IMPLEMENTATION OF DEVIATION ANALYSIS METHOD IN THE UTILISATION PHASE OF THE INVESTMENT PROJECT: A CASE STUDY

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Abstract: Management of investment projects incorporates phases of pre-investment, investment and utilisation. A well-conducted pre-investment and investment phases reduce the risk of problems that might occur in the utilisation phase, but cannot be eliminated entirely, as the development of internal and external assumptions may not be consistent with the plan. Therefore, even in the utilisation phase, it is necessary to analyse the economic results actually achieved with planned one. The article presents application of the deviation analysis method in the utilisation phase of the assessed investment project. Net Present Value (NPV) deviation analysis is focused on the EBITDA indicator and supplemented by specifying the causes of deviations. The results of the study show that deviations of NPV are caused mainly by lowering the production volume of both products and by a decrease in variable costs per unit. The presented measures lead to the reduction in the probability of the deviations occurrence.

Key words: investment, deviation analysis, cash flow, net present value

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Introduction

Performance improvement assumes successful realization of investment projects. The success of investment projects depends on of many factors occurring in different stages of the project life cycle- at the preparation stage, during the implementation and operation of the investment. The success or failure of the investment projects often influences the economic stability of the company and its prospects. The issue of management of investment projects, their success and risk factors have been the subject of much academic research and scientific publications. Alias at al. (2014) studied the relationship between critical success factors and project performance. They described variables for project success namely project management action, project procedures, human factors, external issues and project related factors. Skrodzka (2015) assessed the effectiveness of investment in the shares of the Polish IT sector with the help of rates of return, and risk-sensitive profitability measures. Lendo-Siwicka et al. (2016) presented the result of a risk analysis for a building object, made after completion

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of the investment and accepting it for use. Todorović et al. (2015) investigated in which way project success analysis could improve knowledge management in project environment. Their paper presented an integrated framework for project success analysis as a new knowledge-based approach in project management. Badewi (2016) tested the impact of benefits management (BM) practices on the success of investments in projects, taking into consideration the impact of project management (PM) practices on that success. The conventional way of the investment process mostly prefers the issue of the preparation and implementation phase. In the utilization phase, the monitoring of planned indicators and identification of deviations (particularly in revenues) is underestimated. Identification of causes of variations as well as execution of direct corrections can improve whole process of investment and financial decision making (Drábek and Merková, 2015). Success of future investment projects is supported by elimination of past mistakes and strengthening the factors that lead to the success of previous projects. Post audit is an effective tool that can enhance learning from the failures and successes of the past. Post-audits are commonly used, ex-post to find out how the investment profitability actually played out. Planning, operational management, and post-audits are separate processes and there are commonly discontinuities between them that create remarkable inefficiencies both in management and corporate learning for future investments (Sandström et al., 2016). Lefley (2016) investigated practices of large organisations with respect to post-audits of capital projects with the aim of improving management decision making in the future. Soares et al. (2007) presented a post-audit study concerning the accuracy of capital budgeting procedures. Their study was based on the statistical analysis of the deviations occurring between effective and forecasted performance of companies after implementing their projected investments. More widespread adoption of post-completion auditing procedures can yield considerable benefits. Neale (1991) revealed the prevalence of post-auditing procedures and reported the benefits which managers attributed to post-auditing. Azzone and Maccarrone (2001) focused on the benefits and problems generated by the implementation of a post-auditing system. In this article, the procedure of implementation of post-audit is introduced. The capital project has been assessed in the utilization phase using the deviation analysis method.
Due to the specification of the expected financial results of the investment project it is necessary to analyse currently achieved economic results with planned results, even in the phase of its implementation. Conducted analysis of deviations must be accompanied by finding the causes of deviations or accountability for deviations, and measures leading to a reduction in the probability of their occurrence.

Case Study Description and Problem Definition

The objective of the study is focused on the case study of an investment project that aims to introduce a new production – the production of dampers for motorsport in a running operation. Ensuring an effective production of damping parts was

related to the acquisition and initialization of the automatized machining center UNICEN 504 with a cost of EUR 204.000. The product specifications consist of single-shock absorbers, gas-liquid phase with multi-stage control options. Currently, the investment project has completed the first year of production of above mentioned shock absorbers.
The aim of this paper is to measure the deviations of cash flow actually achieved from operating activities against the planned cash flow, with emphasis on the planned EBITDA indicator, from the first year of operation of the project. Moreover, in case of significant negative deviations propose measures for their elimination in the coming years of the economic life of the investment project.

