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Accountability Of Temporal Indicator's Remoteness Factor In The Model Dynamics Criterion While Forming A Portfolio Of Project-Oriented Enterprise Development

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ABSTRACT

In this paper, we suggest a calculation method for remoteness coefficients for indicators in the temporal order in purpose to evaluate projects when constructing the project portfolio. It is based on maintaining the order of remoteness coefficients values in certain places. This was achieved through the use of a special approach to the selection of matrix elements, which has the dimension of the temporal order, and the introduction of a universal system of local indexes for these areas. Due to computer experiment we proved that from a practical standpoint the temporal order of eight indicators is a rational one.

General Terms

Project Portfolio Management, Method, Evaluation.

Keywords

The project portfolio construction, dynamics indicators, temporal indicators, criteria, rating, period, remoteness coefficient change

1. INTRODUCTION

Studying the projects selection for portfolio of project-oriented enterprise development, we established the feasibility of applying of criteria of model dynamics indicators [1-2]. Here in this paper we offer to improve it in order to consider the factual order of temporal indicators, taking into account the contribution to the results of the portfolio projects.

2. BASIC POINTS OF THE PROJECT PORTFOLIO CONSTRUCTION

The criterion of model dynamics indicators is defined as the inequality of rate of change of those indicators that are connected with the development strategies of the enterprise [3]. It has the following form:

$$ {}_a h_1^e > {}_b h_2^e > \ldots > {}_r h_j^e > \ldots > {}_w h_N^e , \quad (1) $$

where ${}_{a,b,\ldots}h$ are rates of change of indicators *a, b,* ....(temporal indicators) for a certain period of time between certain reference points;
N is number of indicators.

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e is an index that shows that the temporal indicators relate to model dynamics criterion.
Lower right index determines the location of a particular indicator in the model dynamics, its model rating (MR). It definitely is "bound" to a particular indicator (lower left index). For instance, in our case, MR *2* corresponds to the index *b*, and MR *N* corresponds to the index *w*. Therefore, it can be stated that the compliance with the requirement (1) implements the selected strategic line of enterprise behavior.
It should be noted that (1) only indicates the sequence of temporal of indicators and makes no claim to their absolute values. It is very important for the functioning of the enterprise in the implementation of new development projects. The introduction of a specific project results in a change of not of all indicators that are fixed in (1) [4]. . Therefore, we must strive to pick up other projects in the portfolio in a way when the criterion of model dynamics indicators is not changed. However, it is very difficult to achieve and the factual order (factual rating FR) for different periods will not correspond to the model 1. For example, it may have the following form:

$$ {}_b h_1^f > {}_r h_2^f > ... > {}_w h_j^f > ... > {}_a h_N^f , \qquad (2)$$

where f is an index which indicates the number of the period for which we calculate the factual values of the temporal indicators, taking into account the contribution to the results of the portfolio projects.
Typically, the factual figures are recorded in the table, which has the form given below.

Table 1 – The values of the factual ratings of the temporal indicators for different periods

Indicator		Period number between the reference points				
Title	Model rating	*1*	...	*f-1*	*f*	*f+1*
Growth Rate a	*1*	${}_a h_j^1$	…	${}_a h_1^{f-1}$	${}_a h_N^f$	${}_a h_1^{f+1}$
Growth Rate b	*2*	${}_b h_2^1$	…	${}_b h_2^{f-1}$	${}_b h_1^f$	${}_b h_j^{f+1}$
...	...	…	…		…	…
Growth Rate r	*j*	${}_r h_N^1$	…	${}_r h_j^{f-1}$	${}_r h_2^f$	${}_r h_2^{f+1}$
...	...	…	…	…	…	…
Growth Rate w	*N*	${}_w h_1^1$	…	${}_w h_N^{f-1}$	${}_w h_j^f$	${}_w h_N^{f+1}$

The analysis of the table shows that for the period *f* the factual ratings correspond the condition (2), and for the period *f-1* correspond the model ratings. For all other periods, the criterion of model dynamics (1) is broken.

