University of South Bohemia in České Budějovice

Faculty of Economics

Study program: N6208 Economics and management

Field of study: Accounting and financial management

Diploma work

Analysis of methods financing and investment calculation

Head of diploma work: Author:

Ing. Daniel Kopta, Phd. Ondřej Šanda

2008

ZADÁNÍ DIPLOMOVÉ PRÁCE

Jméno a příjmení: Ondřej Šanda

Studijní obor: Účetnictví a finanční řízení podniku.

Název tématu: Analýza investiční činnosti vybraného podniku.

Cíl práce:

- Nalezení vhodných metod pro tvorbu a hodnocení investičního projektu (včetně metod pro volbu nejpřijatelnější formy jeho financování)
- Použití výše uvedených metod a postupů při tvorbě konkrétního investičního záměru

Osnova:

1. Investiční rozhodování, předinvestiční příprava a základní metody hodnocení efektivnosti investičního projektu.
2. Charakteristika možných způsobů pořízení dlouhodobého majetku a analýza jejich výhodnosti.
3. Analýza finanční situace podniku a možnosti zhodnocení dopadu investice na tuto finanční situaci.
4. Návrh vlastní metodiky umožňující posouzení vhodnosti realizace investičního záměru..
5. Vlastní analýza konkrétního investičního záměru podniku.
6. Vyhodnocení získaných výsledků z pohledu vhodnosti navržených metod hodnocení
7. Vyhodnocení získaných výsledků z pohledu výhodnosti navrhované metodiky

Seznam odborné literatury:

Blaha,Z. -Jindřichovská, I.:Jak posoudit finanční zdraví firmy, Management Press 1996

Brealey,-R Myers,S.C.:Teorie a praxe firemních financí, Victoria publisching, 1993.

Doležal, J.-Fireš,B.-Míková,M.:Finanční účetnictví, Grada 1995.

Fotr, J.:Podnikatelský plán a investiční rozhodování. Grada, 1996

Grůnwald, R.:Analýza finanční důvěryhodnosti podniku, Ekopress, Praha, 2001

Křemek,V.-Petráková,I.:Investování, CVUT, 1993

Mařík,M.,Moderní metody oceňování podniku, Ekopress, 2001

Neumaierová, I., Neumaier, I.:Výkonnost a tržní hodnota firmy, Grada, 2002

Valach,J.: Investiční rozhodování a dlouhodobé financování, Ekopress, 2001

Wawrosz, P., Zdroje financování podnikatelské činnosti, Sagit, Praha, 1999

Vedoucí bakalářské práce: Ing.Daniel Kopta

Prohlašuji, že svoji diplomovou práci jsem vypracoval samostatně pouze s použitím pramenů a literatury uvedených v seznamu citované literatury.

Prohlašuji, že v souladu s § 47b zákona č. 111/1998 Sb. v platném znění souhlasím se zveřejněním své diplomové práce, a to v nezkrácené podobě elektronickou cestou ve veřejně přístupné části databáze STAG provozované Jihočeskou Univerzitou v Českých Budějovicích na jejích internetových stránkách.

České Budějovice, 30.4.2008

Bc.Ondřej Šanda

Tímto děkuji Ing. Danielu Koptovi, Phd. za odborné vedení, pomoc a rady, které mi poskytl při tvorbě této diplomové práce.

ABSTRAKT

Smyslem této diplomové práce je popsat proces investičního rozhodování a s ním spojeného financování z teoretického a samozřejmě i z praktického hlediska na konkrétním případě.

Za nejdůležitější fázi celého procesu se přitom považuje kalkulace kapitálových výdajů, ale hlavně predikce peněžních příjmů plynoucích z investice. Vyčíslené hodnoty peněžních příjmů a kapitálových výdajů jsou pak základem pro zjištění, zda je projekt rentabilní či nikoliv.

Existuje řada metod, pomocí nichž lze takovéto závěry činit. Liší se zpravidla v tom, že zohledňují nebo naopak nezohledňují faktor času, nebo za efekt plynoucí z investice berou jiné faktory. Mezi nejpoužívanější patří tzv. Čistá současná hodnota investice, vnitřní výnosové procento nebo doba návratnosti.

Stejně jako budoucnost je ve většině případů nejistá a nepředvídatelná, stejně tak i efekty plynoucí z investičních projektů mohou být mnohdy značně odlišné od předpokládaných scénářů. Proto se v poslední době stále více přihlíží k možným rizikům investičních projektů a jejich dopadům. Analýza rizika je zahrnuta i v této diplomové práce v podobě analýzy citlivosti konkrétního investičního projektu.

Dalším velice důležitým krokem je výběr způsobu financování projektů. Existuje řada možností a jejich kombinací, které jsou závislé zejména na postavení a finančním zázemí podniku. Je třeba tedy rozhodnout o nejlepším a pro konkrétní podnik nejvhodnějším způsobu financování projektu, což ve většině případech není vůbec jednoduché.

V poslední době je pro řadu subjektů též možné využít podpory z fondů Evropské Unie ve formě dotací. Přestože získání dotace z těchto fondů představuje velice náročný administrativní proces, takto získané finance jsou pro podnik velice lukrativní, protože jsou nevratné a mohou pokrývat podstatnou část kapitálových výdajů celého projektu.

Klíčová slova: investiční rozhodování a kapitálové plánování, čistá současná hodnota, vnitřní výnosové procento, doba návratnosti, analýza citlivosti, fondy EU

TABLE OF CONTENT

1 INTRODUCTION

Due to permanent changes of market conditions and situation together with high demands on market supply, each company must be pro-active and effective in using its sources to maintain or improve its market position and competitiveness. An investment activity is therefore one of the most important factors and management of the company should devote enough time and attention for this activity.

Main goal of this diploma work is to describe a process of investment decision and capital budgeting in theoretical and practical way. A large number of firms only roughly estimate investment cash flows without considering risk and use very simple methods or none at all. This is a reason why they usually face serious problems and poor financial results.

The investment decision and capital budgeting process has many steps while each of them must be considered and fulfilled to proceed to another one. Starting with formulation of long-term goals and investment strategy following with search of investment possibilities to investment assessment and its execution if effective, the very last step, controling and monitoring the investment execution must not be ignored.

A crucial factor of the investment decision and capital budgeting is the cash flow prediction. Even a use of the most accurate methods of investment evaluation (e.g. net present value, internal rate of return) is pointless if the predicted cash flows from the investment are imprecise. Hence, the cash flow prediction is the most difficult phase because of unforeseeable future of the investment. The future represents uncertainty and risk therefore risk analysis should be employed to get better and more precise results.

The decision on appropriate source of investment financing is another very important step. There is a lot of possible sources of investment financing that usually depend on position and financial background of the company. It is necessary to decide which financial source is the best and optimal for particular company in the case of particular investment.

Recently it is possible to use financial support from funds of European Union. Although it is very administravely difficult to apply and obtain the funds from this source, it´s very lucrative source for investor. It can cover part or total cash outflow of the investment and moreover it´s usually non-reversible.

In conclusion, this diploma work should reflect theoretical knowledge and practical experience gained through years of studying and practising this discipline. Each and every firm has its own specific characteristics, limited opportunities and operates in different markets so the investment activity should be also adapted to these different conditions.

2 METHODOLOGY

Working on this diploma study the methodology was moreless systematic. Comprehensive theoretical knowledge had to be first gained before other steps could be made. As a theoretical background, the literature which will be mentioned in chapter „literary search“ served more than well. Another very important source of information was internet search which is advantageous for its latest news and enormous range of information. For the information of special character (technical information, prices of real estate, insurance conditions and so on) , personal contact with number of organizations representatives had to be arranged.

Crucial aspect of whole procedure of working on this diploma study was about close contact and co-operation with representatives of company where investment project was being analysed.

2.1 Company and an investment idea

The XY company (Ltd.) was established in 2007 as a consulting agency in area of energy savings and effective energy using. There are two owners of this company who have been working in power industry for many years. As a minor activity, they are considering an investment into building of solar thermal power plant. This investment would serve as a good example and an object of analysis when advicing to the clients. Moreover, this investment is able to generate positive cash flow if it is well planned and executed.

The company is an owner of real estate located in suitable are in South Bohemia. It is field of no buildings and forest around, 300 m far from station of energy distribution network. A running solar thermal power plant is ensured by set of so-called „Photovoltaic collectors“. There is a lot of technical and economical information about photovoltaic system which needs to be gathered and analysed. This sophisticated information is included in chapters Theoretical background and Practical applications.

2.2 Energy output

An amount of power produced from square metre of PV system depends on efficiency of PV cells, duration and intensity of sun shine. An average annual duration of sun shine in Czech Republic ranges between 1450 to 1750 hours where parts of Czech Republic as Moravia or South Bohemia increasing this average statistic. Major part of total annual length of sun shine is reached in summer months, respectively from April to September. Intensity of sun shine is measured in watts of solar energy falling on square metre of Earth surface. Likewise length of sun shine, intensity is also higher in summer months than in the winter. It ranges from 400 mostly during winter months to 700 W/m2 in the summer. So multiplying duration of sun shine by its intensity and average efficiency of PV cells, annual power production from square metre of PV modul is derived. In the conditions of Czech Republic, 80 – 120 kWh can be annualy produced from 1 m2 of PV panel.

2.3 Investment effeciency calculation

An investment idea is to build solar thermal power plant at the real estate owned by XY company and sell 100% of produced power into energy distribution network run by energetical corporations. Government of Czech Republic annually sets level of purchasing price as price for kWh of energy. It equals to 13,46 CZK/kWh (incl.VAT 9%) in 2008 and it is annualy adjusted by inflation rate (at least 2% every year). Minimal level of purchasing price is guaranteed by government for period of 20 years ahead.

The XY company must decide how power-full photovoltaic system should be. Annual energy consumption, possibility of purchaser, initial investment capacity, location capacity and much more factors need to be considered analysing this investment project and its size.

2.3.1 Annual cash flow

When it comes to annual incomes from this investment, multiplying size of photovoltaic system expressed by square metres of PV collectors by average production from square metre of PV modul, we get total production of energy by power plant. It is expected that this amount will decrease because the efficiency of PV cells decreses during its life-time. Producers of photovoltaic systems usually guarantee 90% of nominal capacity in 12 years and 80% in 25 years of its life-time. Multiplying total power production in years 1 to 20 by purchasing price (adjusted by inflation rate 2% annually), prediction of annual incomes from this investment is made.

On the other side, there are specific operational outcomes involving this investment. Despite the PV system works moreless automatically, there are activities that need to be done by labour. For example, PV collectors need to be washed, snow in the winter must be cleared to function properly, reports from metering system must be registered, little administration is necessary and so on. So there is a need for technical and administrative labour but it doesn´t count for full-time job at all. Part of the labour has character of fixed costs and part is variable depending on size of power plant. The amount of labour necessary to ensure a good run of PV system is normalized as 36 hours yearly plus additional 1 hour per week per each 100 m2 of PV system. Actual price per hour of labour is predicted as 80 CZK while 4% annual increase in labour price is expected.

There are also specific risks concerning this investment. Every PV system should be insured against natural disaster, vandalism and theft. The conditions and sum of annual insurance depend on size, location and value of power plant. Annual insurance fee is predicted as 0,7% from value of PV system (initial investment).This kind of expense is relatively stable during life-time of the PV system, therefore only 1% annual increase can be expected.

