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RISK EVALUATION AND CONSORTIUM CONFIGURATION IN R&D PARTNERSHIPS

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Abstract This article present a risk evaluation method, suitable to partners with historical record, or fresh partners. First of all, an evaluation algorithm is presented which combine three different risk evaluation methods, trying to minimize, if is possible, the weakness for each method. Furthermore, each evaluation method is described and exemplified. This algorithm is suitable to complex and simple projects or other initiatives evaluation and also to old (with records regarding participations in projects) partners or new ones. The same algorithm could be set inside an organization to establish project teams.

1 INTRODUCTION

By excellence, R&D is an activity having a major risk coefficient, so preliminary risk evaluation must be made, in sense to be assured that the R&D funding contractor has the financial and technical potential to develop the R&D project. Other direction of risk evaluation is to evaluate the R&D project itself, as a set of activities developed by a contractor or a consortium of contractors.

Contractors' evaluation is made by analyzing a set of mandatory documents presented in original once, by recording the institution in Potential Contractors Register. Those checks are mainly oriented to R&D contractor capacity and have no debts to state budget.

Romanian research system covers more then 700 private and public entities, having R&D as principal domain of activity. So, are registered 74 universities (56 public universities and 18 private universities), 38 R&D national institutes, 327 public entities subordinated to Ministry of Education and Research or other ministries, Romanian Academy and over 270 enterprises with R&D main domain of activity.

As R&D personal, last record published by Romanian Ministry of Education and Research, present as being 39 985 persons, with 25 785 researchers and 6 400 PhD's. The majority of researchers (53%) are in Engineering and Technical Sciences. As age repartition, 1-2% decreasing is registered for 30-49 years old and 2-3 increasing for over 50, comparatively with last year records. The main age group is 40-49 and less than 30 years old is relatively constant, having 14% from total researchers. So in this, context more efforts must be made by funding managers, in hope to a better spending character and to assure an increased ROI for each project funded from public sources.

So in this, context more efforts must be made by funding managers, in hope to a better spending character and to assure an increased ROI for each project funded from public sources. Also the same effort must be made by contractor management to use the best partner to fit to project profile.

The digital era offer new ways to making business. Their success consists in obtaining the needed information, their refinement and the possibility to execute transaction in real time, together with new risk evaluation methods. The virtual enterprises or web-enterprises are also global scale enterprises, acting on planetary level by using ICT. As a matter of fact, enterprises are "based on information", on knowledge, build on advanced information processing technology. In those enterprises, the management structure is simpler, with less bureaucracy and, in conclusion, more flexible. The information has a multiplier role, activating all economical sectors.

2 PARTNERSHIPS IN RD CONTEXT

The Interest Cluster is defined as area where more IGs (Interest Group), enterprises, RD units or other organizations develop their commercial activities (e.g. ITC, construction, healthcare). The IGs' topology can by fixed (grouped by capital nature, such as transnational companies) or dynamic (enterprises can migrate from one IG to another or make their own businesses) [1].

The IG model presents, alliance centric view, the projects that can be initiated between IG members. The success of organizational structures presented be is critically affected by e-legal frame and ICT meanings, together with a clear management strategy. The main role of IG for certify, for each member, the historical records of their activity in other RD project and also to configure the best possible project alliance in order to accomplish the project objectives.

