

MULTICRITERIA SELECTION OF PERSPECTIVE OBJECTS FOR INVESTMENTS: DSS SVIR VS. MUCHNIK METHOD

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Abstract: *The problem of selection of perspective objects for investments is considered. Objects are Russian companies of mobile communication. To solve this problem we use the decision-making support system (DSS) SVIR and manual procedures of the Muchnik method. We shortly describe these tools and show that both approaches lead to close results. The paper is prepared on the basis of B.Sc. thesis of the first author*

Keywords: *multicriteria selection, DSS SVIR, Muchnik method*

Introduction

Selection of perspective objects for investments is usually formulated as a multicriteria problem. Such a selection needs a lot of subjective information, which can not be easily formalized. So, experts prefer to solve the mentioned problem independently without support of any automated decision-making support systems (DSS). However, there are advanced and available DSS on software market, which could solve such problems more effectively and give the results being close to expert opinions. In the paper we consider a particular problem related with the selection of companies of mobile communication to be perspective for investments. This problem is resolved with the support of DSS SVIR and simultaneously by means of the Muchnik method. DSS SVIR was developed in Saint-Petersburg Transport University and it is used in various applications [Mikoni, 2009a, 2009b]. The Muchnik method was proposed by his author to one large Russian company of mobile communication [Alexandrov, 2011]. We demonstrate that both approaches lead to close results. So, the trained DSS SVIR could substitute the work of qualified experts in the mentioned problems.

Multicriteria problem setting

2.1. SPARK data base

Data for this research were taken from the Russian large data base (DB) SPARK, which contains information about financial activity of almost all registered legal entities. SPARK is created on the basis of annual reported data presented by state and private Russian companies. It contains hundreds of lines (objects) and 51 columns (parameters) for each object. Figure 1 demonstrates the part of SPARK. Here: the columns titled as 'Активы' (Actives), 'Амортизация' (Amortization), et al mean the parameters reflecting economical activity of companies under consideration, RUR means Russian National Currency 'Rubles'. To construct criteria one uses both primary parameters taken directly from the SPARK and so-called derivative parameters, which are the certain combinations of the primary parameters.

	A	B	C	D	E	F	G	H	I	J	
1	СПАРК										
2	1	2	3	4	5	6	7	8	9	10	
3	АКТИВЫ всего	Амортиза ция	ВНЕОБОРОТ НЫЕ АКТИВЫ	Валовая прибыль	Внереализа ционные доходы	Выручка от продажи (за минусом НДС, акцизов ...)	ДОЛГОСРОЧ НЫЕ ОБЯЗАТЕЛЬ СТВА	Дебиторс кая задолжен ность (более года)	Дебиторска я задолженн ость (менее года)	Денежны е средства	
4	2007, RUR	2007, RUR	2007, RUR	2007, RUR	2007, RUR	2007, RUR	2007, RUR	2007, RUR	2007, RUR	2007, RUR	
5	71 913 000		4 426 000	40 175 000		186 009 000	284 000		8 601 000	58 201 000	
6	525 796 000		248 013 000	40 551 000		46 780 000	180 515 000		193 789 000	25 409 000	
7	466 064 000	30 098 000	365 663 000	69 527 000		327 478 000	303 000	1 282 000	73 708 000	2 576 000	

Fig. 1. The part of DB SPARK

For our research we took the group of the first 60 companies having the complete data list. Its activity refers to 2007 year that was the last year before the world crisis came. To simplify the analysis we did not consider the data related with the other years although such a dynamics helps to correct the decision-making

2.2. Criterion for object selection

For decision-making our experts created 3 criteria. Each criterion is defined by a set of derivative parameters. Here is its description:

1) Particular criterion **Profitability**

Parameters of the criterion are:

- *Profitability of investments*: net profit / (equity capital + long-term liabilities)
- *Profitability of property, plant and equipment*: net profit / (property, plant and equipment)
- *Profitability of products*: net profit / cost of sold goods

We need the maximization of all these parameters. The parameter preferences are:

$$\text{Profitability of investments} > \text{Profitability of property, plant and equipment} > \text{Profitability of products}$$

Here the sign '>' means the preference between the parameters

2) Particular criterion **Liquidity**

Parameters of the criterion are:

- *Current liquidity ratio*: (current assets – long-term account receivable)/ (short-term liabilities). The recommended values of this indicator are 1.5-2.5
- *Cash liquidity ratio*: (cash resources + short-term financial investments)/(short-term liabilities). The recommended values of this indicator are 0.2 – 0.5.

