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METHODS OF SELECTION OF INVESTMENT PROJECTS IN PRACTICE OF LOCAL GOVERNMENTS

Abstract: *The attainment of the development of the local government unit requires a certain investment projects. The decision to implement or reject the investment is a complex process. Since the accuracy of forward-looking decisions depends on the competitiveness of the city or district, investment decisions can be divided into three groups: decisions corrugated rejection or acceptance of a particular investment project, decisions concerning the selection of an investment option among several competing, and decisions about the must unitable development program). In the first part of the article the autor shows the essence of simple statistical methods: the utility value analysis, the synthetic index method and taxonomic methods. In addition the autor presents a method of dynamic comparison of investment project by NPV and IRR. In the empirical part the autor evaluates fundamental investment projects in Baltic Sea spa town Kołobrzeg in Poland. Case study is based on data from the Multi-Year Financial Plan for the years 2013-2018 and the budget 2013. In conclusion, after comparing the results of different methods, you will find considerable variation order of preference of decision-making in the implementation of project, using different methodology of choice. Assessment of the effectiveness of investment projects should be made by applying the package methods, as the simplified point method used so far seems to be too unreliable. The problem, however, presented to the city in Poland, is universal to other European Union countries, including Slovakia.*

Keywords: *local development, investment project, local government, classification methods*

JEL: R 28, R 53, C 61

Introduction

Making an optimal investment decision in practice of local governments is not an unequivocal issue: most often we have to deal with a situation in which the investment project is to achieve several objectives simultaneously. This requires making decisions based on several criteria. A classic example of such a situation is the need to choose between a project that brings direct income while not complying with other requirements, for example, environmental ones, and a project that generates a lower income but meets the requirements of environmental protection.

Three types of methods can be used to solve such problems:
1. methods based on the aggregation of decision criteria to make the choice on the basis on one aggregated characteristics;
2. methods based on multi-criteria programming procedures;
3. methods of comparing investment projects [5], [6].

This article is an attempt to present the nature and application possibilities of selected methods of the first and third group. The application part has been based on procedures of selection and choice of projects and investment tasks in the framework of Multi-Year Financial Plan (WPF) and the Local Development Programme (PRL) of the Polish, Baltic Sea spa town Kołobrzeg [16].

1 Investment Projects

The investment project is a set of investment tasks, interdependent and jointly pursuing the aim of an investment undertaking [11], [12].

The development of local government units is achieved mainly through certain investment projects, especially direct investments (property) that can be divided according to the objectives and functions into several types:
1. *Expansion projects*, which aim to enter thus far unexplored markets or expand products on existing markets. These projects require a strategic analysis of demand and are associated with large financial costs. Although they are of the risky nature, their character is developmental.
2. *Reconstruction projects*, which aim to maintain its current business activity or reduce costs, by replacing worn or obsolete assets with new ones.
3. *Adaptation projects* that focus on adapting activities to the new regulations (most commonly in the environment). When deciding on adaptation, social limitations are very important.
4. *Innovation projects* that use new technologies to help maintain a strong competitive position over a long time. They concern introduction of new products and services on markets [1], [2], [10], [13].

Lots of factors have an influence on the final investment decision among which are included: specific nature of the given venture, skills and competences of the staff preparing the project, possibilities of prediction of opportunities and risks which result from ambient of the local government unit, etc. Generally, decisions affecting the development of the unit can be divided into two basic groups:

a) decisions for acceptance or rejection of a single project,
b) decisions relating to the selection of one project among several available.

The basis for the use of economic calculation in the assessment of investment objectives is the selection of a criterion of the calculation, that is, such an amount whose optimization allows the evaluation of different options of action. It is widely recognized that the best criterion for the evaluation of development ventures is maximization of profit from the employed capital. In the case of local government units, it poses formal difficulties due to the tangible and intangible aspects of the profit of the local government unit. The above factors make that by the evaluation of the effectiveness of investment projects, two groups of methods are applied:

a) *statistical methods* (undiscounted): payback period, accounting rate of return, profitability thresholds account, sensitivity analysis, etc.;
b) *dynamic methods* (discounted): net present value NPV, internal rate of return IRR, modified internal rate of return MIRR, profit index PI, etc.