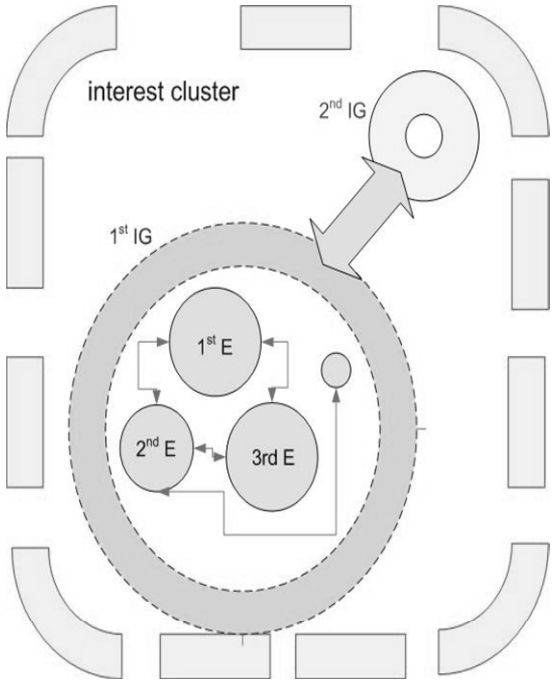

Figure 1. Interest group topology [2]

The algorithm presented in figure 2 start with an initial state of a RD unit, as potential partner. It must to fulfill the financial statements (as is done in PCR – Potential Contractors Register from RD Ministry) and also to establish the competences and usable equipments in a web form, becoming a registered partner. After that, an initial financial evaluation is made, accordingly with the statements, the status being changed in evaluated partner.

The second branch of algorithm, try to fit consortium with the desired project objectives, using combined Monte Carlo method, for fresh partners, having a disadvantage because of impossibility to establish the refinement degree, with Neural Network technique, based on historical records of similar projects and other participations in RD projects for each evaluated partner. All predictive methods present it degree of incertitude, having no as objective to eliminate it, just to evaluate it.

Being declared selected partner and all consortium being established, the project is launched. Each selected partner must accomplish their assigned tasks, obtaining project results. Those results are compared with the objectives and are registered, forming the partner history, data that will be used by neural network for next consortium configuration.

