USING AHP AND FINANCIAL CRITERIA FOR EVALUATING ALTERNATIVES TO REDUCE RISK OF INVESTMENT

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Abstract   In todays highly turbulent business environment, characterized by uncertainty, it is important to find out adequate approach to solve high-stake problems. This paper presents different criteria for business decision making, and their application in practice. Analytical Hierarchy Process (AHP) is a method of multi-criteria evaluation which organizes and simplifies decision-making. Making the decision should include analysis of financial benefits that certain investment brings. The paper also presents financial criteria in evaluating the efficiency of investments, such as net present value, internal rate of return and payback period. Particular emphasis is on the model for calculating the cost of corporate capital (CAPM), which serves as the basis for calculating the optimal rate for discounting, as well as on the WACC coefficient for calculating the discount rate. A numerical example is given to illustrate its application to solving the real problems.

Paper type:

1. INTRODUCTION

In complex organizations, it is important to determine what the principles, style, guidelines for decision making are, and the structure of the organization structure that will lead and supervise the process of decision making (Wally & Baum, 1994). Structured methods utilizing the theoretical and practical advances have become important aids to decision-making in all sectors. If the benefits of various actions are unpredictable, so that the links between variables are unknown or even non-linear, we are talking about a world we are faced with today. Making a decision should also include analysis of financial benefits that a certain investment brings (Belli, Anderson, Barnum, Dixon, & Tan, 2001). It is important to analyze the expected future investment incomes and assess whether their present value is at the level of passing the profit.

Making estimates is not only difficult when it comes to estimating future cash flows; it is also difficult when it comes to predictions regarding many factors that may affect its value. It is primarily the risk that the future brings. This is a very important factor which affects the real future flows, therefore it is important to make as precise estimates as possible. Although many models for risk assessment have been developed over the years, certainly none of them can positively claim to what extent risk could affect the business. On the other hand, the same models help to reduce uncertainty and to identify the adverse situations that may occur, so they can be included when we are calculating future incomes of an investment.

The aim of this paper is to present different criteria in business decision making and their implementation in practice. The solutions may be useful with strategic decision making which needs to be swiftly and appropriately defined.

Analytical Hierarchy Process (AHP) is the methodology used to solve problems at the strategic level (Saaty, 1980). Vijayakumar, Suresh & Subramanya (2010) used the AHP to prioritize the factors affecting ERP implementation on the basis of the priority value obtained by this method for each cell in the framework. Xiaohua & Zhenmin (2002) have introduced the index system for appraising the sustainable development of rural energy and have calculated the weighting of each index using the AHP. Aras, Erdog mus & Koc (2004) have used the AHP to determine the most convenient location for the construction of a wind observation station on campus.

Herein, the AHP method will be used to unify different criteria for decision making. Afterwards, the financial criteria in grading investment efficiency will be shown, such as net present value, an internal rate of profitability and return deadline. Capital Asset Pricing Model (CAPM) will particularly be emphasized, and it will serve as a basis for calculating the optimum rate for discount income, as well as WACC–rate for calculating discount rate. Based on applying these financial criteria, the choice of the alternative will be justified.

2. FINANCIAL CRITERIA AND EFFICIENCY OF THE INVESTMENTS

Measuring the effects of the investment and their quantitative expression allows assessment whether these effects are expected to exceed the total investment required. Based on this assessment, a decision is made whether to implement a particular investment or to drop it. Depending on the information we want to obtain from the evaluation process and the application of decision making methods, a process which would give the most quality results is chosen (Knežević, Barjaktarović Rakočević & Đurić, 2011). Some of the methods most frequently used in practice are: net present value, internal rate of return, cost-benefit ratio, total costs of assets, payback period, added economic value, return on investment, "balanced scorecard" method (Cobbold & Lawrie, 2002); (Baker, 2000).

Net present value (NPV) is the difference between the market value of the investment and expenditure which was requested in the beginning. It is an indicator of the added value of existing enterprise value which provides a realization of the project. The problem is to determine whether or not the future value of the investment is above the values embedded in it. Talking about the payback period we can think of two parameters: one represents the time required to generate investment cash flows sufficient to cover the initial costs, while the second represents the time required for the discounted cash flows to exceed initial investment (Ross, Westerfield & Jordan, 2003). The internal rate of return (IRR) can be helpful when it comes to investment where it is expected that all net cash flows are positive, or when is just one investment being decided on. However, when the decision should be made between several investments, IRR can cause problems. As for the mutually exclusive projects, reliance on the IRR can also be a problem. Although it is true that the project with higher NPV is certainly a better investment alternative, it does not mean that the project with higher IRR is certainly a good investment. This will depend on the discount rate. Specifically, the discount rate is the key variable in this process, and it can be difficultly estimated. Although it is often talked about how the discount rate should be the one that prevails in the capital market, this is a very unsafe way to select it.

