VILNIUS UNIVERSITY

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ANALYSIS AND EVALUATION OF THE EFFICIENCY OF INVESTMENT PROJECTS (USING THE DISCOUNTED CASH FLOW METHODS)

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VILNIAUS UNIVERSITETAS

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INVESTICINIŲ PROJEKTŲ EKONOMINIO EFEKTYVUMO ANALIZĖ IR VERTINIMAS (TAIKANT DISKONTUOTŲ PINIGŲ SRAUTŲ METODUS)

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INTRODUCTION

Relevance of the subject. Increasing investments in the national economy is one of the most effective means to promote both the overall economic growth and the structural reforms in order to achieve stable economic growth rates. This is particularly relevant in the present phase of development of the economies of Lithuania and of other European Union Member States still under the adverse impact of the global economic crisis. While public investments contribute to the process, substantial changes can only be expected if the private sector is involved. It should be noted that investments are not less significant on the level of companies as they represent one of the most important factors influencing a company‘s financial position, business development, going concern and competitiveness. Only in very rare cases companies launch loss-making investment projects having other, non-business objectives and agreeing to losses in advance.

The efficiency of investments largely depends on the appropriate drawing up of investment projects. Continuous creating of a company‘s value can only be ensured by a sound investment project comprising a detailed analysis of all the assumptions underlying its implementation, correct calculation of the expected cash flows, and an in-depth assessment of risks. The wave of bankruptcies in the world including Lithuania in 2008-2009 was caused both by the financial crisis and by too optimistic companies‘ expectations for future prospects, lack of reserve development scenarios, and deficiencies of investment projects such as inadequate justification or appraisal.

The author‘s professional experience of over 14 years allows concluding that the analysis and evaluation of investment projects requires techniques which correspond to the business environment in Lithuania and which enable a detailed, objective and cost-effective the analysis of investment projects‘ efficiency using up-to-date evaluation methods. Up until now, however, there is neither any consistent methodology applicable to public projects (comparable to those available in the neighbouring countries such as Poland or Russia) nor any commercial product for this purpose. While solutions offered by foreign vendors are available in the market, usually they are not adapted to the Lithuanian business environment and are not regionalised at all.

Research problem and its study. Modern concepts of the efficiency of business rely on the principles of maximising of profit and creating of value added, therefore, economic evaluation of an investment project usually has priority among other indicators describing investment projects‘ efficiency such as technological, social, legal, environmental and other indicators. Only a project that is cost effective can be successfully completed without external aid (i. e. state authorities, public institutions, charities etc.) and bring the expected benefits to its promoters. Evaluation of investment projects‘ economic efficiency including its principles, methods and indicators has always been in the focus of attention of both researchers and practitioners.

The field of evaluation of investment projects‘ efficiency does not easily fit into any specific branch of economics. Its theoretical background comprises the areas of corporate finance, investments, value of business and other areas of research of economics. Mention should be made of the following foreign researchers involved in the study of the theoretical and practical aspects of investments and investment projects: Ch. Agar (1995, 2005), J. M. Bartley (2001), P. Belli, J. Anderson, H. Barnum, J. Dixon, J.

P. Tan (1997, 2004), F. P.Boer (1999), R. Brealey, S. Mayers, A. Marcus (2001, 2008), E. Brigham (1993, 2002), T. Copeland (2000, 2004), A. Damodaran (2002, 2004), M. Ehrhardt (2002), F. J. Fabozzi (2003), A. Fight (2006), A. Gregory (1999), E. A. Helfert (2001), A. F. Herbst (2002), J. Hitchner (2006), J. V. Horne, J. Wachowicz (2005), T. Koller (2000), E. J. McLaney (2006), L. T. Miller, Ch. S. Park (2004), J. Murrin (2000), M. Nowak (2005), R. Reider, P. Heyler (2003), P. A. Ryan (2002), W. Sharpe (1995, 2000), G. Alexander, J. Bailey (1995, 2000), A. Stabryła (2006), P. Tufano (2004), И. А. Бланк (2000, 2002, 2006), П. Л. Виленский, В. Н. Лившиц, С. А. Смоляк (2004), В. Галасюк (1999), В. Глазунов (1997), В. В. Ковалев (1995, 2000), Я. С. Мелкумов (1997), А. С. Нешитой (2006), В. Рутгайзер (2007), Г. С. Староверова, А. Ю. Медведев, И. В. Сорокина (2006), Т. В. Теплова (2008), В. В. Царев (2004), В. Д. Шапиро (1996, 2001, 2004) etc. In Lithuania, the problem has been studied by V. Aleknevičienė (1997, 2009), M. Butkus (2007), D. Cibulskienė (2007), B. Galinienė (2005), R. Ginevičius (2005, 2009), J. Mackevičius (2005, 2007, 2009), R. Martinkutė (2007), R. Norvaišienė (2005), T. Petravičius (2008), V. Podvezko (2005), J. Rojaka, (2009), R. Rudzkis (2009), A. V. Rutkauskas (2002, 2006), L. Simanauskas (2002, 2006), S. Šidlauskas (2006), R. Tamošiūnienė (1999, 2003, 2006, 2008), M. Tvaronavičienė (2006), R. Urniežius (2001), L. Ustinovičius (2004), E. Valakevičius (2007), S. Valentinavičius (2010), E. K. Zavadskas (2004), V. Zubrecovas (2010) etc.

A detailed analysis of works by these and other authors has shown that aspects of applicability of different methods for the evaluation of investment projects‘ efficiency have not been sufficiently studied although they can have considerable effect on the results, scope and content of analysis.

Considering that the timeframe of implementation of an investment project can be 20 to 30 years, one may conclude that more than one completely different evaluation methods can be used during a project‘s lifecycle, with the results of the methods‘ application not necessarily correlating among themselves. The more so that the business sector is quite inert with respect to new research methods and cannot adapt quickly to the proposed changes. They require considerable additional investments by banks and larger companies in the modernisation of information systems and personnel training, therefore, such changes are implemented rarely and only upon practical testing of the new methods. Therefore, in the author‘s view, the current technique of evaluating investment projects based on cash flows can fully meet the investors‘ needs provided that specific features of the technique‘s application are taken into account.

Subject of research: evaluation of economic efficiency of investment projects.

Objective of research: to develop a model for the evaluation of economic efficiency of investment projects based on the discounted cash flow methods and adapted to the Lithuanian business environment.

The following **tasks** have been formulated in order to achieve this objective:

1) assess the effects of investments on competitiveness of companies and the national economy and on economic growth;
2) examine the process of analysis and management of investment projects, with a focus on the key process components ensuring an objective and quality evaluation of an investment project;

3) make an analysis of the influence of risks and uncertainty in the process of implementation and evaluation of an investment project;
4) examine the cash flows‘ composition and calculation methods as well as the factors influencing the changes in and measurement of cash flows; analyse the time value of money and discounting processes and determine the methods suitable for the calculation of discount rates;
5) make a comparative analysis of investment projects‘ evaluation methods and models proposed in research works and a critical assessment of the opportunities for their application;
6) develop the methodologies for the application of the net present value and internal rate of return techniques that ensure the assessment of effects produced by different factors;
7) develop a model for the assessment of economic efficiency of investment projects enabling the adoption of optimal investment decisions by companies and the testing of the possibility for the application of the model to the Lithuanian business environment

Research methods. The methods of induction and deduction were used in researching the subject of the thesis and in achieving set objective:

1) the induction method is used in the initial phase in which the components of the object of study (i. e., methods of computing cash flows, risk assessment, investments‘ evaluation indicators and methods) are examined in detail in order to identify the specific aspects of their application to the evaluation of investment projects;
2) the opportunities provided by the deduction method are made use of in the next phase where the methodology selected in the first phase is used as a basis for the development of the model for the evaluation of investment projects‘ efficiency; the model is tested taking account of its practical applications.

The following investigation methods were also used in this work: 1) the analysis, synthesis, systematising, comparing, abstracting and summarising of research papers published by Lithuanian and foreign authors; 2) methods of statistical analysis such as collection, grouping, classification, processing, regressive and correlation analysis of data; 3) non-structured interview with management of a company in order to determine the general criteria for the selection and evaluation of investment projects; 4) adapting the developed theoretical model to the evaluation of investment projects – mathematical modelling with the use of information technologies.

Sources of research. Theoretical studies in this thesis relating to the critical analysis of the investment projects‘ evaluation methodologies are based on the sources of research published by Lithuanian and foreign authors. Sources of statistical information on the material investment trends in Lithuania and the European Union include the EUROSTAT and the database of the Lithuanian Department of Statistics. An analysis of the use of the investment projects‘ evaluation methods in different countries has been made on the basis of research done by Graham, Harvey (2001, 2002); Ryan, Ryan (2002); Truong, Partington, Peat (2005); Silvola (2006); Lam, Wang and Lam (2007); Hermes, Smid, Yao (2007) etc. The opportunities for the application of the

model have been studied based on the information on projects currently implemented in Lithuania.

Novelty and theoretical significance of the work. The theoretical and application research conducted by the author contributes to the development of the science of economics from the following points of view:

- a model for the evaluation of economic efficiency of investment projects has been developed including a comprehensive algorithm for the analysis and evaluation of an investment project. The algorithm is based on the latest scientific research in the field of application of the discounted cash flow methods. The proposed model enables to analyse uncertain and complicated situations in the adoption of investment decisions that may be evaluated in different cross-sections and with different development scenarios with the aim to use the invested capital efficiently;
- the methodological framework of an investment project‘s life cycle has been supplemented by including the liquidation phase, the significance of which has been underestimated up until now, in the analysis process;
- key methodologies for the computation of cash flows from operations, investments and financial activities have been developed for the purposes of evaluation of investment projects; the methodologies contain consistent descriptions of the information movement directions, interrelations of individual factors and sources of formation of cash flows for each type of an investment project‘s activities;
- the methodology for the determination of discount rates corresponding to the business environment in Lithuania;
- three techniques for the evaluation of investment projects‘ efficiency based on discounted cash flows have been worked out: 1) the technique based on the net present value (NPV) method; 2) the technique based on the internal rate of return (IRR) method; and 3) the technique for the resolution of conflict between the NPV method and the IRR method.

Practical significance of research. The development of a theoretical model for the evaluation of economic efficiency of investment projects with the four supplementary techniques formed the basis for the development of algorithms for the key analysis and evaluation processes, which have been joined together into a computer-aided system (computer-aided model). The model is adapted to the resolution of different tasks relating to the analysis and evaluation of investment projects. As business processes are quite unique, full automation of the model has not been achieved; however, typical solutions for individual sectors and groups thereof (production, trade, real estate development, service provision and agriculture) have been developed. The selected sectors account for nearly 80% of the national GDP, therefore, the model has a very broad area of application. The model may be used to:

- make the cash flow forecasts for a project and assess the projected financial position of the company and the results of the investment project being implemented;

- assess the projected sources of funding of an investment project, the related costs and the allocation principles;
- make an analysis of selected risks and create a risk management system for an investment project;
- conduct continuous monitoring of the implementation of an investment project and make an analysis and evaluation of the potential implementation scenarios;
- avoid detailed analyses of investment projects that have no good prospects and withdraw from them in due time.

Structure and scope of the work. The doctoral thesis consists of the introduction, 4 sections, conclusions and 10 annexes. The volume of the work excluding annexes is 190 pages. 34 tables and 42 figures are included in the text. 230 references were used in the writing of the thesis.

1. THEORETICAL ASPECTS OF INVESTMENT PROJECTS' ANALYSIS AND EVALUATION

Investments play a very important role in the economy. They contribute to the stable economic growth, socio-economic welfare of population, and increasing of economic potential and international competitiveness of a country. This has been confirmed by an analysis of material investments in Lithuania. Based on the national economic indicators for 1997 – 2008, a strong direct interdependence between material investments, direct foreign investments, productivity and the gross domestic product has been established. The calculated correlation ratio is close to one. An evaluation of the effect of material investments and direct investments on the GDP has also shown that there is a very close, nearly direct, dependence between the indicators considered as the correlation ratio between material investments and the GDP dynamics is 0.988, between the value of direct foreign investments and the GDP is 0.990, and between investments and productivity 0.981. The strong dependence is also confirmed by the results of a regressive analysis.

The process of adoption of investment decisions is a multi-stage one and is implemented through investment projects. An appropriately prepared investment project becomes a tool for the stakeholders in the business idea being realised; the tool helps to define the objectives to be achieved, to describe the means for the achievement of the objectives, and to evaluate the efficiency of the project using specific economic methods. Based on the evaluation, the proposed project is approved or rejected. Thus the process of preparation and implementation of an investment project, in particular its quality and appropriate management, is of utmost importance for the successful business development and continuous growth of investments in the national economy.

Depending on the step in the implementation process, an investment project can be clearly structured as a set of components that are called phases of the life cycle. The methodological framework applied and the reliability of analysis highly depends on the phase the project is in. It is proposed that the following phases of an investment project are identified: 1) pre-investment – identification, pre-selection, drawing up and evaluation of a project; 2) investment – construction of a facility, installation of equipment, establishment of infrastructure, other preparatory technical and

organisational processes; 3) operating – launching of operations, organisation of production/commercial processes and monitoring; and 4) liquidation – closing of operations, selling of assets, and summarization of the project‘s results.