3. CRITERION FOR RATIONAL PROJECT PORTFOLIO CONSTRUCTION

The rational criterion of portfolio formation that is formed by the projects selection from the list of possible ones will be the minimization of the value of the sum of integral coefficients of the factual ratings deviations from the model ones:

$$\sum_{f=1}^{F} K^f \to \min . \qquad (3)$$

The values of K^f are calculated based on the data from the table 1 using the formula proposed in [5]:

$$K^f = 1 - \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(Q_{ij}^f \cdot a_{ij}^f)}{N(N-1)} , \qquad (4)$$

where *i, j* are indices of rows and columns of the temporal order of the period *f*;

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Q_{ij}^f is the value in the cell *ij* of the matrix of the temporal orders of the period *f*;

a_{ij}^f is the coefficient that for the period *f* takes into account the remoteness of factual rating of temporal indicator from its model one.

The method for constructing the matrices of temporal orders, that contain the values Q_{ij}^f , are given in [6]. The calculation of the coefficient a_{ij}^f , which logically can be called as the remoteness coefficient, is done by the method that is proposed by us and described in the earlier work [7]. However, the problem of evidence of its correctness and efficiency for different number of elements of model dynamics criterion stays actual.

4. RESEARCH OF A REMOTENESS COEFFICIENT CHANGE

To answer this question, let us consider the model of the remoteness coefficient matrix in the form of a system of triangular areas (Fig. 1). Such area selection fits the principle of harmonization of different interaction of separations [8].

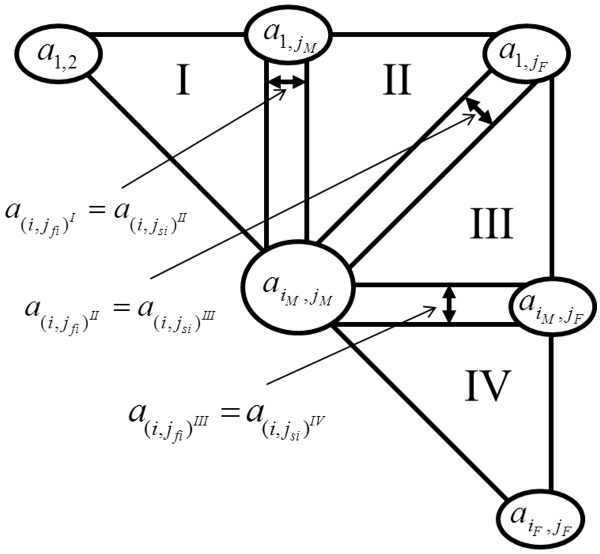

Fig. 1. Equality condition for the elements in neighboring areas

The conditions of equality of the core matrix elements values, located at the vertices of the triangular areas (items marked by ovals in Fig. 1), are the boundary conditions of connection. The core matrix elements values are given in [9]. In addition, the condition of equality of contiguous areas elements should also be executed:

$$a_{(i,j_{fi})^{v}} = a_{(i,j_{s_i})^{v+1}}, \quad (5)$$

where *v* is the index of the triangular area $v = \overline{I, IV}$.

Then, local indexes can be expressed through the indexes of the main matrix for each triangular area (Fig. 2).

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Area №	Area form	Local indexes			
		i_s	i_f	j_s	j_f
I		1	i_M	2	j_M
II		1	i_M	j_M	j_F
III		1	i_M	j_M	j_F
IV		i_M	i_F	j_M	j_F

Fig. 2. The correspondence between local indexes and main matrix indexes of for the selected areas

Let's study the model given on Fig. 3.

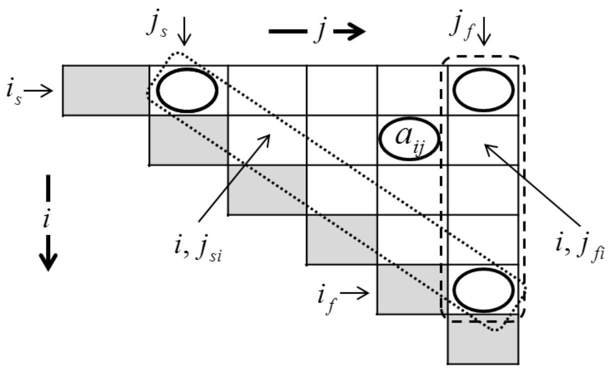

Fig. 3. A system of local indexes for the examined area

In this model a_{ij} values for every element can be determined using the formula:

$$a_{ij} = a_{i,j_{fi}} - (j_f - j)\Delta_j, \tag{6}$$

where Δ_j is the step between elements values in i-th row.

