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SUSTAINABLE INVESTMENT PROJECT EVALUATION*

Tadeusz A. Grzeszczyk [1], Małgorzata Waszkiewicz [2]

[1,2] *Warsaw University of Technology, Faculty of Management, ul. Narbutta 85, 02-524 Warsaw, Poland*

E-mails: [1]Tadeusz.Grzeszczyk@pw.edu.pl ; [2]Malgorzata.Waszkiewicz@pw.edu.pl

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Abstract. This paper concerns a current problem of multifaceted evaluation of investment projects. Information that contains the actual value of the initiated investment is often the basis for making decisions regarding its further implementation, especially when significant changes occur in the project's environment. The process of project evaluation should therefore include all factors that may affect its value. However, there is a research gap regarding the insufficient development of methods of commercial real estate investment evaluation that integrate quantitative (financial) approaches and qualitative factors that influence the value of project, and also refer to the achievements in the scope of project management. The purpose of this paper is to introduce the integrated method of investment project evaluation based on the common valuation method (an income approach), supplemented by the results of the implementation of the Real Options Method (ROM) and complemented by the project sustainability factor. Case studies were carried out to prove that an exit option (resignation) can support the ongoing evaluation of the investment. Individual in-depth interviews (IDI) were conducted to examine the sustainability impact on its value. Three case studies involving commercial properties have verified the possibility of applying the proposed integrated method. The following findings were discovered as a result: nowadays, in the turbulent project environment, the common investment project valuation methods need to be extended to support the managerial decision regarding their further implementation and the securing of their flexibility. Also, sustainability has been recognized as a factor that increases the project value, which should be taken into account during the evaluation process. A comparative analysis indicates that the accuracy of the proposed new method delivers a more precise determination of the investment value than the common valuation methods.

Keywords: investment project; project management; project evaluation; real options; project sustainability

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JEL Classifications: G11, H43, O22, R30, Q01, Q56

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1. Introduction

Investments of all kinds are associated with uncertainty (Haight & Singer, 2005). The dynamics of changes shaping the contemporary economic conditions forces investment projects to provide a certain degree of flexibility, easily defined as "an ability to change" (Asokan, Yarime & Esteban, 2017), or - from the system point of view – a feature that supports changes in the system (Ferguson et al., 2007). This is one of the reasons why evaluation of investment projects becomes an important scientific problem. Evaluation of a project's flexibility has been described in the academic literature on the theory of real options and usually concerns evaluation of this parameter in relation to broadly understood investment projects (Borison, 2001; Lantz, Mili & Sahut, 2012). However, there are not many academic reflections addressing the flexibility of real estate investment projects in terms of their evaluation, e.g. real option application in pricing (Leung & Hui, 2002), which becomes a key issue given its specificity.

The purpose of this paper is to introduce the integrated method of investment project evaluation based on the common valuation method (in this case an income approach), supplemented by the results of the implementation of the Real Options Method (ROM) and complemented by the real estate sustainability factor. The proposed method is more precise and accurate than the commonly available valuation methods (thanks to incorporating the factor of sustainability) and could be particularly useful in terms of the significant and unexpected change in the project environment that occurs during project execution and enables to achieve planned deliverables. The results of the research on the new method proposed in this paper indicate that using the ROM in evaluation process helps better estimate the project's final result and accounts for the flexibility of real estate. It also provides an additional support in making investment decisions by delivering a number of recommendations coming from exit option calculation and accounting for a sustainability level of the property. Incorporating the sustainability factor further clarifies the value obtained, which means that the integrated method of real estate evaluation enables more accurate results. The result of the comparative analysis indicates that the accuracy of the proposed new method is higher than standard evaluation methods. The arithmetic mean of the accuracy of the common valuation methods for the analyzed cases was 79.48%, while the arithmetic mean accuracy of the results obtained using the integrated evaluation method was 86.87%.

2. Literature Review

In this paper, a new method is applied to the cases of commercial investment projects. A common characteristic of commercial real estate is that the activities carried out in such properties (industry, retail or office work) tend to be profit-oriented. A specific feature of this sector is the high financial value related to the object of trade, which hinders operation in this particular sector. From the perspective of new investments in commercial real estate, the main problem is the high sensitivity to changes with the simultaneous low flexibility of this type of projects. The aspect of a long-term investment with large expenditures and the resulting high investment risk also need to be stressed. Therefore, it is necessary to include mechanisms that secure the flexibility of such projects in evaluation process. One of such mechanism can be implemented based on the ROM (Grzeszczyk & Waszkiewicz, 2016). The flexibility value, calculated against the ROM, ensures the investor's possibility to react to environmental changes. It also secures the decision-making process by providing long-term recommendations. Companies use real options to value the flexibilities inherent in real estate development projects and active management is the most effective risk management tool in property development (Bauer, 2009). Also, flexibility equals a range of options an investor can choose from (Lucius, 2001). The exit option (resignation from further implementation of the project) has been selected for future research because it enables supporting an ongoing decision to either continue or abandon the investment project and a possible re-sale of the results obtained as part of its previous implementation. At this point it should be emphasized that the new method concerns an ongoing evaluation, i.e. evaluation during its life cycle, which continuously seeks feedback on how the project is progressing (Cleland, 1985).