The parameter preferences are:

$$\text{Cash ratio} > \text{Current ratio}$$

3) Particular criterion **General financial rate**

Parameters of the criterion are:

- *Operating period, days*. It is defined as a difference between the registration date and the reporting date (31.12.2007).
- *Current assets*. It is the primary parameter taken from the SPARK

We need the maximization of all these criteria. The parameter preferences are:

$$\text{Current assets} > \text{Operation period}$$

The group of parameters related with the criterion **Profitability** has the first priority for investors. This group provides the high profit from investments. The group of parameters related with the criterion **Liquidity** has the second priority. This group provides the low risk of investments based on good financial conditions. The group of parameters related with the criterion **General financial rate** has the last priority. This group provides the low risk of investments based on a high reputation.

Decision making with the DSS SVIR

3.1. General description of SVIR

The DSS SVIR was developed in St. Petersburg State Transport University for the solution of typical problems of multicriteria selection. SVIR consists of four groups of methods:

- Methods of **vector optimization**. The methods of this group operate with relations on the set of preferences
- Methods of **scalarization** of vector assessments. These methods are associated with the transformation of a vector optimization problem to a scalar optimization problem
- Methods of **classification**. They deal with relations between objects and classes, whose descriptions are fixed by experts
- Methods of **analysis of hierarchies**. They use pairwise comparisons of objects by experts

SVIR has the convenient graphical user interface and instructional material to study the system functionality. These circumstances make the system be useful both for students and for experts. This moment there are two versions of the program: the Russian version and B-release of the English version. In the paper we use the methods of vector optimization and the methods of scalarization in the framework of the Russian version.

3.2. Forming hierarchy of targets

The first step for problem solution in the DSS SVIR consists in constructing a graph of goals. Such a graph is determined by an expert using the set of given criteria. It is presented on figure 2

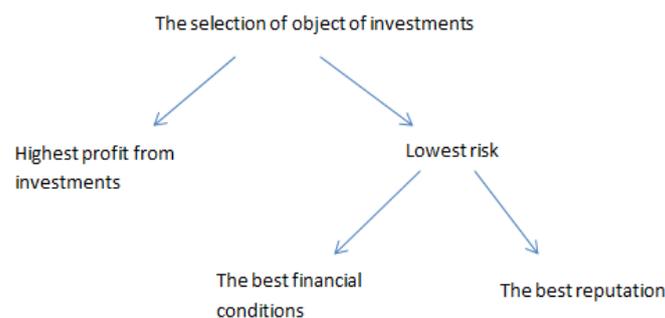


Fig. 2. Graph of goals.

Three final tops on the mentioned graph correspond to three groups of parameters mentioned in the section 2.2. This graph allows SVIR to construct the model of choice. This model is presented in three sheet tables. Figure 3 shows one of these tables. .

