitly considers "key performance indicators" regarding the disclosure of inventions and their patentability and will be treated separately, highlighting the major sensitivity of the technology & knowledge transfer process in relation to these parameters of analysis, in which intellectual / industrial property plays a fundamental role.

For the evaluation of the performance of the technological / knowledge transfer activities, carried out at the level of a university, the proposed decision-making model includes six levels (see page 49 from [1]). Taking into analyse a case study, i.e. University POLITEHNICA from Bucharest (UPB), where UPB's mission – M, from the perspective of technology / knowledge transfer is to contribute to economic and societal development, at different levels: local, regional, national and international, with five objectives (O), pursued in the activity of technological transfer / knowledge, 11 main groups (G) of technology transfer mechanisms, with their 26 individually associated mechanisms (T) and 42 performance indicators (I), we elaborated a complex decision-making model to be taken into account when analysing the performance in technology / knowledge transfer, extensively developed in the third phase of the contract "Development of the capacity for transfer and commercialization of research results within institutes and centres of applied research in Romania - implementation of a pilot model for specialized departments" [1].

Within the assumed mission and the strategic objectives defined above, there are four large groups of models unanimously accepted in the literature [2]:

Model 1 - "***Traditional / classical orientation***", in which the research results are obtained and transmitted to the market, through classical mechanisms. In this model, the culture of intellectual property, and the promotion of patenting are distributed uniformly to all departments, without specific differentiation mechanisms, with focus towards indexing in databases of scientific publications and academic performance.

Model 2 - "***Third mission of entrepreneurial type***", in which - in addition to the educational and research activities, in the traditional sense - emphasis is placed on the importance of exploiting new scientific and technological opportunities in order to increase economic competitiveness at national level. To this end, the university-economic partnership is amplified and expanded, through a more active participation in joint entrepreneurial programs. Direct and indirect means are used for knowledge transfer, the development of new technologies being done by involving inventors from academia in the creation of spin-off and start-up companies, and by developing complementary forms of collaboration with local communities.

Model 3 - "***Innovative-disruptive activity***", in which the university manifests itself at international / global level, in order to solve major problems, at the scale of the whole society. The Technology Transfer Office (TTO), as a "profit centre", addresses both SME customers and large companies, by promoting entrepreneurship and stimulating inventiveness, to take over the development of innovative technologies in the early stages, with low TRL (Technology Readiness Level), and support their commercial exploitation.

Model 4 - "***Knowledge generation***", in which the university addresses students and society as a whole, with the responsibility assumed to respond to the need for knowledge development and, in general, to involve all social actors in the production and dissemination of new knowledge. The TTO, as a "centre of intrinsic value of knowledge", through its activity, makes accessible information and novelties, obtained through scientific research, and offer support to the creation of new scientific and technical knowledge, to the detriment of income generation on a commercial basis. "Big data" or "crowd-funding" mechanisms are strongly encouraged, based on the principles of social engagement and global openness.

Our paper is taking into consideration the **2nd model**, aiming to analyse the correlation between the value of a global performance indicator (i.e. the "gross profit" of research results commercialization) and the allocation of resources for the activities that TTO must carry out, in order to meet the objective of increasing the competitiveness of innovation and technology transfer / knowledge from UPB. It starts from the allocation of resources for the activities carried out by TTO (see table at pages 77&78 from [1]), in the right column being detailed, each of the 15 activities separately, with the mention of a necessary allocation of resources (number of annual hours), allocated to full-time jobs. These activities depend, both as a structure and as a share of allocated resources (number of hours of full-time equivalent - FTE - within TTO), on the CANVAS model assumed and described accordingly (see page 45 from [1]).

<u>**Note**</u>: The example, in the table from page 79 [1], corresponds to the planning (at the level of year 2015) that TTO from UPB, which employs 2 FTE people, assumed as analysis parameters to be used and the planned allocation of resources, initially determined. So, the data analysis, from the mentioned table, leads to a total of 3200

hours / year, allocated to the 15 mentioned activities, which are involved in the achievement of the 8 performance indicators (marked in yellow, in the table from page 79 [1]), having the highest contribution to technology transfer / knowledge activities, in the benefit of socio-economic environment / innovation ecosystem, where university is fully integrated.