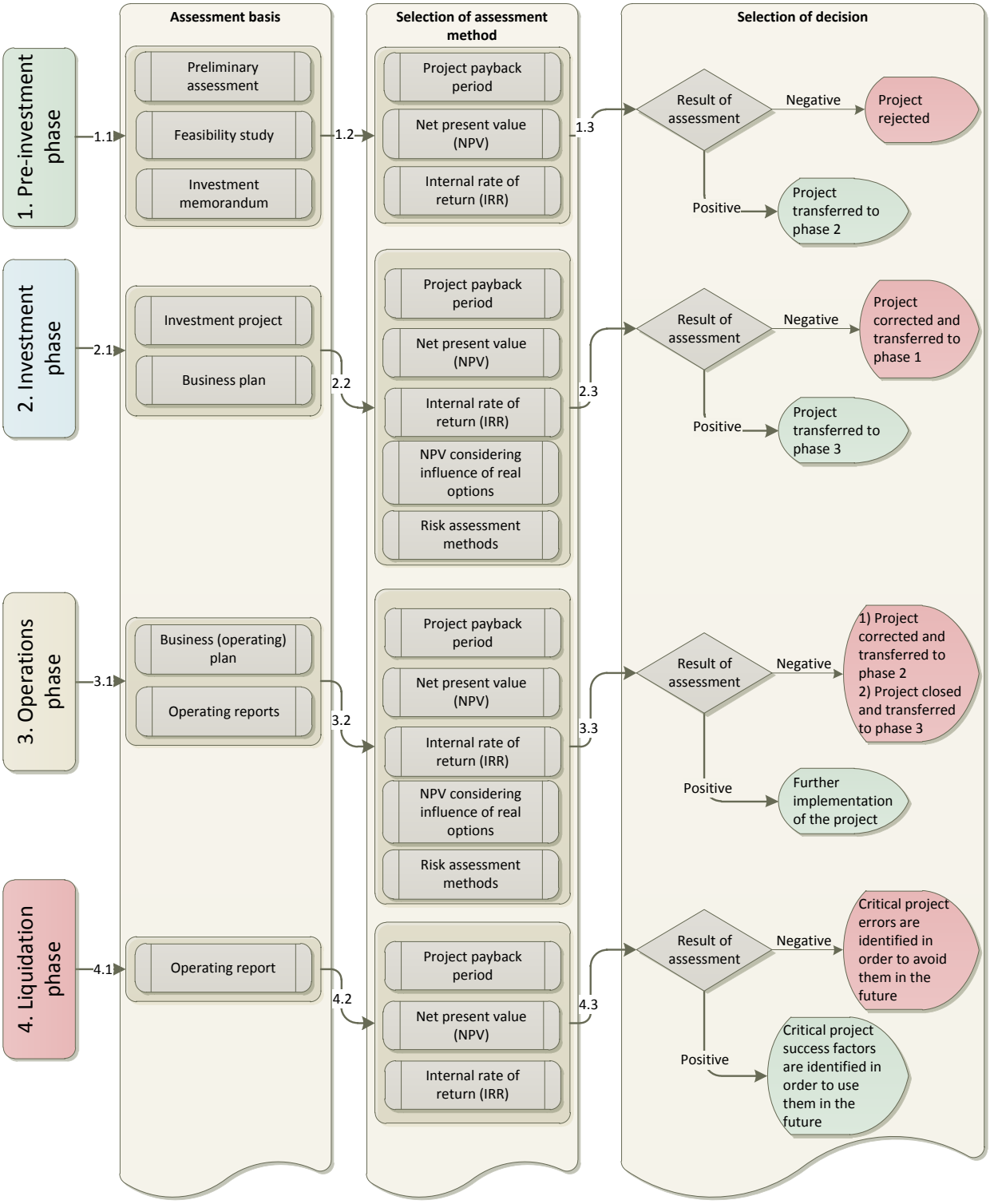

Fig. 1. Technique for the assessment of cost efficiency of an investment project according to life cycle phases

Source: compiled by the author

Taking peculiarities of each phase into consideration, a technique for the evaluation of economic efficiency of investment projects has been developed. It can be used as a basis for the assessment of the attractiveness of investments and for the adoption of decisions in each phase of the project‘s life cycle (see Fig. 1). The proposed technique can be conventionally structured as follows: 1) basis of evaluation – documents to be prepared in specific phases of the project‘s life cycle are identified; 2) selection of evaluation method – a list of main methods to be employed in the evaluation of the project‘s efficiency is provided; 3) selection of solution – a specific solution is proposed on the basis of the information available and the evaluation methods selected.

The analysis itself is made in the same sequence; the analysis should be divided into parts according to the four phases. While decisions are usually adopted by business owners or managers, there is a wide range of stakeholders as well. It includes potential creditors, suppliers and contractors, financial institutions, major customers of products or services etc. Therefore, documenting of the analysis must receive due attention in terms of description of the investment project as well as the assumptions of its evaluation and the final results.

Selection of evaluation methods depends on the level of available information and the purposes of evaluation. While the evaluation results may change the direction of the project in the pre-investment and investment phases, the purpose of evaluation in the operating phase is more related to the opportunities for the improvement of operations (cutting of costs, offering additional services or updated products, entry into new markets etc.). This is also shown by the solution selection stage when the range of potential solutions becomes narrower depending on the phase of the project‘s implementation.

2. COMPOSITION AND METHODS OF CALCULATION OF AN INVESTMENT PROJECT‘S CASH FLOWS

The final evaluation of an investment project is based on the project‘s net cash flows, however, it must be noted that this is an integrated value determined by different activities implemented during the project‘s implementation and operation. Therefore, an evaluation of investment projects should include a determination of the groups of cash flows as well as of the principles of grouping. Cash flows of investment projects are usually grouped as follows: 1) cash flows from operations; 2) cash flows from investments; and 3) cash flows from financial activities. This both facilitates the analysis and enables one to avoid errors when cash flows not related to the project or its participants are included in the calculations.

The calculation of the cash flows from operations is the most important and, at the same time, most complicated process. Figure 2 illustrates the methodology for the calculation of cash flows form operations, which was developed by the author. It is based on the indirect method of cash flows‘ calculation which is most widely used in practice. In case of investment projects the cash flows from operations should be calculated as the sum of net profit/loss and annual depreciation adjusted by the change in net working capital.

Figure 2 shows that cash flows are formed of the five conventionally determined accounting components: 1) production (trade, provision of services or other business activities); 2) costs; 3) income; 4) working capital; and 5) asset accounting. In addition, information from financial statements for two years is used for the calculation of cash flows. The arrows depict the types of relationships and the directions of information flows, whereas the numbering of individual steps marks the detailed descriptions of calculation of different factors. Such detailing of the calculations is justified by the fact that the size of cash flows from operations is the main indicator of the cash flows generated by a company that are sufficient for the repayment of loans, maintaining of technical capacities, paying of dividends and making new investments without using external financing sources.

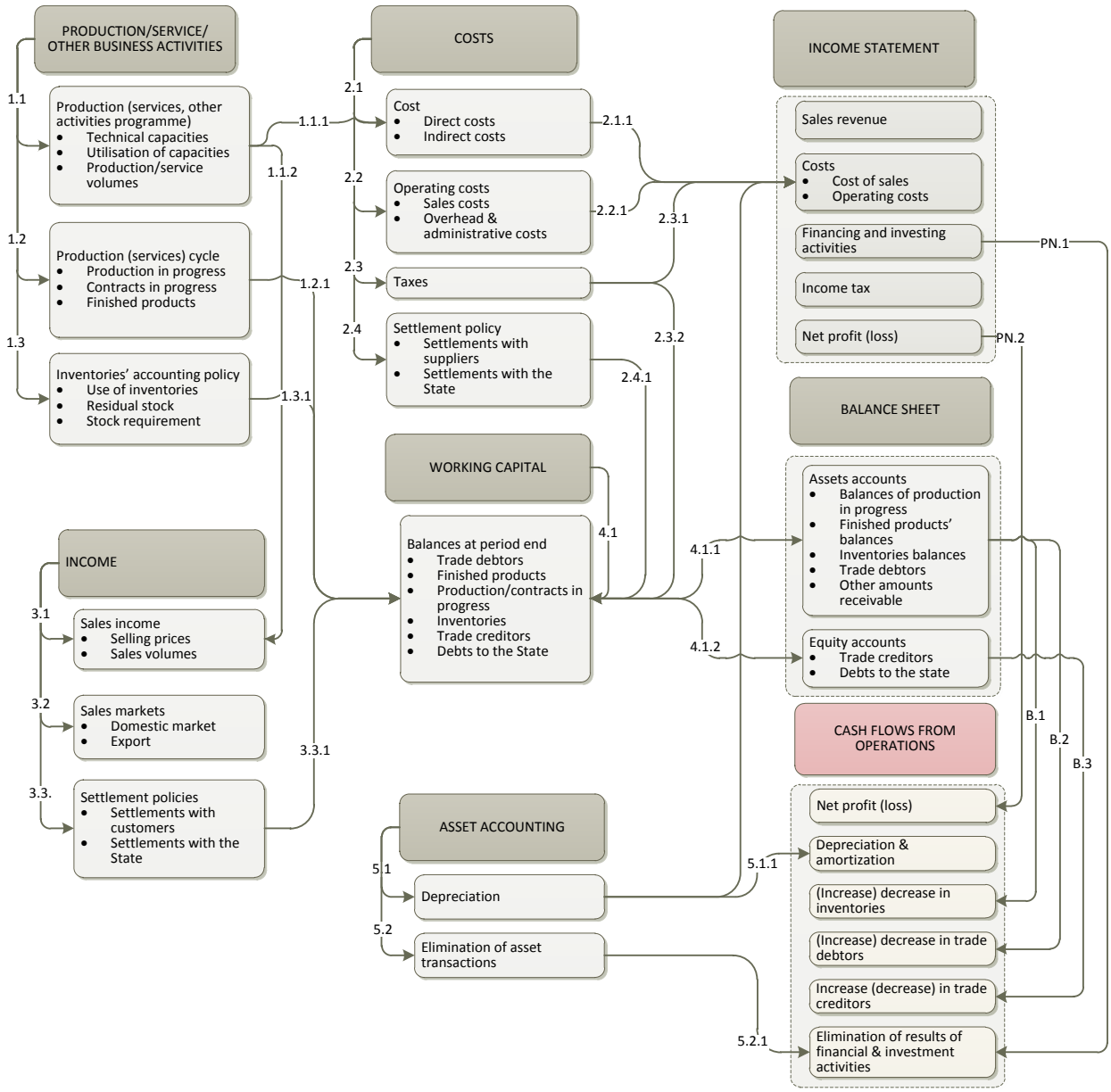

Fig. 2. Technique for the calculation of cash flows from operations for the purposes of evaluation of investment projects

Source: compiled by the author

The thesis also contains descriptions of the techniques developed by the author for the calculation of the cash flows from companies‘ investment and financial activities for the purposes of assessment of investment projects‘ economic efficiency.

Studies have shown that cash flows from a project‘s investment activities form under an investment programme identifying the schedule, structure and scope of projected investments as approved by the company‘s owners or management. In the accounts these operations are recognised as acquisition of assets. If any realisation of assets takes place in the course of a project (sale of old assets - at the start of the project and of assets acquired during the project – at the closing of the project), this is carried in the assets disposal item. If spare assets have been invested in securities or lent to other parties during the project, “other investment activities“ are recorded. Finally, all these operations are reflected in the relevant items of the cash flows from investments.

The volumes of cash flows from financial activities are mostly influenced by the results of investments. The working capital requirement also contributes to these cash flows; this is particularly relevant in the beginning of the operating phase when raw materials are purchased, salaries are paid etc. but no payments for products or services sold are received as yet. Taking account of these needs and the funding sources one may calculate the cash flows by items in the cash flow statements.

In the calculation of cash flows of an investment project, the factors influencing the project and its cash flows can be grouped into 1) external factors and 2) internal factors (see Figure 3).

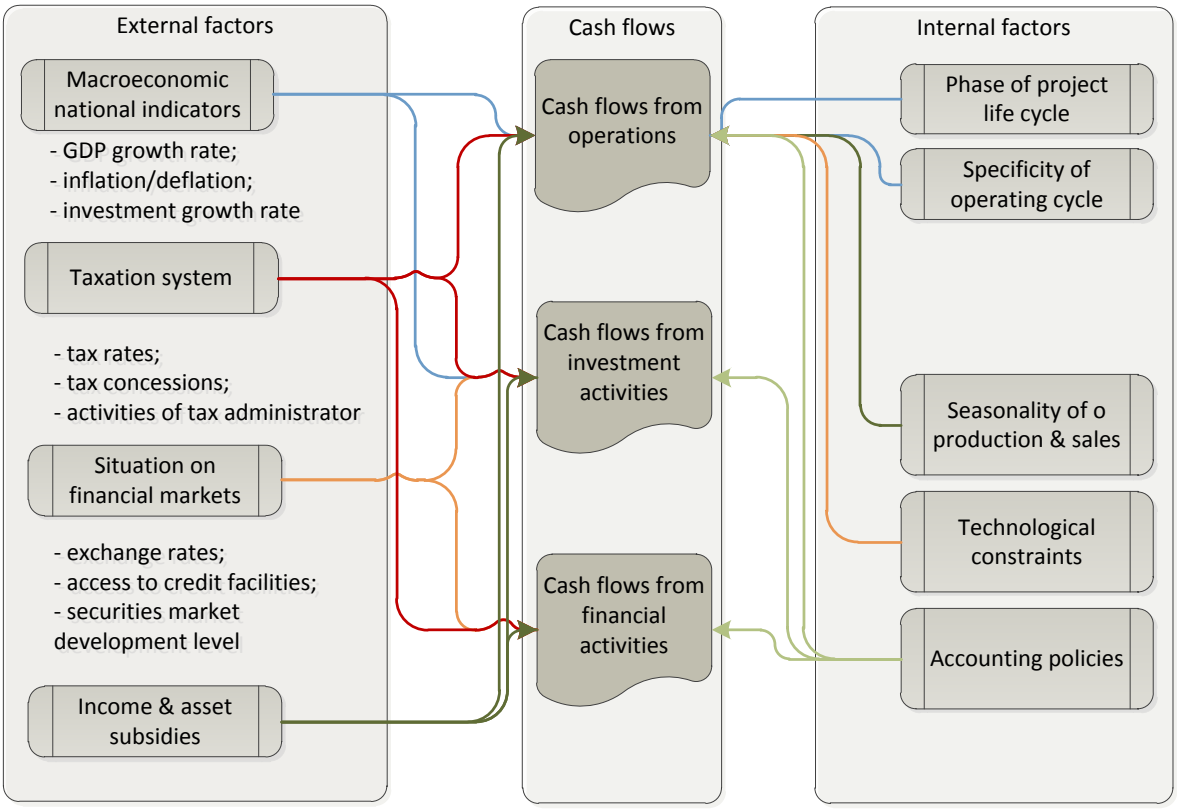

Fig. 3. Main factors influencing the cash flows of an investment project

Source: compiled by the author based on Бланк, 2004; McLaney, 2006; Ehrhardt, Brigham, 2002

Figure 3 depicts the grouping of factors and their influence over the cash flows from different types of activities. It shows that the cash flows are affected by the factors in different ways. While internal factors usually have stronger influence over the project‘s cash flows compared to the external ones, a company has broader opportunities for controlling them by selecting equipment and sales markets and market segments, by offering a diversified assortment of goods and services, or by other strategic and tactical decisions. Thus many internal factors maybe included in the cash flow calculations with sufficiently detailed information on their potential impact. It must be noted that while the information is available and can be reliably assessed, some factors are often eliminated from the calculations or included into them with certain qualifications that can have a significance influence over the assessment results. The most important of them are related to the time factor (the cyclical and seasonal aspects of the planned activities) and the accounting policies selected by the company (depreciation, recognition of income and costs, accounting for inventories, production in progress and finished products).
Part of the factors, however, have to be disregarded due to the lack of information or the high financial and time costs of information processing. In such a case it is possible to assess the effect of the factors not included in the initial calculations by adjusting the discount rate.

3. METHODS OF DISCOUNTING THE CASH FLOWS OF INVESTMENT PROJECTS

The evaluation of an investment project is started upon completion of the cash flows calculation. The majority of the methods of evaluating the economic efficiency of investment projects is based on the discounted cash flows, i. e. the cash flows of a project must be discounted to the present or projected value, with the relevant discount rate applied.