Repairs or revisions, administrative costs and fees and other outgoings belong among other operational expenses. Annual operational expenses are calculated as 0,3% of initial investment. 3% annual increase can be expected.

Having annual incomes and expenses predicted and calculated, we can proceed to the calculation of annual cash flow. It is derived from Earnings before interest and taxes. Annual incomes reduced by annual expenses and depreciation mean a figure of EBIT. An amount of interest from debt is missing in this caculation. It is because an effect of interest as a cost of debt and effect of interest as a interest tax shield will be implied in discounting. Therefore EBIT serves as a tax base to calculate income tax. Income tax in first 5 years after project execution will be 0 regardless the tax base because first 5 years of running this type of power plants is freed from tax. According to this fact, it is more effective for XY company to apply depreciation no earlier than in 6-th year. Linear tax depreciation is used in the calculation while an amount of depreciation in given years is calculated from the initial value of long-term tangible asset decreased by the amount of EU grant. Finally, to get annual cash flow from this investment, depreciation in given years must be added back to earnings before interest after tax.

It is necessary to discount the annual cash flow to include an impact of inflation, cost of capital and risk of this project. The discount rate should represent all this factors in one figure. In our calculation, WACC of this concrete project is used as the discount rate. To be able to calculate WACC, shares of individual capital sources on the whole capital need and their required rate must be specified.

2.3.2 Initial investment

An important role in whole investment process plays an amount of initial investment. Despite an enormous technical progress in this branch, today´s photovoltaic panels are still quite expensive compared to possible generated income from this article. Market price of one photovoltaic panel size of 1,4m2 ranges between 15 000,- to 30 000,- CZK depending on material it is made from, size and producer. There are specialized companies offering complex service and all necessary procedures concerning installation of the PV system, warranty and much more. Despite the company is an owner of real estate (probable location of the investment) we cannot forget to include a market price of this real estate in total sum of initial investment.

Thanks to very specific source of capital, grant from funds of European Union, the initial investment can be much lower than predicted. It depends on the independent comission how much money is granted for the individual projects while maximum is limited at the level of 56% of realiable expenses for small organisations in area of Southwest Bohemia. Despite the character of investment is right and suitable for EU grant, an applicant does not have to get anything, if the comission decides so. However, standard amount of EU grant for this kind of projects is usually about 35% of eligible expenses. This source of finance is very attractive because there is no payback. On the other side, it is very administratively and operationally demanding to get this kind of support.

2.4 Capital budgeting and WACC

The XY company owns real estate as a location for this project in the first variant. The value of this property is 360 ths. CZK. Then, 200 ths. CZK is deposited on the bank accounts and it is free to use for this purpose. In the addition, the shareholders of the company are willing to invest up to 500 ths. CZK each. In conclusion, total sum of internal capital is 1 560 ths. CZK. The owners of the company require at least 15% yield from equity.

A residual source of capital would be drawn from a bank loan. Little investigation was undergone to find out at which interest rates the XY company is able to get bank loan for this type of investment project with specific level of risk. Banks usually offer their capital for 8% p.a. interest rate. Real cost of debt is lower than given 8% because of interest tax shield. 8% interest rate is multiplied by (1-t) where t symbolize tax rate. New legislative changes (low capitalisation rule etc.) applied since 2008 can partially limit interest tax shield[1].

Multiplying cost of equity and cost of debt by their individual shares on total capital needs and making sum of these two numbers, the figure of WACC is derived.

Eu grant, the third source of capital is not considered in the calculation of WACC because the amount of EU grant is directly reduced from initial investment as was mentioned above. EU grant as a source of capital could be included in the calculation of WACC, respectively discount factor (assuming that initial investment stays unchanged by the amount of EU grant) but the method used in this diploma work seems to be more appropriate.

However, finance granted from funds of European Union are not available right away. The investment must be first executed and financed from other capital sources and then part of the capital outcome is repayed from EU funds. It usually takes months full of bureaucracy before money are transferred back to the investor. Therefore, there is a need for temporary capital source. It can be solved by short-term bank loan with one-shot repayment.

2.5 Sensitivity analysis

Even if results of effeciency calculation will be positive figures, future reality can be absolutely different. There is a lot of risk factors affecting this investment. Even if purchasing price is guaranteed by the law and nobody can change it for 20 years ahead, we don´t have certain incomes. Everything depends on how much energy we are able to produce. It is then affected by the solar energy available and effeciency of solar collectors.

[1] §25, odst. 1w zákona č. 586/1992Sb. o daních z příjmů v posledním znění zákona

There can be also different situation in the amount of initial investment. An amount of finance granted from EU funds can be 0 or up to 56% of reliable expenses. It is big difference which affects accepting or not accepting. This project would be uneffective if no support is granted. Generally, producing electricity from solar energy is still, at this level of technical progress, very expensive compared to other sources. Only support in the form of guaranteed purchasing price and EU grants make this investment profitable.

There are many other risk factors involving this investment project. For example, change in purchasing price. Change in the amount of labour, insurance a other operational expenses. Change in tax rate or interest rates from bank loans. These all and many others affecting the overall results from this investment but their impact on whole investment is moreless insignificant. Therefore only change in solar energy, level of effeciency and percentage of EU grant will be considered in sensitivity analysis.

Sensitivity analysis is based on calculations and iterations which are not able to undergo without specialized software. Software called @Risk from Palisade Corporation is used as a very helpful hint to simplify whole process. It is basically macro for Microsoft Excell aplication. It adds very sophisticated statistic and mathematic functions to basic Excell ones.

First step is to define risk inputs and set their probability distribution functions. A simple Triangular probability distribution is chosen. 3 values (min, max, standard) must be specified to let program calculate basic statistic values using 1000 number of iterations. Results of the iteration can be displayed in two ways. First one is a simple probability density while second alternative is a graph of cumulative probability distribution.

The first analysis is simple sensitivity analysis which means a change of risk output (NPV in this diploma work) affected by change of one risk input ceteris paribus. The change of risk input can be expressed in percentage, percentiles of probability distribution, absolute values or so. For the purpose of this diploma work, a range of absolute values was used in analysis.

Another kind of sensitivity analysis is mutual sensitivity analysis. It is characterised by mutual effect of change of risk inputs on output (NPV). It takes all risk inputs and their changes in values into consideration and analyses effect on given characteristic of investment effeciency.

Before the mutual sensitivity analysis can be undergone, mutual correlation of risk inputs must be calculated or predicted. This characteristic is usually calculated using time series or detailed data sets. In the case of this diploma work only subjective estimation must replace comprehensive calculation because there are no such a data available.

3 THEORETICAL BACKGROUND

3.1 Literary search

A literature specialized in this field of study was very important source of teoretical knowledge for a quality made up of this diploma work. Special magazine articles or statistics provided by government or private organizations were also very helpfull aids working on this diploma work. The main sources providing the most important information are mentioned in following paragraphs.

Theory and praxis in business finance written by Brealey and Meyers definitely belongs to main literature sources (exact citation is given in chapter „Information sources“). This publication represents very good manual how to solve problems concerning investment activity in practise. It broadly describes all possible ways how to act in different situations of investment decision and capital budgeting. Moreover the teoretical base of this book is supplemented with concrete and real examples of companies all around the world until the date of book issue. Numbers of czech authors were influenced by this book writting their own piece.

A good example of above mentioned is a book „Investment decision and long-term financing“ from Mr.Valach which serves as a textbook for subjects of same field of study in majority of czech economic universities. This book provides quality overview of investment field of study in the conditions of local legislation and economic background. Czech legislation differentiate from the European one in number of factors, hence some methods and procedures of investment decision and capital budgeting are a bit different. The Mr. Valachs´ book gives a true picture of these unsimilarities and thanks of that provides a good inspiration for investors in Czech Republic.

It is necessary to mention one last publication „Corporate Finance - theory and practice“ written by Jones and Lumby. This book was used as a first recommended publication during my studies of Quantitative finance in Sweden. It is a comprehensive publication containing almost all any investor needs to know. This book extended my knowledge of risk and uncertainity connected with investments apart from the other problems.

3.2 Investment decision

There are two different approaches to investment theory: macroeconomic and microeconomic. Investment represents an increase in investment values during given period of time from macroeconomic perspective. In the other words it is suspensive consumption causing long-lasting utility.

The investment assessment should be done from two different points of view[2]:

a) prompt influence upon agregate demand and related production and employment
b) long-run influence upon property enhancement leading to national product increase in the future, thereby support of economic growth.

Investment produces prompt increase in economic activity and long-run economic growth.

Level of investment activity depends on many factors including mainly:

a) dynamics of GNP growth
b) real interest rate
c) system and level of taxation
d) investors expectations of future trends and possible risk

---

[2] LEVY, Haim - SARNAT, Marshall: Kapitálové investice a finanční rozhodování (překlad). 1. vydání, Praha, Grada Publishing, 1999

As a conclusion of macroeconomic approach, the goverment of individual countries influence economic behaviour of investors by monetary and fiscal politics.

Investment from microeconomic view is analogically expense where convertion into the future incomes is expected during long-run period (more than 1 year). Capital expense include for instance:

- reconstruction or expansion of long-term tangible asset
- research and development
- constant increase of supplies and receivables
- long-term security purchase
- employment training and education
- advertising campaign
- leasing and acquisition evaluation

This conception of investment is quite extended but generally accepted. However, this list is reduced for the needs of this diploma work and present practice as following:

- long-term tangible asset expenses
- long-term intangible asset expenses
- long-term financial asset expenses

Long-term tangible asset expenses include[3]:

- land estate, buildings, works of art and collections expenses (no matter of its value)
- individual chattels expenses (historic value above 40 000 and life-time more than 1 year)
- constant vegetation, basic flock, draught animals and technical recultivation

[3] Český účetní standard pro podnikatele č. 013 Dlouhodobý nehmotný a hmotný majetek

- technical assessment of long-term tangible asset (superstructures, extensions, reconstructions and modernisation)

Decisions on investment have to be based on the returns from given investment project. Despite the project is for social reasons only, if the investment is unprofitable in the long run, it is unwise to invest in it. A lot of money can be easily wasted if the investment turns out to be uneffective or uneconomic.

Often, it is good to know what the present value of the future cash flow is, or how long it will take to mature (give returns). It could be much more profitable to deposit money in the bank to earn interest, or to invest in an alternative project.

3.3 Phases of investment decision process

As a result, most medium-size and large organisations have developed special procedures and methods for dealing with these decisions. A systematic approach to capital budgeting implies[4]:

a) the formulation of long-term goals and investment strategy

b) the creative search for and identification of new investment opportunities and

pre-investment preparation

c) project classification

d) the estimation and forecasting of current and future cash flows of the investment

[4] VALACH, Josef: Investiční rozhodování a dlouhodobé financování. 1. vydání, Praha, VŠE, 2001

e) a set of decision rules that can differentiate acceptable from unacceptable alternatives

f) the controlling of investment cash flows and careful monitoring of crucial aspects of the project after execution

3.3.1 The formulation of long-term goals and investment strategy

The formulation of long-term goals and investment strategy is one of the main managerial activities in each firm. It is very important for its future prosperity and competitive ability. Present practise formulates few generally accepted long-term goals[5]:

- efficiency and financial stability of the company expressed as a market value of the firm, investment efficiency or liquidity
- company´s market share, its maintaining or possible growth
- production program, equipment and technological inovation,
- social goals expressed as wage and social support of the staff, their qualification progress and stimulation
- respect of environment requirements

However, these individual goals are sometimes incompatible and not leading to immediate profitability. Many chinese manufacturies can serve like a good example where social goals are ignored because of managements´ effort to reach maximum effectivity and companys´ market share. Nevertheless companies usually try to reach compromise solution in modern developed economies.