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The common real estate valuation methods (e.g. the investment method as part of the income approach) will serve as the basis for the structuring of a complex, ongoing real estate evaluation method. The investment method as part of the income approach is the most popular one in the case of commercial real estate (McDonald, 2015). This method allows to conduct the useful analysis of financial indicators, such as the net present value (NPV). It is useful only as far as it provides information on the possibilities related to the implementation of projects, but it does not properly support decisions regarding the selection of the most profitable alternatives (e.g. it does not help to compare the amount of expenditure incurred). For projects with a high risk, high uncertainty, and long payback periods, the NPV method can hardly assess the project value (Ma, Du & Wang 2018). Therefore, the financial evaluation of investment projects is difficult using the conventional methods of evaluation such as NPV and leads to major uncertainties (Götze, Northcott & Schuster, 2015). In this regard, common approaches do not take into account the qualitative parameters that may have a significant impact on real estate value, e.g. related to sustainability criteria or the flexibility of real estate investment. Using the NPV in the process of real estate investment projects evaluation may provide a basis for the evaluation method, but as such, the NPV is insufficient.

Improved accuracy of the results of real estate investment projects evaluation can be obtained through developing research on new evaluation methods, such as the decision tree analysis (DTA) that accounts for various scenarios, and the ROM. An approach based on decision trees plays an important role among real options evaluation methods. The DTA is useful in the face of an uncertain future and presents cash flows within a structure of a tree that shows possible scenarios during the lifecycle of the project (Shapiro, Mackmin & Sams, 2013; Cox, Ross & Rubinstein, 1979). The ROM enables dynamic adaptation to changing market conditions – it limits the losses arising from negative changes in the investment environment and takes advantage of opportunities that occur (Leseure, 2010). The real option analysis used in evaluation process quantifies the project value, and thus helps managers make rational decisions (Kodukula, 2006). A real option is a right (not an obligation) to make a managerial decision corresponding to real resources at a predetermined cost and price, within a specified time period (Rogowski, 2008). Some researches argue that an option is a right, but not an obligation, to sell or buy something in the future at a price determined today (Ball, Lizieri & MacGregor, 1998). It is possible to classify options the following way (Trigeorgis, 1996):

- to innovate,
- to expand,
- to defer,
- to contract,
- to stage investment,
- to abandon for salvage value (exit option),
- to switch,
- to shut down and restart.

As far as the exit option is concerned, which is a significant safeguard at the time of market changes forcing critical decisions, it complements the common real estate valuation methods with flexibility and allows the quantitative inclusion of evaluation results. It is also a useful tool that offers direct recommendations for decisions related to the further implementation of investment projects. In computational experiments presented later in this paper, the option to exit an investment was calculated, with its usefulness examined mainly for crisis scenarios for which changing environmental conditions makes it impossible to achieve the project's objectives.

The use of the ROM in real estate evaluation can be supplemented by taking into account the previously disregarded factor of sustainability. Standard factors of commercial real estate evaluation (e.g. office or retail buildings) include parameters related, among others, to location that one can specify as a fixed point in geographic space that must be linked to other complementary real estate parcels (Pearson, 1991) or technical

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standards and maintenance of an organization's buildings and equipment, called Facility Management (FM) (Cotts, Roper & Payant, 2010; Piper, 2002). With that being said, sustainability should be considered as a multifaceted parameter that makes the result of the quantitative analysis more realistic. Literature studies covering research on the evaluation of investment projects and real estate valuation, carried out to identify qualitative aspects that had not been included in the evaluation process and that had a significant impact on the accuracy of the performed calculations, failed to contain the real estate sustainability factor. Although energy efficiency issues are raised in the literature as affecting the value of real estate (Bienert et al., 2019; Lombard, Ortiz & Pout, 2008; Crosby, Devaney & Law 2011), a broader view of real estate evaluation, which takes into account its sustainability, is not common. It seems necessary to empirically examine the significance of sustainability in the evaluation process and to explicitly incorporate sustainability into the real estate investment evaluation method. Therefore, real estate classification by the level of sustainability has been suggested. The resulting real estate classes support the managerial decision (continue, freeze or abandon the project that has already started) by recommending possible alternatives of further project execution. Nevertheless, each real estate investment project should be evaluated from the point of view of sustainability.

3. Methodology

To understand the ROM application, it is necessary to present the most important mathematical relationships. The ROM is a dynamic method that extends the calculation carried out using the NPV method with the flexibility factor and can be expressed by the following equation (Rogowski, 2008):

$$RNPV = NPV + \text{flexibility value}, \tag{1}$$

It is proposed to apply the traditional approach to the ROM, which is based on the Black-Scholes models and binomial trees. In the case of the exit option, in particular, binomial tree models are used, showing a step-like change in the current value of the underlying asset in each of the analyzed periods. This change may occur in two ways: the value of the underlying asset (V) may increase with the probability q or decrease with the probability 1-q. In other words, in the analyzed period, a higher (uV) or lower (dV) value of the underlying asset can be achieved, where:

$$u = u/d, \tag{2}$$

where

u – rate of the underlying asset value increase,
d – rate of the underlying asset value decrease.