Boer (1999) provides a number of examples where the application of discounting methods can give quite contradictory results of evaluation irrespective of the specificity of projects. This is particularly relevant to the research and development projects. Brealey et al. (2001), McLaney (2006), Hitchner (2006), Horne, Wachowicz (2005), Copeland et al. (2000) and other authors note that the discount rate reflects the profit which is generated by an investment project and the amount of which must be sufficient for the investor. This means that the use of the raised capital must be rewarded, with the size of the reward shown by the relative cost of capital which is the equivalent of the discount rate. The cost of capital is usually deemed to be the alternative value of investments which would be gained in case of investment in an asset with the same level of risk rather than in the investment project, i. e. the setting of the discount rate is directly related to the effect of risk and uncertainty.

The author has developed a technique for the setting of the discount rate, which can be applied to the evaluation of investment projects in the business environment of Lithuania. The technique is graphically depicted in Figure 4. It shows that the setting of the discount rate is started from the assessing of the possibility to determine coefficient β (Step 1).

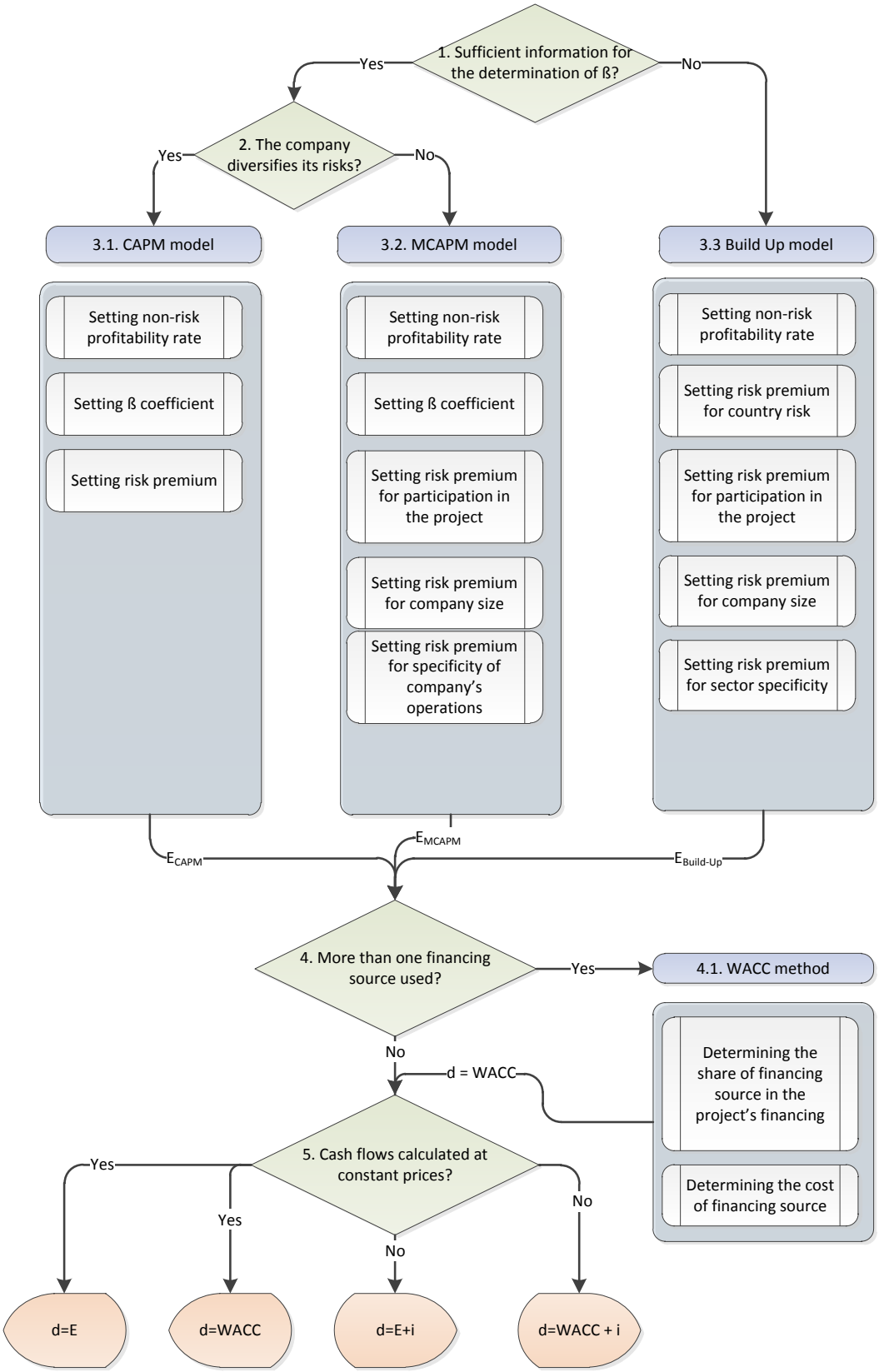

Fig. 4.Technique for the setting of discount rate for the purposes of investment projects' evaluation

Source: compiled by the author

As both CAPM (3.1 in Figure 4) and its modified form MCAPM (3.2) are more reliable in determining the cost of capital if sufficient information is available for the calculation of the requisite variables (in particular, coefficient β), one of the two proposed models should be used (see formulas 1 and 2). Otherwise, a more subjective Build-Up model, partially based on expert evaluation (3.3) is more suitable (see formula 3). Then the cost of capital (the company‘s own capital or shareholders‘ capital) is calculated using one of the following formulas depending on the model selected:

$$E_{CAPM} = r_f + \beta \times RP_m \quad (1)$$

$$E_{MCAPM} = r_f + \beta \times RP_m + r_s + r_u \quad (2)$$

$$E_{Build-Up} = r_f + r_c + RP_m + r_s + r_{in} + r_o \quad (3)$$

where E is the cost of capital;
r_f is the rate of return on investments involving no risk;
β is beta, relative coefficient of risk;
RP_m is risk premium;
r_c is extra premium for country risk;
r_{in} is extra premium for sector specificity;
r_o are other specific risks related to a company or an investment project.

The results of the models (ECAPM, EMCAPM and EBuid-Up) form a basis for the further step in the setting of the discount rate. Step 4 determines whether the investment project under consideration has more than one financing source. If yes, then WACC method is additionally applied; the general formula for this method is as follows:

$$WACC = w_e \times r_e + \sum_n w_n \times r_n \quad (4)$$

where
w_e means the share of own capital in the total investment project financing;
r_e means the cost of own capital after tax;
w_n means the share of borrowed capital in the total investment project financing;
r_n means the cost of borrowed capital after tax.

In the final Step 5, the calculated discount rate is adjusted depending on whether inflation was taken into account in the calculation of the investment project‘s cash flows. Finally, one of four possible results is obtained depending on the project‘s and company‘s specificity; the result will form a basis for the selection of the relevant method for the evaluation of an investment project.

In case if it is expected that the capital structure or cost of capital may change significantly over the projected period and a decision to set a discount rate for each period is adopted, the same sequence is applied in the calculation taking the necessary changes into consideration. It should be noted that applying different models for the setting of discount rates would be unreasonable in this process.

4. ANALYSIS OF APPLICABILITY OF THE DISCOUNTED CASH FLOW METHODS TO EVALUATION OF INVESTMENT PROJECTS

The modern science of economics offers quite a wide range of methods for evaluating the economic efficiency of investments, however, most of them are highly time-consuming and involve complicated calculations. Whereas investors usually require a measure of investment projects‘ efficiency which is readily calculated, objective and easily understandable and which reveals the attractiveness of business ideas.

Despite certain differences in concepts and terminology, most of the Lithuanian and foreign authors identify three key methods for evaluating the efficiency of investment projects based on the calculation of cash flows (Agar, 2003; Copeland et al., 2000; Damodaran, 2002; Ehrhardt, Brigham 2002; Galinienė, 2005; Graham, Harvey, 2002; Mackevičius, 2007; Pike, Neal, 2006; Rutkauskas, 2007 etc.). They include the 1) net present value (NPV) method; 2) internal rate of return (IRR) method; and 3) payback time (PT) method.

While the project‘s economic efficiency indicators calculated by the NPV and IRR methods are most reliable, other auxiliary methods are often used; they determine the individual criteria of investments projects‘ efficiency (payback time method, average annual value method, profitability index etc.) or results of different implementation options.

The table shows that only the NPV and IRR methods (including the modified form of the latter - MIRR) are in line with the majority of the methodological principles of investment projects. This is also confirmed by the popularity of these methods and the frequency of their practical application. Studies by different authors (Arnold, Halzopoulus, 2000; Graham, Harvey, 2001, 2002; Pike, 1988, 1996; Ryan, Ryan, 2002; Truong, Partington, Peat, 2005; Silvola, 2006; Lam, Wang, Lam (2007); Hermes, Smid, Yao (2007) etc.) show the growing popularity of the discounted flow methods, which have become the key evaluation methods for any efficiency analysis of investments since 1997.

Table 1. Comparative analysis of the methods for evaluating efficiency of investment projects

Evaluation criteria	PP	NPV	NPVR	IRR	MIRR
Takes account of time value	No	Yes	Yes	Yes	Yes
Shows rate of return on investments	No	No	No	Yes	Yes
Calculated on the cash flow basis	Yes	Yes	Yes	Yes	Yes
Takes account of total project implementation period	Ne	Yes	Yes	Yes	Yes
Uses discount rate	No (Yes)	Yes	Yes	No *	Yes

*- the method does not require specifying the discount rate but the rate is used in the calculations

Source: compiled by the author

In parallel, another trend has been observed: research conducted by some authors is increasingly directed toward the search for new indicators, evaluation methods or other value and efficiency criteria. Considering that the timeframe of implementation of an investment project may reach 20 to 30 years, one may conclude that more than one different method can be applied throughout its life cycle, with their results not

necessarily correlating among themselves. The more so that the business sector is quite inert with respect to new research methods and cannot adapt quickly to the proposed changes. Therefore, such changes are implemented rarely and only upon practical testing of the new methods. In the author‘s view, the current technique of evaluating investment projects based on cash flows can fully meet the investors‘ needs provided that specific features of the technique‘s application are taken into account.

Considering the above conclusions, the author proposes the application of the net present value (NPV) method as the main method showing the economic effect of a project. The structure of the method is justified, logical and methodologically correct. Its calculations are based on the cash flows generated by an investment project and the selected discount rate corresponding to the level of yield on investments. While the method is widespread and the principle of its calculation is well-known, there is a number of factors the elimination or underestimation of which can considerably distort the evaluation results. The special features of the NPV calculation depending on different cases of investment projects‘ evaluation are presented in Table 2.

Table 2. The use of the net present value method in the evaluation of investment projects

Mathematical expression	Notes on application
$NPV = \sum_{t=0}^{T} \frac{CF(t)}{(1+d)^t}$	Basic formula for NPV calculation.
$NPV = \frac{CF_1}{(1+d_1)} + \cdots + \frac{CF_t}{(1+d_1)\dots(1+d_t)}$	The NPV calculation where the discount rate varies in different periods, i. e. for certain reasons (price levels, change in risk levels etc.) the discount rate differs from year to year.
$NPV = \sum_{t=0}^{T} \frac{CF(t)}{(1+d)^t} + \frac{CF_T}{(d-g)}$	Applicable in cases where the expected cash flows for a certain period T in the investment project analysis can be assessed with reliable justification and detail, with the subsequent application of the selected growth rate g.
$NPV = \sum_{t=0}^{T} \frac{CF(t)}{\left(1+\frac{d}{n}\right)^{t\times n}}$	A more accurate NPV assessment is achieved when the time intervals are shorter than one year (quarters, months etc.). This is of particular importance in case of short-term investment projects with a very uneven distribution of cash flows during a year.
where $CF(t)$ is the cash flow in period t; CF_T is the cash flow in the last year of the defined period; d is the discount rate; d_t is the discount rate in each year t in the forecast period; g is the rate of growth in the expected cash flows; T is the investment project life cycle; n is the number of interest calculation during the year.	

Source: compiled by the author based on McLaney 2006; Hitchner, 2006; Теплова 2008; Galinienė 2005; Cibulskienė, Butkus 2007

At the same time, it must be taken into account that the projected period is a hypothetical value and cannot be applied in the project analysis unconditionally. The length of the projected period must correlate with the project‘s economic life cycle (Gregory, 1999; Higgins, 2007). Two interrelated concepts can be singled out: the economic project life cycle and the optimal economic project life cycle. The years during which a project is implemented and the NPV is positive is the project‘s economic life cycle, while the years when the NPV is the highest are called the optimal economic life cycle. It would be logical to match the projected period with the optimal economic life cycle of a project as the estimated effect of the project is the highest in this period.

On completion of analysis of the NPV method and on evaluation of the features of its application the author developed a technique that ensures a quick and objective process of evaluation of investment projects. The proposed technique is based on the evaluation of the effect of three main variables on the final result. According to the proposed technique, the project‘s NPV is determined by the following variables: 1) the net cash flow; 2) the length of the period under consideration and the interval of analysis; and 3) the discount rate. The technique is graphically depicted in Figure 5.

The technique can be conventionally divided into two parts: 1) preparation of information for the NPV calculation; and 2) assessment of results. The analysis, divided into internal stages and steps, follows the same sequence. Stage 1 includes the calculation of the cash flows and projections. Then an analysis of the length of the period under consideration and the effect of the interval is made. Finally, in Stage 3, the content of the discount rate analysis is defined. The second and the third stages are closely interrelated as interim results form the basis for the calculations in the next stage. Therefore, any change in the above parameters necessitates a change in the results of the other stage as well as a determination whether the changes have a substantial effect requiring modification of the basic parameters of the calculation. Interim results obtained in these stages form a basis for the calculation of the final NPV.

The second part of the technique is clearly defined and does not require detailed calculations. The analysis in this stage includes an assessment of the calculated NPV and a determination of the significance of the non-financial benefits of the contemplated investment project. This phase is not easily structured and goes beyond the limits of the problem of the investments‘ efficiency evaluation. This is because a company can have a number of other objectives related to strategic, marketing or other solutions, where the project is implemented despite the expected negative financial result. In such cases, a cost – benefit analysis can be applied (usually in the evaluation of public projects).