Materials and Methodology

Economic Evaluation of the Investment Project

The evaluation is realised by the financial criteria Net Present Value (NPV) for the economic life of six years (1).

$$NPV = \sum_{n=1}^{N} \frac{CF_n}{(1+i)^n} - IC \qquad (1)$$

where: CF_n – cash flow in year n, IC – investment costs, N – economic life of the investment, n – number of years of economic life of the investment, i – discount rate

The NPV indicator value is determined by the amount of annual cash flow (CF) from the investment, and value of one-time investment costs. Substantial impact on the NPV has an indicator CF, thus generally for investments only cash flow from operating activities is considered. Impact of funding investment is taken into account when discounted at a discount rate that includes a risk of the owner, including the risk of creditors. Relationship for predicting annual CF from operating activities can be expressed, as follows:

$$CF = EBIT \cdot (1-t) + D - \Delta NCWC \qquad (2)$$

$$CF = (EBITDA - D) \cdot (1-t) + D - \Delta NCWC \qquad (3)$$

after adjustment:

$$CF = EBITDA \cdot (1-t) + D \cdot t - \Delta NCWC \qquad (4)$$

and:

$$EBITDA = p_1 \cdot P_1 + p_2 \cdot P_2 - c_{variable1} \cdot P_1 - c_{variable2} \cdot P_2 - C_{fixed} \qquad (5)$$

where: EBIT – earnings before interest and tax; EBITDA – earnings before interest, tax, depreciation and amortization; D – depreciation; t – income tax rate; NCWC – non cash working capital; p – price; P – production; $c_{variable}$ – variable costs; C_{fixed} – fixed costs

EBITDA height can be influenced solely by manufacturing and sales activities, what confirms its calculation method of (5). In the calculation, it is considered that the object of production is signified by two types of dampers (1 – dampers in trucks, 2 – dampers for personal automobiles). Dampers are manufactured in series, particularly in the number of four pieces for automobiles and the number of eight pieces for trucks. Input variables for the case study were planned based upon the expected demand for such products.

Deviation Analysis

Deviation means the difference between the two values of the monitored variables. They can be monitored on a comparison of fact – fact, plan – fact and plan – expectations (Scholleova, 2009). Just deviations in plan – expectations are the subject of this study. This forecasts the delays in implementing the plan. Expectations already include the effect of the measures as a result of last evaluation plan – fact. This comparison is focused on the future and respects the principle of ex-ante evaluation.

The reference criterion is the CF from operating activities in which variations in the area of manufacturing and financial terms and tax savings can be monitored. In production, there are variations in income, which may occur due to variations in prices and sales volumes. Both variations are influenced by the market, which can lead to significant deviations between planned and actual return on investment. Cost variations are partly influenced by the market, especially in the area of variable costs in relation to production volume. Fixed costs are influenced mostly by variations of internal processes in the pre-investment and investment phase of the project. Manufacturing deviations are usually the cause of the financial variations, as produced or sold volumes directly affect yields. Part of quantifying CF from operating activities is depreciation and income tax. Both items generally show no or only very small deviations due to the fact that the method of depreciation of the investment is determined by the Law on Income Tax, which during the period of depreciation of tangible and intangible assets may not change and the changes of income tax rate are expected long term ago, that means they can be assumed with great degree of certainty. The foregoing facts result in a need to regularly assess primarily the indicator EBITDA, including an analysis of the effects of individual analytical quantities on the positive or negative changes. This analysis is appropriate to evaluate precisely by the Deviation Analysis method.

Procedure of Deviation Analysis

The application of this method is carried out in three steps:

1. Selection of a synthetic indicator and its pyramidal decomposition (Figure 1)

Among the indicators of pyramidal decomposition there are logical links, expressed by simple mathematical operations and mutual conditioning, which means that the indicator of a lower degree is an economic criterion for indicator of a higher degree.

2. Quantification of the impacts of different analytical parameters to change in the synthetic indicator

The calculation algorithm depends on the type of linkage among analytical indicators whose effects are calculated. Input data for the calculation of the synthetic indicator X, whose value in this case is determined by two analytical indicators and A, B. The expected value of the indicators is X_0, A_0, B_0, actual values X_1, A_1, B_1.