The calculations made in each node of the binomial tree allow to determine the optimal date of the option execution.

For the process of determining the value of the real option, the possibility to build a replicating portfolio was assumed. It consists of a base instrument and a risk-free investment and duplicates future cash flows generated by the option and is independent of changes in the underlying asset price. In comparison to the option, it gives the same value of the future return, therefore - in order to avoid arbitrage - the option and the portfolio must be sold at the same price (Rogowski, 2008).

In this paper no arbitrage was assumed, which means that there is no possibility of making a profit without risk. This situation may occur when the following condition is met:

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$$u > 1 + rf > d, \quad (3)$$

where rf – risk-free rate (i.e. profitability of Treasury bonds).

The comparison of the calculation results of the intrinsic and total values of the exit option at the time of project implementation provides recommendations that significantly support the investment decision-making process. The decision rules for the exit option are shown in Table 1.

Table 1. Decision rules for the exit option

Decision	Condition
Continue project	rez(V)w, i, n-t < rez(V)i, n-t (intrinsic value< total value)
Abandon project	rez(V)w, i, n-t = rez(V)i, n-t (intrinsic value = total value)

Source: own study based on Rogowski (2008)

where:

rez(V)w, i, n-t – the intrinsic value of the exit option at time n-t,
rez(V)i, n-t – the total value of the exit option at time n-t.

Considering an example of modeling evaluation using real options regarding an investment project in the commercial real estate sector - this project is related to the initiated investment from which the investor is considering withdrawing. This option can be implemented in the next three years, after which time it expires, regardless of whether the project will have been a success or a failure.

The example presented below concerns a real project of an office building located in Warsaw. The NPV for this building was previously calculated using one of the common real estate valuation methods (income approach, investment method). The average capitalization rate was set at 7%. The market value of the project calculated by the NPV was about EUR 43 million. The financial benefits that can be achieved in the liquidation of the project were estimated at nearly EUR 25 million (EUR 24 893 000). This estimation was made based on available market data and an assumption was made concerning the stability of these costs over time. Therefore, the real option calculation described in this paper has the following assumptions:

- type of real option - exit option,
- evaluation method - traditional calculation of the simple real option with the decision tree analysis,
- underlying asset value changes continuously (application of „e" number, where e=2,71828).

The following equations are applied:

$$u = e^{\sigma\sqrt{T/t}}, \quad (4)$$

$$d = e^{-\sigma\sqrt{T/t}}, \quad (5)$$

where:
σ – volatility of the underlying asset,
T – number of years until the option expires,
t – number of subperiods,

when the flows are analyzed per year, then $\Delta t = 1\ (t = T)$,

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under condition (3):

$$q = \frac{e^{(r_f-\delta)\Delta t}-d}{u-d}, \tag{6}$$

$$1-q = \frac{u-e^{(r_f-\delta)\Delta t}}{u-d}, \tag{7}$$

where:
q – arbitration probability of increase,
1-q – arbitration probability of decrease.

When Δt=1, z=30% and n=0,1,2,3, then u, d, q and 1-q are given as it is shown in Table 2.

Table 2. Calculation data summary

Parameter	Value
V – total project benefit	PLN 185,000,000
LV – abandoned project benefit	PLN 107,040,000
t - type of analysis	annual
rf - annual risk-free rate (assumption)	4%
б – cost of lost benefits (assumption)	7%
z – market variability	30%
T – period of analysis	3 years
u	1,3499
d	0,7408
q	0,3612
1-q	0,6388

Source: own study

The example of decision tree of the exit option value is presented in Figure 1.

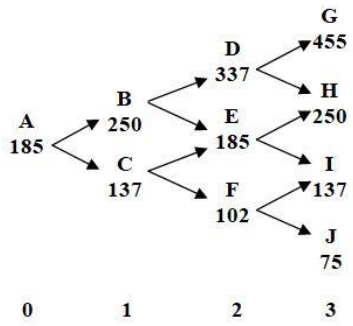

Fig. 1. Exit option value decision tree

Source: own study

In every node of the decision tree, the intrinsic value of the exit option has to be calculated according to the equation:

$$\text{int}(V)w,i,n\text{-}t=\max[LVn\text{-}t\text{-}Vi,n\text{-}t;0] \tag{8}$$

The intrinsic value of the exit option in the form of a decision tree is shown in Figure 2.

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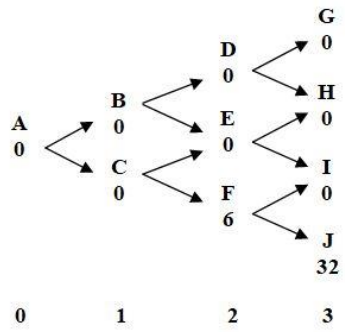

Fig. 2. Intrinsic value of the exit option

Source: own study

According to the principle of backward induction, in each node of the tree the calculation has to be performed following the equation:

$$\text{rez(V)i,n-t=max\{[rez(V)i,n-t+1,increase q + rez(V)i,n-t+1,decrease (1-q)]}e^{-rf}\text{; rez(V)w,i,n-t\},} \quad (9)$$

where:
rez(V)i,n-t+1, increase – the value of the exit option in the i-node at time n-t+1 concerning the option growth comparing to the previous period. An adequate equation is used when the option value decreases at time n-t+1.