So, in our analyse, the first three activities, with biggest planned allocation of resources, are taken into account: i.e. "*Assistance and consultancy services for the evaluation of disclosure of inventions, the development of the procedural steps for granting patents and the capitalization of intellectual property rights*", "*Assistance and consultancy services for licensing of intellectual / industrial property rights and knowledge capital*", and "*Assistance and consultancy services for intangible assets portfolio management regarding intellectual property*", all having as common object of activity the intellectual / industrial property matters, from the stage of disclosure of inventions, continuing with the management of the intangible assets portfolio and concluding with the licensing of property rights to interested partners, usually licensee firms.

The decision support matrix for the evaluation of the global performance indicator of the technology transfer activity from UPB was presented at page 81, from [1]. In this respect, analysing the specific data, the first five performance indicators that contribute to increasing the competitiveness of the innovation and technological / knowledge transfer activity in UPB are, in order of their importance, as follows:

1. Technical / technological innovations;

2. Technologies licensing;

3. Development of new businesses (spin-off and start-up companies);

4. Granting intellectual property rights;

5. Steps taken to protect intellectual property rights.

At the same time, the first five indicators that offer a potential to increase the performance of UPB, on which TTO must focus its special attention, are, also in order of their importance:

1. Technologies licensing;

2. Development of new businesses (spin-off and start-up companies);

3. Steps taken to protect intellectual property rights;

4. Granting intellectual property rights;

5. Research funded by the socio-economic environment (contracts with third parties).

By comparing the two classifications, the motivation for the differences between the categories mentioned above is a rational one, revealing that only the order of the indicators is somewhat different, in the sense that TTO, through its activities and staff, can't support significantly the impact increase of technical / technological innovations, but contributes major to the logistical support of research & innovation activities, in partnership with the socio-economic environment (research contracts with third parties).

From the list of TTO's 15 mentioned activities, we have selected only 4 of them, i.e. "*Assistance and consultancy services for selling of products / technologies / innovative services and brokerage technological / innovative business*", "*Assistance and consultancy services for licensing of intellectual / industrial property rights and knowledge capital*", "*Assistance and consultancy services for starting / developing start-up / spin-off companies and creating / developing innovative business models*", "*Services for vocational training and logistical support in the field of knowledge / technology transfer*". For these 4 activities it was allocated in one year the total sum of 224 thousand RON, as costs, by addition of number of allocated hours multiplied by an average gross rate RON/hour, corresponding to each mentioned activity.

In our assumption, to this allocation, the revenues obtained, corresponding to 4 individually associated mechanisms (T), i.e. "*Licensing of innovative technologies*", "*Royalties from spin-off / start-up companies*", "*Market value of granted patents*", "*Revenues* *from contracts with third parties*", are estimated at 295 thousand RON, so the "gross profit" is 71 thousand RON, as difference between revenues and costs, yearly calculated (i.e., for year 2015 as reference, took from available data of analysis in [1]).

2. PROBLEM FORMULATION

Targeting to find optimal solutions, for any decision-making action, it's recommended to involve multi-domain expertise [3], contributing to offer higher degree of credibility to any decision-making process, especially when the complexity of the field of analyse is high [4]. Considering the real life aspects appearing in real technology transfer and research results commercialization processes and leak of fully objective methods of evaluation, it's necessary to overcome such impediments, making use of some well-known optimization strategies, e.g. Laplace & Hurwitz [5].

In this respect, starting from the above mentioned gross profit estimation, we have implied three experts (E1÷E3), having competences in: assessment & commercializing technologies ("*technology push*") - E1, jurisprudence & marketing ("*market pull*") - E2, and entrepreneurship ("*start-ups*" consultancy & training) - E3.