For all that, the efficiency and financial stability is considered to be crucial goal. Company can proceed to next goals right and only after fulfilling this first one.

---

[5]LEVY, Haim - SARNAT, Marshall: Kapitálové investice a finanční rozhodování (překlad). 1. vydání, Praha, Grada Publishing, 1999

The investment strategy is created from determined long-term goals. It should incorporate a process how to reach those goals. Concretely, it is a choice of investment projects and their right timing that leads to fulfilling determined goals.

There are agressive and conservative strategies distinquished by risk that is allways connected with investment. Investor usually choose agresive strategy if he is about to undergo high risk (e.g. foreign market, unexplored market). On the contrary, investor prefers conservative strategy if he is averse about risk (state securities or real estate investment).

3.3.2 The creative search for and identification of new investment opportunities and pre-investment preparation

Having determined investment goals and optimal strategy, company can proceed to individual projects, their evaluation, selection and execution. Pre-investment preparation is a fundamental prerequisite for successfull execution and operation. It demands various technical and economical activities such as marketing, risk evaluation, financial analysis, technical and technological characteristic of the project and so on. A co-operation of these activities is essential. A proper function of the pre-investment preparation is to identify investment projects from different point of view such as: purpose of the investment, market demand study or cash flow calculation. A less worthy investments are being gradually excluded.

Pre-investment preparation is finished with technical-economic study. It serves to cover all essential technical, business and financial information necessary for objective consideration of an investment. The technical-economic study should consist of[6]:

1) overall list of results
2) reason and development of the project

[6] VALACH, Josef: Investiční rozhodování a dlouhodobé financování. 1. vydání, Praha, VŠE, 2001

3) capacity of the market and production
4) material inputs
5) location and environment
6) technical project
7) organisational project
8) labour demands
9) time plan of an execution
10) financial and economic evaluation including risk consideration of an investment

3.3.3 Project classification

It is possible to classify the projects for both theoretical and practical reasons. One of the main perspectives of classification is undoubtedly a character of benefit to the companys´ wealth[7]:

- projects concetrated on higher cost effeciency by technical a technological innovation,
- projects leading to increase in turnover from existing products by extending production capacity,
- projects leading to increase in turnover from product inovation or new products prodution,
- projects oriented on business risk reduction (e.g. production diversification),
- projects leading to better working, social, health and safe conditions.

[7]LEVY, Haim - SARNAT, Marshall: Kapitálové investice a finanční rozhodování (překlad). 1. vydání, Praha, Grada Publishing, 1999

Degree of dependence[8]:

- mutually exclusive projects (project A or B can be executed, but not both)
- complementary projects (taking project A increases the cash flow of project B)
- substitute projects (taking project A decreases the cash flow of project B)

Degree of statistical dependence:

- Positive dependence (correlation coefficient equals to 1)
- Negative dependence (-1)
- Statistical independence (0)

Type of cash flow:

- Conventional cash flow (only one change in the cash flow sign e.g. -/++++ or +/----, etc)
- Non-conventional cash flows (more than one change in the cash flow sign, e.g. +/-/+++ or -/+/-/++++, etc)

There is of course many other perspectives of classification and every author adds his own one but above mentioned is enough for the purpose of this diploma work

3.3.4 The estimation and forecasting of current and future cash flows

This phase has been generally considered as a crucial for precise investment decision. It is also one of the most difficult ones. Cash inflow and cash outflow prediction is the main goal of this phase.

---

8 LUMBY, S.- JONES, C.: Corporate Finance - theory and practice, 7th ed., London, Thomson Learning, 2006

Because of long-term nature of analysed investment projects, expected cash flow should be also predicted few years ahead. However it is extremely difficult to predict cash flow even for 3 following years in practice because of a present situation full of economic, politic, social or natural changes. Furthermore inflation, interest rates and exchange rates and their possible fluctuation must be taken into account as well.

In conclusion all results of effeciency evaluation of investment projects are unprecise if cash flow prediction is unprecise.

3.3.4.1 Cash outflow identification

All expenses associated with execution of concrete investment project are considered as cash outflow. It is for instance:

- new investment acquisition expense including instalation, transportation, project documentation and so on. Expenses on research and development should be included as well
- expense on stable increase in net working capital raised by new investment

Latter is considered only in the case of investment that cause an increase in fixed property. The increase in net working capital is insignificant or none at all in the case of recovering investments.

Cash outflow can sometimes include also:

- incomes from sale of existing long-term tangible property which is discarded because of new investment. An amount of cash outflow is of course reduced by this income
- effects of taxation resulted from replaced property. An amount of cash outflow is reduced (market value is lower than residual value) or raised vice versa

So called sunk costs should be mentioned talking about cash outflow. This type of costs cannot be considered in investment decisions because it has been irretrievably spent and cannot be taken back.

3.3.4.2 Prediction of cash inflow from investment

As it has been said, crucial phase of whole procedure of investment decision and capital budgeting is future cash inflow prediction. It is also the most difficult step because cash inflow from the investment depends on many usually unstable factors.

Annual benefit from the investment is not a figure of profit but expected cash inflow from the investment.

So the cash inflow from the investment is:

a) annual profit from the investment after tax
b) annual depreciation
c) changes in net working capital
d) cash flow from sale of long-term property at the maturity

ad a) annual profit from the investment is derived from expected increase in turnover due to investment subtracted by operating costs due to investment execution.

ad b) annual depreciation is classificated as cost and it is included in total costs for the purpose of taxation which reduces the profit but it is not a financial expense so it is necessary to add it back to profit after taxation (EAT).

ad c) cash inflow is either raised (decrease of net working capital) or reduced (increase of net working capital) by changes in net working capital (if not included in cash outflow already). The net working capital is converted into money at the maturity of investment what causes increase in cash inflow.

ad d) cash flow from the sale of long-term property at the maturity adjusted by tax depends on market value, residual value and tax regulations related to fixed property.

Because the cash inflow prediction involves possible risk, a variant solution of the cash inflow is used in most cases (e.g. optimistic, realistic and pessimistic presumption).

3.3.5 The investment effeciency evaluation

A final phase of the invesment decision procedure is the investment projects effeciency evaluation with the assistance of variant methods of calculation.

These methods are in economic theory distinguished by different perspectives:

- by factor of time:

  a) static (time factor not considered), used mostly in short life-time of the investment

  b) dynamic (time factor is considered)

- by character of benefits from the investment[9]

  1) methods where the criterion of the evaluation is costs saving (cost criteria of effeciency evaluation)

  2) methods where the criterion of the evaluation is stated profit (profit criteria of effeciency evaluation)

  3) methods where the criterion of the evaluation is cash flow from the investment (net cash flow from the investment)

---

[9] VALACH, Josef: Investiční rozhodování a dlouhodobé financování. 1. vydání, Praha, VŠE, 2001

3.3.5.1 Payback period

The payback period method is defined as 'the time it takes the cash inflow from a capital investment project equals to the cash outflows, usually expressed in years'. The accounting profit increased with depreciation serves as a cash inflow. When deciding between two or more competing projects, the usual decision is to accept the one with the shortest payback period. It is desirable that the expected payback period should be shorter than life-time of an investment. Main disadvantages of the payback method are:

- It ignores the timing of cash flows within the payback period, the cash flows after the end of payback period and therefore the total project return
- It ignores the time value of money
- It is unable to distinguish between projects with the same payback period
- It may lead to excessive investment in short-term projects

Second mentioned disadvantage can be eliminated by discounting cash flows.

Advantages of the payback method:

- Payback can be important: long payback period means capital tied up and high investment risk. Quick, simple calculation and an easily understood concept are few of number of advatages.

Despite the limitations of the payback period method, it is the most widely used method in practice. There are a number of reasons for this:

- It is a particularly useful approach for ranking projects where a firm faces liquidity constraints and requires fast repayment of investments.
- It is appropriate in situations where risky investments are made in uncertain markets that are subject to fast design and product changes or where future cash flows are particularly difficult to predict.
- The method is often used in conjunction with NPV or IRR method and acts as a first screening device to identify projects which are worthy of further investigation.

- It is easily understood by all levels of management.
- It provides an important summary method: how quickly will the initial investment be repaid?

3.3.5.2 Net present value

Net present value is a dynamic method where all possible incomes from the investment are considered. Its basic formula is following:

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

NPV = net present value

CF_n = the net cash flow at the end of year n

i = the discount rate/the required minimum rate of return from investment

N = the duration of the investment project in years.

I = the initial investment

Project can be accepted if the NPV value is positive. It is also necessary to discount initial investment if it is invested gradually.

Comparing projects with different life-time, NPV is converted into an annual average NPV (with present sum factor) or into same life-time (by the smallest mutual multiple).

As an alternative of NPV formula the rentability index can be used. It is ratio of cash inflow from the investment and cash outflow. Project can be then accepted if the value of rentability index is higher or equal to one.

Net present value plays an important role in the world of finance. When used properly, it is a powerful tool that allows business managers to assess projects based on their value. It also adjusts the values of different investment opportunities based on opportunity costs, degree of risk, and the time value of money.

And yet, like any powerful tool, it can be abused. To see why that can be dangerous, a quick overview of the theory behind NPV will be helpful. NPV is the present value (PV) of a project, minus any required investment. The essence of PV is that it allows to state the value of any stream of cash flows in terms of today's money. To do that, investor must first know the cash flows. Investor must also know the correct discount rate to use in the PVcalculation. The discount rate is the rate of return given by equivalent investment alternatives. So, if there is an existing investment in the capital markets equivalent to the project being analyzed and the rate of return of that existing investment is known, investor can now precisely calculate the PV of the cash flows that the project will generate. Subtracting initial investment gives investor the NPV for his project.

Simple enough. Unfortunately, just a few of investors are lucky enough to analyze projects that have a known stream of cash flows. Also, in most real-life situations it's hard to find an existing investment in the capital markets to act as an equivalent. And so, the NPV calculation comes down to two very important assumptions: what the cash flows of the project will be and what the appropriate discount rate is. That is surely difficult to predict the cash flow from the investment and most people are aware that the cash-flow projections are estimates; typically they approach these projections with a reasonable degree of skepticism.

The more difficult part of the calculation is determining the appropriate discount rate. As mentioned above, some projects are not comparable to investments in the capital markets. If a company is trying to decide whether to invest in five-year Treasury notes, it will be no problem finding the appropriate rate of return company´s investors should be demanding. Anybody can daily download this information from websites[10]. However, few

[10] for example: www.cnb.cz

projects are as straightforward as that. Suppose instead of Treasury notes, company is considering making an investment to new product placed at foreign unexplored market. Determining the appropriate discount rate to use in NPV calculation just got a lot harder—investments that are equivalent to this project are scarcer. As a result, finding the rate of return that investors demand for this project will be difficult.