Total value of the exit option is shown in Figure 3.

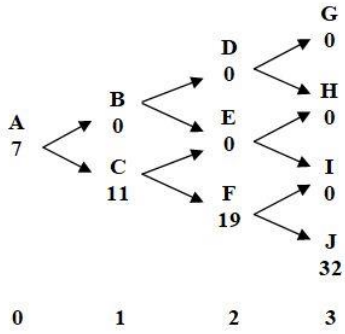

Fig. 3. Total value of the exit option

Source: own study

The ROM brings the result of its total value, which increases the NPV calculation and also supports the decision-making process. At the moment of making a crucial decision about the further project execution, the following decisions can be made by an investor: hold on the option execution (continue the investment) or abandon the investment.

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Table 3. Decision-making process support

Node	Intrinsic value	Total value	Decision to be made	Time period
A	0	7	continue investment	t=0
B	0	0	abandon investment	t=1
C	0	11	continue investment	
D	0	0	abandon investment	t=2
E	0	0	abandon investment	
F	6	19	continue investment	
G	0	0	abandon investment	t=3
H	0	0	abandon investment	
I	0	0	abandon investment	
J	32	32	continue investment	

Source: own study

A number of possible investment decisions, which are the result of intrinsic and total values of the exit option comparison, is presented in Table 3. In the current year of project implementation for nodes C, F and J, the best possible decision is to continue the investment. An exit from the project is recommended in all the remaining nodes.

The value of the office real estate investment project was estimated at PLN 185,000,000 using the common methods. The value of the exit option, i.e. flexibility value at the time t = 0, is PLN 6,780,525. Real options evaluation assumes that the value of the investment goes beyond its value estimated by the classical discounted cash flow (DCF) or the NPV (project value is supplemented by the value of its options) (Larrabee & Voss 2012). It can therefore be concluded that, in a dynamic setting, the total value of the investment project is PLN 191,780,555 with the current recommendation for the investor to continue the project.

Real options take advantage of the opportunity to delay an investment decision until more information is available (Anderson, 2014). The decisions are often made based on factors that vary stochastically. The selected case of calculating the exit option value shows the supporting of decision-making process in a changing environment. Exit options grant managers the flexibility to terminate further investment and to recover some salvage value (Larrabee & Voss 2012). In addition, the analysis carried out confirms that it is necessary to use dynamic evaluation methods in conditions of a turbulent environment.

Literature research have shown that the available traditional methods of real estate evaluation fail to take into account the rate of sustainability. The concept of real estate sustainability can be found in the United Nations Environment Program, which states that green building is, in practice, creating structures and using processes that are environmentally responsible and resource-efficient in the entire building lifecycle, i.e. design, construction, current utilization, current maintenance, renovation, and finally, deconstruction (EPA, 2019; Wilkinson, Remøy & Langston 2014). This approach expands and complements the traditional aspects of design in terms of finance, usability, durability and an overall comfort of the building. A similar definition is quoted by Jones Lang LaSalle analysts, where sustainability is understood as a way of presenting social, economic and environmental factors in the life cycle of a building including design, construction, current utilization and future use (Jones Lang Lasalle IP, Inc., 2019). Green construction can be described as socially, economically, technically and biophysically sustainable (Hill & Bowen, 1997).

There is a growing understanding of the idea of incorporating sustainability criteria into the field of project management, as well as developing approaches, methods, tools and techniques that take this into account (Dobrovolskienė & Tamošiūnienė, 2016) as well as into project evaluation. The relationship between

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sustainability and project management is becoming increasingly important and picking up momentum (Silvius & Tharp, 2013).

Developing the comprehensive real estate ongoing evaluation method, special attention should be paid to aspects of qualitative analysis. In the process of selecting qualitative factors, individual in-depth interviews (IDI) were carried out among business representatives who conduct activities related to servicing the real estate market with foreign capital, with the head office in Mazovia Province, Poland. Due to the strategic location of Warsaw (the capital city of Poland) in this province, it is the most developed investment region in Poland.

Table 4. The impact of commercial real estate sustainability on its value

Expert ID	Does sustainability increase the value of investments?
1	Yes – a per mille influence
2	Yes – it is hard to estimate, but definitely it is an added value
3	Yes – it is hard to estimate
4	Yes – it is hard to estimate, there is no research in this area
5	Yes – it is hard to estimate
6	Yes – it is hard to estimate
7	Yes – the increase in value is proportional to the scale of cost reduction resulting from the use of sustainable solutions
8	Yes – it is hard to estimate
9	No
10	Yes – the value increases up to 50% in comparison to the real estate without sustainability characteristics
11	Yes – it is hard to estimate, there is no research available
12	Yes – it is hard to estimate
13	No
14	Yes – it is hard to estimate
15	Yes – it is hard to estimate
16	Yes – it is hard to estimate
17	Yes – it is hard to estimate
18	Yes – it is hard to estimate
19	Yes – it is hard to estimate