№	Объект	Дебиторская	Краткосрочный	Денежные сре	Оборотные акт	Краткосрочный	К-т общей лике	К-т абсолютн
1	ЗАО "АМТЕЛ-СВЯЗЬ"	0.00	4000.00	1974000.00	17122000.00	17423000.00	0.98	0.1
2	ЗАО "АСТРАХАНЬ GSM"	0.00	0.00	2936000.00	157767000.00	267777000.00	0.59	0.0
3	ЗАО "БАЙКАЛ-ТРАНСТЕЛЕКОМ"	0.00	0.00	13813000.00	113134000.00	50360000.00	2.25	0.2
4	ЗАО "ВБТ"	0.00	0.00	76163000.00	128741000.00	41865000.00	3.08	1.8
5	ЗАО "ГАЗТЕЛЕКОМ"	0.00	0.00	24628000.00	297447000.00	82159000.00	3.62	0.3
6	ЗАО "ГРУППА КОМПАНИЙ"	0.00	0.00	3421000.00	126035000.00	147512000.00	0.85	0.0
7	ЗАО "ДИДЖИТАЛ НЕТВОРК"	0.00	5113000.00	1266000.00	31991000.00	54719000.00	0.58	0.1
8	ЗАО "ДИРЕКТ НЭТ ТЕЛЕКОМ"	0.00	284000.00	387000.00	18206000.00	35808000.00	0.51	0.0
9	ЗАО "ЕВРОТЕЛ"	0.00	31600.00	37263000.00	174504000.00	270226000.00	0.65	0.1
10	ЗАО "ИНТЕГРАЦИЯ СВЯЗИ"	0.00	0.00	3193000.00	17214000.00	11988000.00	1.44	0.2
11	ЗАО "ИТ-ЦЕНТР"	0.00	3699000.00	67821000.00	490478000.00	626495000.00	0.78	0.1
12	ЗАО "КАВКАЗ-ТРАНСТЕЛЕКОМ"	0.00	0.00	2909000.00	130421000.00	62591000.00	2.08	0.0
13	ЗАО "КОЛАМБИЯ-ТЕЛЕКОМ"	0.00	2797000.00	580000.00	59203000.00	110763000.00	0.53	0.0
14	ЗАО "КОМПАНИЯ "ЭР-ТЕЛЕКОМ"	0.00	0.00	3766000.00	51166000.00	119667000.00	0.43	0.0
15	ЗАО "КОМПАНИЯ "ЭР-ТЕЛЕКОМ"	0.00	0.00	1292000.00	47514000.00	20764000.00	2.29	0.0
16	ЗАО "КОМПАНИЯ "ЭР-ТЕЛЕКОМ"	0.00	0.00	938000.00	61313000.00	17793000.00	3.45	0.0
17	ЗАО "КОМПАНИЯ "ЭР-ТЕЛЕКОМ"	0.00	0.00	2887000.00	38905000.00	18145000.00	2.14	0.1
18	ЗАО "КУРСКАЯ ТЕЛЕФОННАЯ КОМПАНИЯ"	0.00	0.00	90000.00	21471000.00	19762000.00	1.09	0.0
19	ЗАО "РК "ВЕКТОР"	0.00	890000.00	403000.00	41022000.00	37097000.00	1.11	0.0
20	ЗАО "РУССДО"	103453000.00	601270000.00	541449000.00	1315624000.00	274867000.00	4.41	4.1
21	ЗАО "РЭЙС ТЕЛЕКОМ"	0.00	0.00	14668000.00	45252000.00	2013000.00	22.48	7.2
22	ЗАО "РЭЙС-КОММУНИКАЦИИ"	0.00	5892000.00	16471000.00	316708000.00	258559000.00	1.22	0.0

Fig. 3. Objects/Parameters table formed in SVIR.

3.3. Problem solution with methods of vector optimization

These methods forms so-called Pareto set, which consists of non-dominated objects [Wiki, Pareto]. To select the Pareto set one uses the correspondent option from the SVIR menu. The list of options is presented on the left low part of figure 4. We also used the other two methods of vector optimization: lexicographic optimization and leximin ordering. Although the former is enough crude and the latter is good rather for the purpose of education however they allowed to reduce the Pareto set.

3.4. Problem solution with methods of scalar optimization

These methods deal with the results of vector optimization that is with Pareto set. Scalarization reduces the vector form of objects presentation to its scalar form [Wiki, Convolution]. In our work we used the general additive convolution method, which averages the particular criteria using their coefficients of importance. Therefore here we deal with weighted sum of 3 normalized criteria Profitability, Liquidity and General financial rate. Figure 5 presents the interface for direct weight assignments.