By cumulating all above mentioned aspects, the present paper deals with the issue related to experts implication decision-making process, under uncertain conditions, applied to optimize the performance of technological / knowledge transfer activities, carried out at the level of UPB. More specific, due to nowadays dynamics in different aspects of technology transfer & research results commercialization, public research organizations, i.e. UPB, are confronted with a variety of decision-making problems, with different degrees of negative / positive influence of some uncertain conditions. For solving this issue, some well-known criteria able to cope with uncertainty, like Laplace & Hurwitz, were adopted, in a modified form, in order to integrate multi-domain expertise, associated with different importance "degree of confidence", when the respective experts contribute to a group decision process, realized by introducing weighted coefficients assigned to each expert, accordingly to their expertise, professional experience, and closeness to the specific decision-making problem [6,7].

In this decision-making process, the options are related to the optimization of a utility function (i.e. "gross profit"), over some alternatives: Ai = {A1, A2,…, Am}, assuming different scenarios: Sj = {S1, S2, …, Sn}, when following a decision-making algorithm, by using different criteria in order to cope with uncertainty conditions, following 9 logic stages of implementation (see page 309, in [6]).

Consequently, by using a utility function (e.g. "gross profit"), the decision-making models, used by the authors, are formulated as presented below.

For a group decision-making model based on a modified Laplace's algorithm, when all possible scenarios are considered equally probable, this approach implies the calculation of an expected payoff matrix row, i.e. "gross profit", for each alternative $(R_{i,j}^{(ie=1\div3)}|_{i=1\div3} - see\ formula\ (1))$, and the selection of the alternative with the best value (best $EV_{i,j}^{(ie=1\div3)}(\mathrm{Ai}|_{i=1\div3}) - see\ formula\ (2)$), corresponding to each evaluation of the three implied experts (Eie (ie=1÷3)) in the group decision-making process.

On another hand, for a group decision-making model based on a modified Hurwitz's strategy, where α is the coefficient of optimism, with $0<\alpha<1$ (coefficient α=0 corresponding to an environment considered to be completely hostile, α=0.5 characterize a neutral environment (neither hostile, nor friendly), and for α=1, the context being most propitious), this approach implies the calculation of an expected payoff matrix row, i.e. "gross profit", for each alternative $(H_{i,j}^{(ie=1\div3)}(\mathrm{Ai}|_{i=1\div3}) - see\ formula\ (3))$, and the selection of the alternative with the best value (best $H_{i,j}^{(ie=1\div3)}(\mathrm{Ai}|_{i=1\div3}) - see\ formula\ (4)$), corresponding to each evaluation of the three implied experts (Eie (ie=1÷3)) in the group decision-making process.

In our study, we suppose three alternatives Ai (i=1÷3), i.e. A1 means the expenses / allocation for TTO's activity increases, A2 is associated with decreasing of expenses / allocation for TTO's activity, and A3 presumes the same allocation for TTO's activity, as calculated (total sum of 224 thousand RON, for one year).

Also, the proposed scenarios, considering "gross profit" of technology transfer and research results commercialization from UPB, are Sj, with j=1÷3, where S1 implies the increase of the "gross profit", S2 is associated with its decrease, and S3 presumes, approximately, an unchanged calculated "gross profit" (71 thousand RON), or, as taken by us into calculation, the average value of the first two scenarios S1 and S2.

Also, we will analyse two cases, referring to the "degree of confidence" allocated to the three implied experts:

- Case 1: $\lambda^{(1)} = 0.15$; $\lambda^{(2)} = 0.35$; $\lambda^{(3)} = 0.50$, their sum being 1.00;
- Case 2: $\lambda^{(1)} = 0.20$; $\lambda^{(2)} = 0.60$; $\lambda^{(3)} = 0.20$, with the same remark as in case 1.

In case 1, "*market pull*" expertise ($\lambda^{(2)}$) is considered as having an average importance, the most important expertise belonging to the "*start-up*" expert (i.e. $\lambda^{(3)} = 0.50$), and the lowest one coming from "*technology push*" expert ($\lambda^{(1)}$); this expertise profile is corresponding to a market – entrepreneurial orientation.