To overcome that difficulty, some analysts use an unfortunate shortcut. In the quest to ensure standard and objective results, companies employ standard discount rates for all projects, often called hurdle rates. There is some logic to this simplification and standardization. If a company only invests in projects that are very similar to the existing business, then one discount rate for all these projects would be correct. This rate would be the rate of return that investors currently demand of the company as a whole.

However, if a company pursues projects outside its core business, that approach will produce misleading results. For example, let's look at a hypothetical company in food industry and investment to production capacity of an existing product. Investors demand a 10 percent return for food industry, and so company uses 10 percent in all its NPV calculations. Now, company is currently reviewing a plan to launch new product placed at foreign unexplored market. If the financial analysts of the company used the 10 percent discount rate, they would be making a big mistake. While investors demand a 10 percent return from an existing products production, they probably demand quite a different rate for new product placed at foreign unexplored market, and that is the rate that company must use.

This is a critical point about the appropriate discount rate: It must represent the risk-adjusted rate of return demanded for the individual project, not the rate of return demanded of the company considering investing in the project. There are formulas using the risk-free rate, market premium, and beta to calculate a discount rate. However, this is not an exact science. The fact of the matter is there is no real way to determine the exact rate. The best any investor can hope for is to come up with a rate that is representative of the risks involved with the investment.

As though the result of an NPV analysis seems to be black and white (either the project is NPV positive or negative), the components of the calculation aren't. In analyzing projects using NPV, financial managers must simply (or not so simply) determine the risk-adjusted discount rate that should be applied to the projected cash flows. If the project has a positive NPV using such a rate, this would probably indicate a project worth doing. But that's not the end of the story. Good managers must then ask themselves why this opportunity is available to the company. What is it about the assumptions underlying the cash-flow projections that make manager confident the opportunity is real?

Using one estimate of cash flow per period also raises the question of how high this estimate should be. As future cash flows cannot usually be predicted with a hundred percent certainty, some probability distribution applies. However, as is the case in many economic decisions, objective probabilities are impossible to generate. The decision makers have to rely on subjective probabilities, which are the personal estimates of those involved in the decision making process. Often a distinction is made between an optimistic, a pessimistic and a neutral prediction per cash flow, each of the predictions is granted a probability to occur (the sum of all probabilities per cash flow being equal to 100%). A possible appropriate estimate of the periodical cash flow will be the expected value (the statistical mean) of the distribution function. It should be noted that 'the statistical mean' is not equal to the cash flow with the highest probability, which is often used as an estimate (of course, in the case of a normal distribution, the statistical mean will be equal to the cash flow with the highest probability of occurrence).

The use of the 'most likely' cash flow will result in a wrong net present value. The 'expected' cash flow, calculated as the statistical mean, should be used. Second, the discount rate is problematic. Besides choosing the right basis for calculating the 'time value of money', its relation to the project risk is a problem. In order to accommodate for project risk a 'risk adjusted discount rate' is often used, which is the sum of a risk-less market rate (e.g. returns on bonds) and some risk premium. Applying a single risk premium assumes a particular risk profile for the whole project. Different stages in the project lifetime and different cash flows may be connected to different risk profiles.

3.3.5.3 The internal rate of return

The IRR is the discount rate at which the NPV for a project equals zero. This rate means that the present value of the cash inflows for the project would equal the present value of its outflows so it is the break-even discount rate. The basic formula of IRR is analogical to one of NPV:

$$\sum_{n=1}^{N} CF_n \frac{1}{(1+i)^n} = I$$

The IRR is found by trial and error. First, a random discount rate is used to calculate NPV. If the NPV is positive, higher discount rate is applied to reach negative NPV and vice versa. Next step uses the results from the first one to calculate final IRR by method of interpolation[11]:

$$\text{IRR} = i_l + \frac{NPV_l}{NPV_l + NPV_h}(i_h - i_l)$$

IRR method is togerher with NPV frequently used method that guarantee the most precise results (based on assumption of precise prediction of investments´ cash flow) but there are few situations when it is limited or even not possible to use it. IRR cannot be used if mutually exclusive investments or investments with non-convensional cash flow are confronted.

It expresses the return in a percentage form rather than in terms of absolute dollar returns, e.g. the IRR will prefer 500% of 1 CZK to 20% return on 100 CZK. However, most companies set their goals in absolute terms and not in % terms, e.g. target sales figure of 2.5 million CZK.

[11] Fotr, J.:Podnikatelský plán a investiční rozhodování. Grada, 1996

3.4 Weighted average cost of capital

This chapter is included because WACC method is usually used to calculate general companys´ discount rate and hence to derive risk-adjusted discount rate applied for particular investment.

The capital funding of a company is made up of two components: debt and equity. Lenders and equity holders each expect a certain return on the funds or capital they have provided. The cost of capital is the expected return to equity owners (or shareholders) and to debt holders, so WACC is the return that both stakeholders - equity owners and lenders - can expect. WACC, in other words, represents the investors' opportunity cost of taking on the risk of putting money into a company.

To understand WACC, think of a company as a bag of money. The money in the bag comes from two sources: debt and equity. Money from business operations is not a third source because, after paying for debt, any cash left over that is not returned to shareholders in the form of dividends is kept in the bag on behalf of shareholders. If debt holders require a 10% return on their investment and shareholders require a 20% return, then, on average, projects funded by the bag of money will have to return 15% to satisfy debt and equity holders. The 15% is the WACC.

If the only money the bag held was 50 CZK from debt holders and 50 CZK from shareholders, and the company invested 100 CZK in a project, the return from this project, to meet expectations, would have to return 5 CZK a year to debt holders and 10 CZK a year to shareholders. This would require a total return of 15 CZK a year, or a 15% WACC Securities analysts employ WACC all the time when valuing and selecting investments. In discounted cash flow analysis, for instance, WACC is used as the discount rate applied to future cash flows for deriving a business's net present value. It also plays a key role in economic value added (EVA) calculations.

Investors use WACC as a tool to decide whether or not to invest. The WACC represents the minimum rate of return at which a company produces value for its investors. Let's say a company produces a return of 20% and has a WACC of 11%. That means that for every dollar the company invests into capital, the company is creating nine cents of value. By contrast, if the company's return is less than WACC, the company is shedding value, which indicates that investors should put their money elsewhere.

WACC serves as a useful reality check for investors. To be blunt, the average investor probably wouldn't go to the trouble of calculating WACC because it is a complicated measure that requires much detailed company information. Nonetheless, it helps investors know the meaning of WACC when they see it in brokerage analysts' reports.

To calculate WACC, investors need to determine the company's cost of equity and cost of debt. Here's a breakdown:

3.4.1 **Cost of Equity**

The cost of equity can be a bit tricky to calculate as share capital carries no "explicit" cost. Unlike debt, which the company must pay in the form of predetermined interest, equity does not have a concrete price that the company must pay, but that doesn't mean no cost of equity exists. Common shareholders expect to obtain a certain return on their equity investment in a company. The equity holders' required rate of return is a cost from the company's perspective because if the company does not deliver this expected return, shareholders will simply sell their shares, causing the price to drop. The cost of equity is basically what it costs the company to maintain a share price theoretically satisfactory to investors. On this basis, the most commonly accepted method for calculating cost of equity comes from the Nobel Prize-winning capital asset pricing model (CAPM)[12]:

$$R_E = R_f + \beta * (R_m - R_f)$$

[12] LUMBY, S.- JONES, C.: Corporate Finance - theory and practice, 7th ed., London, Thomson Learning, 2006

R_f = risk-free rate - This is the amount obtained from investing in securities considered free from credit risk, such as government bonds from developed countries. The interest rate of Treasury Bills is frequently used as a proxy for the risk-free rate.

β = beta - This measures how much a company's share price reacts against the market as a whole. A beta of one, for instance, indicates that the company moves in line with the market. If the beta is in excess of one, the share is exaggerating the market's movements; less than one means the share is more stable. Occasionally, a company may have a negative beta (e.g. a gold-mining company), which means the share price moves in the opposite direction to the broader market.

$(R_m - R_f)$ = equity market risk premium - The equity market risk premium (EMRP) represents the returns investors expect to compensate them for taking extra risk by investing in the stock market over and above the risk-free rate. In other words, it is the difference between the risk-free rate and the market rate. It is a highly contentious figure. Many commentators argue that it has gone up due to the notion that holding shares has become more risky.

The EMRP frequently cited is based on the historical average annual excess return obtained from investing in the stock market above the risk-free rate. The average may either be calculated using an arithmetic mean or a geometric mean. The geometric mean provides an annually compounded rate of excess return and will in most cases be lower than the arithmetic mean. Both methods are popular but the arithmetic average has gained widespread acceptance.

Another way of calculating cost of equity is the one using market share price in calculation. The formula is following[13]:

---

[13] VALACH, Josef: Investiční rozhodování a dlouhodobé financování. 1. vydání, Praha, VŠE, 2001

$$S = \frac{D*100}{R_E - g}$$

Where:

S = market share price

D = annual dividends

R_E = required rate of return from equity (%)

g = constant expected increase in dividends in following years (%)

Converting this formula required rate of return from equity can be easily calculated:

$$i = \frac{D*100}{S} + g$$

This formula has number of modifications depending on the kind of share but generally it is an good way of cost of equity calculation in the case we know market share price and an amount of dividends paid.

Once the cost of equity is calculated, adjustments can be made to take account of risk factors specific to the company, which may increase or decrease company's risk profile of the company. Such factors include the size of the company, pending lawsuits, concentration of customer base and dependence on key employees. Adjustments are entirely a matter of investor judgment and they vary from company to company.

3.4.2 **Cost of Debt**

Compared to cost of equity, cost of debt is fairly straightforward to calculate. The rate applied to determine the cost of debt (Rd) should be the current market rate the company is paying on its debt. Company usually relies on several different types of debt.

Estimate of the general interest rate can be made by looking at company´s long-term debt rating if it is available.

As companies benefit from the tax deductions available on interest paid, the net cost of the debt is actually the interest paid less the tax savings resulting from the tax-deductible interest payment. Therefore, the after-tax cost of debt is Rd (1 - corporate tax rate).

3.4.3 Capital Structure

The WACC is the weighted average of the cost of equity and the cost of debt based on the proportion of debt and equity in the company's capital structure. Theoretically, the market value of both would be desired but it is much easier to get the book value as it is usually used. The proportion of debt is represented by D/V, a ratio comparing the company's debt to the company's total value (equity + debt). The proportion of equity is represented by E/V, a ratio comparing the company's equity to the company's total value (equity + debt). The WACC is represented by the following formula:

$$\text{WACC} = R_E * \frac{E}{V} + R_D * (1 - \text{corporate tax rate}) * \frac{D}{V}$$

A company's WACC is a function of the mix between debt and equity and the cost of that debt and equity. On one hand, in the past few years, falling interest rates have reduced the WACC of companies. On the other hand, the spate of corporate disasters have increased the perceived risk of equity investments.

A reader of this chapter could noticed that debt is cheaper than equity. There are two reasons for this: first, the pretax cost of debt is lower because it has a prior claim on the company's assets. Second, it enjoys the tax shield (i.e. it is a tax-deductible charge), which is why a balance sheet totally devoid of debt may be suboptimal. Because debt is cheaper, by swapping some equity for debt, a company may be able to reduce its WACC.

So why not swap all equity for debt? Well, that would be too risky; a company must service its debt, and a greater share of debt increases the risk of default and/or bankruptcy.