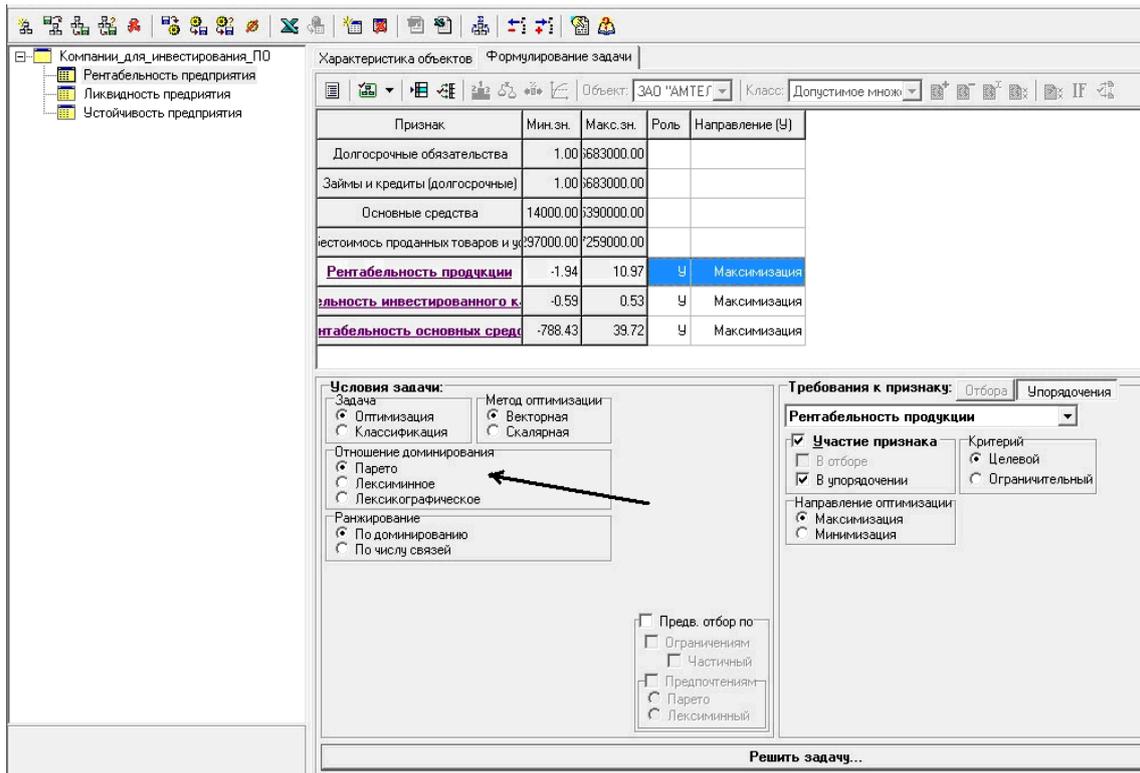


Fig. 4. SVIR is tuned for Pareto-optimization method

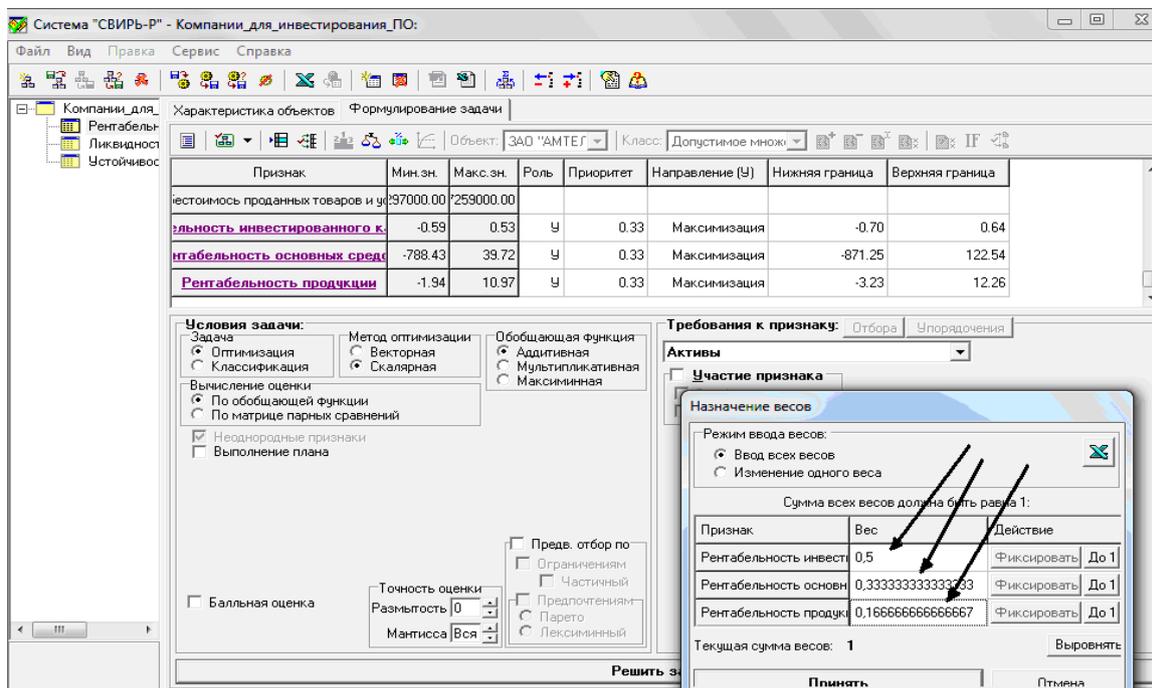


Fig. 5. SVIR interface for direct weight assignment.