Below is shown a selected set of other methods.

2 Utility Value Analysis – AWU

This method belongs to the static subjective methods as the selection criteria and establishing their validity depend on the preferences of decision makers [4], [7].

The procedure of the method is based on four steps:

1. establishment of the criteria for evaluation;
2. determination of the degree of importance of each criterion by giving weight according to the preferences of decision-makers;
3. ranking of specific investment variants by assigning points – their number depends on the degree of meeting a certain criterion;
4. determination of total point grade as a basis for comparison of projects.

The total sum of points for each project is calculated according to the formula

$$O_i = \sum_{j=1}^{n} S_{ij} W_j \tag{1}$$

where:
O_i – point grade of i-th project
S_{ij} – point grade of the degree of fulfillment by the i-th project of the j-th criterion (0-10),
W_j – weight given to the j-th criterion

The choice of this method is shown in the following example. Suppose that a local government unit (JST), in order to increase the degree of competitiveness, intends to carry out a real investment, taking profit maximization K_1 as a basic criterion of the choice. You can choose from seven different investment options. In addition, three other criteria were assumed: the degree of fluctuations of production assets prices K_2, compliance with environmental standards K_3 and increase in the degree of competitiveness K_4.

Table 1

Point value of the investment options

Project	Criterion (+ weight)				Evaluation of the project	Ranked
	K_1(0,55)	K_2(0,10)	K_3(0,20)	K_4(0,15)		
A	6	4,5	6	3,5	5,48	2
B	3	6	2	1	2,80	6
C	5	1	6	5,5	4,88	3
D	7	3	6	7	**6,40**	**1**
E	2	7	4	5,5	3,43	5
F	4	4,5	3	2	3,55	4
G	1	2	1	3,5	1,48	7

Source: Own study based on the sample data

Taking into account the above data, the investor should give the highest priority of importance and begin implementation of the option D.

3 Standardized Stimulants and Destimulants

A similar method of constructing a collective evaluation of the project is proposed by E. Nowak [9]. The difference comes down to the method of calculation of the results. The initial figures are first standardized (normalized). It is aimed at reducing data to comparability. In the method, the division of characteristics into stimulants and destimulants is important. Stimulants are the features whose higher values indicate higher grade of an option. For destimulants, a higher value means less favorable grade. The numerical values for the examined project are normalized by the formulas:

a) for stimulants:

$$Z_{ij}^{S} = \frac{x_{ij}}{\max\limits_{i} [x_{ij}]} \tag{2}$$

b) for destimulants:

$$Z_{ij}^{D} = \frac{\min [x_{ij}]}{x_{ij}} \tag{3}$$

where:

x_{ij} – Output value of the j-th characteristic of the i-th project

max $[x_{ij}]$ – maximum value of the given characteristic

min $[x_{ij}]$ – minimum value of the given characteristic

Such normalized values of the specific criteria inform about the extent to which particular projects are consistent in relation to the given characteristic, with the most preferred option. They take values in the range (0,1). The higher the values are, the more satisfied is the criterion for the grade. The normalized data can be used to calculate the total grade in two ways:

1. If it is additionally assumed that all the criteria are equally important, the aggregate criterion is the following:

$$Z_i = \frac{1}{n}\sum_{j=1}^{n} Z_{ij} \quad (4)$$

where:
Z_i – synthetic grade of the given project
n – number of characteristics for the analysis
z_{ij} – normalized value of the j-th characteristic of the i-th object

2. If not all characteristics are equally important, each criterion is assigned with the weight relevant to the preferences of the investor, in accordance with the principle by which the more important criterion, the greater its weight. Weights are in the range [0,1] and sum to unity. The form of the synthetic indicator is the following:

$$Z_i = \sum_{j=1}^{n} g_j Z_{ij} \quad (5)$$

where:
g_j – weight given to the j-th criterion.