3.5 Risk of investment projects

On a ground of assurance of the return, there are two kinds of Investments - Riskless and Risky. Riskless invesments are guaranteed, but since the value of a guarantee is only as good as the guarantor, those backed by the full faith and confidence of a large stable government are the only ones considered "riskless." Even in that case the risk of devaluation of the currency (inflation) is a form of risk appropriately called "inflation risk." Therefore no venture can be said to be by definition "risk free" - merely very close to it where the guarantor is a stable government.

There are various types of risk from different perspectives:

- based on subject of risk[14]:

a) Personal Risks

This category of risk deals with the personal level of investing. The investor is likely to have more control over this type of risk compared to others.

Timing risk is the risk of buying the right security at the wrong time. It also refers to selling the right security at the wrong time. For example, there is the chance that a few days after you sell a stock it will go up several dollars in value. There is no surefire way to time the market.

---

14 LUMBY, S.- JONES, C.: Corporate Finance - theory and practice, 7th ed., London, Thomson Learning, 2006

Tenure risk is the risk of losing money while holding onto a security. During the period of holding, markets may go down, inflation may worsen, or a company may go bankrupt. There is always the possibility of loss on the company-wide level, too.

b) Company Risks

There are two common risks on the company-wide level.

The first, financial risk, is the danger that a corporation will not be able to repay its debts. This has a great affect on its bonds, which finance the company's assets. The more assets financed by debts (i.e., bonds and money market instruments), the greater the risk. Studying financial risk involves looking at a company's management, its leadership style, and its credit history.

Management risk is the risk that a company's management may run the company so poorly that it is unable to grow in value or pay dividends to its shareholders. This greatly affects the value of its stock and the attractiveness of all the securities it issues to investors.

c) Market Risks

Fluctuation in the market as a whole may be caused by the following risks:

Market risk is the chance that the entire market will decline, thus affecting the prices and values of securities. Market risk, in turn, is influenced by outside factors such as embargoes and interest rate changes.

Liquidity risk is the risk that an investment, when converted to cash, will experience loss in its value.

Interest rate risk is the risk that interest rates will rise, resulting in a current investment's loss of value. A bondholder, for example, may hold a bond earning 6% interest and then see rates on that type of bond climb to 7%.

Inflation risk is the danger that the money one invests will buy less in the future because prices of consumer goods rise. When the rate of inflation rises, investments have less purchasing power. This is especially true with investments that earn fixed rates of return. As long as they are held at constant rates, they are threatened by inflation. Inflation risk is tied to interest rate risk, because interest rates often rise to compensate for inflation.

Exchange rate risk is the chance that a nation's currency will lose value when exchanged for foreign currencies.

Reinvestment risk is the danger that reinvested money will fetch returns lower than those earned before reinvestment. Individuals with dividend-reinvestment plans are a group subject to this risk. Bondholders are another.

d) National And International Risks

National and world events can profoundly affect investment markets.

Economic risk is the danger that the economy as a whole will perform poorly. When the whole economy experiences a downturn, it affects stock prices, the job market, and the prices of consumer products.

Industry risk is the chance that a specific industry will perform poorly. When problems plague one industry, they affect the individual businesses involved as well as the securities issued by those businesses. They may also cross over into other industries. For example, after a national downturn in auto sales, the steel industry may suffer financially.

Tax risk is the danger that rising taxes will make investing less attractive. In general, nations with relatively low tax rates, such as the United States, are popular places for entrepreneurial activities. Businesses that are taxed heavily have less money available for research, expansion, and even dividend payments. Taxes are also levied on capital gains, dividends and interest. Investors continually seek investments that provide the greatest net after-tax returns.

Political risk is the danger that government legislation will have an adverse affect on investment. This can be in the form of high taxes, prohibitive licensing, or the appointment of individuals whose policies interfere with investment growth. Political risks include wars, changes in government leadership, and politically motivated embargoes.

- based on dependence on company´s activity[15]:

a) objective, which is not dependent on company´s activity (e.g. natural, political, economical, social etc.)
b) subjective, which depends on company´s activity (e.g. insufficient technical, economical or personnel knowledge)
c) combined

- based on dependency on overall economic trend or individual company´s trend:

a) systematic, influenced by overall economic trend
b) unsystematic, specific for individual sectors, firms or projects

3.5.1 **Basic calculations of risk**

A standard deviation is the best aid for risk calculation. The concept of standard deviation is based on calculation of deviation of individual cash flows from average expected value. A project with higher standard deviation is then more risky one. The basic formula of standard deviation is following:

---

[15] VALACH, Josef: Investiční rozhodování a dlouhodobé financování. 1. vydání, Praha, VŠE, 2001

$$\sigma = \sqrt{\sum_{j=1}^{N} \left(CF_j - \overline{CF}\right)^2 * p_j}$$

Where:

σ = standard deviation

P_j = individual expected cash flows of different variant (e.g. optimistic,

pesimistic, realistic)

$\overline{P}$ = average expected value of cash flow from investment

p_j = probability of indidual cash flows

j = individual variants of expected cash flow

N = number of variants of exptected cash flow

3.5.2 Simple sensitivity Analysis

A sensitivity analysis is one of the better alternatives to understand uncertainty in any type of financial model. A sensitivity analysis changes each precedent variable at a time and then notes the changes of the resulting variable. For example, precedent variables can be the inputs to the Net Present Value (NPV) calculation such as incomes and outcomes while the resulting variable is the NPV value.

The objective of a sensitivity analysis is to identify critical inputs of the financial model and how their variability impacts the result. This is particularly important in investmentswhere a change of let say 10% in an input can make the project unprofitable.

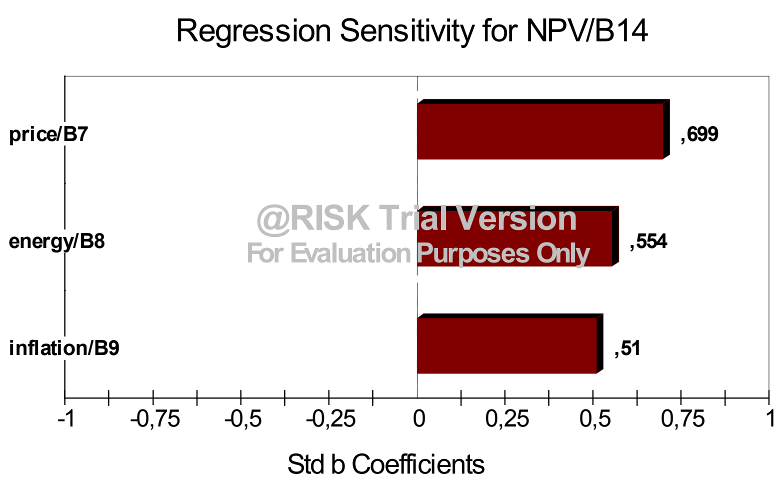
A sensitivity analysis enables managers to understand the dynamics of the underlying variables. Managers are able to establish the deterministic and uncertain variables. The uncertain variables are called critical success factors as they will be the main drivers of the overall result. Managers can then focus their attention in the critical success factors and uncover additional information that may decrease the overall risk of the project.

3.5.3 Mutual sensitivity analysis

A simple sensitivity analysis determines the effect on the overall result by changing one variable at a time. A mutual sensitivity analysis determines the effect of changing all the variables at the same time while introducing probability distributions for each variable. The mutual sensitivity analysis considers all possible combinations and outcomes. The resulting output will be a distribution of the output or resulting variable.

A sensitivity analysis can be represented using a Tornado diagram, which depicts the most sensitive precedent variable along with the impact on the overall result.

Graph no. 1: Tornado Analysis Diagram



3.6 Capital budgeting

Another very important phase of whole investment decision process is the choice of appropriate source to fund an undergoing investment. There are many ways of investment funding what usually depends on type of business, size of business, market position, indebtedness or management capabilities. A possibility of shares or obligations issues as source of funding is closed to the business forms which are not joint-stoct companies. The possibilities of bank borrowing for small firms are quite limited compared to large companies. A highly indebted company faces serious problems of expanding its sources of funds.

It is very important to confront the possibilities of investment funding and costs of these capital sources. It is generally approved that external sources are usually more expensive than internal sources and long-term capital more expensive than short-term one. In the case of investments, only long-term capital funds should be considered because the nature of an investment is also long-termed.

Main goals of capital budgeting are:

- to obtain required amount of capital to undergo planned investment with required rate of return
- to reach as the least WACC as possible
- to not violate financial stability of the business

3.6.1 Internal sources of investment financing

Internal sources are created exclusively by company´s business activity. Internal sources together with owner´s or shareholder´s investment represent company´s equity.

Internal sources of investment funding are[16]:

- depreciation
- retained earnings
- long-term financial reserves

3.6.1.1 Depreciation

Depreciation is considered as an internal source of funding because the long-term asset depreciation does not represent real money outflow therefore this money can be used for any purpose.

Depreciation is part of working costs what influence profit but it is not money outflow so it can be used together with profit for investment funding.

Depreciation differently from the profit is stable source of funding because it is not influenced as many factors as profit is. Depreciation can be used even if no profit is created.

The amout of depreciation depends on amount and structure of long-term asset, its value, life-time and methods of depreciation itself.

3.6.1.2 Retained earnings

For any company, the amount of earnings retained within the business has a direct impact on the amount of dividends. Profit re-invested as retained earnings is profit that could have been paid as a dividend. The major reasons for using retained earnings to finance new investments, rather than to pay higher dividends and then raise new equity for the new investments, are as follows:

[16] VALACH, Josef: Investiční rozhodování a dlouhodobé financování. 1. vydání, Praha, VŠE, 2001

a) The management of many companies believes that retained earnings are funds that do not cost anything, although this is not true. However, it is true that the use of retained earnings as a source of funds does not lead to immediate payment of cash.
b) The dividend policy of the company is in practice determined by the directors. From their standpoint, retained earnings are an attractive sources of finance because investment projects can be undertaken without involving either the shareholders or any outsiders.
c) The use of retained earnings as opposed to new shares or debentures avoids issue costs.
d) The use of retained earnings avoids the possibility of change in control resulting from an issue of new shares.

A company must restrict its self-financing through retained profits because shareholders should be paid a reasonable dividend, in line with realistic expectations, even if the directors would rather keep the funds for re-investing. At the same time, a company that is looking for extra funds will not be expected by investors (such as banks) to pay generous dividends, nor over-generous salaries to owner-directors.

3.6.1.3 Long-term financial reserves

This category consists of reserve funds and long-term reserves.

The long-term reserves differentiate from reserve funds because it is included in liabilities as debt or residual capital and it is accounted as costs.

Funds created from the profit can be used as investment source of funding if it is created for this purpose. Lawful reserve funds can never be used for investment funding.

All above mentioned ways of financing are considered as self-financing through internally created sources. An advantage of self-financing is that it doesnt raise the amount of shareholders or creditors mantaining same level of risk indebtness. Cost of this capital and instability are few of main disadvantages therefore company usually considers combination or pure external financing that is mentioned in next chapter of this diploma work.

3.6.2 External financial sources

Main ways of external financing are as following:

- company shares
- loan stock
- bank borrowing
- lease

3.6.2.1 Company shares

The most common type of shares are ordinary shares. Ordinary shares are issued to the owners of a company. They have a nominal or 'face' value. Ordinary shareholders put funds into their company:

a) by paying for a new issue of shares
b) through retained profits.