Finally we obtained the list of companies to be preferred for investments. This list is presented in table 1

Table 1. Final list of the selected companies (SVIR)

"Baikal-transtelecom" JSC
"Nachodka telecom" Ltd
"Prestige-internet" Ltd
"Teleset" Ltd
"VyatKTV" Ltd
"Gaztelecom" JSC
"Integracia svyazi" JSC
"Megapayge" Ltd
"Borodino-telecom" Ltd
"Sky link" JSC

It is necessary to emphasize that the tuned DSS SVIR can be repeatedly used without any expert for other set of objects (lists of companies) in the framework of the same problem setting (goals, criteria). Speaking "without any expert" we mean the possibility of problem solution by a user, which is not qualified in the area of multicriteria optimization.

Muchnik procedures

4.1. Method description

Muchnik method is a set of manual procedures based on:

- visualization of objects distribution in the space of their parameters
- the simplest binary assessment of objects success on each parameter

According the mentioned method an expert first of all specifies a set of particular criteria and ranks them. Each criterion is considered as a set of primary or derivative parameters. A company can be successful on each of these parameters or can be unsuccessful. In the first case its assessment is equal 1 otherwise 0. Therefore, if a criterion has 3 parameters then a criterion value varies from 0 to 3.

Then our expert constructs a histogram of companies distribution on each parameter from a given criteria and then we set the threshold (thresholds) of success. If we want to have the maximum values of the mentioned parameter then the successful companies are located to the right of the threshold. If we want to have the minimum values of the mentioned parameter then the successful companies are located to the left of the threshold. If we want the values of parameter be inside a certain interval then the successful companies are located between two thresholds. The threshold position is determined very subjectively. Usually one fixes the approximate number of successful companies (5%, 10%, 20%, etc.) and this number allows to determine the threshold (thresholds) position. Figure 6 illustrates such a separation of companies for the parameter «Profitability of investments». The arrow shows the possible threshold position.

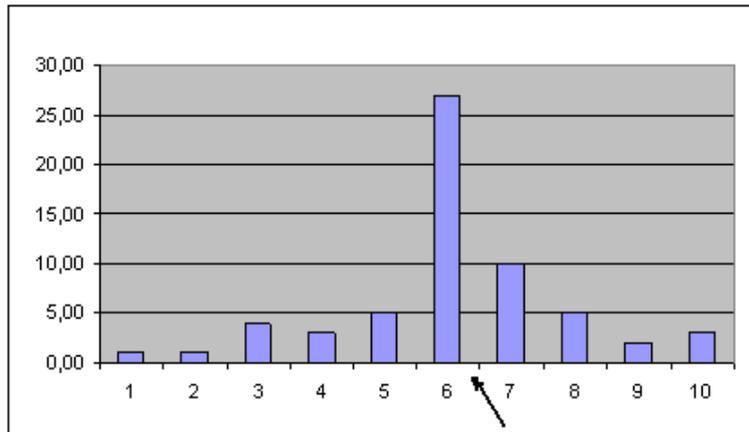


Fig. 6. The histogram of companies distribution on the parameter 'Profitability of investments'. Axis Y is the number of companies, axis X is the category.

The level of success for each criterion also depends on expert opinion and therefore is very subjective. As we mentioned above the criterion Profitability includes 3 parameters and its value varies in the interval [0-3]. An expert can set the value 2 as a threshold for successful companies. It means that the best companies on this criterion are successful on any two or three parameters of this criterion.

The selection procedure contains the following steps:

- 1) Choice of the best companies on the criterion 'Profitability', the other ones are eliminated
- 2) Choice the best companies on the criterion 'Liquidity', the other ones are eliminated
- 3) Choice the best companies on the criterion 'General financial rate'

As a result we obtain the most promising group of companies. If the number of 'the best companies' proves to be too large or too small then one should change the thresholds of success both for parameters and for criteria.

We applied the Muchnik method to the same 60 companies that were used with DSS SVIR. Having made three steps of selection describe above we obtained the list of companies presented in the table 2.

Table 2. Final list of the selected companies (Muchnik method)

"Baikal-transtelekom" JSC
"RUSSDO" JSC
"Sky link" JSC
"SSU" JSC
"Borodino-telecom" Ltd
"Prestige-internet" Ltd
"Radio station "Serebryaniy dozhd" Ltd
"TV Technopark" Ltd
"TC "OSTANKINO"" JSC

Conclusion

In the paper

- the short description of the DSS SVIR and Muchnik method is presented,
- the problem of selecting perspective companies of mobile communications for investment is solved,
- the coincident of results proves to be equal 60% and the experts confirm that SVIR list of selected companies is promising.

In the future we suppose to repeat our experiments in DSS SVIR:

- with the extended list of the criteria,
- with the methods of classification,
- with the methods of analysis of hierarchies,

and compare the results between themselves and with those obtained in this paper

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