In case 2, "*market pull*" expertise is considered as dominant (i.e. $\lambda^{(2)} = 0.60$), the minimal expertise equally coming from the "*start-up*" ($\lambda^{(3)}$), and "*technology push*" ($\lambda^{(1)}$) experts; this expertise profile is corresponding to a market oriented approach, e.g. belonging to a specialist from a company which is buying / (using, through a licensing mechanism) innovative technologies produced by public research organizations.

Both cases, taken into analyse, have a common market oriented approach, because of the actual deficiencies in the processes of technology transfer and universities' research results commercialization, notably concentrated today mainly on "*technology push*" and less on "*market pull*", ideally being to have a reasonably balance of both, i.e. "Demand Readiness Level" (DRL) [8].

As general possibility, different combinations of the weighted expertise, corresponding to other practical applications, could be taken in analyse, in order to reflect group decision-making characteristics, as one of the main purposes of this study.

$$R_{i,j}^{(ie=1\div3)}|_{i=1\div3} = \lambda^{(ie)} * \sum_{j=1\div3} R_{i,j}^{(ie)} \quad (1)$$

$$\text{best } EV_{i,j}^{(ie=1\div3)}(\text{Ai}|_{i=1\div3}) = (max_{j=1\div3} R_{i=1\div3,j}^{(1)} + max_{j=1\div3} R_{i=1\div3,j}^{(2)} + max_{j=1\div3} R_{i=1\div3,j}^{(3)})/3 \quad (2)$$

$$H_{i,j}^{(ie=1\div3)}(\text{Ai}|_{i=1\div3}) = \alpha * max_{j=1\div3} R_{i=1\div3,j}^{(ie)} + (1-\alpha) * min_{j=1\div3} R_{i=1\div3,j}^{(ie)} \quad (3)$$

$$\text{best } H_{i,j}^{(ie=1\div3)}(\text{Ai}|_{i=1\div3}) = \max_{i=1\div3} (H_{i,j}^{(ie=1\div3)}(\text{Ai}|_{i=1\div3})) \quad (4)$$

3. ANALYSIS OF THE DATA

In the chapter dedicated to the analysis of the data, all mentioned above suppositions are gathered in the tables presented below, gathering all necessary information for the development of the present study.

Table 1

Weighted "degree of confidence" for experts Eie (ie=1÷3), in two cases of the study

Cases	Weighted "degree of confidence" for experts Eie (ie=1÷3)		
	λ^(1)	λ^(2)	λ^(3)
Case 1	0,15	0,35	0,50
Case 2	0,20	0,60	0,20

For α, which is the coefficient of optimism, we take into consideration, for the proposed Hurwitz strategy, the following pair of values (α, 1- α):

Table 2

Pair of values for coefficient of optimism / pessimism (α, 1- α)

α	0,4	0,7	0,15
1-α	0,6	0,3	0,85

Also, in the proposed study, we consider 4 representative situations, when analysing the alternatives for allocation funds for TTO's activity Ai (i=1÷3), as scenarios for "gross profit" expected evolution Sj (j=1÷3), associated with their estimation done by the three involved experts Eie (ie=1÷3), characterized by their respective allocated "degree of confidence" $\lambda^{(ie=1÷3)}$ ⇔ Eie (ie=1÷3), when considering two sets of data for $\lambda^{(ie=1÷3)}$ (Case 1 & Case 2), as mentioned above.

As result, all data for "gross profit", in the above 4 mentioned representative situations, are presented in the following tables, and will be used for extracting practical recommendations for choosing one alternative or another for money allocation of the TTO's activity.

3.1 1-st Situation

The data in Table 3 corresponds to a curvilinear evolution for values of Sj (j=1÷3), with a maximum for A1, minimum for A2 and average for A3, for all experts Eie (ie=1÷3) estimation.

By applying the proposed Laplace algorithm, we obtain the best values best $EV_{i,j}^{(ie=1÷3)}(\text{Ai}|_{i=1÷3})$ in the alternative A1 (marked in red colour), so the recommendation is to increase the allocation for TTO's activity (see Table 4).