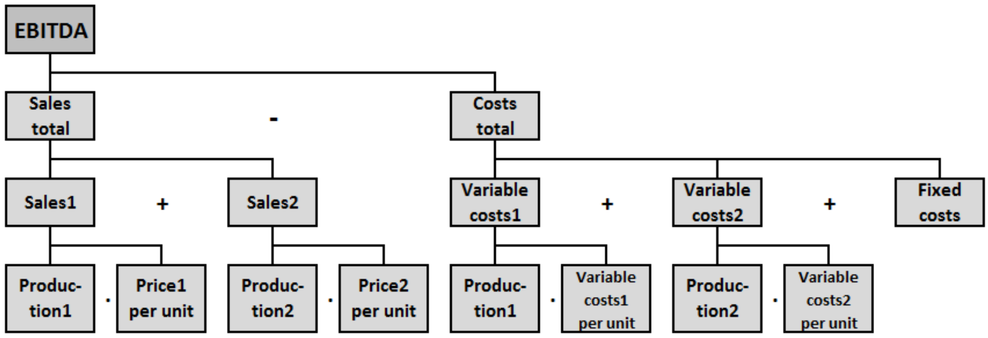

Figure 1. Pyramidal decomposition of the EBITDA indicator

Effects of changes in the analytical parameters on change in the synthetic indicator X at additive binding $(A+B)$ can be quantified, as follows:

Absolute deviation X:

$$\Delta X = X_1 - X_0 = (A_1 + B_1) - (A_0 + B_0) = (A_1 - A_0) - (B_1 - B_0) = \Delta A + \Delta B \quad (6)$$

Relative deviation of percentage change in X:

$$\Delta X = \frac{X_1 - X_0}{X_0} = \frac{\Delta A + \Delta B}{X_0} = \frac{\Delta A}{X_0} + \frac{\Delta B}{X_0} \quad (7)$$

Relative deviation on total change in X in percent:

$$(I_X - 1) \cdot 100 = \frac{\Delta A}{\Delta X} \cdot (I_X - 1) \cdot 100 + \frac{\Delta B}{\Delta X} \cdot (I_X - 1) \cdot 100 \quad (8)$$

Effects of changes in the analytical parameters on change in the synthetic indicator for ***multiplicative binding*** can be quantified by several methods, which differ from each other in calculation method and precision of the calculated values. The most accurate method is logarithmic method. Its use is failing if the index of a synthetic indicator is negative number. Relatively accurate, but algorithmically the most difficult is Functional method. Less accurate method is sequential (chain) method. Lower accuracy of the result depends on the selected indicators order. However,

this insufficiency can be eliminated by the Method of decomposition with residuum, which is though laborious. This issue is elaborated in detail by the authors Kotulič et al. (2010) and Kotulič (2014).
This contribution applies the ***logarithmic method***, which is based on the logarithmic indicator index scaling. Effect of changes in analytical indicators on change in the synthetic indicator X for binding $(A \cdot B)$ is quantified as follows:
Absolute expression of impact:

$$\Delta X = \frac{\log I_A}{\log I_X} \cdot \Delta X + \frac{\log I_B}{\log I_X} \cdot \Delta X \tag{9}$$

Relative expression of impact:

$$(I_X - 1) \cdot 100 = \frac{\log I_A}{\log I_X} \cdot (I_X - 1) \cdot 100 + \frac{\log I_B}{\log I_X} \cdot (I_X - 1) \cdot 100 \tag{10}$$

3. Evaluation of deviation and corrective action
After quantifying the deviations, the causes must be found, and the measures taken, in order to significantly reduce the probability of such deviations in the future.

Results and Discussion

The method of deviation analysis is implemented on the investment project that aims to introduce a new production. The project is economically evaluated using the indicator NPV, and its value is expected to EUR 370,482 for the period of six years. The most important factor that influences the resulting NPV is CF from operating activities. Due to the fact that a depreciation and rate of income tax have on CF from operating activities generally zero, respectively minimal impact, the deviation analysis focuses only on the EBITDA indicator, which is calculated according to equation (5). It is accomplished by a pyramid decomposition of the EBITDA indicator, shown in Figure 1. The challenge is to identify which variables have the strongest impact and positively or negatively affect the decline in actual results compared with EBITDA projected value after the first year of the operation of the project. Input data for the calculation of the deviations are shown in Table 1. For each monitored indicator, three variations are quantified. The calculation procedure is determined by binding among analytical indicators. The values of calculated deviations are shown in the chart in Figure 2 in following order starting from absolute deviation, relative deviation of percentage changes in the synthetic indicator and the relative deviation in the total change of the synthetic indicator.

Evaluation of Deviations

The total deviation of EBITDA indicator is negative. Its value in the first year of operation is decreased by 22.51% against the planned investment. This decline is due to the decrease in revenues (sales total) by 25.66 percentage points and increased costs (costs total) by 3.15 percentage points.

