

ALGORITHM FOR THE RISK MANAGEMENT IN THE CONSTRUCTION COMPANY USING MODERN METHODS

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Abstract

The goal of any business is to create added value while minimizing inputs. Result of the business depends on a large number of internal and external factors that are associated with not only the company itself but also its surroundings and the entire business environment. These external and internal factors pose risks that should be subjects to the management of each business entity. The paper is focused on a detailed analysis of the issue of risk management in the construction companies using different approaches. These approaches are based on traditional methods of qualitative risk analysis and methods of quantitative analysis, it concerns mainly about the sensitivity analysis, methods of scenario analysis and mathematical simulation approach. The outcome of the paper will be summary of approaches, which it is possible to use for the draft of the algorithm for the risk management with the use of selected methods of risk analysis intended especially for the construction company preparation.

Key words

construction company, risk management, sensitivity analysis, simulation

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1 INTRODUCTION

The main objective of the paper is the proposal of the algorithm for the risk management with the use of selected methods of risk analysis intended especially for the construction company. The paper presents the literature review and identification of methods suitable for the risk analysis and risk management. The key part of the paper is the case study including the utilization of identified methods for the risk assessment and the risk planning of the specific construction company in the specific situation. The recommendations following the results of the case study, short discussion and conclusions are also involved.

2 LITERATURE REVIEW

The outcome of the paper will be summary of approaches, which is possible to use for the draft of the algorithm for the risk management with the use of selected methods of risk analysis intended especially for the construction company preparation. Within the research the impacts of partial risk factors on indicator Return on Equity were monitored. Indicator Return on Equity from ratio indicators of financial analysis was chosen. That is a reason, why the financial analysis and risk analysis approaches are commented.

Financial analysis consists in the assessment of the state of financial health of the company and its development based on an analysis of data from financial statements of the period just ended. The task of thus conceived analysis is to supplement the financial statements and to assess what is the level of financial health at the end of the period and what has been achieved within the company's performance during this period [1].

Financial analysis interprets company's past and present financial health and could help to predict its future development [2].

Financial analysis involves comparing of the firm's performance with other firms in the same industry field and evaluating of trends in the firm's financial position over time. One rich source of information for financial statement analysis are the audited financial statements. Financial statements are usually part of the annual report that listed companies submit to regulatory agencies such as Securities and Exchange Commission and Stock Exchange entities [3].

Financial ratio analysis is a process of determining and interpreting relationships between the items of financial statements to provide a meaningful understanding of the performance and financial position of an enterprise. Ratio analysis is an accounting tool for presenting of accounting variables in a simple, concise, intelligible and understandable form. Ratio analysis is a study of relationships among various financial factors of a business [4].

Risk can be defined as a possibility that events will turn out differently than anticipated [5]. The risk can be considered to be an element of uncertainty, which more or less influences expected results of the human work and companies as well. The risk is on the one hand connected to expectations to achieve extraordinary economic results; on the other hand it could be threatened by danger of failure leading to losses, which can significantly affect the financial stability of the company and can lead to its downfall [6].

The main objective of the risk management of the company is to increase the probability of the success of the project and to minimize the danger of its failure.

The steps of the project risk management are as follows:

- determination of risk factors of the project,
- assessment of the importance of risk factors,
- project risk assessment,
- valuation of the risk of the project, suggestion and acceptance of operations for its decreasing,
- preparation of the plan of correction operations [7].

3 METHODS/METHODOLOGY

Methodology used in the paper is based on analysis in the area of methods of financial analysis and risk analysis. The results of analysis allow the selection of suitable indicators and risk management approaches for the risk management of construction company. Possibilities of utilization of selected indicators and risk management approaches on the case study are verified.

The first method used within the case study is the financial analysis. The financial analysis evaluates the economic development of the company for a certain period. Usually, the considered period is represented by 5 years or more. As input values for financial analysis may be indicated financial statements - balance sheet, profit and losses, eventually cash flow statement can be used. In the Czech Republic, according to the Accounting Act no. 563/1991 Coll. for financial statements, two documents are considered: the balance sheet and profit and loss statement. The balance sheet shows the balance between assets and sources of property coverage. Profit – loss account shows evidence of revenues, costs and economic results.

The development of company management is expressed by using indicators representing financial stability and performance. For the preparation of financial analysis it is possible to use several methods, each of which represents different outputs. These methods can be divided into the following groups – elementary methods, method of financial ratios and summary indicator [8].