Table 3

Scenarios for profit evolution Sj (j=1÷3) in the 1-st situation

Experts Eie (ie=1÷3)	Alternatives Ai (i=1÷3)	Rewards ("gross profit") Ri,j (thousand RON)		
		Scenarios for profit evolution Sj (j=1÷3)		
		S1 - Increase	S2 - Reduction	S3 - average(S1,S2)
E1	A1	85,00	60,00	72,50
	A2	80,00	55,00	67,50
	A3	82,00	58,00	70,00
E2	A1	88,00	59,00	73,50
	A2	83,00	55,00	69,00
	A3	85,00	57,00	71,00
E3	A1	94,00	58,00	76,00
	A2	85,00	54,00	69,50
	A3	90,00	56,00	73,00

Table 4

Data calculated for best values in Laplace strategy

Case 1 (thousand RON)	Case 2 (thousand RON)	
Formula best EV(Ai)	Formula best EV(Ai)	Alternatives
111,00	133,20	A1
103,00	123,60	A2
107,00	128,40	A3

Also, when considering proposed Hurwitz algorithm, the results are as follows and the recommendation is identical as in Laplace strategy (see Table 5).

Table 5

Data calculated for best values in Hurwitz strategy

	Formula best Hi,j ^ (ie) (thousand RON)					
	Case 1 / S1-Increase	Case 2 / S1-Increase	Case 1 / S2-Reduction	Case 2 / S2-Reduction	Case 1 / S3-Average(S1,S2)	Case 2 / S3-Average(S1,S2)
A1	66,12	82,08	90,06	109,44	46,17	59,28
A2	60,47	75,06	82,36	100,08	42,22	54,21
A3	63,51	78,84	86,51	105,12	44,35	56,94

3.2 2-nd Situation

Table 6

Scenarios for profit evolution Sj (j=1÷3) in the 2-nd situation

Experts Eie (ie=1÷3)	Alternatives Ai (i=1÷3)	Rewards ("gross profit") Ri,j (thousand RON) — Scenarios for profit evolution Sj (j=1÷3): S1 - Increase	S2 - Reduction	S3 - average(S1,S2)
E1	A1	72,00	65,00	68,50
	A2	86,00	70,00	78,00
	A3	78,00	68,00	73,00
E2	A1	78,00	64,00	71,00
	A2	82,00	68,00	75,00
	A3	80,00	66,00	73,00
E3	A1	84,00	62,00	73,00
	A2	90,00	68,00	79,00
	A3	86,00	65,00	75,50

The data in Table 6 corresponds to a curvilinear evolution for values of Sj (j=1÷3), with a maximum for A2, minimal for A1 and average for A3, for all experts Eie (ie=1÷3) estimation.

By applying the proposed Laplace algorithm, we obtain the best values best $EV_{i,j}^{(ie=1\div3)}(\mathrm{Ai}|_{i=1\div3})$ in the alternative A2 (marked in red colour), so the recommendation is to decrease the allocation for TTO's activity (see Table 7).

Table 7

Data calculated for best values in Laplace strategy

Case 1 (thousand RON)	Case 2 (thousand RON)	
Formula best EV(Ai)	Formula best EV(Ai)	Alternatives
106,25	127,50	A1
116,00	139,20	A2
110,75	132,90	A3

Also, when considering proposed Hurwitz algorithm, the results are as follows and the recommendation is identical as in Laplace strategy (see Table 8).

Table 8

Data calculated for best values in Hurwitz strategy

	Formula best Hi,j ^ (ie) (thousand RON): Case 1 / S1-Increase	Case 2 / S1-Increase	Case 1 / S2-Reduction	Case 2 / S2-Reduction	Case 1 / S3-Average(S1,S2)	Case 2 / S3-Average(S1,S2)
A1	63,51	78,84	86,51	105,12	44,35	56,94
A2	68,73	85,32	93,62	113,76	47,99	61,62
A3	65,69	81,54	89,47	108,72	45,87	58,89