The numerical example illustrates the method (with the data from Table 1). Suppose that K_2 is a destimulant and other criteria are stimulants. The output data are presented in Table 2.

Table 2

Values of criteria for investment options

Project	Criterion			
	$K_1^{(S)}$	$K_2^{(D)}$ [%]	$K_3^{(S)}$ [%]	$K_4^{(S)}$
A	1,3898	8	100	115
B	1,2922	5	90	101
C	1,3204	20	100	119
D	1,5821	11	100	125
E	1,2915	2	95	119
F	1,3043	8	92	104
G	1,1440	13	80	115
max [X_{ij}]	**1,5821**		**100**	**125**
min [x_{ij}]		**2**		

Source: Sample data

After normalization by the method of quotient mapping (2,3), the results of calculations are presented in Table 3. Values of the synthetic criterion are calculated for identical weights of criteria. Then, the most effective is project E.

Table 3

Normalized values of the criteria and values of the synthetic criterion

Project	Criterion				Synthetic index	Ranked
	K_1	K_2	K_3	K_4		
A	0,8785	0,2500	1,0000	0,9200	3,0485	3
B	0,8168	0,4000	0,9000	0,8080	2,9248	4
C	0,8346	0,1000	1,0000	0,9520	2,8866	5
D	1,0000	0,1818	1,0000	1,0000	3,1818	2
E	0,8163	1,000	0,9500	0,9520	**3,7183**	**1**
F	0,8244	0,2500	0,9200	0,8320	2,8264	6
G	0,7231	0,1538	0,8000	0,9200	2,5969	7

Source: Own calculation

4 Taxonomic Measure of the Investment Choice

The method enables comparing multi-feature objects by constructing a synthetic indicator which is the basis for their linear ordering [4], [14], [18], [20]. The starting point of the analysis is to determine the so-called observation matrix whose rows indicate consecutively considered investment projects, and columns present the values of the individual characteristics. Standardization can be done according to the formula in point 3 or on the basis of a methodology based on the standard deviation. An important element in the procedure is to determine the coordinates of the so-called standard P_0 ($z_{01,}z_{02},..z_{0n}$). Then, the distances of each value of observation matrix from the standard are calculated. In the literature there are different definitions of the term "distance". The most common measure is the so-called Minkowski metric [17]:

$$d_{iK} = \left[\sum_{j=1}^{n} \left| Z_{ij} - Z_{Kj} \right|^{P} \right]^{\frac{1}{P}} \tag{6}$$

where:
d_{ik} – distance between the i-th and the k-th object,
z_{ij}, z_{kj} – implementation of the j-th characteristic for the i-th and the k-th object,
m – number of characteristics,
p – natural number

For p=2, the Minkowski metric is defined by the Euclidean distance and as such is often used to calculate taxonomic measure. After receiving the vector containing the distances of each project from the standard, one calculates the standard deviation and the arithmetic mean, which allows to calculate the degree of deviation of the given project from the standard according to the following formula:

$$C_{i0} = \sqrt{\sum_{S=1}^{n} (Z_{iS} - Z_{0S})^2} \quad (7)$$

where:
c_{i0} – value of distance of the i-th project from the standard

Using the formulas [4]:

$$\overline{C} = \frac{1}{W} \sum_{i=1}^{W} C_{i0} \quad (8)$$

$$C_O = \overline{C} + 2S_0 \quad (9)$$

$$S_0 = \sqrt{\frac{1}{W} \sum_{i=1}^{W} \left(C_{i0} - \overline{C_0}\right)^2} \quad (10)$$

it is possible to rank the projects in accordance with their similarity to the standard. The final taxonomic measure is the following:

$$d_i = 1 - \frac{C_{i0}}{C_0} \quad (11)$$

This index ranges from 0 to 1: the value is closer to unity, the project is more similar to the standard.