In the case study the method of financial ratios was used. This method is based on the ratio of two or more variables from the financial statements and it is represented by four basic indicators - liquidity, leverage, activity and profitability. Case study works with one of the most used indicators – Return on Equity. Return on Equity is expressed as follows:

$$\text{Return on Equity} = \text{Net profit} / \text{Equity} \quad (1)$$

The next group of methods is connected with the risks management. Within the qualitative risk analysis it is necessary to mention mainly PEST analysis, Porter's model and the SWOT analysis as the basic approaches for the determination of relevant risk factors connected with the company or the project. In the case of quantitative analysis the sensitivity analysis, scenario analysis and the probability analysis can be used. The sensitivity analysis is very simple method analysing the rate of dependence of the key economic "success" indicator (e.g. the profit, NPV, ROE, etc.) on independent variables mathematically influencing mentioned key indicator. Probability analysis uses the Monte-Carlo simulation for the determination of the probability distribution of the key economic "success" indicator depending on identified

independent variables – risk factors. The scenario analysis is in principle similar to the probability analysis, but works with limited number of scenarios and risk factors. The next disadvantage in comparison with the Monte-Carlo simulation is the necessity to use the discrete probability distribution for input variables – risk factor. From these reasons the scenario analysis is not used as a method for the quantitative analysis in the case study.

4 RESULTS

In the frame of the paper the case study is focused on formulating of basic steps of risk analysis of economic development of the construction company using available information about the company and its surroundings. Performing risk analysis is proposed in the following steps:

- qualitative analysis of internal and external environment,
- sensitivity analysis,
- probabilistic analysis.

4.1 Qualitative analysis of internal and external environment

Detailed qualitative analysis of internal and external environment was elaborated within the documents [9]. Qualitative analysis was carried out with methods - PEST analysis - analysis of the macro environment, Porter's five forces model - microenvironment analysis, SWOT analysis and financial analysis. Outputs of qualitative risk analysis are shown in Tab. 1 and in Fig. 1.

Tab. 1: Qualitative analysis – identification of risk factors

Number of risk	Description
R1	Decreasing production and investments in constructions
R2	Decreasing of number of skilled and educated graduates
R3	Big competition
R4	Increasing prices of energy and fuels
R5	Corruption
R6	Decreasing profitability
R7	Increasing of other resources of the company
R8	Decreasing of the turnover of actives in the company

Probability	Intensity of negative impacts				
	ES	S	M	H	EH
EH – extremely high					R1
H - high			R6	R3	
M - middle			R4	R5	
S - small		R7		R8	
ES – extremely small	R2				

	The most important risks
	Middle important risks
	Less important risks

Fig. 1: Qualitative analysis – risk factors importance assessment

4.2 Sensitivity analysis

Sensitivity analysis is used to determine the significance of partial risk factors that affect the final criterion indicator of economic development of the construction company. As a final criterion an indicator Return on Equity (ROE) is considered.

Regarding the fact that for the need of the case study data from the financial statements for the period of 6 years were available, the sensitivity analysis was performed for each of those years separately. Based on the comparison of results for individual years the order of importance of partial risk factors was determined. As risks factors evaluated in following analysis the input variables intended for ROE calculation were used. We evaluated the following partial risk factors:

- sales,
- material consumption,
- costs for services,
- costs for wages,
- operational costs,
- equity.

Tab. 2 shows the results of calculating of ROE for each of monitored years. In tables 3-8 there are described the changes of ROE compared with ROE - zero variant caused by an increase of partial risk factor by 10 %. Tab. 9 provides a summary of the percentage changes in the ROE indicator for each of monitored years by increasing of values of the relevant risk factors by 10 %.

Tab. 2: ROE calculation – zero variant

Years	1	2	3	4	5	6
Net profit (CZK)	18 075	9 142	12 423	6 502	2 351	3 237
Equity (CZK)	47 693	34 831	35 421	42 362	44 935	48 267
ROE	0.3790	0.2625	0.3507	0.1535	0.0523	0.0671

1 Euro = 27 CZK

Tab. 3: Sensitivity analysis – 10% increase of sales

Years	1	2	3	4	5	6
Net profit (CZK)	35 041	24 980	32 767	28 707	19 768	19 896
Equity (CZK)	47 693	34 831	35 421	42 362	44 935	48 267
ROE	0.7347	0.7172	0.9251	0.6777	0.4399	0.4122
Change of ROE	93.86%	173.24%	163.76%	341.51%	740.82%	514.63%