There are several ways to calculate the cost of capital, but one of the most used concepts is the weighted average cost of capital (WACC). WACC represents the cost of capital for the company and can be interpreted as the desired yield for the whole company. WACC is nothing more than the average value of the financing costs and also represents the total return that a company must earn from their investments in order to maintain its market value to satisfy creditors, shareholders and other financiers, and not to invest elsewhere. CAPM is located in the heart of modern finance. The main idea is that all individuals are similar to each other, and they differ only in terms of available resources and their aversion to risk.

3. THE DECISION MAKING PROCESS UNDER UNCERTAINTY

Problem solving is the process of identifying differences between the current system state and the desired state, and therefore taking actions to eliminate these differences. We can say that uncertainty is present in every decision no matter how simple the problem seems. The question is whether the decision maker is willing to ignore the uncertainty and to accept the risk of wrong decisions.

In this paper we propose framework for decision making under uncertainty (Fig.1.). The first step refers to identifying business goals and the reasons for finding a solution which would lead to achieving them. It includes:

- Defining goals and demands
- Analysis of the approach to achieving golas
- Sending offers and waiting for a response, etc.

Fig. 1 Conceptual framework

The second step evaluates the proposed alternatives by using AHP method. It consists of the following steps: (1) Choosing the requirements to be prioritized; (2) Setting the requirements into the rows and columns of the n x n AHP matrix; (3) Performing a pair-wise comparison of the requirements in the matrix according to a set of criteria; (4) Summing the columns; (5) Normalizing the sum of rows; (6) Calculating the row averages. AHP uses mathematics to identify inconsistencies in the evaluation of the results that may arise due to personal prejudice, irrational reasoning or by using political attitudes (Saaty, 1980).

The third step focuses on the optimization of benefit through defining the contract in detail. The fourth step checks the evaluated alternatives using financial indicators. Finally, the fifth step chooses the most feasible alternative.

4. ILLUSTRATIVE EXAMPLE: THE SOFTWARE VENDOR SELECTION IN PHARMACEUTICAL COMPANY

Full and precise understanding of business goals and needs of companies which demand appropriate software solution is the key to success. It is vital for business clients who will use the software solution to participate in making the purchase for

business needs with a team that works providing it. Additionally, an organization that does not adopt a rigorous approach to evaluation and selection of software vendor and package that they are going to use, is always exposed to this kind of risk. The AHP method enables the evaluation of criteria hierarchically and enables an easier choice of the most suitable alternative. The activity of defining business goals and demands is explained hypothetically in the following examples.

4.1. Identification of business requirements

A large pharmaceutical company, PharmaCompany, has to spend large sums of money on monitoring and coordination of the entire business, to reclaim its leading position in the market. Costs of operations coordination and administration have exceeded the optimal level in two years, and in comparison to the leading company in the sector they are much higher. The general manager has decided to implement ERP software solution that will help overcome this problem. The aim of this solution is to assist in planning, prioritizing and monitoring of all activities, in the optimization of costs, as well as the business contribution to justify the investment.

Using the AHP method the qualitative characteristics will be analyzed for potential software vendors. Special attention will be on evaluating characteristics of the preferred supplier and their products. Combined rating will be used after, because it gives the overall impression of the proposed solutions. Using the cost benefit analysis will determine future costs and benefits, and on the basis of these indicators NPV, IRR and payback period for investment can be calculated.

Cost structure of ERP system implementation, which is monetary expressed through cost benefit analysis, consists of the following basic elements: software license, maintenance, consulting, customization, internal costs. The benefits of introducing such a system, also monetary expressed, are: increased sales as a direct result of improved services to customers, increased productivity, reduced inventory, reduced product obsolescence, reduced costs, quality, penalties delivery, redistribution of labor.

The time for exploitation of investment is ten years. Because of the huge investment in this type of software and the time that vendor will devote to its software maintenance, this number of years is optimal. Based on the trends in systems of information and communication technologies, it is estimated that significant change in the structure of ERP systems and their introduction will not occur until that time.