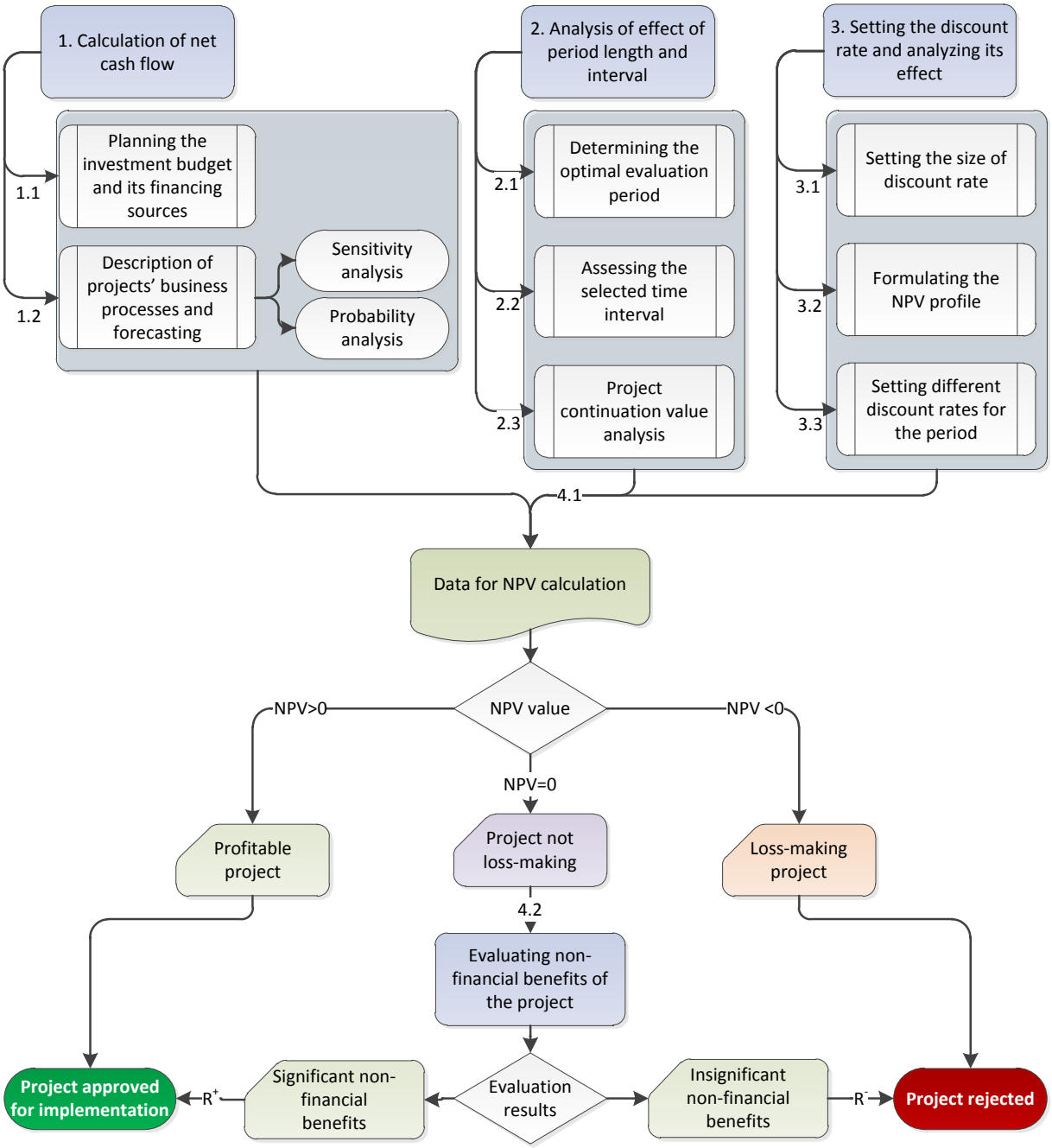

Fig. 5. Technique for the net present value calculation for the purposes of investment projects' evaluation

Source: compiled by the author

The internal rate of return (IRR) method and the modified IRR method (MIRR) show the relative yield on investments. The **IRR** is one of the most popular methods in the practice of evaluation of investment projects' efficiency. Despite that the IRR method is not always recommended both by researchers and experts, it is applied more frequently than the NPV method.

The IRR depends only on the internal parameters of the project describing the project itself, with no options of use of net profit analysed beyond the limits thereof. Thus the calculation method must be based solely on the specific patterns of allocation

of revenues and investments. Generally, where investments and return thereon (the revenue generation period) can be expressed in the form of cash flows, the IRR is calculated using the following equation to determine the unknown *d** (Copeland, Koller, Murrin 2000):

$$\sum_{t=0}^{T} \frac{CF(t)}{(1+d)^t} = 0 \qquad (7)$$

where *d* = IRR* is the internal rate of return corresponding to the cash flow *CF (t)*.

The IRR method is applied on an assumption that the cash flows are reinvested at the same rate of return. However, this is quite rare in practice and internal reinvestment rates vary widely. In such cases the modified internal rate of return (MIRR) method is more reliable. In case of MIRR, the interim cash flows generated by a project are reinvested at a marginal rate – the cost of capital rate. The MIRR is a discount rate at which the future value of the cash flows generated by a project is equal to the present value of investments, with the interim cash flows reinvested at the set marginal rate (Yeomin, Youngna, 2002).

The MIRR value is found from the following formula (Староверова et al., 2006).:

$$(1+MIRR)^t = \frac{FV^+}{PV^-} \rightarrow MIRR = \sqrt[t]{\frac{FV^+}{PV^-}} - 1 \qquad (8)$$

where *MIRR* is the modified internal rate of return;

FV^+ is the future value of positive cash flows (in the last revenue generation period);

PV^- is the present value of negative cash flows (at the beginning of investment period);

t is the period between the first investments and the last revenue generation period.

To sum up the results of the analysis of the IRR and MIRR methods, the technique for evaluating the efficiency of investment projects with the application of the IRR and MIRR methods was developed (see Figure 6).

Similarly, the proposed IRR/MIRR technique is based on the evaluation of the effect of the three main variables on the final result. According to the proposed technique, the project‘s IRR/MIRR depends on the following variables: 1) the net cash flow; 2) the length of the period under consideration and the interval of analysis; and 3) the reinvestment (for MIRR only) and the marginal yield rate. All the assumptions described above are also applicable to this method, while the reliability of results mainly depends on the cash flow information and the data necessary for the reinvestment rate.

The NPV and the IRR methods are equally reliable, therefore, not both of them are used in all cases and decisions can be adopted on the basis of only one of them. Usually the IRR method is given the priority as it is more obvious to the investors and shows the required profitability of the project. In most cases, the results obtained from

the NPV and IRR analysis are the same, however, conclusions can differ greatly in case of non-typical investment projects.

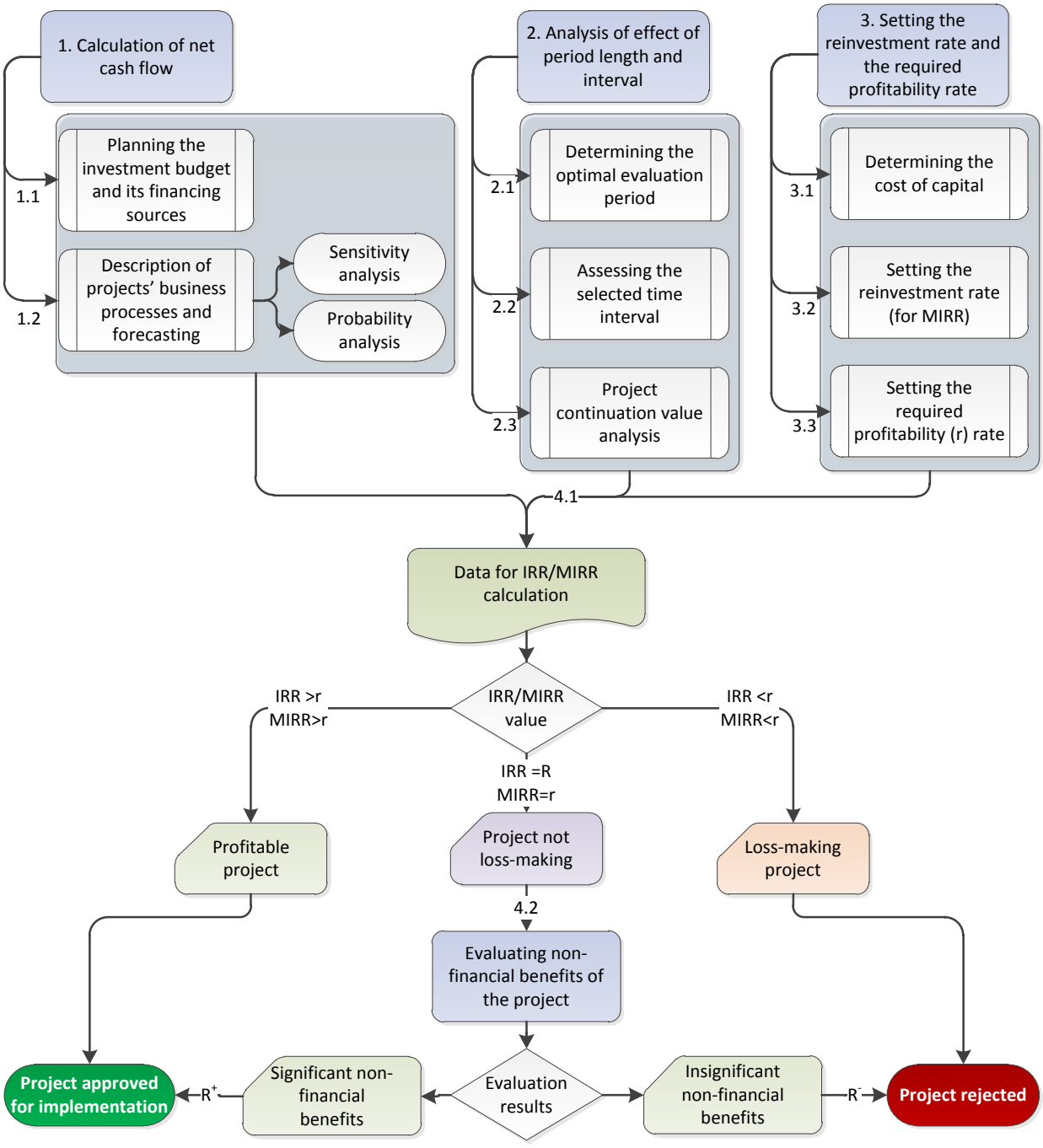

Fig. 6. Technique for the IRR/MIRR calculation for the purposes of investment projects' evaluation

Source: compiled by the author

A technique for the resolution of the NPV and IRR conflict has been proposed (see Figure 7) enabling the evaluation of two alternative projects based on their NPV and IRR values. The technique does not include the preparation of data and the analysis of the specificity of the NPV and IRR (MIRR) indicators. Thus the author makes an

assumption that the calculated values of the indicators are correct and that they are independent from the ways of calculating an investment project‘s cash flows, effects of risks or discount rate parameters. While the technique covers only a comparison of two alternative projects, the total number of projects under consideration is not limited and the rating and elimination method can be applied.

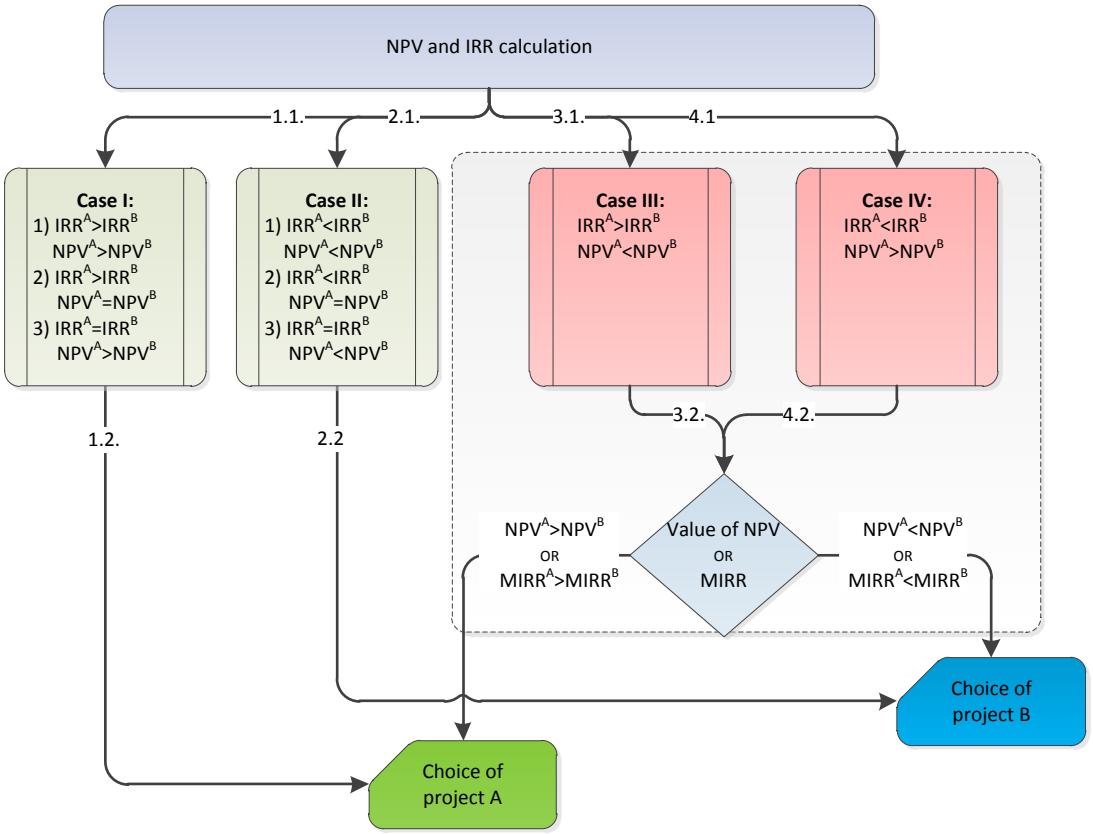

Fig. 7.Technique for the resolution of conflict between the IRR and NPV methods

Source: compiled by the author

5. THE RECOMMENDED MODEL FOR EVALUATING THE ECONOMIC EFFICIENCY OF INVESTMENT PROJECTS AND THE OPPORTUNITIES FOR ITS PRACTICAL APPLICATION

The recommended model for evaluating the economic efficiency of investment projects is presented in Figure 8. It is proposed that the evaluation should be a three-phased process:

1. Developing the project‘s financial model
2. Selection and application of the method for evaluating the project‘s investments
3. Analysis and interpretation of results and drawing up of conclusions.

Each stage is further divided into 2 – 3 substages called modules, which describe larger groups of evaluation actions, which, on their turn, comprise individual steps.

While all the three stages are closely interrelated, the necessity of each of them is determined by several aspects. Each stage requires different types of information, qualifications of analysts, and participation of decision-makers. The methodological basis differs from stage to stage as well. The first stage is based on the theoretical

grounds of corporate economics, accounting, working capital management and efficiency assessment. In the second stage, financial management and investment efficiency evaluation methods are applied. The third stage requires knowledge in strategic, risk and investment management as well as practical experience.