1 Euro = 27 CZK

Tab. 4: Sensitivity analysis – 10% increase of material consumption

Years	1	2	3	4	5	6
Net profit (CZK)	12 660	3 829	7 096	2 457	-2 506	-748
Equity (CZK)	47693	34831	35421	42362	44935	48267
ROE	0.2654	0.1099	0.2003	0.0580	-0.0558	-0.0155
Change of ROE	-29.96%	-58.12%	-42.88%	-62.21%	-206.60%	-123.10%

1 Euro = 27 CZK

Tab. 5: Sensitivity analysis – 10% increase of costs for services

Years	1	2	3	4	5	6
Net profit (CZK)	11 858	2 898	3 896	-4 431	-4 159	-2 977
Equity (CZK)	47693	34831	35421	42362	44935	48267
ROE	0.2486	0.0832	0.1100	-0.1046	-0.0926	-0.0617
Change of ROE	-34.40%	-68.30%	-68.64%	-168.14%	-276.90%	-191.95%

1 Euro = 27 CZK

Tab. 6: Sensitivity analysis – 10% increase of costs for wages

Years	1	2	3	4	5	6
Net profit (CZK)	15 689	6 716	8 902	1 154	-2 084	-1 495
Equity (CZK)	47693	34831	35421	42362	44935	48267
ROE	0.3290	0.1928	0.2513	0.0272	-0.0464	-0.0310
Change of ROE	-13.20%	-26.54%	-28.34%	-82.25%	-188.63%	-146.19%

1 Euro = 27 CZK

Tab. 7: Sensitivity analysis – 10% increase of operational costs

Years	1	2	3	4	5	6
Net profit (CZK)	17 940	8 881	12 256	6 350	2 230	3 094
Equity (CZK)	47693	34831	35421	42362	44935	48267
ROE	0.3761	0.2550	0.3460	0.1499	0.0496	0.0641
Change of ROE	-0.75%	-2.85%	-1.34%	-2.34%	-5.14%	-4.43%

1 Euro = 27 CZK

Tab. 8: Sensitivity analysis – 10% increase of equity

Years	1	2	3	4	5	6
Net profit (CZK)	18 075	9 142	12 423	6 502	2 351	3 237
Equity (CZK)	52 462	38 314	38 963	46 598	49 429	53 094
ROE	0.3445	0.2386	0.3188	0.1395	0.0476	0.0610
Change of ROE	-9.09%	-9.09%	-9.09%	-9.09%	-9.09%	-9.09%

1 Euro = 27 CZK

Tab. 9: Sensitivity analysis – Summary table of changes

Years	1	2	3	4	5	6
Sales	93.86%	173.24%	163.76%	341.51%	740.82%	514.63%
Material consumption	-29.96%	-58.12%	-42.88%	-62.21%	-206.60%	-123.10%
Services	-34.40%	-68.30%	-68.64%	-168.14%	-276.90%	-191.95%
Wages	-13.20%	-26.54%	-28.34%	-82.25%	-188.63%	-146.19%
Operational costs	-0.75%	-2.85%	-1.34%	-2.34%	-5.14%	-4.43%
Equity	-9.09%	-9.09%	-9.09%	-9.09%	-9.09%	-9.09%

Based on comparison of data from table 9 it is evident following rank of importance of partial risk factors (sorted from the most important factor to less important):

- sales,
- costs for services,
- material consumption,
- costs for wages,
- equity,
- operational costs.

4.3 Probability analysis

Based on available financial data for the last 6 years we have been implemented prognosis of economic development of the monitored construction company for the following seventh year. Making forecasts is not the main topic, for case study simple access for the development trend of the series was used. For a more precise prognosis would be necessary to use detailed internal corporate information, planned investment activities, etc.

For the determination of the result for the seventh year we have used data from the profit lost account of previous years. The values for seventh year using trendlines were assessed. The values of partial risk factors identified with trend analysis are listed in Tab. 10. The resulting value of the ROE for the projected seventh year is 3.46 %.

Tab. 10: Prognosis of inputs – 7th year

Year	7
Sales	185,646
Material consumption	41,281
Services	76,729
Wages	52,115
Operational costs	1,397
Equity	45,117

1 Euro = 27 CZK

Using the data and program Crystal Ball the simulation of ROE value creation depending on the development of four key partial risk factors that were indicated in the sensitivity analysis was done:

- sales,
- costs for services,
- material consumption,
- costs for wages.