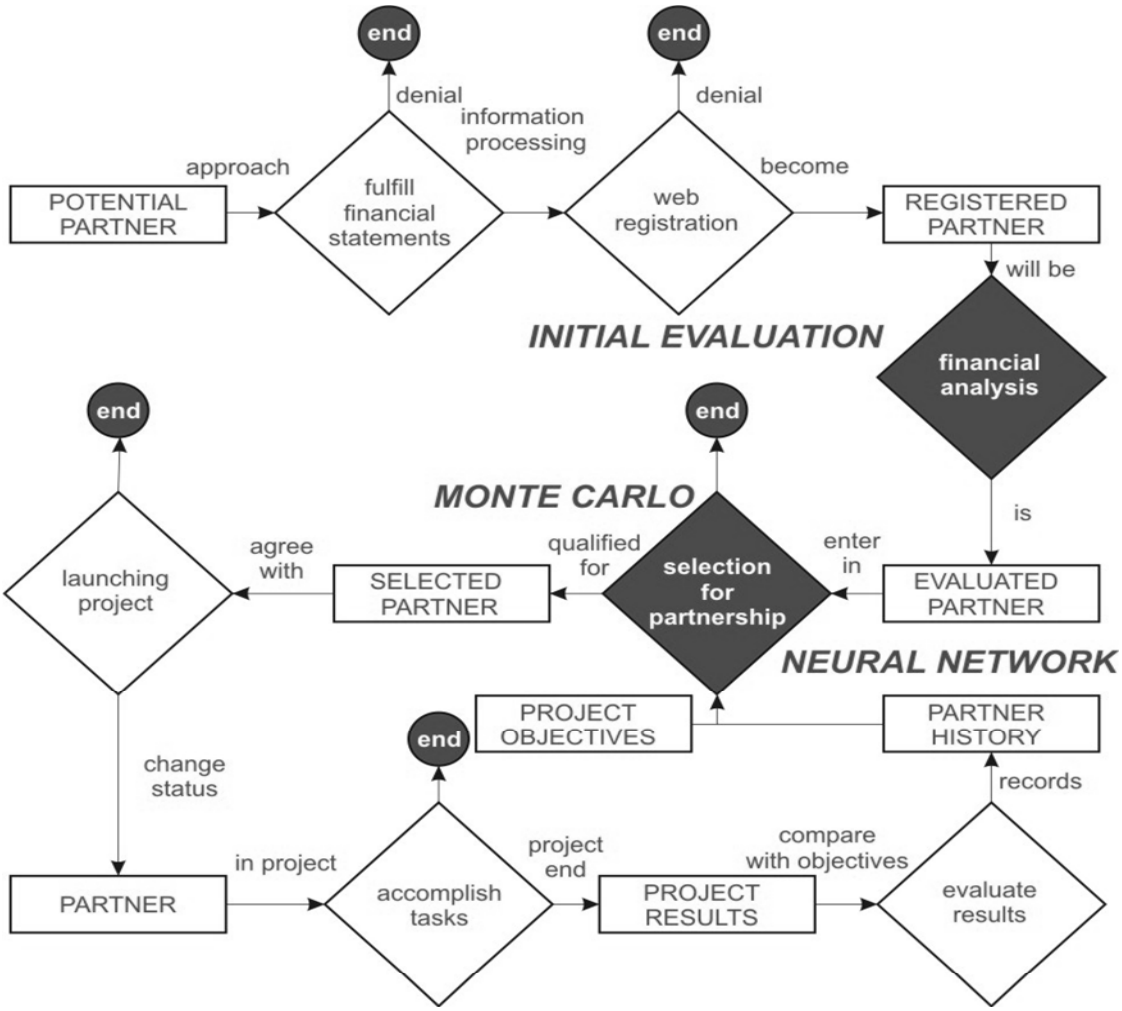

Figure 2. Evaluation and consortium configuration algorithm

3 PARTNERS AND PROJECTS FINANCIAL ANALYSIS

In order to select business partners we will use a system of economical and financial indicators, who permit evaluation of the financial standing and the management quality. This core of indicators doesn't end the possibilities of selection, but has the advantage that we could choose the most competitive enterprises based on economical and technical potential, efficiency use of resources and economic performance in business environment. So, a set of financial indicators are defined:

- Cash ratio (Cr) – cash assets /current liabilities,
- Short term cash ratio (CSi) - cash account/short term debts. Under the Romanian market circumstances, where loan securities (accepted bill and note of hand) don't have a large extension (like in the functional free market countries) this rate is very useful,
- Financial security (FS) – Permanent capital /Capital resources,
- Solvency ratio (Sr)– Permanent capital/Own capital,
- Assets turnover ratio (ATr) – Profit/Assets value, this rate reflect economic ,performance independent on financing way or fiscality,
- Profit rate (Pr) – Net value of profit/Own capital,
- Indebtedness ratio (Ir) – Debts/Capital resources,
- Debt collection ratio (DCr) – (Debts x 360)/Sales value,
- Productivity (W) – Sales value/Number of employees,

Table 1. References values for financial analyses

Indicator	Values
Cr	0,8 - 1
CSi	0,2 – 0,3
FS	38% - 50%
Sr	30% - 50%
ATr	> 30%
Pr	15 -20%
Ir	< 50%
DCr	< 60 days (velocity)

The references values of those indicators are in the table 1. Most of this indicators are used by PCR, as unified initial evaluation method. The disadvantage of PCR adopted method is the fact that, this register could not compare two contractors, just assuring that each contractor fulfill minimal requirements.

A very simple comparative evaluation method is the scoring method. Each indicator trust domain is divided in more segments corresponding to a score, total partner score being the sum for each indicator, as it shown in table 2.