This formula provides line-by-line calculations and filling the matrix, i.e. for $i = const$, and $j = \text{var}$.

The model in Fig. 3 shows that the number of elements in a row for different i is not equal. It can be calculated as:

$$m_j = (j_f - j_s) - (i - i_s). \tag{7}$$

Accordingly, the step between elements values in i-th row will be calculated as:

$$\Delta_j = \frac{a_{i,j_{fi}} - a_{i,j_{si}}}{(j_f - j_s) - (i - i_s)}. \tag{8}$$

In this formula, the components included in the numerator depend on the i values.

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Using analogical inference with (Eg. 6) the first component can be calculated from the following dependency:

$$a_{i,j_{fi}} = a_{i_s,j_f} - (i_s - i)\Delta_i \,, \tag{9}$$

where: $$\Delta_i = \frac{a_{i_s,j_f} - a_{i_f,j_f}}{i_f - i_s}, \tag{10}$$

Δ_i value determines the step between elements values in j_f column.

The second component is defined as:

$$a_{i,j_{si}} = a_{i_s,j_s} - (i_s - i)\Delta_{is} \,, \tag{11}$$

$$\text{where: } \Delta_{is} = \frac{a_{i_s,j_s} - a_{i_f,j_f}}{i_f - i_s}. \tag{12}$$

Δ_{is} value determines the increment between elements $a_{is,js}$ and $a_{if,jf}$, which are parallel to the main diagonal.

Having analyzed the formulas (Eg. 6) - (Eg. 12) we can see that all incoming parameters are determined by the elements values of the main matrix. They depend on what triangular area is examined. Depending on that, local indexes values (Fig. 2) and appropriate elements of the main matrix are chosen. The formulas received made the basis of a computer program for the calculation of remoteness coefficients for N =4-12, that was designed in MS Excel development framework. The scheme of stage analysis and synthesis of complex objects was used in calculation algorithm development [10].

The remoteness coefficients values for N =4, the table of correspondence between local indexes and main matrix indexes (Fig.2) and the number of temporal order elements N were used as input data. The programming algorithm provides the automatically selection of borders of four triangular areas and the validity check of the arrangement of initial matrix elements in the $N \times N$ matrix. Fig. 4 shows a sample of the calculation of remoteness coefficients for N =10.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1	**0**	**0,75**	0,90	1,05	1,20	**1,35**	1,39	1,43	1,46	**1,50**	0	0
2	0,75	**0**	0,73	0,88	1,03	1,18	1,21	1,25	1,29	1,43	0	0
3	0,90	0,73	**0**	0,70	0,85	1,00	1,04	1,08	1,21	1,35	0	0
4	1,05	0,88	0,70	**0**	0,68	0,83	0,86	1,00	1,14	1,28	0	0
5	1,20	1,03	0,85	0,68	**0**	**0,65**	0,79	0,93	1,06	**1,20**	0	0
6	1,35	1,18	1,00	0,83	0,65	**0**	0,63	0,76	0,90	1,04	0	0
7	1,39	1,21	1,04	0,86	0,79	0,63	**0**	0,60	0,74	0,88	0	0
8	1,43	1,25	1,08	1,00	0,93	0,76	0,60	**0**	0,58	0,71	0	0
9	1,46	1,29	1,21	1,14	1,06	0,90	0,74	0,58	**0**	**0,55**	0	0
10	1,50	1,43	1,35	1,28	1,20	1,04	0,88	0,71	0,55	**0**	0	0
11	0	0	0	0	0	0	0	0	0	0	**0**	0
12	0	0	0	0	0	0	0	0	0	0	0	**0**

Fig. 4. Remoteness coefficients values a_{ij} for N =10

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It is obvious that the arrangement of initial matrix elements (in bold) corresponds to the planned arrangement (Fig. 1).