The example is based on the figures from the previous examples. Table 4 shows auxiliary calculations and values c_{i0}. After calculations, we have: c^{-} = 0.7238, s_0 = 0.2302 and c_0= 1.1843. Using the formula (11), the Table 4 presents measures of agreement

Table 4.

Deviations of options from the standard and taxonomic values and ranks of projects' options

Project	Deviations				C_{i0}	d_i	Ranked
	K_1 $(z_{i1}-z_{01})^2$	K_2 $(z_{i2}-z_{02})^2$	K_3 $(z_{i3}-z_{03})^2$	K_4 $(z_{i4}-z_{04})^2$			
A	0,0148	0,5625	0,0000	0,0064	0,7640	0,3549	3
B	0,0336	0,3600	0,0100	0,0369	0,6637	0,4396	2
C	0,0274	0,8100	0,0000	0,0023	0,9163	0,2263	7
D	0,0000	0,6694	0,0000	0,0000	0,8182	0,3092	5
E	0,0337	0,0000	0,0025	0,0023	0,1963	**0,8342**	**1**
F	0,0308	0,5625	0,0064	0,0282	0,7924	0,3309	4
G	0,0767	0,7160	0,0400	0,0064	0,9160	0,2266	6

Source: Own calculation

5 The Dynamic Method – Comparison of Investment Project through NPV and IRR

A formula describing the present value (*present value)* is as follows :

$$PV = \frac{k_0}{(1+r)^0} + \frac{k_1}{(1+r)^1} + ... + \frac{k_n}{(1+r)^n} = \sum_{j=0}^{n} \frac{k_j}{(1+r)^j} \quad (12)$$

where:
k_j – expected value of the net cash flow at the end of period j,
r – cost of capital – the discount rate or the internal return rate IRR.

For investors, the information about PV is still insufficient. They expect knowledge about the values NPV and IRR. The formula to calculate the present value of the updated NPV is as follows:

$$NPV = PV - I_0 = k_0 \sqrt{\left[1 + \sum_{l=1}^{j} \left(\frac{k_j}{k_0}\right)_k \left(\frac{1}{1+r}\right)^l\right]^2} - I_0 \quad (13)$$

where:
k_0 – value of the net cash flow “period zero”,
I_0 – value of the initial expenditures,
at the constraints: $0 \leq I_0 \leq PV$, $0 \leq NPV \leq PV$, $0 \leq IRR \leq 1$, k_0 0, > 0, 0 < ≤ 1

NPR and IRR values are measures of usefulness of the investment project for investors, whereas NPV describes the absolute increase in the value of investments, and IRR describes the rate of return of the invested capital from the whole project. The NPV value can vary from 0 to the value of PV [3], [8], [15],[19]. So we have:

$$\frac{NPV}{PV} = 1 - \frac{I_0}{PV} = 1 - \sin\left(\frac{\Pi}{2} * \frac{r}{IRR}\right) \quad (14)$$

under the conditions:

$$0 \leq \frac{NPV}{PV} \leq 1$$

$$0 \prec \frac{I_0}{PV} \leq 1$$

The following example illustrates the procedure of supporting the decision of selection of the optimal investment project for equal costs of capital on the 10% level. Table 6 shows the basic data about the projects, while Table 6 presents the NPV and IRR values before modification.

Analysis of the results indicates a certain dilemma: the project with the highest NPV is the fourth order of the IRR value and the project with the highest IRR is the second in order the NPV value.