Table 2. Scoring evaluation for partners

Indicators for partners' analyses	**21-25 points**	**16-20 points**	**11-15 points**	**6-10 points**	**0-5 points**
Current ratio	>2	1.5-2	1.25-1.5	1 -1.25	0.75-1
Cash ratio	>30%	25%-30%	20%-25%	15%-10%	5%-10%
Return on assets	>5%	4%-5%	3%-4%	2%-3%	1%-2%
Return on equity	>10%	7%-10%	4%-7%	1%-4%	<1%
Equity-debt ratio	>30%	25-30	20%-25%	15%-10%	5%-10%

Together with the partner evaluation, a project proposal and project results must be done. First to establish if the project have the potential to reach the proposed objectives and second, after project ending, to compare the results obtained with those objectives. Data obtained from second evaluation are registered for each partner in historical record. The indicators set for economic analysis of research project are:

- Weight of implementation (WI),
- Total venues (TV)
- Efficiency ratio (Er)- Benefit/Costs
- Profit (P) – (Venues – Costs)
- Profit rate of costs (PCr) – Profit/Costs
- Social and economic impact of the research project.

Similarly with partner evaluation, a scoring method could be defined, the values and the scoring for each segment being revealed in table 3. The scoring method have the disadvantage to unused the historical data about partners, consortium or project type.

Table 3. Scoring evaluation for projects

Indicators for project' analyses	**21-25 points**	**16-20 points**	**11-15 points**	**6-10 points**	**0-5 points**
Weight of implementation	> 90%	85%-90%	80%-85%	75%-80%	75%
Global efficiency rate	1.75-2	1.5-1.75	1.25-1.5	1-1.25	1
Efficiency ratio	25%-30%	20-35%	15%-20%	15%-20%	10%-15%

4 MONTE-CARLO METHOD

Monte Carlo method is used to cover all possibilities that can occur in project development, establishing so a risk potential. First, the trust value and the signification of the considered random variables is established (table 1). An important number of observations for each individual variable must be made, in order to tabulate the corresponding occurrence frequency for each interval of the variable' values.

Table 4. Partners and projects historical records

Partners		Project	
Total points	**No. of obs.**	**Total points**	**No. of obs.**
0-5	0	0-5	3
6-10	3	6-10	5
11-15	2	11-15	8
16-20	3	16-20	9
21-25	5	21-25	13
26-30	7	26-30	10
31-35	6	31-35	14
36-40	4	36-40	8
41-45	9	41-45	2
46-50	4	46-50	3
51-55	8	51-55	7
56-60	12	56-60	5
61-65	7	61-65	6
66-70	4	66-70	4
71-75	1	71-75	3
75-80	4	TOTAL	100
80-85	2		
85-90	1		
90-95	4		
95-100	2		
100-105	1		
105-110	2		
110-115	4		
115-120	3		
120-125	2		
TOTAL	100		

Table 5. Cumulative scores

	Partners		Project		
No.	**Rand. No.**	**P**	**Rand. No.**	**R**	**P+R**
1	61	55	48	31	86
2	47	49	40	27	76

3	50	51	25	21	72
4	67	58	11	13	71
5	73	63	66	38	101
6	27	32	61	35	67
7	18	24	26	22	46
8	16	23	48	31	54
9	54	52	75	51	103
10	96	118	42	28	146
11	56	53	5	7	60
12	82	86	82	56	142
13	89	99	0	0	99
14	75	69	79	53	122
15	76	72	89	63	135
16	85	89	69	39	128
17	70	61	83	57	118
18	27	32	2	4	36
19	22	28	72	46	74
20	56	53	67	39	92

Table 6. P+R distribution

		30 observations	20 observations	12 observations
P+R	mean	87,73	91,4	85,33
	sigma	34,32	32,59	32,23
	sigma/mean	0,39	0,35	0,37

Based on these tables, for each variable is created a cumulative frequency table. If there is possible, for the relieving of the computation, the cumulative frequency curves is mapped, for each individual variable. The graph is analyzed in order to establish if it resemble to the form of a known distribution. The probability distribution type can be appreciate through goodness of fit tests (Kolmogorov-Smirnov, Pearson) which measure the conformity between the theoretical distribution and the values of the random variable' distribution from the given dates or from measuring.