Mentioned risk factors were completed by (normal) probability distributions and the simulation of the creation of ROE indicator was carried out. Results of the simulation are shown in Fig. 2 and in Tab. 11.

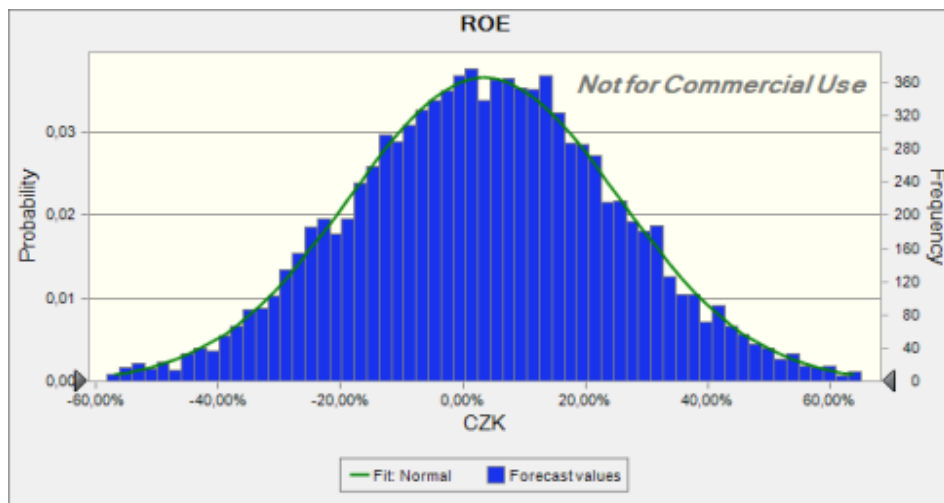


Fig. 2: Results of simulation – probability distribution of ROE

Tab. 11: Results of simulation – statistic data

Statistics	Forecast values
Trials	10 000
Base Case	3.46%
Mean	3.40%
Median	3.43%
Mode	---
Standard Deviation	21.96%
Variance	4.82%
Skewness	0.0295
Kurtosis	3.05
Coeff. of Variability	6.46
Minimum	-74.55%
Maximum	94.02%
Range Width	168.56%
Mean Std. Error	0.22%

5 DISCUSSION

Case study is oriented on valuation of the possibility of assessment of risks arising from ordinary activities of selected construction company. Risk analysis is divided into three parts. Qualitative analysis provides general information about the general risks arising from ordinary activities of the construction company and the results and subsequent recommendations are dependent on adequate knowledge of the company and its surroundings. In the case of sufficient knowledge of business operations and enterprise surrounding the qualitative analysis and its outputs is the key method for risk management and planning of possible corrective measures.

Quantitative risk analysis uses the analysis of dependence of selected key indicator of economic success of the company on risk factors. This key indicator may be the profit or its expected development, in the case of the case study was chosen ROE indicator, which reports about the contribution of existing and planned business venture for its owner. Sensitivity analysis aims to determine the significance of risk factors in terms of the impact of potential changes on the final indicator. The influence of those the most important risk factors is projected into mathematical simulation. Mathematical simulation is used to determine the level of uncertainty of expected development of monitored key indicator. As it is evident from Fig. 2 or from Tab. 11, degree of uncertainty when predicting ROE for the next period is very high that reduces the possibility of interpretation and formulation of recommendations. These are intended mainly to recommend the efficient management of the most significant risk factors (results from the sensitivity analysis) to reduce the degree of uncertainty (given by the probability distribution) of the key risk factors - inputs for the calculation of selected key indicator.

6 CONCLUSION

The outcome of the paper was the summary of approaches, which would be possible to use for the draft of the algorithm for the risk management with the use of selected methods of risk analysis intended especially for the construction company preparation.

The paper includes the review of related literature and the formulation of methods used for the risk management. The most important part of the paper is the application of identified methods on the case study oriented on the proposal and the verification of the basic steps of the risk analysis and risk management. This proposal includes the qualitative analysis leading to identification and valuation of risks connected with internal and external conditions of the company. This analysis is supported by supplementary quantitative analysis describing the dependence of the selected key economic success indicator (the case study works with ROE). The results lead to the determination of the most important variables needed to be managed very efficiently to reach expected or better economic results. Based on results of the paper it is possible to recommend the usage of in paper solved approaches for the algorithm for the risk management determination.

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