Table 1. The values of variables and changes that are part of the pyramid model EBITDA

Indicator	Plan for 1st year	Actual for 1st year	Absolute change	Relative change	Index changes
1	*2*	*3*	*3-2*	*[(3-2)/2]*	*(3/2)*
Production1	104	88	-16	-0.1538	0.8462
Production2	180	172	-8	-0.0444	0.9556
Price1 per unit	950	925	-25	-0.0263	0.9737
Price2 per unit	500	470	-30	-0.0600	0.9400
Variable costs1 per unit	420	450	30	0.0714	1.0714
Variable costs2 per unit	220	235	15	0.0682	1.0682
Fixed costs	2,000	2,000	0	0.0000	0.0000
Sales1	98,800	81,400	-17,400	-0.1761	0.8239
Sales2	90,000	80,840	-9,160	-0.1018	0.8982
Sales total	188,800	162,240	-26,560	-0.1407	0.8593
Variable costs1	43,680	39,600	-4,080	-0.0934	0.9066
Variable costs2	39,600	40,420	820	0.0207	1.0207
Variable costs	83,280	80,020	-3,260	-0.0391	0.9609
Costs total	85,280	82,020	-3,260	-0.0382	0.9618
EBITDA	103,520	80,220	-23,300	-0.2251	0.7749

Decline in total sales was negatively affected by both, revenues from the sale of dampers for trucks (sales1) by 16.81 percentage points and revenues from sales of dampers for personal automobiles (sales2) by 8.85 percentage points. The decline in sales was caused by lowering the production volume of both products and lowering their prices. Such decline was caused by providing quantitative discount due to ordering the certain large number of dampers, which consequently led to a lower average sale price of products.

The most significant effect on the total decline in sales was affected by a decrease in the production volume of dampers for trucks (production1) by 14.49 percentage points with the impact on the total amount of EBITDA up to 64.38 percentage points. Decrease in total costs was caused by the combination of an increase in variable costs per unit and reduction in the production volume for both types of dampers.

Even in this case, the most significant effect on the total decline in costs was caused by a decrease in production of dampers for trucks by 6.71 percentage points with the impact on the total amount of EBITDA - 29.80 percentage points.

Draft Measures

The anomalies and their causes form the basis for decisions on management of investment projects in the coming years of its economic life. The problem can be solved in several ways.

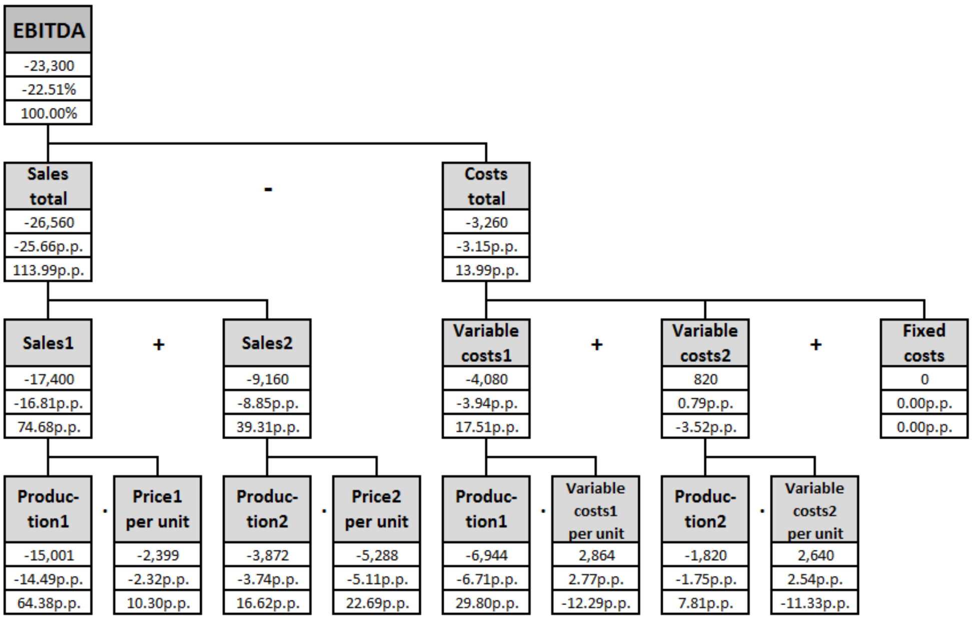

Figure 2. Decomposition values of the pyramid model EBITDA

One solution can be based on current average prices of the shock absorbers and variable costs while keeping the originally planned production (Table 2).

Table 2. NPV values

Variant	NPV_{Plan}	NPV_{Actual}	$NPVV_{Variant}$
EUR	370,482	353,498	300,092
Absolut change from NPV_{Plan} in EUR	-	-16,984	-70,390
Relative change from NPV_{Plan} in %	-	-4.58	-18.99

There are many other combinations of price levels, variable and fixed costs as well as production volume there. For this reason, it is appropriate to apply the Monte Carlo simulation to calculate the NPV indicator. Monte Carlo simulation is used when there are multiple risk factors (in our case prices, costs, production volume) usually of the continuous nature. The objectivity of the results depends on the objectivity of the estimated input data, as well as on the number of repetitions performed.