Table 6

NPV and IRR values before modification ; $r_{const} = 0,10$

Project	Horyzon [year]	I_0 [thousand. zł PL]	PV [thousand. zł PL]	NPV [thousand. zł PL]	IRR	I_0/PV	NPV/PV	r/IRR
A	10	250	337,951	87,951	0,176814	0,739752	0,260248	0,565566
B	8	100	128,038	28,038	0,173070	0,781017	0,218983	0,577801
C	20	400	498,895	98,895	0,134825	0,801772	0,198228	0,741703
D	15	75	91,273	16,273	0,136538	0,821711	0,178289	0,732397
E	5	50	53,071	3,071	0,123759	0,942134	0,057866	0,808022
F	6	75	78,395	3,395	0,115305	0,956697	0,043303	0,867265
G	10	250	251,927	1,927	0,101792	0,992350	0,007650	0,982400
H	3	250	246,198	-3,802	0,091342	1,015441	-0,01544	1,094787

Source: Own calculation

Table 7

Modified value of usefulness of the criterion NPV*

Project	Horyzon [year]	I_0 [thousand. zł PL]	$\propto(0)=90^0 r/IRR$	$\sin\propto=I_0/PV^*$	$PV^* =I_0/\sin\propto$	$NPV^*=PV^*- I_0$	NPV^*/PV^*
A	10	250	51	0,776057	332,141	72,141	0,223943
B	8	100	52	0,788033	126,898	26,898	0,211967
C	20	400	67	0,918814	435,344	35,344	0,081186
D	15	75	66	0,912946	82,152	7,152	0,087054
E	5	50	73	0,954875	52,363	2,363	0,045125
F	6	75	78	0,978343	76,660	1,660	0,021657
G	10	250	88	0,999618	250,096	0,096	0,000382
H	3	250	99	0,988936	252,797	2,797	0,011064

Source: Own calculation

It does not allow us to decide which project is better. Using the proposed model of description of relationships between components of each project, one calculates an angle $\propto$ on the plane $< PV – I_0 >$ and the modified value of NPV/PV^* index. The calculations are presented in Table 7.

6 Case analysis – choice of priority investment projects in Kołobrzeg in 2013

In order to verify the described methods and procedures, a set of projects and investment tasks in the municipality of Kołobrzeg in 2013 was analyzed. The system of criteria, by which local authorities made decisions of implementation priorities, was grouped into three segments:

1. social aspects of the project: the territorial range of impact of the project; influence on the economic and social development of the city, project relationship

to education, project's impact on the security of the residents, project relationship to the use of free time;
2. economic aspects of the project: the impact on the city budget, the economic benefits for the people, the use of non-commercial, non-returnable funds, the use of funds from the European Union, the use of non-commercial loans, public-private partnerships;
3. aspects of marketing and infrastructure: the continuation of investment, new investment, the impact on the environment, the use of existing facilities, improving the image of the city, improving the technical infrastructure of the city.

A point scale was developed for each criterion: 0 – no, 2 – to 20%, 5 – 20% to 50%, 10 – more than 50%. Based on the procedure, the priority projects selected for the implementation received the points shown in Table 8.

Table 8

Scoring rank and status of implementation of investment projects by the ranking algorithm of the Kołobrzeg Town Hall

Project number	Name of the project	Points UM (0-50)	Ranked by UM	Budget of project [zł PL]
P1	Renovation of roads in the Podczele Neighbourhood	33	6	700 000
P2	Reconstruction of streets in the Spa Zone	36	4	1 100 000
P3	Reconstruction of the riverfront of the Parsęta river (at the Lighthouse)	34	5	505 750
P4	Improving acces to the Port of Kołobrzeg from the land side – stage I	45	1	36 000 000
P5	Improving acces to the Port of Kołobrzeg from the land side – stage III	31	7	2 500 000
P6	Revitalization of the Żeromski Park	28	11	520 000
P7	Improving the environment in the Parsęta river basin	30	8	650 500
P8	Flood Protection in the Western District	29	10	300 000
P9	Construction of the Center of Social Affairs	25	13	1 000 000
P10	TV monitoring in the town	27	12	400 000
P11	Construction of a technical entry to the sea beach (Arciszewskiego Str.)	30	8	420 000
P12	Construction of the Regional Centre of Innovation and Administration	22	15	700 000
P13	Construction of bicycle paths (Bałtycka Str., Wiosenna Str.)	23	14	230 000
P14	Town Hall renovation – stage II	38	3	1 500 000
P15	Modernization of the Kołobrzeg pier	40	2	2 080 000