Once the decision on purchasing a software package is made, the procurement team makes a list of potential vendors of the desired solution. Afterwards, they are forwarded a formal request for making an offer. As potential suppliers in this example, the pharmaceutical company will chose between the two software vendors, Pitech and EffSoft. Then it is necessary to give a professional assessment of the companies as well as evaluating the proposed software packages. The company's team will conduct expert evaluation with AHP methodology. Ratings will be based on objective assessment of competence and the quality of suppliers and software

products themselves. Products should be measured and should meet both the needs of different users and the company's needs to maximum extent. The decision maker must evaluate the importance of each criterion, and then the alternatives based on that criterion.

4.2. Evaluation of software vendors and packages on offer

Vendors will be evaluated based on the following criteria and their sub-criteria: financial stability (turnover, annual rate of growth, profitability, cash surplus), geographic presence (location of branch offices, nearest locations), technical expertise (employees, investment in R&D, investment in training and education), customer base and references (clients, references), quality management (top management experience, quality management initiatives, awards and recognition). Table 1 shows the values of weights of criteria as well as their sub-criteria calculated using the AHP method.

Table 1   Criteria and corresponding weights for evaluation of vendors

No	Criterion	Weight	Sub-criterion	Weight
1	Customer base and references	0.160	Clients	0.125
			References	0.875
2	Geographic presence	0.112	Location of branch offices	0.167
			The nearest location	0.833
3	Technical expertise	0.358	Employees	0.637
			Investments in R&D	0.258
			Investments in training and education	0.105
4	Quality management	0.070	Top management experience	0.637
			Quality management initiatives	0.258
			Awards and recognition	0.105
5	Financial stability	0.300	Turnover	0.057
			The annual rate of growth	0.145
			Profitability	0.558
			Cash surplus	0.240

Software products are evaluated based on three criteria: business functions, technology and operations. The relative weights of these criteria were determined by AHP method and their values are 0.60, 0.10 and 0.30. Using these criteria, the combined solution from comparison of these alternatives is:

$$\text{Combined rating} = \varphi_1 \, (\text{Vendor rating}) + \varphi_2 \, (\text{Product rating})$$

where $\varphi_1 = 0.20$ and $\varphi_2 = 0.80$ are the weights assigned to vendor and product based on their relative importance ($\varphi_1 + \varphi_2 = 1$). Overall rating for the vendor EffSoft is

0.726; and for PiTech is 0.274. Overall rating of the product ES is 0.780; and for the product PT is 0.220. Accordingly, Combined rating of products are as follows:

$$ES: 0.20 \times 0.726 + 0.80 \times 0.780 = 0.769$$

$$PT: 0.20 \times 0.274 + 0.80 \times 0.220 = 0.231$$

Product ES's rank is higher than the rank of the product PT. Therefore, product ES better suits the requirements of the company in business, technological and operating terms than product PT.

4.3. Using financial criteria to justify the selected alternative

Calculation of WACC. WACC would be used as the discount rate to calculate NSV investments. The following will show the calculation of the components required for finding this discount rate:

$$WAAC = \frac{E}{V} R_E + \frac{D}{V} R_D (1-T)$$

where E is market value of the company's equity; D is market value of the company's debt; R_E is cost of equity, while R_D is cost of debt. Ratio E/V is percentage of financing that is equity, D/V is percentage of financing that is debt, where $V = E + D$. T is corporate tax rate.

Cost of equity calculates by following:

$$R_E = R_f + \beta_i * (E(R_m) - R_f)$$

where R_f is risk-free rate; $E(R_m)$ is the expected market return; value of $(E(R_m) - R_f)$ is market risk premium (as a reward for bearing the risk of not investing in risk-free securities). Risk-free rate, $R_f = 3.54\%$, was obtained using the average interest rate paid on government bonds of Great Britain (3.86%) and Germany (3.21%) for 10 years maturity.

The expected market return, $E(R_m) = 8.45\%$ (Tab. 2), was obtained by the yield of the four European stock market indexes (Frankfurt, Paris, London, Amsterdam).