Source: own study

The research covered 19 enterprises whose activity consists in investing in commercial real estate (10 enterprises), advising in the planning and implementation of investment projects in the commercial real estate sector (6 enterprises) and developing investment projects in the commercial real estate sector (3 enterprises). The legitimacy of introducing a real estate sustainability factor to the method of the ongoing investment project evaluation as a qualitative supplement was examined. When asked whether this factor affects the value of commercial real estate, 17 experts (89.5% of respondents) answered affirmatively, which supports the consideration of this aspect in the calculation process related to the investment projects value estimation. The sustainability impact on the real estate value was also examined. Respondents clearly stated that real estate sustainability is an added value, however, they could not precisely determine the value's increment (Table 4).

Therefore, to identify the impact of the sustainability factor on the investment project value, the proposed methodology presumes own classification of real estate depending on sustainability level and impact on the investment decision related to its further implementation. The list of real estate classes in the quality analysis is presented in Table 5.

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Table 5. Real estate classes in terms of sustainability

Real estate class	Impact on project quantitative evaluation	Investment decision support
0	Negative	Exit
1	Slight	No recommendation
2	Positive	Continue
3	Very favorable	Definitely continue

Source: own study

Class 0 is a real estate that has not been subjected to the certification process, and therefore its sustainability rate cannot be determined. It is uncompetitive in relation to the other investment projects and may favor the decision to abandon the project.

Class 1 is a real estate with a slight degree of sustainability confirmed by a certificate of the lowest level, such as *pass* in BREEAM or *certified* in LEED (or another lowest rating in different certification systems). It is weakly competitive because it does not meet a number of sustainability requirements. In this case, there is no recommendation regarding the direction of further proceedings with the investment project since the identified sustainability features are not significant enough to affect its value.

Class 2 implies a confirmed positive degree of real estate sustainability, which means that it is competitive in this area. It can get a higher certification than the one achieved by the real estate at the basic level, but still not the highest, i.e. *good* and *very good* in BREEAM or *silver* and *gold* in LEED. In this case, it is recommended to continue the project.

Class 3 means that real estate has a definitely advantageous sustainability rating, confirmed in the certification process by obtaining the highest possible rate, such as *outstanding* in BREEAM or *platinum* in LEED. In this case, it is strongly recommended to continue that project.

It should be mentioned that supporting decisions by determining the degree of sustainability in the overall project evaluation is of secondary importance and therefore it cannot negate the decision resulting from the analysis with the use of real options – it can only strengthen or weaken it. Some believe, however, that probably in the near future, due to market requirements for financial terms of lease, the following elements for buildings will be identified: *pass*, *excellent* or *outstanding* (Shapiro, Mackmin & Sams, 2013). The results of individual IDI do not point to the existence of another qualitative factor that should be included in the modern integrated evaluation method and which would have a noticeable impact on the value of investment projects.

The heterogeneity of the real estate market, its lack of centralization, and the scarcity of market information make valuation a complex and difficult process that often gives imprecise results and in which the use of common methods does not really solve the problem. Studies show that real estate appraisers operating in the same market can make valuations that trigger a wide range of prices to be achieved (Myers, 1977). The development of a method based on common valuation methods but supplemented with the ROM and taking into account the real estate sustainability factor, is necessary to ensure a reliable evaluation of investment projects in today's changing world. As part of the proposed integrated method of real estate evaluation, a sequence of actions can be outlined, based on the combination of common real estate valuation methods, the ROM, and the sustainability aspect for the implementation of the real estate investment projects evaluation.

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Five stages of the integrated evaluation method can be found below.

1. Structuring the evaluation process

In this stage, the ongoing assumptions and objectives of evaluation (for the sequence of actions to be initiated) are mainly formulated, preliminary data is prepared, and the issues related to calculations made in subsequent stages are sorted out.

2. Determining the initial value and viability of the project

The second stage is carried out using common methods of real estate valuation. This evaluation is preliminary and constitutes a starting point for further estimation of the value of the investment project.

3. Modifying the underlying asset value and adjusting the viability of the project

Activities carried out in this stage are to complement the initial estimate of the previous action by taking into account project flexibility. This parameter is taken into account as a result of using the ROM (in this case the exit option), which means introducing the necessary adjustment of the project value and providing a recommendation supporting the key managerial decision regarding the continuation of the project.

4. Determining the final value and viability of the project

In the fourth stage, the basic calculations terminate in order to determine final results. The qualitative factor is taken into account in the form of investment project sustainability. This factor cannot change a decision about further implementation or abandonment of the project but is either a confirmation or a negation of the legitimacy of recommendations resulting from the use of the ROM.

5. Summarizing the evaluation process

This summary may take the form of an evaluation report, which will allow access to knowledge and investment recommendations resulting from the current implementations.

Stages 2-4 show the ROM and sustainability integration within the real estate evaluation (Figure 4).