Deviation analysis is appropriate to apply also after the second year of life of the investment, and thus to assess the investment according to current information. Such approach just confirms the nature of the deviation analysis that is understood as a continuous, systematic, repeated and never-ending process. The process, also called as post audit (PA), enables correct quantification of investment effects and declaration of the real contribution of investment to the growth of corporate performance (Drábek and Merková, 2015). The presented results point out to various corrective actions to reach the planned NPV value. But as mentioned above, in order to capture changes in all variables and reflect their influence on the final variable NPV it is necessary to use simulation based on Monte Carlo. This approach has been presented e.g. in Janekova et al. (2016), where simulation was used in the preparation phase to predict NPV, as well as in some articles mentioned in Introduction.

Summary

Investment project management in practice mainly focuses on the preparation and implementation of a phase of investment. During the use of investment, a management of deviations in the planned indicators' values (e.g. CF or costs) is often neglected, but no less important to the overall success of the investment project. Early identification of the sources and causes of deviations creates an opportunity for implementing appropriate measures in order to eliminate or compensate for the differences and achieving the intended project outcomes.

The aim of this paper was to present a method of assessing the investment project in the utilisation phase of the investment. The deviation analysis method was implemented on the investment project that aims to introduce a new production. The project was economically evaluated by using the indicator NPV, but the deviation analysis was focused only on the indicator EBITDA. Decomposition of the synthetic indicator EBITDA defined the bindings among the analytical variables. Through the quantification of changes in the analytical variables, their impact on a change of the EBITDA indicator was quantified. The most significant effect on the projected EBITDA value showed the decline in sales of colour printing, where at the same time both, sales price and sales volume had a negative impact on the total CF.

Due to this observation, it is possible in the future to introduce such measures aiming to reduce the resulting deviations and achieve the planned NPV. The presented case study highlighted the importance and possibilities of ex-post analysis of the investment project as part of project management. An illustration of the deviation analysis demonstrated on the EBITDA indicator may remain as a model for similar analysis and after appropriate modifications is applicable anywhere in the corporate practice.

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IMPLEMENTACJA METODY ANALIZY ODCHYLENIA W FAZIE UŻYTKOWANIA PROJEKTU INWESTYCYJNEGO: STUDIUM PRZYPADKU

Streszczenie: Zarządzanie projektami inwestycyjnymi obejmuje etapy: przedinwestycyjny, inwestycjny i wykorzystania. Dobrze prowadzone fazy przedinwestycyjne i inwestycyjne zmniejszają ryzyko pojawienia się problemów, które mogą wystąpić w fazie wykorzystania. Nie można ich jednak całkowicie wyeliminować, ponieważ rozwój wewnętrznych i zewnętrznych założeń może nie być zgodny z planem. Dlatego też, nawet w fazie wykorzystania, konieczne jest dokonanie porównania wyników ekonomicznych faktycznie osiągniętych z planowanymi. W artykule przedstawiono zastosowanie metody analizy odchylenia w fazie wykorzystania projektu inwestycyjnego. Analiza odchylenia wartości bieżącej netto (NPV) koncentruje się na wskaźniku EBITDA i uzupełniona jest poprzez określenie przyczyn odchyleń. Wyniki badania wskazują, że odchylenia wartości bieżącej netto spowodowane są głównie przez obniżenie wielkości produkcji obu produktów i zmniejszenie kosztów zmiennych na jednostkę. Prezentowane działania prowadzą do zmniejszenia prawdopodobieństwa występowania odchyleń.

Słowa kluczowe: inwestycja, analiza odchyleń, przepływ środków pieniężnych, wartość bieżąca netto

投資項目利用期偏差分析方法的實施：案例研究

摘要：投資項目管理包括投資前期，投資和利用階段。良好的投資前期和投資階段降低了使用階段可能發生的問題的風險，但不能完全消除，因為內部和外部假設的發展可能與計劃不一致。因此，即使在利用階段，有必要分析實際實現的經濟效益。本文介紹了偏差分析方法在評估投資項目利用階段的應用。淨現值偏差分析集中在EBITDA指標上，並通過指定偏差原因進行補充。研究結果表明，NPV的偏差主要是由於降低了兩種產品的生產量和每單位可變成本的降低。所提出的措施導致偏差發生概率的降低。

關鍵詞：投資，偏差分析，現金流量，淨現值