Simply retaining profits, instead of paying them out in the form of dividends, offers an important, simple low-cost source of finance, although this method may not provide enough funds.

3.6.2.2 Loan stock

Loan stock is long-term debt capital raised by a company for which interest is paid, usually half-yearly or yearly and at a fixed rate. Holders of loan stock are therefore long-term creditors of the company. Loan stock has a nominal value, which is the debt owed by the company, and interest is paid at a stated "coupon yield" on this amount.

3.6.2.3 Bank borrowing

Borrowing from banks is an important source of finance for companies. Bank lending is still mainly short term, although medium-term lending is quite common these days.

Short term lending may be in the form of:

a) an overdraft, which a company should keep within a limit set by the bank. Interest is charged (at a variable rate) on the amount by which the company is overdrawn from day to day;
b) a short-term loan, for up to three years.

Medium-term loans are loans for a period of from three to ten years. The rate of interest charged on medium-term bank lending to large companies will be a set margin, with the size of the margin depending on the credit standing and riskiness of the borrower. A loan may have a fixed rate of interest or a variable interest rate, so that the rate of interest charged will be adjusted every three, six, nine or twelve months in line with recent movements in the Base Lending Rate.

Lending to smaller companies will be at a margin above the bank's base rate and at either a variable or fixed rate of interest. Lending on overdraft is always at a variable rate. A loan at a variable rate of interest is sometimes referred to as a *floating rate loan.* Longer-term bank loans will sometimes be available, usually for the purchase of property, where the loan takes the form of a mortgage. When a banker is asked by a business customer for a loan or overdraft facility, he will consider several factors, known commonly by the mnemonic PARTS:

- Purpose (The purpose of the loan A loan request will be refused if the purpose of the loan is not acceptable to the bank)
- Amount (The amount of the loan. The customer must state exactly how much he wants to borrow. The banker must verify, as far as he is able to do so, that the amount required to make the proposed investment has been estimated correctly)
- Repayment (How will the loan be repaid? Will the customer be able to obtain sufficient income to make the necessary repayments?)
- Term (What would be the duration of the loan? Traditionally, banks have offered short-term loans and overdrafts, although medium-term loans are now quite common)
- Security (Does the loan require security? If so, is the proposed security adequate?)

3.6.2.4 Lease

A lease is an agreement between two parties, the "lessor" and the "lessee". The lessor owns a capital asset, but allows the lessee to use it. The lessee makes payments under the terms of the lease to the lessor, for a specified period of time.

Leasing is, therefore, a form of rental. Leased assets have usually been plant and machinery, cars and commercial vehicles, but might also be computers and office equipment. There are two basic forms of lease: "operating leases" and "finance leases".

3.6.2.4.1 Operating leases

Operating leases are rental agreements between the lessor and the lessee whereby:

a) the lessor supplies the equipment to the lessee

b) the lessor is responsible for servicing and maintaining the leased equipment
c) the period of the lease is fairly short, less than the economic life of the asset, so that at the end of the lease agreement, the lessor can either
    i. lease the equipment to someone else, and obtain a good rent for it, or
    ii. sell the equipment secondhand.

3.6.2.4.2 Financial leases

Finance leases are lease agreements between the user of the leased asset (the lessee) and a provider of finance (the lessor) for most, or all, of the asset's expected useful life.

Suppose that a company decides to obtain a company car and finance the acquisition by means of a finance lease. A car dealer will supply the car. A finance house will agree to act as lessor in a finance leasing arrangement, and so will purchase the car from the dealer and lease it to the company. The company will take possession of the car from the car dealer, and make regular payments (monthly, quarterly, six monthly or annually) to the finance house under the terms of the lease.

Other important characteristics of a finance lease[17]:

a) ownership right to the subject of the lease is transfered from the lessor to the lessee at the end of lease period.
b) the lease period must exceed 20% of depreciation period stated by law, at least 3 years (8 years in the case of real estates)
c) a price of the subject of the lease at the end of lease cannot be higher than residual value after equal depreciation

Why might leasing be popular?

---

[17] dle zákona č.586/1992 o daních s příjmů v aktuálním znění

The attractions of leases to the supplier of the equipment, the lessee and the lessor are as follows:

- The supplier of the equipment is paid in full at the beginning. The equipment is sold to the lessor, and apart from obligations under guarantees or warranties, the supplier has no further financial concern about the asset.
- The lessor invests finance by purchasing assets from suppliers and makes a return out of the lease payments from the lessee. Provided that a lessor can find lessees willing to pay the amounts he wants to make his return, the lessor can make good profits. He will also get capital allowances on his purchase of the equipment.

Leasing might be attractive to the lessee:

- if the lessee does not have enough cash to pay for the asset, and would have difficulty obtaining a bank loan to buy it, and so has to rent it in one way or another if he is to have the use of it at all; or
- if finance leasing is cheaper than a bank loan. The cost of payments under a loan might exceed the cost of a lease.

Operating leases have further advantages:

- The leased equipment does not need to be shown in the lessee's published balance sheet, and so the lessee's balance sheet shows no increase in its gearing ratio.
- The equipment is leased for a shorter period than its expected useful life. In the case of high-technology equipment, if the equipment becomes out-of-date before the end of its expected life, the lessee does not have to keep on using it, and it is the lessor who must bear the risk of having to sell obsolete equipment secondhand.

The lessee will be able to deduct the lease payments in computing his taxable profits.

3.6.2.5 European Union funds

A use of European Funds is special and from the others different way of funding the investment. Since Czech Republic became a member of European Union there is a new yet unexplored possibility for czech investors to use other external source than just a bank borrowing, leasing or so.

There is a possibility to use European funds of various specialization. This kind of source is usually non-reversible and sometimes cover up to 75% of the initial investment.

For the programming period of 2007-20013 Czech Republic is allowed to draw finance from the European Union funds up to 26,69 mld. €, approximately 752,7 mld. CZK. An amount of 132,83 mld. CZK must be contributed from national sources to co-finance the investment projects because European Union finances up to 85% of investment expenditures. Furthermore a system of programming documents and necessary institutional background must be ready. Primarily a sufficient amount of quality projects must exist because Czech Republic could not draw any single euro without it.

A realization of policy of economic and social cohesion (ESC) is ruled by princible of programming when the projects are not chosen randomly but according to how they help to eliminate problems identified in the strategic documents.

The highest priority strategic document on the field of European Union for realization of ESC policy is „Community Strategic Guidelines for Cohesion policy (CSGCP)“ in which the main priorities of ECS policy for 2007-2013 are defined.

Besides that each member of European Union defines its own „National development plan (NDP)“ describing main developing problems of given country. Since the priorities of given country does not usually correspond to the ones defined by ESC on the supranational level, a joint agreement between CSGCP and NDP must be found.

A document representing the joint agreement and also defining a way of ESC policy implementation in the given EU member country is „National strategic reference framework (NSRF)“. Czech NSRF describes strategic objectives, the way of managing and co-ordination of ESC policy in Czech Republic. It represents a system of cash flow from EU funds into Czech Republic and introduces „operational programmes (OP)“ for ESC policy implementation.

In the system of programming documents, the operational programmes are the most important documents for investors because they are thematically and regionally defined and specify the objectives desired to be reached by the executed projects. For the 2007-2013 there is 26 operational programmes devided into three targets of ESC policy:

- Convergence objective
- Regional competitiveness and employment objective
- European territorial co-operation objective

Convergence objective is for support of economic and social development of less developed regions and member countries. In Czech Republic all regions of cohesion except Prague are included in this group of regions. It is implemented by 8 thematic operational programmes (21,23 mld. EUR, app. 598,62 mld. CZK) and 7 regional operational programmes (4,66 mld. CZK, app. 131,38 mld. CZK). An amount of 25,89 mld. EUR (app. 730 mld. CZK) can be draw to reach covergence objective in Czech Republic

A whole diploma work could be spent analysing individual operational programmes[18] and their specialization but for the purpose of this concrete diploma work simple characterization of the most frequented and used OP is sufficient.

3.6.2.5.1 Operational Programme Enterprise and Innovation

The global objective of the OP Enterprise and Innovation is to improve the competitiveness of the CR by the end of the programme period and to bring the innovative

[18] http://www.strukturalni-fondy.cz

performance of the industry and service sectors closer to the level of the major European industrial states. The OP EI should achieve this by significant support of innovations and close interconnection of the development and research area with the business sphere. Emphasis is put on the implementation of results from the R&D sphere into practice. Therefore, all forms of cooperation aiming at achieving these goals should be stimulated. Supporting the formation of an appropriate environment for business and innovations is also an inseparable part, as it will motivate both the establishment of new firms and the development of already existing ones. The programme will also focus on supporting business activities in the area of energy savings and stronger promotion of renewable sources of energy. Technical assistance will be used to support the preparation of pilot projects to strengthen absorption capacities, particularly in the field of innovative interventions.

One of the subprogrammes of operational programme Entreprise and Inovations is specified in area of support for energy production from renewable sources. Concretely, this kind of support is included in subprogramme Ekoenergy. Ministry of industry and trade and specialized unprofit organization Czechinvest are authorized with administration of this operational programme. The ministry of industry and trade specifies comprehensive information and strict conditions of supporting concrete types of investment projects in the strategic document. Support is usually in the form of grant or subordinate loan while amount of grant ranges between 0,5 mil. CZK to 100 mil. CZK. Maximum amount of grant is stated as percentage of eligible expenses according to „map of public support". Eligible expenses are classified as long-term tangible and intangible properties, costs of publicity and so on, but no second-hand property, labour, insurance, fees and penalties, VAT, loan repayments, interests or costs before date of acceptance are supported. In the case of company´s investment into solar thermal power plant, support could be granted for overall purchase and instalation of PV system. Following table (Table no.1) contains maximum levels of support depending on location of investment and character of subject applying for EU grant.