3.3 3-rd Situation

Table 9

Scenarios for profit evolution Sj (j=1÷3) in the 3-rd situation

Experts Eie (ie=1÷3)	Alternatives Ai (i=1÷3)	Rewards ("gross profit") Ri,j (thousand RON) — Scenarios for profit evolution Sj (j=1÷3): S1 - Increase	S2 - Reduction	S3 - average(S1,S2)
E1	A1	85,00	60,00	72,50
	A2	82,00	64,00	73,00
	A3	79,00	68,00	73,50
E2	A1	88,00	55,00	71,50
	A2	85,00	60,00	72,50
	A3	82,00	65,00	73,50
E3	A1	94,00	60,00	77,00
	A2	90,00	65,00	77,50
	A3	86,00	70,00	78,00

The data in Table 9 corresponds to a relative linear evolution for values of Sj (j=1÷3), with a maximum for A1, minimal for A3 and average for A2, for all experts Eie (ie=1÷3) estimation.

By applying the proposed Laplace algorithm, we obtain the best values best $EV_{i,j}^{(ie=1\div3)}(\mathrm{Ai}|_{i=1\div3})$ in the alternative A3 (marked in red colour), so the recommendation is to maintain not modified the allocation for TTO's activity (see Table 10).

Table 10

Data calculated for best values in Laplace strategy

Case 1 (thousand RON)	Case 2 (thousand RON)	
Formula best EV(Ai)	Formula best EV(Ai)	Alternatives
110,50	132,60	A1

111,50	133,80	A2
112,50	135,00	A3

Also, when considering proposed Hurwitz algorithm, the results are as follows and the recommendation is identical as in Laplace strategy (see Table 11).

Table 11

Data calculated for best values in Hurwitz strategy

	Formula best Hi,j ^ (ie) (thousand RON)					
	Case 1 / S1-Increase	Case 2 / S1-Increase	Case 1 / S2-Reduction	Case 2 / S2-Reduction	Case 1 / S3-Average(S1,S2)	Case 2 / S3-Average(S1,S2)
A1	66,99	83,16	91,25	110,88	46,78	60,06
A2	67,43	83,70	91,84	111,60	47,08	60,45
A3	67,86	84,24	92,43	112,32	47,39	60,84

3.4 4-th Situation

Table 12

Scenarios for profit evolution Sj (j=1÷3) in the 4-th situation

Experts Eie (ie=1÷3)	Alternatives Ai (i=1÷3)	Rewards ("gross profit") Ri,j (thousand RON)		
		Scenarios for profit evolution Sj (j=1÷3)		
		S1-Increase	S2-Reduction	S3-Average(S1,S2)
E1	A1	85,00	55,00	70,00
	A2	82,00	57,00	69,50
	A3	79,00	59,00	69,00
E2	A1	88,00	56,00	72,00
	A2	85,00	58,00	71,50
	A3	82,00	60,00	71,00
E3	A1	94,00	53,00	73,50
	A2	90,00	59,00	74,50
	A3	86,00	65,00	75,50

The data in Table 12 corresponds to a relative linear evolution for values of Sj (j=1÷3), with a maximum for A1, minimal for A3 and average for A2, for all experts Eie (ie=1÷3) estimation.

By applying the proposed Laplace algorithm, we obtain equal best values best $EV_{i,j}^{(ie=1\div3)}(\mathrm{Ai}|_{i=1\div3})$ in all alternatives A1÷A3 (marked in red colour), so no clear / unique recommendation is concluded for the allocation of TTO's activity (see Table 13).

Table 13

Data calculated for best values in Laplace strategy

Case 1 (thousand RON)	Case 2 (thousand RON)	
Formula best EV(Ai)	Formula best EV(Ai)	Alternatives
107,75	129,30	A1
107,75	129,30	A2
107,75	129,30	A3

But, when considering proposed Hurwitz algorithm, the results are as follows, and the recommendation is to maintain not modified the allocation for TTO's activity (a prudent decision, when the distinction between the alternatives Ai is not very clear, and no firm recommendation is applicable), i.e., the alternative A3 (marked in red colour – see Table 14).