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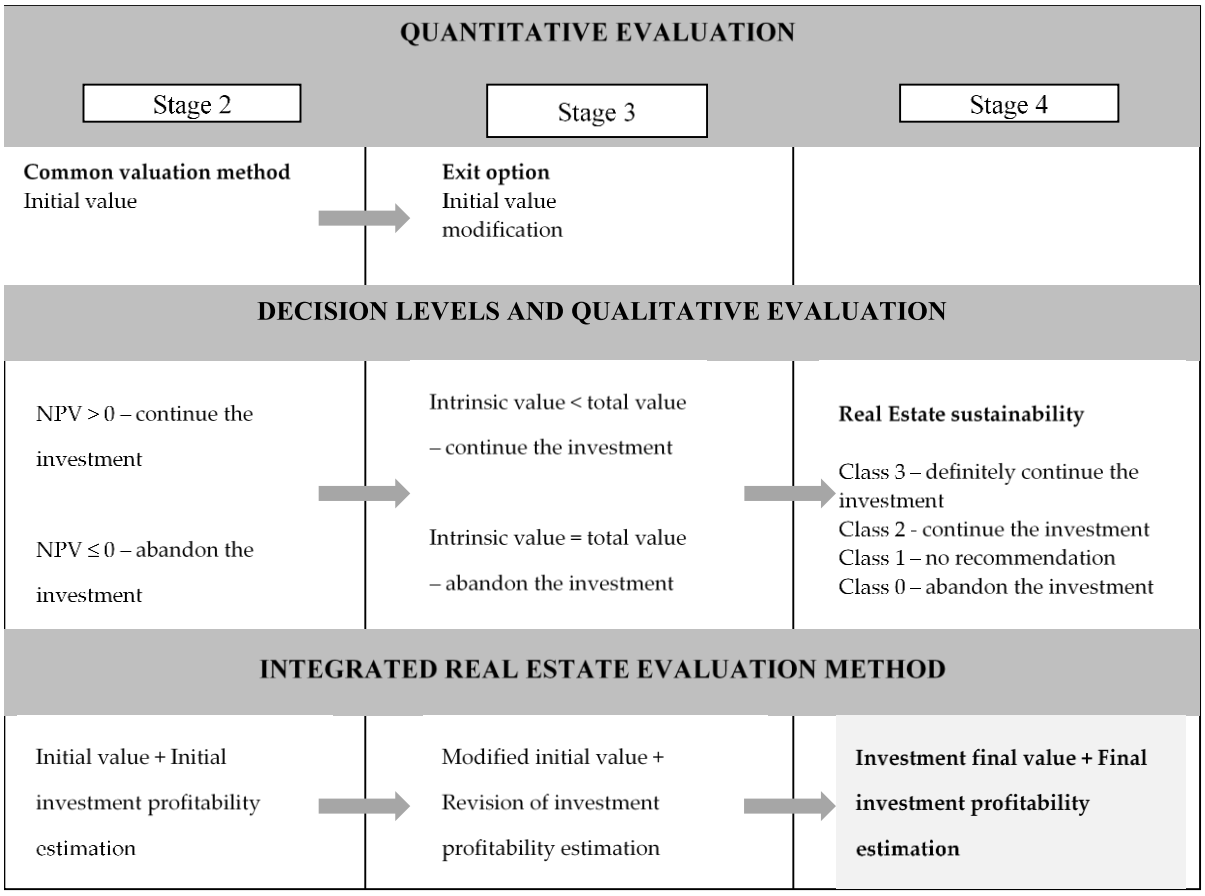

Fig. 4. The ROM and sustainability integration within the real estate evaluation method – stage 2-4

Source: Waszkiewicz 2016

Thanks to the new integrated evaluation method, the results will present a quota amount along with the direction of the adjustment of the value obtained and with the corresponding recommendation.

4. Research Results and Interpretation

The verification of the proposed integrated method of real estate evaluation was carried out in case studies developed on the basis of the actual data from the investment projects carried out by companies investing in commercial real estate, which participated in the IDI characterized in the previous section of this paper. Practical implementation of the developed method was carried out, making it possible to collect data and carry out a comparative analysis (Table 6).

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Table 6. Characteristics of selected investments

	INVESTMENT 1	INVESTMENT 2	INVESTMENT 3
Function	Shopping center	Office real estate	Office real estate
Net internal area	90,000 sqm.	41,000 sqm.	16,300 sqm.
Real estate class	A	A	A
Certification type	BREEAM	BREEAM	LEED
Rating	very good	very good	platinum
Real estate class (own classification)	2	2	3
Other information	1,050 parking spaces, location in the city center, coverage of 1,795,000 people, examples of sustainable solutions: individual air-conditioning control, R410 refrigerant; six streams of waste segregation (glass, plastic, paper, used lighting, batteries and biological waste); basin faucets with reduced waterflow (4.5 l/min); gray and rainwater system; flexible light control system (LED lighting).	800 parking spaces, location in the city center, examples of sustainable solutions: low-carbon technologies; solar control and individually controlled blinds; leak detectors to prevent waterloss.	148 parking spaces, location in the city center, examples of sustainable solutions: geothermal cooling and heating system; photovoltaic panels on the roof of the building; gray and rainwater system; LED lighting adapting to the intensity of light coming from outside the building; parking spaces for charging electric cars.