Table no.1: Distribution of EU grant in individual parts of Czech Republic for period 2007-2013

Region NUTS II.	Small organization	Middle-size organization	Large organization
Central Moravia, Northwest, Central Bohemia, Moravia-Silesia, Northeast, Southeast	60%	50%	40%
Southwest (1.1.2007 - 31.12.2010)	56%	46%	36%
Southwest (1.1.20011 - 31.12.2013)	50%	40%	30%

Source: Ministry of Enterprise and Trade, Operational programme Enterprise and Innovation documentation

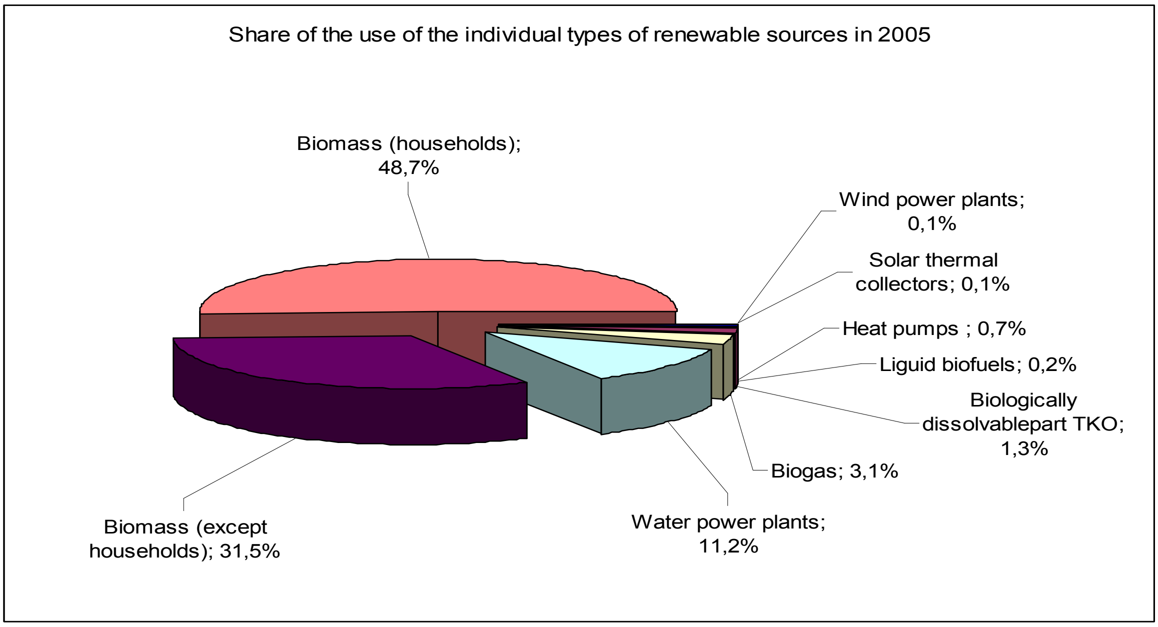
3.7 More about character of the investment

3.7.1 Renewable source of energy

Energy production from renewable sources is very frequented theme of conversation nowadays. Globally, today´s environment is getting polluted and natural sources more valuable because of their lack. On the other side, man consumes more and more energy because of technical progress. There are natural sources (for example sun, water or wind) which remain stable on the amount and relatively renewable. Scientists have already invented a way how to produce energy using these natural sources as the inputs. But still the energy production using these renewable natural sources is expensive and not so effective compared to the energy produced in coal or nuclear power stations. Therefore the energy produced from renewable sources is supported by governments of any developed country all over the world.

In compliance with the EU Regulations 2001/77/EC, the share of electric power generation from renewable energy sources on total gross electricity consumption should increase to 8 % in the Czech Republic by the year 2010. In the year 2005 the share of renewable sources of energy on primary consumption of energy sources should have reached 5 to 6 % according to the objectives of the State Energy Policy. In 2006, only 4.4% were achieved, which means that the current state in the Czech Republic does not meet the set objective. Following graph (no.2) is segmenting shares of use of the individual renewable sources in year 2005:

Graph no.2: Share of use of the individual types of renewable sources in 2005



Source: Ministry of Enterprise and Trade, Operational programme Enterprise and Innovation documentation.

3.7.2 Solar Energy

Solar thermal power station represents clean, quiet and environmentally saving way how to produce electricity from solar energy. The only inputs we need are solar collectors and intensive sun shine to start producing electricity. Amounts of electricity produced from square metre of solar collector depends on type of collector, duration and intensity of sun shine. Therefore the production of solar energy is much more effective in areas like California in USA, Spain or Morocco for example. Moravia and South Bohemia are locations where annual duration and intesity of sunshine are of the highest in Czech Republic. So the right location of solar thermal power station is crucial success factor investing into this project.

A photovoltaic (PV) or solar cell is the basic building block of a PV (or solar electric) system. An individual PV cell is usually quite small, typically producing about 1 or 2 watts of power. To boost the power output of PV cells, they are connected together to form larger units called modules. Modules, in turn, can be connected to form even larger units called arrays, which can be interconnected to produce more power, and so on. Because of this modularity, PV systems can be designed to meet any electrical requirement, no matter how large or how small.

By themselves, modules or arrays do not represent an entire PV system. We also need structures to put them on that point toward the sun, and components that take the direct-current electricity produced by modules and "condition" that electricity, usually by converting it to alternate-current electricity.

The size of an array depends on several factors, such as the amount of sunlight available in a particular location and the needs of the consumer. The modules of the array make up the major part of a PV *system*, which can also include electrical connections, mounting hardware, power-conditioning equipment, and batteries that store solar energy for use when the sun isn't shining.

Among typical system components belongs PV Array which is made up of PV modules, environmentally-sealed collections of PV Cells - the devices that convert sunlight to electricity. The most common PV module that is 0,45 m2 in size. Often sets of four or more smaller modules are framed or attached together by struts in what is called a panel. This panel is typically around 1,4 m2 in size. An important part of overall system is so-called „balance of system equipment (BOS)“ including mounting systems and wiring systems used to integrate the solar modules into the structural and electrical systems. The wiring systems include disconnects for the dc and ac sides of the inverter, ground-fault protection, and overcurrent protection for the solar modules. Most systems include a combiner board of some kind since most modules require fusing for each module source circuit. Some inverters include this fusing and combining function within the inverter enclosure. Dc-ac inverter is the device that takes the dc power from the PV array and converts it into standard ac power. The key component of the system providing feedback to the customer is the power and energy metering. Without proper metering the customer will never know whether the system is operating properly or not. A simple meter, registering the power output of the PV system and recording the energy delivered to the house, factory or energy distribution network can provide the owner with the satisfaction that they can monitor the performance of the system.

Maximum power output of most properly installed PV systems occurs near midday on sunny days in the spring and fall. If the owner fully understands this characteristic they will not be disappointed with unavoidable low output in the middle of the winter. The meter is also a way of proving to the owner that the equipment is properly installed. Often, the owner's primary indication of whether they feel the system is operating properly or not is their monthly electric bill. If the owner suddenly begins using more electricity, they may not see much decrease in their bill and assume the PV system is under-performing. A meter can help avoid disputes between the installer and the owner by showing that the system performs as advertised.

3.7.3 Technology

There are following types of PV cells differing by materials used for their production:

First type of PV cells is made from amouphous silicon. They are expanded in area of small amounts of energy needed (ex. pocket calculators). Degree of efficiency measured in standard test conditions reaches up to 10%, while in common outdoor conditions ranges between 2-6%. Long-term instability is one of the main disadvantages of these types of PV cells.

Well-developed type of PV cells nowaday´s are the ones made from single-crystalline silicon. These PV cells can reach up to 20% of their efficiency in standard test conditions, 14-16% in common use. Surface structuring or antireflex layer can increase efficiency of single-crystalline silicon PV cells even more. However, this type of PV cells is quite expensive compared to its output.

Poly-crystalline (multi-crystalline) silicon PV cells are also used for solar thermal power plants and their efficiency ranges between 11-14% in common conditions. There is a problem with decrease in degree of efficiency during their life-time. It is decreasing more and faster than in the case of single-crystalline silicon PV cells.

Solar modules produce dc electricity. The dc output of solar modules is rated by manufacturers under Standard Test Conditions (STC). These conditions are easily recreated in a factory, and allow for consistent comparisons of products, but need to be modified to estimate output under common outdoor operating conditions. STC conditions are: solar cell temperature = 25 oC; solar irradiance (intensity) = 1000 W/m2 (often referred to as peak sunlight intensity, comparable to clear summer noon time intensity); and solar spectrum as filtered by passing through 1.5 thickness of atmosphere (ASTM Standard Spectrum). A manufacturer may rate a particular solar module output at 100 Watts of power under STC, and call the product a “100-watt solar module.” This module will often have a production tolerance of +/-5% of the rating, which means that the module can produce 95 Watts and still be called a “100-watt module.” To be conservative, it is best to use the low end of the power output spectrum as a starting point (95 Watts for a 100-watt module).

4 PRACTICAL APPLICATIONS

This part of a diploma work is aimed to apply theoretical knowledge on a concrete investment project. It describes detailed analysis and calculations of the investment project specified in methodology part. It provides reader with explanations of techniques that were made analysing this investment project.

4.1 Reasoning of this investment

Following a structure of technical-economic study, reason for this investment project must be specified. The XY company is going to specialize in area of consulting about the problems as energy savings, effective energy using and promotion of renewable sources as a energetical inputs. This investment would serve as a good example and a object of analysis when advicing to the clients. Moreover, this investment is able to generate positive cash flow if it is well planned and executed.

4.2 Capacity and the location

When it comes to a capacity of the market, it is almost unlimited because the government of Czech Republic guarantees that 100% of energy production is obliged to be purchased by administrator of energy distribution network in given area. So the only limitations in this project are specified by capital and other internal sources of the company.

The XY company is an owner of real estate in South Bohemia. It is highly suitable location for photovoltaic system because of several factors. It is located at the flat ground where no forest and buildings are in surroundings. Almost no shadow falls at this area during a day. It is near from the station of energy distribution network. A dimension of this real estate is 1200 m2. An area for photovoltaic power plant should be around two times bigger than the dimension of photovoltaic panels so the company can build up to 600 m2 of PV system.

4.3 Annual incomes

Annual incomes are derived from annual production and the price of energy guaranteed by the special law[19]. Following table shows price decision made by energetical regulation office:

Table no.2: Purchasing prices for production of electricity using solar energy

Date of execution	Purchasing price for energy delivered into energy distribution network (CZK/MWh), incl. VAT 9%
Executed after 1.1.2008	13460
Executed from 1.1.2006 till 31.12.2007	13800
Executed before 1.1.2006	6570

Source: Price decision made by Energetic regulative office no.7/2007

Another important factor is sophisticated calculation of annual energy production. It depends on natural conditions, respectivelly amount of solar energy falling on m2 of earth in given area. A formula for calculation of the amount of solar energy per m2 multiplies duration of sunshine per year (or shorter period) by average intensity of sunshine in given period of time. Following table shows this calculation.

Table no.3: Solar energy per m2 in South Bohemia in 2006

Time period	Sunshine duration (hours)	Intensity of sunshine (W/m2)	Average air temperature (Celsius)	Annual amount of solar energy per m2 (Wh)
April-September	1320	604	19,65	797280
October-March	430	451	2,72	193930
Total				**991210**

Source: Czech hydrometeorologic institut, own calculations

[19] Price decision by Energetic regulative office no. 7/2007 from 13.november 2007

Next table (no.4) represents trend in solar energy per m2 of earth in area of South Bohemia for period 2002-2006 following above mentioned calculations:

Table no.4: Trend of solar energy per m2 in South Bohemia (2002-2006)

Year	**2002**	**2003**	**2004**	**2005**	**2006**
Amount of solar energy per m2 in South Bohemia (Kwh/m2)	913	1023	1050	896	991
Average					**975**

Source: Czech hydrometeorologic institut

Effeciency of PV panels differs from material used for its production. The most effective PV panels are the ones made from multi-crystalline silicon. A price/effeciency rate seems to be the best from all. Despite the effeciency can reach up to 16% in standard test conditions, more important are the values in common outdoor conditions. The distributors of PV systems state standard value according to 12%.

The distributors also guarantee 90% of its nominal output in 12 years of the life-time and 80% in 25 years. It corresponds with 0,8% decrease in nominal output annualy.