Table 2 Calculating expected market return

Year:	DAX	CAC40	FTSE100	AEX
1/12/2009	21.5%	14.1%	21.1%	22.3%
1/12/2008	-40.8%	-42.3%	-33.3%	-50.1%
1/12/2007	24.3%	5.8%	6.3%	5.9%
1/12/2006	21.3%	16.6%	11.5%	14.0%
1/12/2005	26.8%	22.1%	15.3%	24.5%
1/12/2004	9.5%	8.7%	8.3%	53.6%
Average	10.43%	4.16%	7.53%	11.7%
Total average		8.45%		

Beta coefficient, obtained as the average of β coefficients of four European companies in the same industrial sector, is equal to 1.116. Accordingly, the cost of equity is:

$$R_E = 3.54\% + 1.116 \text{ x } (8.45\% - 3.54\%) = 9.01\%$$

The cost of borrowed capital (debt) calculates using following expression:

$$R_D = (R_f + \text{ credit risk rate})(1-T)$$

where the value given in the firs brackets presents interest rate at which company lends money. Here it is obtained using interest rates of UniCredit Bank in Serbia (Tab. 3).

Table 3   Estimated interest rate on borrowed capital

Product	Borrowed capital	Interest rate
EffSoft company	280,000.00 €	5,50%
P-Tech company	310,000.00€	4,86%

Given that tax rate in Serbia amounts 20% (Source: http://www.invest-in-serbia.com/laws/srpski/Zakon_porezu_dobit_preduzeca.pdf), the cost of borrowed capital is calculated (Tab. 4). Accordingly, calculated WACC is shown in Table 5.

Table 4   Estimated cost of borrowed capital

The cost of debt for EffSoft product	RD= 5.50% (1- 0.2) = 4.40%
The cost of debt for P-Tech product	RD= 4.86% (1- 0.2) = 3.88%

Table 5   Value of WACC for both alternatives

WACC (EffSoft)	WACC = ½ * 9.01% + ½* 4.24% = 6.62 %
WACC (P-Tech)	WACC = ½ * 9.01% + ½* 3.88% = 6.44 %

WACC is further used as the discount rate to calculate the NPV of investments (using the value of the estimated costs and benefits of these two investments). Payback period and internal rate of return (IRR) are also calculated and summary results are given in the Table 6.

Table 6   Simulation results

Investment	Discount rate	Criterion		
		NPV	IRR	Payback period
EffSoft	0.0662	1630463.19 €	41.15%	6.41 years
P-Tech	0.0644	1519093.81 €	36.78%	6.95 years

As can be seen from Table 6, both alternatives satisfy the requirement that the NPV is greater than zero. Furthermore, the values of IRR for both alternatives are higher than the discount rate, and this is requirement for the investment to be justified. When considering the repayment period, it also leads to the conclusion that both alternatives are acceptable.

When comparing the alternative criteria, the first alternative (software solution EffSoft) is more cost effective one. Although the discount rates are very similar, a considerable difference between corresponding NPVs is obvious and amounts to € 111,369.38. A larger difference between the values of IRR is also noticeable, which point to the higher cost effectiveness of the first alternative. The values of the discounted return periods are nearly the same, and also indicate the agreement of all the criteria which show that the implementation of the EffSoft software solution is more cost-effective.

5. CONCLUSION

This paper points out the entire decision making process applied by several methods. Using data obtained by AHP method, alternatives were checked by financially criteria. An investor must carefully implement the methodology which is shown in this paper. It is very important to do the analysis of future revenues and costs and their reduction to present value for making decisions of cost effectiveness. It is important to understand the significance of the fact that the value of money today cannot be identified with the value of money tomorrow. Having this in mind, a more realistic value can be estimated in future cash flows and the profitability of the project can be evaluated.

It happens that discount rate is taken as already given by the capital market. The discount rate cannot be equal for all companies, nor can it be equal for all investments. Also, since it is important to calculate the ratio between own and borrowed funds and that the cost of borrowed funds differs from the value of the loan, WACC cannot have the same value for all investments. When particular attention is paid to the cost of capital when calculating, the risk that a loan carries for investment must be estimated. The better the estimation of risk, and therefore better the estimation of WACC, the investors will have more precise information on what kind of risk investment the company carries. Consequently, a better estimate of WACC means a great deal for a company, because it allows it to get authentic information on the present value of future cash flows.

Therefore, making investment decision is not an easy task and carries with itself the risk and uncertainty. Only a detailed analysis of all aspects of investment can make a rational decision. Using an illustrative example we confirmed applicability of proposed framework to make better decision in sense of risk minimizing through the selection of the best alternative.

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BIOGRAPHICAL NOTES

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