This situation is a particular one, and relative hard to be found in practice, but the coupling of Laplace and Hurwitz strategies reveals a possible "way out" when fuzzy situations could appear.

4. CONCLUSIONS

As a practical conclusion, in the first 3 situations it appears an expected normal correlation between the maximum "gross profits" estimated by experts and the recommended alternatives for financing TTO's activities. Only the 4-th situation reveals a "tricky issue", implying a two steps procedure, starting with a Laplace strategy when recommendation is "fuzzy" and continuing with the Hurwitz algorithm, leading to a "conservative" attitude when addressing TTO's allocations.

It is obvious that the developed Laplace & Hurwitz models are very sensitive, referring to the estimated values of "gross profit" taken into calculation by different experts, and depending on the alternatives Ai and the scenarios Sj.

The major contributions of the study are related to the obtaining of some practical modified optimization strategies of Laplace & Hurwitz, in order to consider experts' opinions with different importance ("degree of confidence"). These opinions are based on the usage of the calculated value for a utility function / expected payoff (i.e. "gross profit") for each particular problem. So, it was shown that the final group decision depends not only on the used strategy according to the principles of Laplace & Hurwitz but is also influenced by the introduced weighed coefficients expressing the experts' opinion importance.

Future developments address the usage of other different strategies (not only Laplace and Hurwitz), for a more precise and objective estimation of the weights for experts' opinions, in the aggregation of a group decision. Another perspective direction is related to the use of other different estimation utility functions that differs from the present used "gross profit", resulting from technology transfer & research results commercialization in a public university.

Table 14

Data calculated for best values in Hurwitz strategy

	Formula best Hi,j ^ (ie) (thousand RON)					
	Case 1 / S1-Increase	Case 2 / S1-Increase	Case 1 / S2-Reduction	Case 2 / S2-Reduction	Case 1 / S3-Average(S1,S2)	Case 2 / S3-Average(S1,S2)
A1	63,95	79,38	87,10	105,84	44,65	57,33
A2	64,82	80,46	88,28	107,28	45,26	58,11
A3	65,69	81,54	89,47	108,72	45,87	58,89

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ALGORITM DE LUARE A DECIZIILOR PENTRU OPTIMIZAREA PROCESULUI DE COMERCIALIZAREA A REZULTATELOR CERCETĂRII ÎN UNIVERSITATEA "POLITEHNICA" DIN BUCUREŞTI

Rezumat: Universitățile și organizațiile publice de cercetare se confruntă astăzi cu necesitatea imperioasă de a contribui mult mai mult la procesele de transfer de tehnologie şi la comercializarea rezultatelor cercetării aplicative. În acest sens, este nevoie să existe un algoritm decizional, care să urmeze modele diferite, în funcție de misiunea acestora şi de obiectivele strategice, cel orientat antreprenorial fiind astăzi cel mai provocator. Lucrarea de față ține cont de alocarea banilor pentru activitățile realizate de un Birou de Transfer Tehnologic (TTO), i.e. cel de la Universitatea „POLITEHNICA" din Bucureşti (UPB), de veniturile obținute de UPB prin comercializarea rezultatelor cercetării şi, prin adaptarea strategiilor decizionale Laplace & Hurwitz, ținând cont de condițiile de incertitudine şi o procedură de analiză a datelor, am oferit recomandări cu privire la „creşterea-scăderea-menținerea la fel" a alocării banilor pentru TTO, în diferite scenarii similare de „creştere-scădere-menținere la fel", „profitul brut" provenind din comercializarea rezultatelor cercetării, implicând expertiză diferită („impuls de tehnologie", „atragere pe piață" şi „start-up") în estimarea acestei evoluții a profitului, cu două seturi de „grad de încredere" (cazurile 1 & 2). Am demonstrat că modelele dezvoltate Laplace & Hurwitz sunt foarte sensibile, referindu-se la valorile estimate ale „profitului brut" luate în calcul de diferiți experți, în funcție de alternativele de alocare a banilor pentru TTO, şi de cele trei scenarii presupuse de eficiență a comercializării rezultatelor cercetării.

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