The processing of calculation results for N =4-12 confirms that in all cases the elements $a_{1,2}$ =0,75, a_{1,j_M} =1,35, a_{1,j_F} =1,5 from the first row are situated in the cells with the indexes 2, $j_{N/2+1}$, j_N accordingly (Fig. 5).

	j	2	3				$j_{N/2+1}$				j_{N-1}	j_N
N	12	**0,75**	0,87	0,99	1,11	1,23	**1,35**	1,38	1,41	1,44	1,47	**1,50**
	10		**0,75**	0,90	1,05	1,20	**1,35**	1,39	1,43	1,46	**1,50**	
	8			**0,75**	0,95	1,15	**1,35**	1,40	1,45	**1,50**		
	6				**0,75**	1,05	**1,35**	1,43	**1,50**			
	4					**0,75**	**1,35**	**1,50**				

Fig. 5. Cell indexes values for the elements $a_{1,2}$, a_{1,j_M} , a_{1,j_F} arrangement in the first matrixes rows for N =4-12

A similar result is obtained for the elements a_{1,j_F} =1,5, a_{i_M,j_F} =1,2, a_{i_F,j_F} =0,55 that are located in the last column of the matrixes (Fig. 6).

i	N: 12	10	8	6	4
1	**1,50**				
2	1,44	**1,50**			
	1,38	1,43	**1,50**		
	1,32	1,35	1,40	**1,50**	
	1,26	1,28	1,30	1,35	**1,50**
$i_{N/2}$	**1,20**	**1,20**	**1,20**	**1,20**	**1,20**
	1,07	1,04	0,98	0,88	**0,55**
	0,94	0,88	0,77	**0,55**	
	0,81	0,71	**0,55**		
i_{N-2}	0,68	**0,55**			
i_{N-1}	**0,55**				

Fig. 6. Cell indexes values for the elements a_{1,j_F} , a_{i_M,j_F} , a_{i_F,j_F} arrangement in the last matrixes columns for N =4-12

To answer the question about the rational number of temporal order elements the number of computer experiments was done. These experiments used the actual temporal orders where all alternate scrambling only belonged to one of the four

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selected areas (Fig. 1). For each of these cases and different N values, the coefficient K was calculated using the (Eg. 4). Fig. 7a shows the calculation results.

№ space	N				
	4	6	8	10	12
II	0,42	0,53	0,58	0,61	0,63
III	0,44	0,55	0,6	0,63	0,66
I	0,54	0,63	0,67	0,69	0,71
IV	0,60	0,68	0,73	0,73	0,75

a)

№ space	N			
	4-6	6-8	8-10	10-12
II	20,8	8,6	4,9	3,2
III	20,0	8,3	4,8	4,5
I	14,3	6,0	2,9	2,8
IV	11,8	6,8	0,0	2,7

b)

Fig. 7. Coefficient K values (a) and its relative percentage %% variation (b) for different areas and N values

As it can be seen, regardless of N the smallest K value appears when permutations take place in the areas II and III. And the biggest K value is observed in the area IV. The calculation of coefficient K variation by areas with K increase showed the following. With N increasing from N =8 to N =10, the K variation doesn't exceed 5% (Fig. 7b). Therefore, further increasing of the number of temporal order elements is not reasonable.

5. CONCLUSION

A calculation method for remoteness coefficients for any number of indicators in the temporal order was proposed. It is based on maintaining the order of remoteness coefficients values, which are used in the present method, in certain places. This was achieved through the use of a special approach to the selection of matrix elements, which has the dimension of the temporal order, and the introduction of a universal system of local indexes for these areas. The computer experiment that was conducted shows the versatility of the method developed. Furthermore, it was proved that from a practical standpoint the temporal order of eight indicators is a sufficient one. A further increasing in the number of indicators may change the value of the integral criterion of not more than 2.5%.

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