Source: own study based on data obtained from enterprises investing in commercial real estate

The accuracy of the proposed method can be determined by comparing the results of the evaluation with the market prices of the real estate concerned. Thus, the following equation can be used for this purpose:

$$Tr_{zm} = \frac{Wzm}{Wr}, \tag{10}$$

where:
W_{zm} – result determined using integrated evaluation method,
Wr - real estate market value,
Tr_{zm} - accuracy of the new real estate evaluation method.

Similarily, the following equations can be formulated, which are helpful in the evaluation process followed by the common valuation method and the ROM:

$$Tr_{mk} = \frac{Wmk}{Wr}, \tag{11}$$

$$Tr_{mo} = \frac{Wmo}{Wr}, \tag{12}$$

where:
W_{mk} – result determined using the common real estate valuation method,
W_{mo} - result determined using the ROM,
Tr_{mk} - accuracy of the common real estate valuation method,
Tr_{mo} - accuracy of the ROM.

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In the case of the first of the analyzed investment projects, the evaluation result using the integrated evaluation method consists of the information on the current value of the real estate (EUR 191.78 million) and takes into account the project's flexibility. In addition, the result indicates that this value should be adjusted upwards due to the sustainability features of the investment project. The recommendation indicates that for a given moment (t = 0) the continuation of the project is economically justified. Data for this project, obtained from one of the experts participating in the individual in-depth interview, shows that the investor was offered to buy the investment after it started. After the negotiation stage, the transaction amount was set at EUR 200 million. It turned out that the transaction did not materialize, and the investor decided to finalize the construction. Eventually, the property was sold for EUR 290 million two years after being put into use. These data indicate that the current value of the investment project determined by using the integrated evaluation method was more accurate than the valuation provided by common methods. In addition, the investor received a satisfactory amount of EUR 290 million intuitively implementing the indication in line with the assessment. It means that the accuracy of the integrated evaluation method in this case was 95.89%.

The current value of the second analyzed investment project was evaluated using the integrated evaluation method at EUR 159.94 million. According to calculations, this result should be corrected upwards due to the sustainability features of the project. At the moment of analysis t = 0, the recommendation was to continue. Also, in this case, the investor considered the decision to sell the initiated project, with the preliminary negotiations ended at EUR 165 million (the elements that have contributed to a value higher than the common methods valuation or the integrated evaluation method are unknown). The transaction ultimately did not materialize - the investor, despite transient problems with the continuation of the investment project, completed the construction of the property. One year after it was put into use, the property changed the owner and the transaction amount reached EUR 226.05 million. These data indicate that determining the current value of real estate using the integrated evaluation method is closer to the market price (accuracy of the proposed method is 96.93% compared to the accuracy achieved with the valuation made using common methods amounting to 90.91%). What is more, the result of the assessment indicates the need to correct this value upwards and shows that it is economically justified to continue the project.

The last analyzed investment project was evaluated using the integrated evaluation method at EUR 64.07 million. The result of the calculations is an indication (supported by the sustainability characteristics of the project) of increasing this amount at the analyzed moment (t = 0). It is highly recommended to continue the investment project. In this case, however, the investor decided to sell the project that had not yet been completed. The final transaction amount was EUR 94.5 million. As in the previous case, the reasons for the significant increase in the market value of this project are unknown. It can be concluded that this was mainly due to the flagship ‘green’ strategy of the investment project implementation using a variety of solutions with the highest degree of sustainability. An expert who worked on the implementation of this investment project stated that even at the design stage of the facility, it was decided to implement highly energy-efficient solutions that were supposed to bring real benefits in the phase of its operation. In addition, the investor originally assumed the real estate would be used only for their own purposes (as a headquarters of their company), which is why a great care for the quality of construction materials and the use of innovative technologies could be observed. Also, in this case, the accuracy of the integrated evaluation method is better than the value resulting from the valuation using common methods (67.80% compared to 55.03%).

Table 7 presents a summary of the most important results of studies on the validity of the new evaluation method and the results of the implemented method verification.

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Table 7. Results of the research on the new method of real estate investment projects evaluation

	Value determined by common valuation method	**Value determined by the ROM**	**Evaluation results using new method**	**Real estate market value**	**Accuracy of common valuation method**	**Accuracy of new method**
Investment 1	W_{mk1} = EUR 185 million	W_{mo1} = EUR 191,78 million	W_{zm1}= EUR 191,78 million, including upward value adjustment and recommendation to continue	Wr_1 = EUR 200 million	Tr_{mk1} = 92,50%	Tr_{zm1}= 95,89%
Investment 2	W_{mk2} = EUR 150 million	W_{mo2} = EUR 159,94 million	W_{zm2}= EUR 159,94 million, including upward value adjustment and recommendation to continue	Wr_2 = EUR 165 million	Tr_{mk2} = 90,91%	Tr_{zm2}= 96,93%
Investment 3	W_{mk3} = EUR 52 million	W_{mo3} = EUR 64,07 million	W_{zm3}= EUR 64,07 million, including upward value adjustment and strong recommendation to continue	Wr_3 = EUR 94,5 million	Tr_{mk3} = 55,03%	Tr_{zm3}= 67,80%

Source: own study

where:
$W_{mk1,\ldots,n}$ - value of investment "n" determined by the traditional method,
$W_{zm1,\ldots,n}$ - value of investment "n" determined by the new method,
$Wr_{1,\ldots,n}$ - market value of investment "n",
n – number of cases analyzed (n=3),
where real estate market value equals to real estate market selling price.