A table with random number is chosen/is generated. This table must be choose/generate so that the numbers included into it to be from the range of real values of the variables. If needed, combination of existing numbers can be made, using the tenth comma and the sign + and -. From the table is chosen for each individual variable values which will be considered as real given variable. For many cases, these values will be different to the precedent obtained values.

For the chosen values, the corresponding values are searched. This is made by using the curves mapped by the distribution function or calculate it through interpolation. A statistical study of the last values obtained is made, searching the average, the standard deviation and if it is the case the variation coefficient. If the standard deviation is large (larger than the determination degree imposed by the problem), the number of observation of the studied phenomena is increased.

From a given set of partners we what to choose the optimal one for the development of a project. In order to do this, some certain economical indicators was observed. One part of these indicators concerned the financial analyses of the partners; the other part concerning the manner of the partners to develop a project. For application of the Monte Carlo simulation, we use the scoring method. This one consist in transcription of economic indicators in scores, in order to give a cumulative score for each partner, so that we can compare partners (table 2 and 3).

We consider a number of 100 observation (partners) for whom we calculated the indicators above mentions. The results are centralized into table 4. Using a table with random numbers, we determine the cumulative scores for partners and project for twelve initial values and twenty values (table 5), the record with highest P+R being declared best option.

We can increase the number of observation in order to obtain more favorable values or we can choose the better one from the ones obtained. It is proved that the increasing of the trials' number can lead on to weaker result than the initial one, this being one of the biggest disadvantage of the Monte-Carlo method.

5 NEURAL NETWORK TECHNIQUE

Last technique presented is neural network, applied on Microsoft Analyses Server, used also in other predictive processes, set known as Business Intelligence. That suppose al large amount of registered data with diverse structure, most time from different databases, using the data mining process. This data are numbers and letters, informative fields and selection fields, having a table structure, some have an aggregate data structure;

We present a three-tier structure, using large implemented Operating Systems and Database Servers: MS W2003 Servers and MS SQL 2005. The concept of data' is referred to three different layers: Data layer, Information layer and Knowledge layer. Data layer, where primary data are inserted in the system, information. All data are stored in a data warehouse as main repository of the R&D historical data.

Information is data obtain after aggregation process, using aggregate functions depending on subject, interconnected by communication nods existent between organizations involved named data mart. This concept supposes a repository of data gathered from operational data and other sources that is designed to obtain knowledge. So, the information is obtained from data warehouse after suffering an data mining process. Also, an OLAP (On- Line Analytical Processing) system is provided, to assure a framework for the analysis of multidimensional data. Metadata are expressed in a condensed data mine-able format, or one that facilitates the practice of data mining [5].

The third layer, knowledge is resulted after two separate processes of knowledge discovery and prediction. Knowledge discovery provides information for AS IS stage of the system, having a readable form and being understood by a user. Otherwise, the second process, forecasting, or predictive modeling provides predictions of supposable future events, having in mind preset scenarios and can be transparent and readable for some algorithms or opaque in others, such as neural networks [4]. Each phenomena must be

modeled with specific or combined methods in order to assure more accurate result of prediction, methods tested in time, based on history records. The system infrastructure is presented in figure 3, where are underlined the layers mentioned above together with its components (e.g. Predication, Notification, OLAP etc.) [3].

An example for creating the template mining model for the selection of partners is given. Firs of all we have to create the mining model following the syntax:

```
CREATE MINING MODEL <name>
(
< column definitions>
) USING <algorithm>[(<parameters>)]
[WITH DRILLTHROUGH]
CREATE MINING MODEL PartnerSelection
(
[Partner_code] TEXT  KEY,
[Domain] TEXT  DISCRETE,
[Cash ratio] DOUBLE CONTINUOUS,
[Type] TEXT DISCRETE,
[Relation_To_HOH] TEXT DISCRETE PREDICT,
[Project] DOUBLE DISCRETIZED PREDICT
) USING Microsoft_Neural Network
```