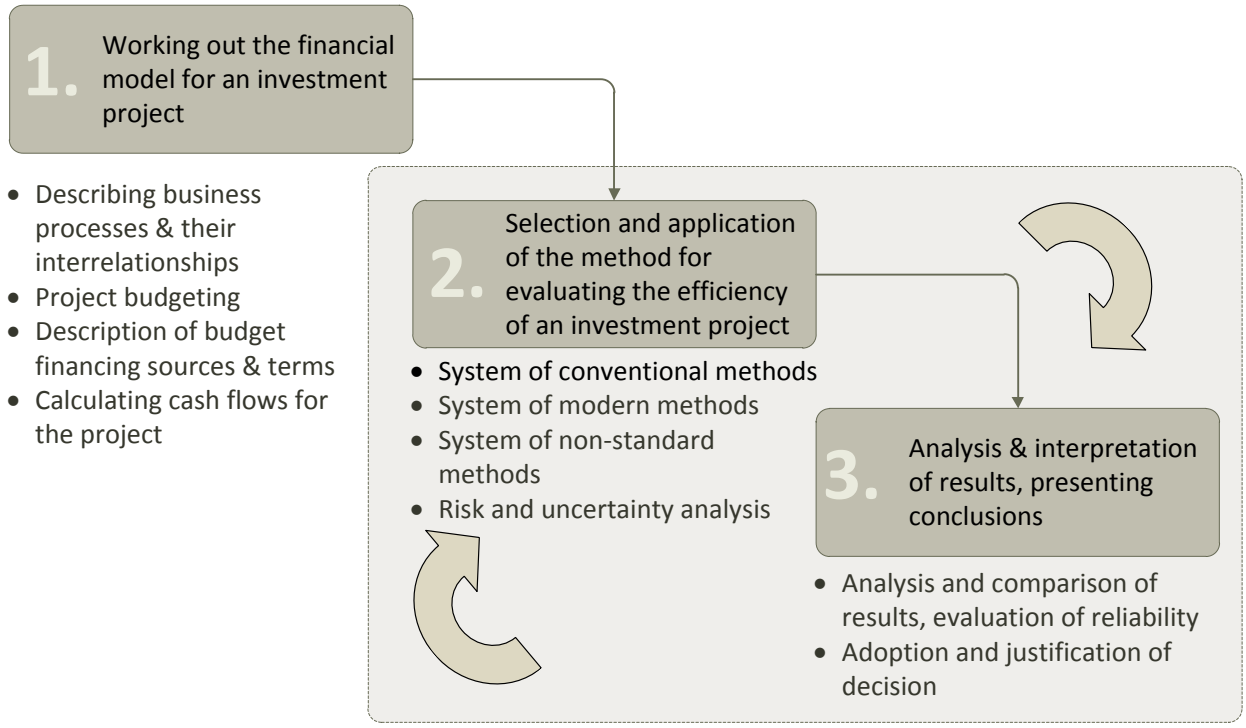

Fig. 8. Model chart and main evaluation stages

Source: compiled by the author

The individual stages of the model and their components are shown in Figures 9-11. As shown by the Figures, each stage consists of a number of internal procedures which have also been structured and described. This enables the application of the model to the evaluation of investment projects in economic sectors/ by interest groups that differ in their complexity and value. The model can be considered to be a universal tool assisting in making an objective financial and economic evaluation of the investment concerned, however, there are certain assumptions underlying the reliability of the results. The most general of them are these: 1) reliability and sufficiency of baseline date; 2) correct description of internal processes of the investment project; 3) reliability of forecasts; 4) correctness of description of main risks; 5) commercial focus of the investment project (only some of the model‘s procedures are suitable for public (non-commercial) projects.

The recommended model is highly formalised, which reduces the influence of potential artificial corrections. However, full elimination of subjectivity or elements of expert evaluation is neither possible nor expedient (in particular for the purposes of long-term forecasts).

The purpose of Stage I in the evaluation is to develop a financial model for an investment project enabling the description of the projected business processes and the determination of cash flows on their basis (Step 1.1). In the financial model development

phase, attention should be focussed on the correct description and presentation of the project‘s business processes.

The next step (1.2) has a more technical nature and involves the preparation and entry of basic data required for the calculations. Normally, source data are not suitable for use in a model, therefore, additional calculations are required to form the requisite data structure. It should be emphasised that Steps 1.1 and 1.2 are related to Step 3.1, when the project’s cash flow calculation method is selected. Where the cash flows are to be calculated based on the scenarios of the company‘s operations “with the project“ and “without the project“, all the algorithms must be adapted to the company‘s operations as a whole. Thus the scope of the basic data varies depending on the option selected. Business development projects that provide for a release of a new product or launching of a new activity should be evaluated based on the direct cash flow calculation method.

Stage I, Model 2 includes two steps: Step 2.1 – drawing up of the project‘s budget and detailed investment schedule; Step 2.2 – description of the project‘s financing structure and conditions. It is very important to draw up the budget execution plan as accurately as possible and to define a specific financing structure. These parameters determine both the cash flows distribution in time and the discount rate, therefore, they have a direct effect on the result variables (NPV, IRR and other indicators of investment efficiency).

Successful implementation of Steps 3.1 and 3.2 is determined by the correct completion of previous tasks. Upon appropriate modelling of business processes and having sufficient data for the description of the requisite parameters, the calculation of cash flows and their allocation to different activities is not a complicated task, with the techniques worked out for its carrying out. Therefore, Step 3.3 is the most important among Steps 3.1 to 3.3 as it analyses the effect of different factors upon the project‘s cash flows. It is important to identify those factors that can have the strongest effect on the characteristics of the project‘s cash flows and to thoroughly examine the effect.

Stage II involves the selection and application of the methods for evaluating the efficiency of investments. It is comprised of two modules that describe the aspects of methods‘ selection and risk assessment: 1) different methods to evaluate the efficiency of investments are applied; 2) a risk and uncertainty analysis is made.

The investment projects‘ evaluation methods and the relevant techniques proposed by the author form a basis for the implementation of Steps 1.1 to 1.3. The systems of traditional and non-conventional methods aimed at value creation can be applied as auxiliary ones. This is because non-conventional methods result in over-simplification and the results obtained do not reflect the real situation. Whereas the methods focused on value creation are not widespread in practice (in particular, in Lithuania) and their results form a basis for decision-adoption very rarely.

The risk and uncertainty analysis (module 2) is also rare in the investment project‘s evaluation practice in Lithuania, even though in this case the reason is the lack of specific knowledge and requisite data rather than the disregard of the risk factor itself. Despite this, risk analysis must be made even for the smallest projects. Whereas when complex infrastructure, research and development projects are concerned, elimination of the risk factor raises doubts over the results of evaluation of the entire project. Analysis

of this type should be made as follows: Step 2.1 – Analysis of the type „What if" that includes the assessment of sensitivity, scenarios and non-loss-making; Step 2.2 – Setting of discount rate; Step 2.3 – probability analysis.

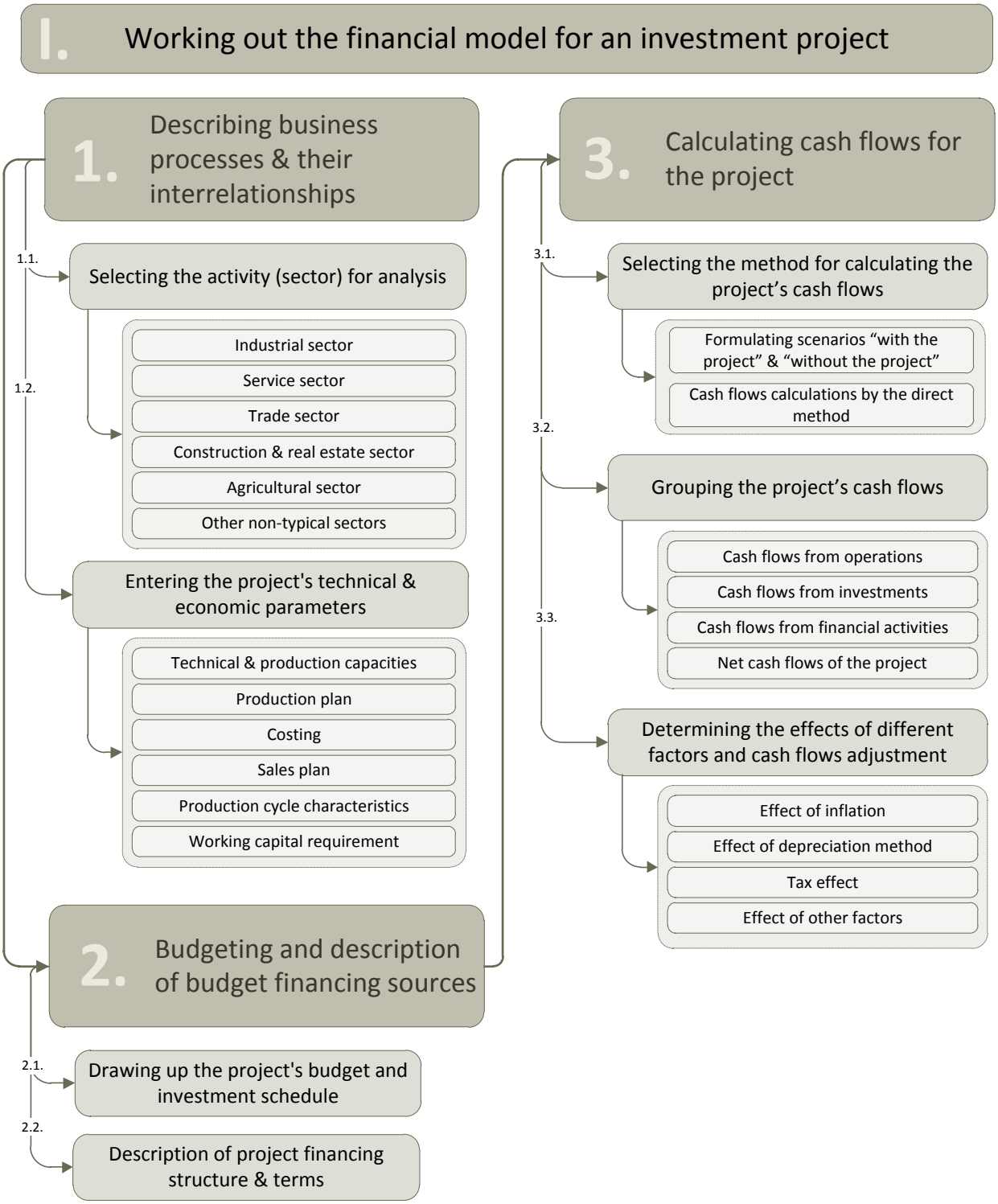

Fig. 9. Stage 1 – Working out the financial model for an investment project
Source: compiled by the author

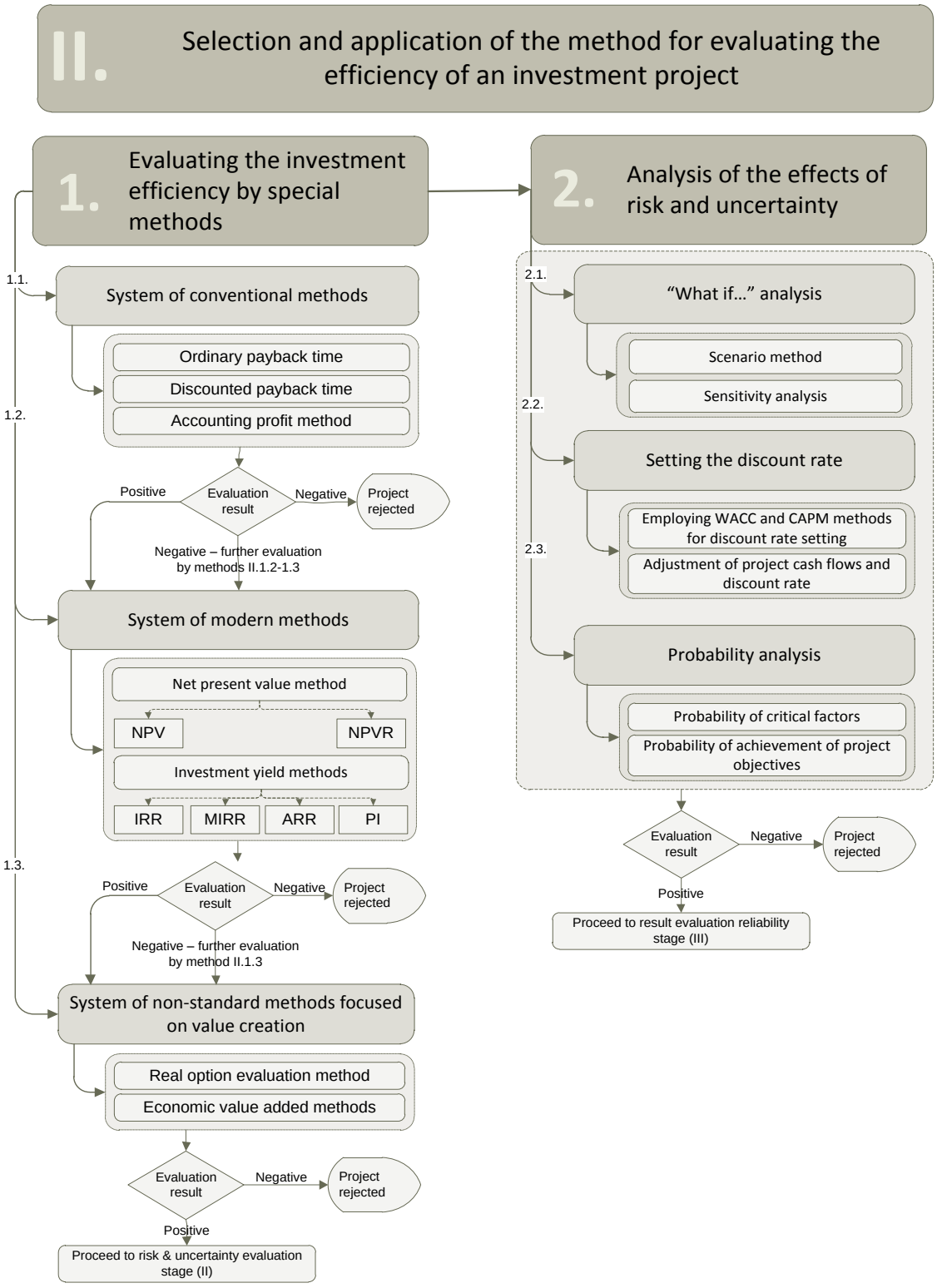

Fig. 10. Stage 2 – Selection and application of the method for evaluating the efficiency of an investment project

Source: compiled by the author

In Stage III of the evaluation, analysis of results is made and the final conclusion on the expediency of implementation of the investment project is reached. Even though this is the last evaluation stage, actually Stages II and III are cyclical ones, i. e. certain evaluation method is applied in the analysis of an investment project and the result is

analysed in detail. The entirety of such interim results forms a basis for the formulation of the conclusion.

The final Stage III involves two modules: 1) analysis, comparison and evaluation of reliability of the results obtained; 2) adoption and justification of the decision. Step 1.1 of this module, the results are analysed and compared and their reliability is determined. All the main assumptions are reviewed and the critical factors influencing the results are considered. The probability of changes in the project‘s critical parameters is assessed and the correctness of the selected basic values of the parameters are correct. If the answers are positive, the evaluation proceeds to Step 1.2 in which the interpretation of the verified results takes place. A project report is drawn up; it details the main calculation assumptions and the main evaluation results. The values obtained are interpreted and explained in detail and the results of different project scenarios are compared. Upon conclusion of such preliminary project report , the final decision on the expediency of the project is adopted in Step 2.1.