Source: Own work based on *Wieloletnia prognoza finansowa Gminy Miasto Kołobrzeg 2013-2018* [16]

The author made the calculations for the above-mentioned investment projects according to the previously presented procedures. The cumulative presentation of the results of calculations are shown in Table 9.

Table 9

Comparison of investment projects according to various methods

Project number	Ranked by UM	AWU	K_{synt}	d_i	NPV	NPV*
P1	8	5,22 (10)	0,6711 (9)	0,5110 (8)	0,212 (6)	0,159 (6)
P2	9	5,15 (11)	0,6685 (10)	0,4945 (9)	0,257 (5)	0,188 (5)
P3	3	7,12 (2)	0,8120 (3)	0,7152 (3)	0,960 (2)	0,770 (2)
P4	1	7,45 (1)	0,9115 (1)	0,8570 (1)	8,820 (1)	7,232 (1)
P5	13	4,52 (14)	0,5870 (15)	0,3974 (15)	0,125 (11)	0,086 (11)
P6	11	5,38 (9)	0,6805 (8)	0,4110 (13)	0,195 (8)	0,156 (7)
P7	10	5,75 (7)	0,6815 (7)	0,5312 (7)	0,165 (9)	0,107 (9)
P8	4	6,65 (4)	0,7175 (6)	0,6912 (5)	0,147 (10)	0,101 (10)
P9	15	4,10 (15)	0,6110 (14)	0,4030 (14)	0,100 (13)	0,069 (13)
P10	7	5,40 (8)	0,6614 (11)	0,4681 (10)	0,120 (12)	0,083 (12)
P11	6	6,54 (6)	0,7715 (4)	0,6873 (6)	0,199 (7)	0,151 (8)
P12	14	4,65 (13)	0,6211 (13)	0,4110 (12)	0,070 (15)	0,055 (15)
P13	12	5,00 (12)	0,6560 (12)	0,4419 (11)	0,084 (14)	0,063 (14)
P14	5	6,60 (5)	0,7218 (5)	0,6944 (4)	0,360 (4)	0,195 (4)
P15	2	7,10 (3)	0,8565 (2)	0,7315 (2)	0,624 (3)	0,581 (3)

Source: Own work

Summary

The article presents a selected range of methods supporting decision-making processes of selection and choice of favorable investment projects in the activities of local governments. The practice of self-governments is often limited to the use of simple, subjective processes, preferring the interests of the currently ruling local political option or pressure groups, and decisions of the selection of projects for implementation are not always rational economically and socially. The use of a broader package of methods and processes for comparing investment projects with different characteristics concerning a different content-wise sphere, allows for making adequate choices more objectively, both the selective and preferential ones. The results of the comparison of the projects shown in Table 9, as the elements of the Budget of Kołobrzeg town for the year 2013, lead to several conclusions:

a) there is a positive correlation between the results of the different methods of calculation;
b) individual investment projects in the rankings according to specific methods differ slightly;
c) the most favourable projects for the town of Kołobrzeg are the following: reconstruction of the Parsęta riverfront (at the Lighthouse), improving access to the Kołobrzeg port, modernization of Kołobrzeg pier;
d) the first two projects are being implemented, the third one is waiting for the start of the implementation.

By the final decisions about the order of execution of certain projects, in addition to the presented calculation procedures which have a supporting character, financial aspects are taken into account (availability of resources to implement a project) and social factors, and in particular the social consultations with the local community.

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