HIDDEN_NODE_RATIO
HOLDOUT_PERCENTAGE
HOLDOUT_SEED
MAXIMUM_INPUT_ATTRIBUTES
MAXIMUM_OUTPUT_ATTRIBUTES
MAXIMUM_STATES
SAMPLE_SIZE

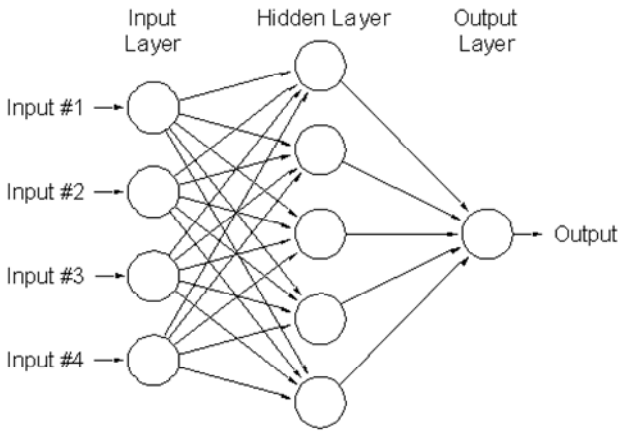

Figure 3. Neural Network Parameters and Graphic [6]

In order for our data to be relevant and to be able to compare to the Monte Carlo model we will populate the data base with 100 entries using the following syntax:

```
INSERT INTO PartnerSelection(
   [Partner_Code],[Domain],[Cash ratio],
   [Type],[Relation_To_HOH],[Project])
OPENQUERY('PartnerSelectionVirtualEnterprises',
   'SELECT [Partner_Code],[Domain],
                [Cash ratio],[Type],
                [Relation_To_HOH],[Project]
                FROM Partners')
INSERT INTO PartnerSelection
( Partner_Code, Domain, Cash ratio, [Type],
  [Credit Rating],
```

```
  Projects(SKIP, [Project Name])
SHAPE {OPENQUERY('Projects',
  'SELECT ID, Domain, Cash ratio, Type, Rating FROM Partners')}
APPEND
( {OPENQUERY('Project',
   'SELECT Project_Code, Rating FROM 'Projects'')}
        RELATE Project_Code TO Partner_Code)
        AS ProjectTeam
```

The following example illustrates a polling query and associated incremental processing query that would be used to detect the presence of new events in the fact table and incrementally add those rows to a partition.

SELECT * from Partners WHERE LastUpdated > coalesce(?, -1) AND LastUpdated <= ?.

SELECT * from Partners WHERE
LastUpdated > coalesce(01/04/2007 10pm, -1) AND
LastUpdated <= 01/04/2007 10.15 pm

6 CONCLUSIONS

Main contribution presented in this papers is the risk evaluation and consortium configuration algorithm, in RD partnerships, combining three different methods of risk evaluation: scoring, Monte Carlo and neural network prediction.

Most of scientific approaches, for typical, analytical or predictive reports and analyses, are called Business Intelligence (BI). The funding activity from public budget must be respected in every country, is governed by a local law frame which, after Romanian adhesion on EU, is accordingly with EU funding policy fir R&D activity.

R&D funding management requires special tools in comparison with generally BI concept. These tools are more oriented to frauds detection, preventive control, reallocating and forecasting budgets. More then this, large data volume is involved, obtained from different organizations, with many inconsistencies, providing huge problems for data automation.

In this context, preset scenarios and templates, must be set for each type of activity, resulting complex algorithms. The knowledge obtained can be transparent and readable for some algorithms or opaque in others, such as neural networks. The modeling of economic and technical phenomena, implied by an R&D project, must be based on Romanian experience (previous R&D funding programs) but also on EU experience (results of FP7 and before) in order to assure more accurate result of prediction, methods tested in time, based on history records.

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