This step usually involves all the stakeholders of the project, to whom the project is presented, the underlying assumptions are overviewed and the evaluation results obtained are examined in detail. If the results are satisfactory to all the parties, the evaluation phase is closed, reports and minutes are drawn up, and decisions on further implementation of the investment project are adopted. In case if the results raise well-founded doubts for any of the parties or if all the parties agree that they are not satisfied with the results, a decision on the recalculation of the results is adopted or the project is rejected an inefficient one.

The recommended model is largely automated and adapted to the resolution of various tasks related to the analysis and evaluation of investment projects. As each business process is quite unique, the model cannot be fully automated, however, type solutions for individual economic sectors and groups thereof have been developed: production, trade, real estate development, service provision and agriculture. A summarised version has also been prepared for other economic sectors facilitating their analysis and evaluation.

In order to examine the model‘s applicability and specific features with respect to the above-mentioned sectors, additional research of the sectors‘ investment projects has been conducted. To sum up the results of the model‘s practical applicability analysis, the following limitations can be identified:

- insufficient risk assessment and analysis tools (lack of imitation modelling functionalities, probability analysis solutions require improvement); there are no opportunities for evaluating the formation and efficiency of investment project portfolios;
- statistical-econometric evaluation of forecasts not provided for;
- insufficient algorithms in the model for evaluating the weighted capital costs and capital assets.

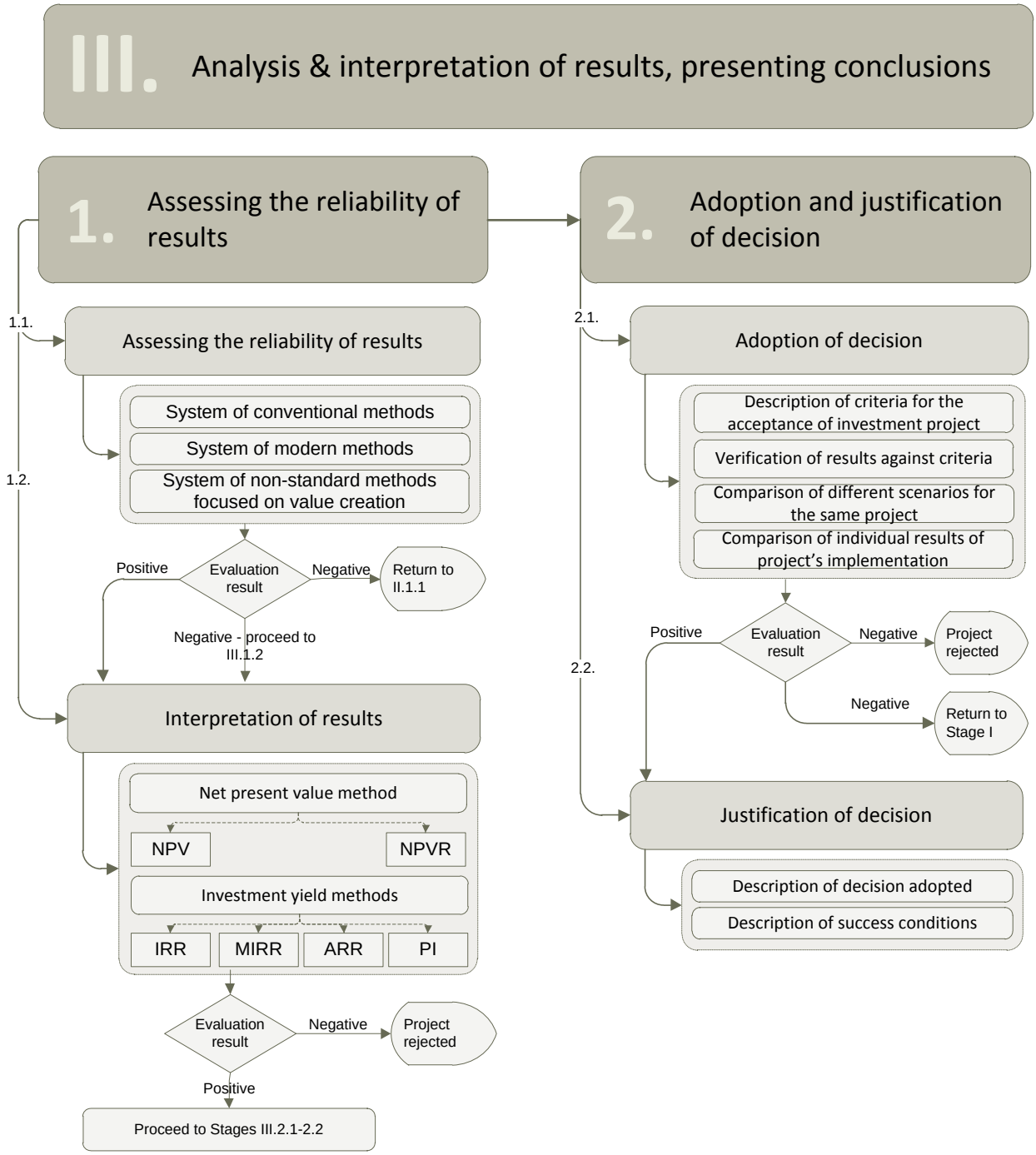

Fig. 11. Stage 3 – Analysis & interpretation of results, presenting conclusions

Source: compiled by the author

At the same time the model has a number of advantages, the main of them being the following:

- typical solutions developed for individual sectors facilitate and speed up the initial phase of investment projects‘ analysis and evaluation when its financial economic model is being developed;
- effective and functional algorithms ensuring an accurate (up to one month) description of an investment project‘s budget and financing sources;

- opportunities for determining costs and selling price dynamics both for the entire forecasted period and for individual revenue and cost items;
- automated generation of main financial statements (balance sheet, profit and loss account, cash flow statement);
- efficient algorithm for the calculation and graphical processing of the company‘s financial indicators; possibility to generate automated reports to Ms Words, which speeds up the investment project‘s description process and minimises the probability of errors;
- the model can be applied both to Lithuanian and foreign entities. This is ensured by: 1) the projected financial statements are drawn up in accordance with the Lithuanian Business Accounting Standards (VAS) and the International Accounting Standards (IAS); 2) the model supports the multilingual functionality (at present one of four languages can be selected: Lithuanian, English, Russian or Polish); 3) different rates of the key taxes and contributions (social security, profit, real estate, income, VAT etc.) can be selected and the taxation base can be adjusted.

CONCLUSIONS AND PROPOSALS

The following conclusions have been drawn up on examination of the theoretical and practical aspects of investment projects‘ analysis and evaluation:

1. The analysis of the material investments‘ dynamics has shown that investments play an important role in the national economy. They contribute to the stability of economic growth, socio-economic welfare of population, and increasing of the country‘s economic potential and international competitiveness. Over the period under consideration, i. e. 1997-2008, the volumes of material investments in Lithuania have grown from LTL 5.49 bn in 1997 to LTL 21.63 bn in 2008, i. e. as many as 3.9 times. The share of material investments in the GDP was 18% in 1997-2008. The larger part of them (approx. 64%) was earmarked for the purchase, construction and reconstruction of buildings and engineering structures. An assessment of the effect of material investments and direct foreign investments upon the GDP has shown that there exists a close, nearly direct, interdependence between the indicators under consideration: the correlation ratio between material investments and GDP dynamics is 0.988, between the value of direct foreign investments and GDP – 0.990, and between investments and productivity – 0.981. The results of the regressive analysis also confirm the presence of a strong interrelationship.

2. Business entities implementing investment projects contribute directly to the overall volumes of sectoral and national investments. Thus the GDP growth and dynamics are determined also by the economic efficiency of investment projects. High quality of preparation and detailed description of an investment project is very important for the achievement of its results and the lowering of the risk of failure. It determines competitiveness of an entity; in case of major projects, this can be the matter of survival of a company or even the whole branch.

3. An examination of an investment project‘s life cycle has shown that the phase in which the project is in largely determines the methodological basis and the reliability

of analysis. Therefore, it is proposed that the widely applied three-phase model is supplemented by the fourth, liquidation phase, in which the final evaluation of the project‘s results takes place and thus the reliability of previous calculations is verified and important conclusions that are useful for subsequent projects of the company are drawn up.

4. On completion of the examination, a technique for the evaluation of economic efficiency, based on a project life cycle model and comprising a set of relevant evaluation methods, has been worked out. It enables the determination of investments‘ attractiveness and the adoption of decisions in each phase of the project cycle. The proposed technique can be conventionally structured as follows: 1) basis of evaluation – documents to be prepared in specific phases of the project‘s life cycle are identified; 2) selection of evaluation method – a list of main methods to be employed in the evaluation of the project‘s efficiency is provided; 3) selection of solution – a specific solution is proposed on the basis of the information available and the evaluation methods selected. The recommended methodology can be successfully applied in different entities irrespective of their size or sector and of the scope of the project being implemented. In addition, continuous monitoring of the project’s results allows timely adjusting of decisions and avoiding the effect of adverse external factors.

5. Upon summarisation of modern methods for assessing the efficiency of investment projects, it has been established that most of them are based on cash flows, therefore, correct calculation of an investment project‘s cash flows is very important for the reliability of the analysis results. Studies have shown that an error of the same size (40%) in the discount rate and cash flow calculation processes has a varying effect upon the evaluation results. In case of incorrect setting of a discount rate, the deviation is approx. 20%, while an error of the same size in the cash flow calculations has a cardinal effect (the opposite, i. e. over 100%)

6. Considering the results of analysis of different scientific sources and practical cases, in cash flows should be grouped as follows for the purposes of calculation of an investment project‘s cash flows: 1) cash flows from operations; 2) cash flows from investments; and 3) cash flows from financial activities. This both facilitates the analysis and allows avoiding the error of including cash flows that are not related to the project or its participants. As such grouping conforms to the Lithuanian Business Accounting Standards and the International Accounting Standards, it also facilitates the results‘ analysis and interpretation for different users of information. The calculation of the cash flows from operations is the most important and, at the same time, most complicated process. Depending on whether new operations or expansion of current operations are planned, cash flows can be calculated for the investment project only, with the net cash flow increment determined, or for two scenarios – “with the project” and “without the project”, with the difference between them corresponding to the cash flow of the investment project under consideration. Calculations of cash flows from investment and financial activities are not complicated and the underlying principles are the same as for the cash flows from operations.

7. Upon systematisation of the cash flow calculation methods, an integrated technique has been developed for the calculation of the cash flows for each activity of an

investment project . For the purposes of such calculations, two main groups of factors influencing the project and its cash flows can be identified: 1) external factors; 2) internal factors. A detail analysis of the two groups has shown that different factors have varying influence over the cash flows from different activities. This is determined both by the company‘s capabilities to control the impact of these factors and by the specific character of the factors. While internal factors usually have stronger influence over the project‘s cash flows compared to the external ones, a company has broader opportunities for controlling them by selecting equipment and sales markets and market segments, by offering a diversified assortment of goods and services, or by other strategic and tactical decisions. Most internal factors (the cyclical and seasonal aspects of the planned activities, accounting policies etc.) can be included in the calculations if sufficiently detailed information on potential impact is available.

8. Upon examination of the risk assessment and the cost-of-capital determination models proposed by different researchers, a technique for the setting of discount rates has been worked out. The technique which is suitable for the Lithuanian business environment comprises the CAPM (Capital Asset Pricing Model), its modified version MCAPM, and a cumulative Build-Up model based on expert evaluation. They are used in determining the cost of (company‘s or shareholders‘) equity which, together with the cost of external financing, forms the basis for the setting of a discount rate. The weighted average cost of capital (WACC) method is used for this purpose. The technique also offers a possibility to assess inflation and varying discount rates over the project implementation period.

9. An overview of the feasibility of applying the NPV method leads to a conclusion that, while the calculation principle of the method is relatively simple, there are a number of factors that may change the evaluation results. A consistent NPV determination technique has been worked out; it considerably expands the framework for the calculation of the initial NPV mathematical expression through the inclusion of several additional factors, which increases the reliability of the analysis. The main factors include the length of the period under consideration, the interval length and allocation in the projected period, and extended project value. According to estimations, the impact of each of them upon the evaluation result may vary between 5 and 30%. An error of such a size is a substantial one in the adoption of investment decisions, therefore, elimination of such deviations in the initial phase of evaluation is important.

10. As investment projects differ in many ways, it is expedient to use more than one selection criterion for their evaluation; therefore, it is proposed that, apart from NPV, the internal rate of return (IRR) method and its modified form (MIRR) are used as they show the relative profitability of investments. A technique developed based on these methods allows selecting the most acceptable option from a number of investment projects differing in the scope of investments or expected profit. It has been established that in most cases the results of the NPV and the IRR analyses are the same, however, there may be differences between the conclusions of evaluation of non-typical investment projects. A situation where the projects‘ evaluation results are contradictory is called the IRR and NPV conflict. A technique enabling to avoid errors in investment projects‘ evaluation has been worked out for such cases.

11. Based on the examinations involving the theoretical and application aspects of the analysis and evaluation of investment projects, i. e. the investment project‘s life cycle model, the cash flow calculation and the discount rate setting methods, as well as the main and auxiliary methods for evaluating investment projects‘ efficiency, a model for the evaluation of investment projects which enables the analysis and selection of alternative investment projects has been developed.

The proposed model consists of three stages which, at the same time, show the sequence of the analysis: 1) working out the financial model for an investment project; 2) selection and application of a method for evaluating the efficiency of an investment project; and 3) analysis and interpretation of results and presenting conclusions. Each phase consists of several internal procedures which have been structured and consistently described within the framework of the technique. This allows applying the model to the analysis of investment projects differing in their complexity, value, sector or interest groups in order to achieve an objective financial and economic evaluation.

12. A computer version has been developed within the theoretical framework of the model, which enables a detailed evaluation of investment projects in the five main sectors. A market analysis of similar software products has shown that, although most products are multilingual ones, other country-specific parameters are lacking (such as tax accounting requirements, accounting standards etc.) as well as a mechanism for their entry and calculation. As there is no commercially available product in Lithuania with the investment product evaluation functionalities taking the peculiarities of national legislation, business environment and other specific parameters into account, the model can become an alternative to software products currently offered by foreign companies.