Accuracy of the calculations made using the new integrated evaluation method is contained mainly in its quantitative dimension. The arithmetic mean of the accuracy of the common methods for the analyzed cases was 79.48%, while the arithmetic mean accuracy of the results obtained using the integrated evaluation method was 86.87%. The financial dimension of improving viability of the proposed method is presented in Table 8.

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Table 8. The financial dimension of improved viability of the new evaluation method

	Real estate market value	**Accuracy of the traditional method**	**Accuracy of the new method**	**Adjustment of the new method evaluation result**
Investment 1	Wr_1= EUR 200 million	Tr_{mk1}= 92,5%	Tr_{zm1}= 95,89%	+ EUR 6,78 million
Investment 2	Wr_2= EUR 165 million	Tr_{mk2}= 90,91%	Tr_{zm2}= 96,93%	+ EUR 9,94 million
Investment 3	Wr_3= EUR 94,5 million	Tr_{mk3}= 55,03%	Tr_{zm3}= 67,80%	+ EUR 12,07 million

Source: own study

The conducted case studies have confirmed that the new integrated evaluation method allows more accurate determination of real estate values in comparison with the other methods analyzed.

5. Conclusions

The ROM uses the NPV method and, similarly to the DTA, it accounts for many development scenarios. The undoubted advantage of this method is that it additionally takes into account the flexibility of the investment project, which allows the project to adapt to changes occurring in its environment. It also helps support the making of decisions on how to proceed with the project by providing ongoing recommendations derived from the implementation of the ROM and the real estate sustainability factor. In literature the high potential of evaluation tools using the ROM is often emphasized (Schulmerich, 2010). However, this solution might not be enough to evaluate highly complex real estate investment projects. Therefore, integrating a higher number of methods is justified.

The ROM allows for adjusting the results obtained based on the DCF analysis (often unadjusted) and accounting for additional benefits and advantages that are hard to measure (Myers, 1977). It should be noted, however, that this estimation takes place in a limited, quantitative range. Furthermore, considering the ROM, it is assumed that during the intrinsic value of the exit option calculation, the benefits from the liquidation of the project are constant, which is not reflected in real life. As work progresses, the benefits of liquidation usually increase. The method of evaluation of the initiated investment project should take into account the actual state of the works performed and their contribution to the potential liquidation value. It is therefore necessary to continue the research on the usefulness of this interesting and increasingly popular quantitative method in the process of evaluation of various types of investment projects.

The proposed new method of investment projects evaluation does not undermine the achievements of other evaluation methods. On the contrary, it complements them with elements important from the point of view of the accuracy of evaluation. The ROM accounts for the right of the decision-maker to change the previously made decision, which becomes necessary when executing investment projects in a turbulent environment. Evaluation of investment projects using real options comes with many benefits, which is particularly evident comparing this method with the common methods based on the determination of the NPV and the calculation of the DCF. It provides greater opportunities for evaluation of strategic investment projects, also because it indicates real alternatives to proceed with the projects that are being implemented. Using real options enables to comprehensively evaluate an investment project, including both its initial value (which is the result of the passive management of an investment project) and the premium resulting from the implementation of options (resulting from the active project management) (Borison, 2001).

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The need to take into account the sustainability factor in real estate evaluation has been proved. Future findings should focus on the quantitative impact of sustainability on the real estate value. Putting forward a new, multifaceted method of evaluation with a greater accuracy than the methods currently used may contribute to the development of basic research in the management sciences on innovative evaluation methods of real estate investment projects. A dynamic and integrated method is an important complement to the existing methods, while the results of this research may provide the basis for extending the scope of applications of the integrated evaluation method to other types of investment projects in the future.

The integrated evaluation method can serve as a significant support tool for company managers who invest in this sector, make important managerial decisions, and consequently require support throughout this process. It also allows to maintain flexibility in the decision-making process for long-term investments, plus it offers three-level recommendations that are more advanced than those derived from the NPV only. It can also be useful for companies carrying out investments (in particular for project managers as well as consultancy departments) as far as commercial real estate investments are concerned. After introducing the right modifications, the proposed method can provide support for financial institutions (investment funds, banks, etc.), and consequently set a new direction for further research.

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Tadeusz A. GRZESZCZYK, PhD is the Associated Professor at Warsaw University of Technology, Faculty of Management. His interests and research work include project management and evaluation, sustainability in project management the use of AI methods in project evaluation systems and decision support in management.
ORCID ID: orcid.org/0000-0002-4898-1931

Malgorzata WASZKIEWICZ, PhD is the Assistant Professor at Warsaw University of Technology, Faculty of Management. Her research interests are: project management, evaluation of investment projects, property management and design thinking.
ORCID ID: orcid.org/0000-0002-6758-7104