APPROVAL AND PUBLICATION OF RESEARCH

The main statements and results of the research have been published in the following research papers:

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ABOUT THE AUTHOR

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Education

1993 –1997	Vilnius University, Faculty of Economics (Bachelor's Degree in Economics)
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Professional experience

1996	AB Nesta (Accountant Cashier)
1997 – 2003	UAB Meida (Economist Consultant)
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Fields of research interests

Financial analysis, evaluation of investment projects' efficiency, modelling of business processes with the use of IT tools

REZIUME

Temos aktualumas. Investicijų didinimas į šalies ūkį yra viena iš veiksmingiausių priemonių, skatinanti ne tik bendrą ekonomikos augimą, bet ir prisidedanti prie struktūrinių permainų, kurių dėka ekonomikos augimo tempai įgytų stabilumo. Tai ypač aktualu dabartiniu Lietuvos ir Europos Sąjungos šalių ekonominės raidos etapu, kai pasaulinės finansinės krizės padariniai labai neigiamai paveikė jų socialinę ekonominę gerovę. Nors valstybių investicijos ir prisideda prie šio proceso spartinimo, tačiau tik įtraukus privatų sektorių galima tikėtis esminių permainų. Kartu reikia pažymėti, kad investicijos ne mažiau reikšmingos ir įmonėms. Investicijos yra vienas iš svarbiausių veiksnių, turinčių įtakos įmonių finansinei būklei, veiklos plėtrai, tęstinumui ir konkurencingumui. Tik retais atvejais įmonės imasi įgyvendinti nuostolingą investicinį projektą, turėdamos kitų nekomercinių tikslų ir iš anksto sutikdamos su patiriamais nuostoliais.

Investicijų efektyvumą didžiąja dalimi lemia tinkamai parengti investiciniai projektai. Tik gerai parengtas investicinis projektas, kuriame įvertintos visos jo įgyvendinimo prielaidos, teisingai paskaičiuoti laukiami pinigų srautai ir išsamiai ištirti galimi rizikos veiksniai, užtikrins pastovų įmonės vertės kūrimą. Bankrotų bangą pasaulyje ir Lietuvoje 2008 – 2009 m. lėmė ne tik prasidėjusi finansinė krizė, bet ir pernelyg optimistinės įmonių ateities prognozės, atsarginių plėtros scenarijų nebuvimas ir neapgalvoti, nekorektiškai parengti ar įvertinti investiciniai projektai.

Daugiau nei 14 metų autoriaus profesinė patirtis parodė, kad investicinių projektų analizei ir vertinimui reikalinga Lietuvos verslo sąlygas atitinkanti metodika, kuri leistų išsamiai, objektyviai ir minimaliomis sąnaudomis atlikti šiuolaikiniais metodais grindžiamą investicijų efektyvumo analizę. Deja, iki šiol ne tik nėra parengta vieningos metodikos, kuri galėtų būti taikoma valstybinių projektų analizės atveju, kaip jau daug metų atliekama kaimyninėse šalyse (pvz. Lenkijoje, Rusijoje), bet ir nėra nė vieno tokio pobūdžio komercinio produkto, kurį būtų galima panaudoti tam tikslui. Nors rinkoje yra prieinamų užsienio įmonių siūlomų sprendimų, tačiau dažnai jie neatitinka Lietuvos verslo sąlygų ir visiškai nėra regionalizuoti.

Mokslinė problema ir jos ištyrimo lygis. Visos šiuolaikinės veiklos efektyvumo koncepcijos remiasi pelno maksimizavimo ir vertės kūrimo principais, todėl, nors investicinio projekto efektyvumą apibūdina nemažai technologinių, socialinių, teisinių, aplinkosauginių ir kitų rodiklių, ekonominiam vertinimui įprastai teikiama pirmenybė. Tik ekonomiškai efektyvus projektas be išorės pagalbos (valstybės, visuomeninių organizacijų, labdaros fondų ir pan.) gali būti sėkmingai įgyvendintas ir atnešti laukiamos naudos jo iniciatoriams. Investicinio projekto ekonominio efektyvumo vertinimas, jo atlikimo principai ir būdai, taikomi metodai ir rodikliai visada buvo mokslininkų ir praktikų dėmesio centre.

Investicinių projektų efektyvumo vertinimo sritį sunku priskirti konkrečiai ekonomikos mokslo šakai. Jos teorinį pagrindą sudaro įmonės finansų, investicijų, verslo vertės bei kitų ekonomikos mokslų tyrimų sritys. Iš užsienio šalių mokslininkų, nagrinėjančių investicijų ir investicinių projektų teorinius ir praktinius aspektus, reikėtų išskirti Ch. Agar (1995, 2005), J. M. Bartley (2001), P. Belli, J. Anderson, H. Barnum, J. Dixon, J. P. Tan (1997, 2004), F. P. Boer (1999), R. Brealey, S. Mayers, A. Marcus

(2001, 2008), E. Brigham (1993, 2002), T. Copeland (2000, 2004), A. Damodaran (2002, 2004), M. Ehrhardt (2002), F. J. Fabozzi (2003), A. Fight (2006), A. Gregory (1999), E. A. Helfert (2001), A. F. Herbst (2002), J. Hitchner (2006), J. V. Horne, J. Wachowicz (2005), T. Koller (2000), E. J. McLaney (2006), L. T. Miller, Ch. S. Park (2004), J. Murrin (2000), M. Nowak (2005), R. Reider, P. Heyler (2003), P. A. Ryan (2002), W. Sharpe (1995, 2000), G. Alexander, J. Bailey (1995, 2000), A. Stabryła (2006), P. Tufano (2004), И. А. Бланк (2000, 2002, 2006), П. Л. Виленский, В. Н. Лившиц, С. А. Смоляк (2004), В. Галасюк (1999), В. Глазунов (1997), В. В. Ковалев (1995, 2000), Я. С. Мелкумов (1997), А. С. Нешитой (2006), В. Рутгайзер (2007), Г. С. Староверова, А. Ю. Медведев, И. В. Сорокина (2006), Т. В. Теплова (2008), В. В. Царев (2004), В. Д. Шапиро (1996, 2001, 2004) ir kiti. Lietuvoje šią problematiką nagrinėjo V. Aleknevičienė (1997, 2009), M. Butkus (2007), D. Cibulskienė (2007), B. Galinienė (2005), R. Ginevičius (2005, 2009), J. Mackevičius (2005, 2007, 2009), R. Martinkutė (2007), R. Norvaišienė (2005), T. Petravičius (2008), V. Podvezko (2005), J. Rojaka, (2009), R. Rudzkis (2009), A. V. Rutkauskas (2002, 2006), L. Simanauskas (2002, 2006), S. Šidlauskas (2006), R. Tamošiūnienė (1999, 2003, 2006, 2008), M. Tvaronavičienė (2006), R. Urniežius (2001), L. Ustinovičius (2004), E. Valakevičius (2007), S. Valentinavičius (2010), E. K. Zavadskas (2004), V. Zubrecovas (2010) ir kiti. Šių autorių darbuose analizuojamas platus su investicinių projektų valdymu, analize ir vertinimu susijusių klausimų spektras. Tačiau atlikus išsamią šių bei kitų mokslinės literatūros šaltinių analizę, paaiškėjo, kad nėra pakankamai gerai ištirti atskirų investicinių projektų ekonominio efektyvumo vertinimo metodų pritaikomumo aspektai, galintys turėti reikšmingos įtakos analizės rezultatams, apimčiai ir turiniui.

Lygiagrečiai ryškėja tendencija, kai mokslininkų tyrimai vis labiau nukrypsta į naujų rodiklių, vertinimo metodų, kitų vertės ir efektyvumo kriterijų paiešką. Autoriaus nuomone, tai labai svarbi kryptis, tačiau ne mažiau reikšmingi yra ir taikomieji jau sukurtos metodologijos tyrimai. Atsižvelgiant į tai, kad investicinio projekto įgyvendinimo terminai kartais siekia 20 – 30 metų, darytina išvada, kad per visą gyvavimo ciklą jo vertinimui gali būti pritaikyti net keli visiškai skirtingi metodai, kurių rezultatai nebūtinai tarpusavyje koreliuoja. Tuo labiau, kad verslo sektorius yra gana inertiškas naujų mokslinių metodų atžvilgiu ir negali greitai prisitaikyti prie siūlomų pakeitimų. Iš bankų ar stambesnių įmonių tai papildomai reikalauja nemažų investicijų informacinių sistemų atnaujinimui, personalo apmokymui, todėl jei tokie pokyčiai ir įgyvendinami, tai gana retai ir tik išbandžius naujus metodus praktikoje. Įvertinus šias aplinkybes, autoriaus nuomone, esama pinigų srautais grindžiama investicinių projektų vertinimo metodologija gali visiškai patenkinti investuotojų poreikius, su sąlyga, kad bus atsižvelgta į įvairius aspektus, susijusius su jos taikymo ypatumais.

Tyrimo objektas – investicinių projektų ekonominio efektyvumo vertinimas.

Tyrimo tikslas – sukurti investicinių projektų ekonominio efektyvumo vertinimo modelį, pagrįstą diskontuotų pinigų srautų metodais ir pritaikytą Lietuvos verslo sąlygoms.

Šiam tikslui pasiekti keliami tokie **uždaviniai:**

1) įvertinti investicijų įtaką įmonių ir šalies ūkio konkurencingumui ir ekonomikos augimui;

2) išnagrinėti investicinių projektų analizės ir valdymo procesą, išskiriant svarbiausius jo elementus, užtikrinančius objektyvų ir kokybišką investicinio projekto vertinimą;
3) atlikti rizikos ir neapibrėžtumo įtakos analizę investicinio projekto įgyvendinimo ir vertinimo procese;
4) išnagrinėti pinigų srautų sudėtį, skaičiavimo būdus bei veiksnius, turinčius įtakos jų kitimui ir vertinimui; išanalizuoti pinigų laiko vertės ir diskontavimo procesus bei išskirti metodus, tinkančius diskonto normai apskaičiuoti;
5) atlikti mokslo darbuose siūlomų investicinių projektų vertinimo metodų ir modelių lyginamąją analizę bei kritiškai įvertinti jų taikymo galimybes;
6) parengti grynosios dabartinės vertės ir vidinės grąžos normos taikymo metodikas, užtikrinančias skirtingų veiksnių įtakos vertinimą;
7) sukurti investicinių projektų ekonominio efektyvumo vertinimo modelį, leidžiantį priimti optimalius investavimo sprendimus verslo įmonėse, ir patikrinti šio modelio taikymo galimybes Lietuvos verslo sąlygomis.

Tyrimo metodai. Disertacijos objekto pažinimui ir iškeltam tikslui pasiekti buvo taikyti indukcijos ir dedukcijos metodai:

1) pradiniame tyrimų etape naudojamas indukcinis metodas, apimantis tyrimo objekto sudedamųjų dalių (pinigų srautų skaičiavimo būdai, rizikos vertinimas, investicijų vertinimo rodikliai ir metodai) išsamią analizę siekiant išskirti specifinius jų taikymo aspektus vertinant investicinius projektus;
2) kitame etape naudojamasi dedukcinio metodo galimybėmis, kai, remiantis pirmojo etapo metu pasirinkta metodologija, formuojamas investicinių projektų ekonominio efektyvumo vertinimo modelis, kuris tyrimo eigoje patikrinamas atsižvelgiant į jo praktinio taikymo galimybes.

Rengiant darbą taip pat buvo taikomi šie tyrimų metodai: 1) Lietuvos ir užsienio autorių mokslinių publikacijų analizė, sintezė, sisteminimas, lyginimas, abstrahavimas ir apibendrinimas; 2) statistinės analizės metodai: duomenų rinkimas, grupavimas, klasifikavimas, apdorojimas, regresinė ir koreliacinė analizė ir pan. 3) nestruktūrizuotas interviu su įmonės vadovais, kurio metu buvo siekiama išaiškinti bendrus investicinių projektų pasirinkimo ir vertinimo kriterijus; 4) sukurto teorinio modelio adaptavimas investicinių projektų vertinimui, buvo naudojamas matematinis modeliavimas taikant informacinių technologijų priemones.

Tyrimo šaltiniai. Teoriniai disertacinio darbo tyrimai, susiję su investicinių projektų vertinimo metodologijos kritine analize, remiasi Lietuvos ir užsienio šalių autorių mokslinės literatūros šaltiniais. Statistinės informacijos šaltiniais apie materialiųjų investicijų tendencijas Lietuvoje ir Europos Sąjungoje tapo „Eurostat“ ir Lietuvos statistikos departamento duomenų bazės. Investicinių projektų efektyvumo vertinimo metodų taikymo įvairiose šalyse analizė atlikta pagal Graham, Harvey (2001, 2002); Ryan, Ryan (2002); Truong, Partington, Peat (2005); Silvola (2006); Lam, Wang and Lam (2007); Hermes, Smid, Yao (2007) ir kitų autorių tyrimus. Modelio praktinio pritaikymo galimybių tyrimai atlikti pagal Lietuvoje įgyvendinamų investicinių projektų informaciją.

Darbo mokslinis naujumas ir jo teorinė reikšmė. Autoriaus atlikti teoriniai - taikomieji tyrimai prisideda prie ekonomikos mokslo plėtros šiais pagrindiniais aspektais:

- sukurtas investicinių projektų ekonominio efektyvumo vertinimo modelis, kuriame pasiūlytas kompleksiškas investicinio projekto analizės ir vertinimo algoritmas, sudarytas remiantis naujaisiais moksliniais pasiekimais diskontuotų pinigų srautų metodų taikymo srityje. Siūlomas modelis leidžia atlikti neapibrėžtų ir sudėtingų situacijų analizę priimant strateginius investavimo sprendimus, kurie gali būti įvertinti įvairiais pjūviais ir skirtingais vystymosi scenarijais, užtikrinant veiksmingą investuoto kapitalo naudojimą;
- papildyta investicinio projekto gyvavimo ciklo metodologinė bazė, į analizės procesą įtraukiant likvidacinę fazę, kurios reikšmė iki šiol buvo nepakankamai įvertinta. Šių tyrimų pagrindu buvo sukurta ekonominio efektyvumo vertinimo metodika;
- parengtos pagrindinės, investicinės ir finansinės veiklos pinigų srautų sudarymo investicinių projektų vertinimo tikslu metodikos, kuriose nuosekliai aprašytos informacijos judėjimo kryptys, pavienių veiksnių tarpusavio priklausomybė bei kiekvienos investicinio projekto veiklos pinigų srautų formavimosi šaltiniai;
- parengta diskonto normos nustatymo metodika, atitinkanti Lietuvos verslo sąlygas;
- sukurtos trys diskontuotų pinigų srautų metodais besiremiančios investicinių projektų ekonominio efektyvumo vertinimo metodikos: 1) grynosios dabartinės vertės (NPV) metodo taikymo metodika, 2) vidinės grąžos normos (IRR) taikymo metodika, 3) NPV ir IRR metodų tarpusavio nesuderinamumo problemos sprendimo metodika. Jose išsamiai aprašyti investicinių projektų vertinimo algoritmai taikant platų NPV ir IRR metodų galimybių spektrą.

Praktinė darbo reikšmė. Sukurtas teorinis investicinių projektų ekonominio efektyvumo vertinimo modelis su keturiomis jį papildančiomis metodikomis tapo pagrindu pagrindiniams analizės ir vertinimo procesų algoritmams parengti; jie sujungti į vieną kompiuterizuotą sistemą (kompiuterizuotas modelis). Modelis pritaikytas universaliems uždaviniams, susijusiems su investicinių projektų analize ir vertinimu, spręsti. Kadangi verslo procesai kiekvienu atskiru atveju yra gana unikalūs, visiško modelio automatizavimo nėra pasiekta, tačiau yra sukurti tipiniai sprendimai atskiriems ūkio sektoriams ir jų grupėms: gamybos, prekybos, nekilnojamojo turto vystymo, paslaugų teikimo ir žemės ūkio. Pasirinkti ūkio sektoriai sukuria beveik 80 proc. šalies BVP, todėl jo praktinio pritaikymo sritis yra gana plati. Naudojant modelį galima:

- parengti įgyvendinamo projekto pinigų srautų prognozes ir įvertinti būsimą įmonės finansinę būklę bei įgyvendinamo investicinio projekto rezultatus;
- įvertinti numatomus investicinio projekto finansavimo šaltinius, jų sąnaudas, atsiradimo ir paskirstymo principus;
- atlikti pasirinktų rizikos veiksnių analizę bei suformuoti reikiamą investicinio projekto rizikos valdymo sistemą;

- vykdyti nuolatinę įgyvendinamo investicinio projekto stebėseną ir analizuoti bei vertinti galimus projekto įgyvendinimo scenarijus;
- išvengti išsamios neperspektyvių investicinių projektų analizės ir laiku iš jų pasitraukti.

Darbo struktūra ir apimtis. Disertacinį darbą sudaro 4 pagrindiniai skyriai, įvadas, išvados ir 10 priedų. Bendra darbo apimtis be priedų – 190 puslapių be priedų. Tekste pateiktos 34 lentelės ir 42 paveikslai. Rengiant darbą buvo panaudoti 230 literatūros šaltiniai.

IŠVADOS IR PASIŪLYMAI

Ištyrus teorinius ir praktinius investicinių projektų analizės bei vertinimo aspektus, teikiamos šios išvadas:

1. Atlikta materialiųjų investicijų dinamikos analizė parodė, kad investicijos atlieka svarbų vaidmenį ekonomikoje. Jos objektyviai prisideda prie stabilaus ūkio augimo, užtikrina gyventojų socialinę ekonominę gerovę, sudaro prielaidas didinti šalies ekonomikos potencialą ir tarptautinį konkurencingumą. Per nagrinėjamą 1997 – 2008 m. laikotarpį materialiųjų investicijų apimtis Lietuvoje išaugo nuo 5,49 mlrd. Lt 1997 m. iki 21,63 mlrd. Lt 2008 m., t. y. padidėjo net 3,9 karto. Materialiųjų investicijų dalis BVP struktūroje 1997 – 2008 m. vidutiniškai siekė 18 proc. Daugiausia (apie 64 proc.) buvo investuojama į pastatų ir inžinerinių statinių įsigijimą, statybą bei rekonstrukciją. Materialiųjų investicijų ir tiesioginių užsienio investicijų įtakos bendrajam vidaus produktui įvertinimas atskleidė, kad tarp nagrinėjamų rodiklių yra labai glaudi, beveik tiesioginė, priklausomybė – materialiųjų investicijų ir BVP dinamikos koreliacijos koeficientas yra lygus 0,988, tiesioginių užsienio investicijų vertės ir BVP koreliacijos koeficientas – 0,990, o investicijų ir darbo našumo koreliacijos koeficientas – 0,981. Stipraus ryšio buvimą patvirtina ir atliktos regresinės analizės rezultatai.

2. Investicinius projektus įgyvendinantys ūkio subjektai tiesiogiai prisideda prie bendros ūkio sektorių ir visos šalies investicijų apimties. Taigi įgyvendinamų projektų ekonominis efektyvumas lemia ir šalies BVP prieaugį bei jo kitimo tempą. Todėl kokybiškai parengtas ir išsamiai aprašytas investicinis projektas turi didelę įtaką ir jo rezultatų pasiekimo galimybėms bei mažina nesėkmės riziką. Nuo to priklauso ūkio subjekto konkurencingumo lygis, o didelių projektų atveju sprendžiamas ir pačios įmonės, o kartais net ir visos ūkio šakos išlikimo klausimas.

3. Ištyrus investicinio projekto gyvavimo ciklą, nustatyta, jog tai, kokioje fazėje yra nagrinėjamas projektas, didele dalimi lemia taikomą metodologinę bazę ir atliekamos analizės patikimumą. Atsižvelgiant į tai, plačiai taikomą 3 fazių modelį siūloma papildyti ketvirta, likvidacine faze, kurios metu vykdomas galutinis projekto rezultatų įvertinimas ir tokiu būdu patikslinamas ankstesnėse fazėse atliekamų skaičiavimų patikimumas, daromos svarbios išvados, naudingos įgyvendinant kitus įmonės projektus.

4. Remiantis atliktais tyrimais buvo sukurta ekonominio efektyvumo vertinimo metodika, pagrįsta projekto gyvavimo ciklo modeliu ir apimanti atitinkamą vertinimo metodų kompleksą, leidžianti nustatyti investicijų patrauklumą ir priimti reikiamus sprendimus kiekvienoje gyvavimo ciklo fazėje. Siūlomos metodikos struktūrą sąlygiškai skirstoma į 3 dalis: 1) vertinimo pagrindas – nurodomi konkretūs dokumentai, kurie

rengiami konkrečioje projekto gyvavimo ciklo fazėje; 2) vertinimo metodo pasirinkimas – pateikiamas pagrindinių investicinių projektų ekonominio efektyvumo vertinimo metodų sąrašas; 3) sprendimo pasirinkimas – turimos informacijos ir pasirinktų vertinimo metodų pagrindu siūlomas konkretus sprendimo variantas. Rekomenduojama metodika gali būti sėkmingai taikoma skirtingose įmonėse neatsižvelgiant į jų dydį, priklausomybę tam tikram ūkio sektoriui ar įgyvendinamo investicinio projekto mastą. Be to, nuolatinė investicinio projekto rezultatų stebėsena leidžia laiku pakoreguoti priimamus sprendimus ir išvengti nepalankių aplinkos veiksnių įtakos.

5. Apibendrinus šiuolaikinius investicinių projektų efektyvumo vertinimo metodus, nustatyta, kad dauguma jų remiasi pinigų srautais, todėl teisingas investicinio projekto pinigų srautų apskaičiavimas turi didelę reikšmę analizės rezultatams ir jų patikimumui. Tyrimai parodė, kad to paties dydžio (40 proc.) paklaida diskonto normos ir pinigų srautų apskaičiavimo procese turi nevienodą įtaką vertinimo rezultatams. Neteisingos diskonto normos nustatymo atveju rezultatai nukrypsta apie 20 proc., o tokio pat dydžio paklaida sudarant pinigų srautus rezultatą pakeičia kardinaliai (priešingai, t. y. virš 100 proc.).

6. Įvairių mokslinių šaltinių ir praktinių atvejų analizė parodė, kad sudarant investicinio projekto pinigų srautus, tikslinga juos skirstyti į tris veiklų grupes: 1) pagrindinę, 2) investicinę ir 3) finansinę. Tai ne tik palengvina analizės atlikimo procesą, bet ir leidžia išvengti klaidų, kai į skaičiavimus įtraukiami pinigų srautai, nesusiję su nagrinėjamu projektu ar jo dalyviais. Toks skirstymas tuo pačiu palengvina rezultatų analizę ir interpretavimą skirtingiems informacijos vartotojams, nes atitinka VAS ir TAS nuostatas. Reikšmingiausias ir kartu sudėtingiausias yra pagrindinės investicinio projekto veiklos pinigų srautų sudarymo procesas, kurio tikslas – kuo išsamiau ir objektyviau aprašyti planuojamos veiklos verslo procesus ir nustatyti veiksnius, turinčius didžiausią įtaką. Atsižvelgiant į tai, ar planuojama nauja veikla, ar siekiama išplėtoti esamą veiklą, pinigų srautai gali būti sudaromi tik investiciniam projektui, kai skaičiuojamas grynasis pinigų srautų prieaugis arba analizuojami du scenarijai „su projektu“ ir „be projekto“, o jų skirtumas atitinka analizuojamo investicinio projekto pinigų srautą. Investicinės ir finansinės veiklos pinigų srautų skaičiavimai nėra sudėtingi, tačiau jiems taikomi tie patys principai, kaip ir pagrindinės veiklos pinigų srautams.

7. Susisteminus taikomus pinigų srautų skaičiavimo metodus, buvo parengta apibendrinta metodika, kuria vadovaujantis galima sudaryti kiekvienos investicinio projekto veiklos pinigų srautus įtraukiant svarbiausius veiksnius. Atliekant šiuos skaičiavimus tikslinga išskirti dvi pagrindines veiksnių grupes pagal jų įtakos pobūdį įgyvendinamam projektui ir jo pinigų srautams: 1) išorės veiksniai ir 2) vidaus veiksniai. Detaliau išanalizavus šias veiksnių grupes, nustatyta, kad skirtingi veiksniai turi nevienodą įtaką atskirų veiklų pinigų srautus. Tai lemia įmonės galimybės kontroliuoti šių veiksnių poveikį ir pačių veiksnių specifika. Nors vidaus veiksniai daro didesnį poveikį investicinio projekto pinigų srautams nei išorės, tačiau įmonė turi daugiau galimybių juos reguliuoti pasirinkdama vienokią ar kitokią technologinę įrangą, realizavimo rinkas ir jų segmentus, pasiūlydama diversifikuotą prekių ir paslaugų asortimentą ar kitus strateginius bei taktinius sprendimus. Atsižvelgiant į tai, sudarant

investicinio projekto pinigų srautus dauguma vidaus veiksnių (planuojamos veiklos ciklišKumas, sezoniškumas, taikoma apskaitos politika ir kt.) gali būti įtraukti į skaičiavimus turint pakankamai išsamią informaciją apie galimą jų poveikį.

8. Pagal skirtingų mokslininkų siūlomus rizikos ir kapitalo kainos nustatymo modelius buvo parengta diskonto normos nustatymo metodika, kuri gali būti taikoma Lietuvos verslo sąlygomis. Metodika apima CAPM (kapitalinio turto įkainojimo modelis), jo modifikuota išraiška MCAPM ir kumuliatyvinis, ekspertiniu vertinimu pagrįstas Build-Up modelis. Jais remiantis apskaičiuojama nuosavo (įmonės ar akcininkų) kapitalo kaina, kuri kartu su išorinio finansavimo kaina tampa diskonto normos nustatymo pagrindu. Tam taikomas svertinės kapitalo kainos (WACC) metodas. Metodikoje papildomai numatytos infliacijos ir skirtingų diskonto normų per projekto įgyvendinimo laikotarpį įvertinimo galimybės.

9. Apibendrinus NPV metodo taikymo galimybes, darytina išvada, kad nors jo skaičiavimo principas yra sąlygiškai paprastas, yra nemažai veiksnių, galinčių iš esmės pakoreguoti vertinimo rezultatus. Buvo parengta nuosekli NPV nustatymo metodika, kuri gerokai išplečia pradinės NPV matematinės išraiškos skaičiavimo bazę ir įtraukia visą eilę papildomų veiksnių, leidžiančių padidinti analizės patikimumą. Pagrindiniai iš jų – vertinamo laikotarpio trukmė, diskonto normos dydis, vidinio intervalo ilgis ir pasiskirstymas per prognozuojamą laikotarpį, pratęsta projekto vertė. Pagal atliktus skaičiavimus, kiekvieno jų poveikis vertinimo rezultatui gali svyruoti nuo 5 iki 30 proc. Tokio dydžio paklaida yra esminė priimant investavimo sprendimus, todėl ypatingai svarbu eliminuoti tokio pobūdžio nukrypimus jau pradinėje vertinimo stadijoje.

10. Kadangi investiciniai projektai gali skirtis įvairiais aspektais, jų palyginimui tikslinga naudoti daugiau nei vieną atrankos kriterijų, todėl greta NPV siūloma taikyti vidinės grąžos normos (IRR) ir jos modifikuotos išraiškos (MIRR) metodus, parodančius santykinį vykdomų investicijų pelningumą. Jų pagrindu parengta metodika leidžia pasirinkti priimtiniausią variantą iš nagrinėjamų investicinių projektų aibės, lyginant skirtingus pagal investicijų apimtį ar generuojamo pelno dydį projektus. Nustatyta, kad daugumoje atvejų NPV ir IRR analizės rezultatai yra vienodi, tačiau netipinių investicinių projektų vertinimo išvados gali skirtis. Situacija, kai šie projekto vertinimo rodikliai duoda prieštaringus rezultatus, apibūdinama kaip IRR ir NPV konfliktas. Tokiems atvejams parengta metodika, leidžianti išvengti investicinių projektų vertinimo klaidų.

11. Remiantis atliktais tyrimais, kurių metu išnagrinėti teoriniai ir taikomieji investicinio projekto analizės ir vertinimo aspektai – investicinio projekto gyvavimo ciklo modelis, pinigų srautų skaičiavimo ir diskonto normos nustatymo metodai, investicinio projekto vertinimo pagrindiniai ir pagalbiniai metodai, buvo parengtas investicinių projektų ekonominio efektyvumo vertinimo modelis, leidžiantis atlikti alternatyvių projektų analizę ir atranką.

Rekomenduojamą modelį sudaro trys etapai, kartu nusakantys ir analizės atlikimo eiliškumą: 1) projekto finansinio modelio sudarymas; 2) projekto investicijų efektyvumo vertinimo metodo parinkimas ir taikymas; 3) rezultatų analizė, interpretavimas ir išvadų pateikimas. Kiekvienas iš etapų susideda iš kelių vidinių procedūrų, kurios irgi buvo struktūrizuotos ir nuosekliai aprašytos apibendrintoje

metodikoje. Tai leidžia modelį taikyti skirtingų pagal sudėtingumą, vertę, ūkio sektorių ar interesų grupes investicinių projektų analizei, siekiant gauti objektyvų finansinį ekonominį jo įvertinimą. Visi modelyje aprašyti žingsniai turi aiškų algoritmą, todėl modelio taikymas nėra komplikuotas, nors reikalauja specifinių nagrinėjamos mokslo srities žinių.

12. Teorinio modelio bazėje buvo sukurtas ir jo kompiuterinis variantas, kuriuo galima atlikti išsamų 5 pagrindinių ūkio sektorių investicinių projektų vertinimą. Atlikus tokių programinių produktų rinkos analizę paaiškėjo, kad nors dauguma produktų yra daugiakalbiai, tačiau trūksta kitų nagrinėjamos šalies parametrų (mokesčių apskaitos reikalavimai, apskaitos standartai ir pan.) ar jų įvedimo ir skaičiavimo mechanizmo. Kadangi Lietuvos rinkoje nebuvo rasta nė vieno komercinio produkto, kuriame būtų realizuotos investicinių projektų vertinimo galimybės atsižvelgiant į konkrečius šalies teisinius aktus, verslo aplinkos ypatumus bei kitus specifinius parametrus, sukurtas modelis galės tapti alternatyva užsienio įmonių siūlomiems programiniams produktams.