Adding data to the following formula we get annual energy gains from square metre of PV panel:

$$EP_t = SE * AE*(1\text{-}d)^t$$

Where:

EP = Energy production from square metre of photovoltaic panel in given year

SE = Amount of solar energy falling on square metre of the earth per year

AE = Average effeciency of photovoltaic panel in %

d = Annual decrease in nominal output

Using given data, the most probable energy production from square metre of PV panel is going to be 117 kWh. This amount multiplied by total dimension of PV system (in m2) and purchasing price (per kWh) we get annual incomes from this investment.

4.4 Annual expenses

Running this investment project requires certain operational expenses. Concretely, it is labour, insurance and other operational expenses.

An amount of labour depends on size of PV system. It is necessary to control a state of PV system, its output, clean PV panels from dust, snow, leafs or so. Somebody have to cut a grass under the PV system or secure an area from vandalism and so on. The amount of labour necessary to ensure a good run of PV system is normalized as 36 hours yearly plus additional 1 hour per week per each 100 m2 of PV system. Actual price per hour of labour is predicted as 80 CZK while 4% annual increase in labour price is expected.

Each PV system should be insured against a natural disaster, vandalism and theft. The conditions and sum of annual insurance paid depends on size, location and value of PV system. An annual insurance fee is predicted to be 0,7% from value of PV system (initial investment). This kind of expense is relatively stable during life-time of the PV system, therefore only 1% increase can be expected.

Among other operational expenses belong small repairs or revisions, administrative costs and fees and other outgoings. Annual operational expenses are calculated as 0,3% of initial investment. 3% annual increase can be expected.

There is a question of depreciation. Despite it is cost and does not represent cash flow, it must be considered in the calculation of NPV because it works as a tax shield. It means that tax base is reduced by annual depreciation before calculating income tax. Photovoltaic system is classified in 2.amortizing group and the period of amortization is 5 years[20]. For our calculation, linear tax depreciation for brand new long-term tangible asset is used. 21% from historic value decreased by the amount EU grant represents depreciation in a first year of amortizing. It is 19,75% for following years. First year of amortizing the PV system is postponed by 5 years because incomes from first 5 years of running solar thermal power plant are freed from income tax[21].

4.5 Annual cash flow

Incomes are predicted using approximate annual energy production from 600 m2 of PV system (0,8% annual decrease is considered) which is about 71 MWh in the first year. This amount of production is multiplied by purchasing price actually corresponding to 12 348 CZK/MWh (without VAT 9%). State energetical regulation office guarantee at least 2% increase in purchasing price for energy produced from renewable source, concretely solar energy. So the total incomes in the first year after execution this investment project are predicted to be 876 ths. CZK.

Total labour expenses in the first year are predicted on the level 28 ths. CZK. Insurance as a percentage (0,7%) from intial investment (8 357 ths. CZK) is going to be approximately 59 ths. in the first year. Other operational expenses amount to 25 ths. CZK.

Another step is a calculation of earnings before interest and taxes (EBIT) in each year during life-time of the investment. EBIT is expected to be negative figure from 6. to 10. year because the depreciation will be applied. It will cause cumulating tax loss that can be used to reduce positive tax base at the time XY company reports positive figures. In conclusion, first tax concerning this investment project will not be paid until 12. year of the investment life-time. First five years it is because incomes from this activity are freed from income tax and other 6 years because tax base will be at 0.

---

[20] §31, odst. 1d zákona č. 586/1992Sb. o daních z příjmů v posledním znění zákona
[21] §4, odst. 1e zákona č. 586/1992Sb. o daních z příjmů v posledním znění zákona

To get annual cash flow from this investment, depreciation in 5. to 10. year must be added back to earning before interest after tax.

4.6 Initial investment

An important part of the investment analysis process is a calculation of the initial investment. A majority of the initial investment is spent for photovoltaic panels. There is a lot of producers (Kyocera, Solartec, …) and distributors of different kinds of PV panels (single-crystalline silicon, multi-crystalline carbon, amorphous and so on.) on the market. This competition pushes prices down. An average price for 1,4 m2 large PV panel (multi-crystalline silicon) is 19 500 CZK (without VAT 9%). Installing whole PV system, price for set of PV panels usually includes all necessary cables, equipment and service.

Another part of initial investment is a value of real estate used as a location for PV system. The market price of real estate classified as a regular field in given area is about 300 CZK per square metre. So the total market value of this land is 360 000 CZK. Despite it is only tiny part of the amount of initial investment, it must be considered in the calculation.

So the total initial investment before (EU grant) using 600m2 PV panels amounts to 8 717 ths. CZK (8 357 ths. CZK PV system and 360 ths. CZK real estate).

4.7 EU grant

Thanks to very specific source of capital, grant from funds of European Union, the initial investment can be much lower than predicted. It depends on the independent comission how much money is granted to the individual projects while maximum is limited at the level of 56% of realiable expenses (8 357 ths CZK is eligible in this project) for small organisations. Despite the character of investment is right and suitable for EU grant, an applicant does not have to get anything, if the comission decides so. However, standard amount of EU grant for this kind of projects is usually about 35% of eligible expenses. This source of finance is very attractive because there is no payback. On the other side, it is very administratively and operationally demanding to get this kind of support. In conclusion, the initial investment can be reduced by 2 925 ths. CZK thanks to support of EU. So the total initial investment would be only 5 792 ths. CZK.

4.8 Capital budgeting and WACC

The adjusted income must be discounted to consider inflation, cost of capital and risk of this project. The discount rate should represent all this factors in one figure. Weighted average cost of capital calculated on the level of whole company adjusted to the characteristics and risk of individual project is mostly used. In our calculation, WACC of this concrete project is used as the discount rate. To be able to calculate WACC, shares of individual capital sources on the whole capital need and their required rate must be specified.

The XY company owns real estate as a location for this project. The value of this property is 360 ths. CZK, as was stated before. Then, 200 ths. CZK is deposited on the bank accounts and it is free to use for this purpose. In the addition, the shareholders of the company are willing to invest up to 500 ths. CZK each. In conclusion, total sum of internal capital is 1 560 ths. CZK. It amounts to 24% of total capital needs. The owners of the company require at least 15% from equity.

A residual source of capital would be drawn from a bank loan. An approximate interest rate is predicted to be about 8% p.a. Table no.5 shows calculation of WACC of this investment project:

Table no.5: WACC

Source of capital	Amount of capital	Percentage of total capital	Required rate
Bank loan	4 232 143	73,1%	8%
Equity	1 560 000	26,9%	15%
Total	5 792 143	100,0%	
WACC			**8,7%**

Eu grant, the third source of capital is not considered in this calculation because the amount of EU grant is directly reduced from initial investment. EU grant as a source of capital could be included in the calculation of WACC, respectively discount factor (assuming that initial investment stays unchanged by the amount of EU grant) but the method used in this diploma work seems to be more appropriate.

However, finances granted from funds of European Union are not available right away. The investment must be first executed and financed from other capital sources and then part of the capital outcome is repayed from EU funds. It usually takes months full of bureaucracy before money is transferred back to the investor. Therefore, there is a need for temporary capital source. It can be solved by short-term bank loan with one-shot repayment. Another table (no.6) shows possible scenario of bank loans for this investment:

Table no.6: Timetable of repayments

Bank loan 1

Amount	2 925 000
Duration in years	1
Number of repayments	1
Interest rate (p.a.)	8%
Repayment	3159000

Bank loan 2

Amount	4 232 143
Duration in years	20
Number of repayments	240
Interest rate (p.a.)	8%
Repayment	35 399

There is a theoretical risk that the EU grant will be rejected and the investor will not get any support. In that case, this source would have to be substituted with anything else, most probably with loan. The total amount of loan would reach up to 7 157 ths. CZK and annual repayments 718 ths. (assuming same interest rate 8%). This almost equals to the annual cash flow from this investment.

4.9 Partial results

A appendix no.1 contains overall calculation of NPV from this investment in the case of 600m2 large PV system built on the real estate which XY company owns. The figure of NPV is positive and amounts to 1 490 ths. CZK. To better imagine benefits from this investment, another indicators are added. Firstly, it is rentability index 1,26 (cash flow/initial investment). As higher figure of rentability index as better while all numbers above 1 are acceptable. Payback period of this investment is slightly less than 12 years which means that capital investment would be repaid before the end of life-time. Internal rate of return is 12,6%. It is more than discount rate. Considering stable percentage of EU grant and cost of bank loan (8%), this investment would bring investors as much as 29,7% of their investment annualy.

4.10 Sensitivity analysis

Despite all these positive results and figures, reality can be absolutely different. There is a lot of risk factors affecting this investment. Even if purchasing price is guaranteed by the law and nobody can change it for 20 years ahead, we don´t have certain incomes. Everything depends on how much energy we are able to produce. It is then affected by the solar energy available and effeciency of solar collectors. And this is what is unstable and uncertain. Analysing trend of solar energy falling on the earth in the past, it was quite different year by year. It usually ranges between 950 and 1050. Let say that minimum value equals to 950 while maximum value can be up to 1050. An average value in past 5 years was 975.

Analogically, producers of PV panels stating different information about effeciency of their products. For example, Nelumbo s.r.o., distributor of PV systems states these values as following:

Table no.7: Average effeciency of solar collectors

Solar collector efficiency	Minimum	Standard	Maximum
Individual values in %	11%	12%	14%
Average solar collector efficiency			**12,3%**

Source: Information from ditributor (Nelumbo)

There can be also different situation on the side of capital outcome. An amount of finances granted from EU funds can be 0 or up to 56% of reliable expenses. It is big difference which affects accepting or not accepting. This project would be uneffective if no support is granted. Generally, producing electricity from solar energy is still, at this level of technical progress, very expensive compared to other sources. Only support in the form of guaranteed purchasing price (or green bonus) and EU grants make this investment profitable. Another table shows all possible scenarios what aplicant can get:

Table no.8: EU grant distribution

EU grant	Minimum	Standard	Maximum
Percentage	0%	35%	56%
Average percentage			**30,3%**

There are many other risk factors involving this investment project. For example, change in purchasing price. Change in the amount of labour, insurance a other operational expenses. Change in tax rate or interest rates from bank loan. These all and many others affecting the overall results from this investment but their impact on whole investment is moreless insignificant. Therefore only change in solar energy, level of effeciency and percentage of EU grant will be considered in this sensitivity analysis.

Sensitivity analysis is based on calculations and iterations which are not able to undergo without specialized software. Software called @Risk from Palisade Corporation is used as a very helpful hint to simplify whole process. It is basically macro for Microsoft Excell aplication. It adds very sophisticated statistic and mathematic functions to basic Excell ones.

4.10.1 Risk inputs

First step is to define risk inputs and set their probability distribution functions. A simple Triangular probability distribution is chosen. 3 values (min, max, standard) must be specified to let program calculate basic statistic values using 1000 number of iterations. Results of the iteration can be displayed in two ways. First one is a simple probability density while second alternative is a graph of cumulative probability distribution. Appendix no.2 contains graphs of probability distribution (both probability density and cumulative probability) for each risk input.

Considering interval from 950 to 1050 and most likely value 975 kWh/m2 of solar energy per year, there is a 35% chance that amount of solar energy cross 1000 kWh/m2 and 65% probability that lower than 1000. Weighted arithmetic mean equals to 991,7 kWh/m2 while standard deviation is 21,2 kWh/m2.

An average effeciency of solar collector is predicted to be between 11,387% and 13,452% with 90% probability. There is almost 65% probability that this figure will be approximately 12,1%.

Interpreting result of EU grant probability distribution, an amount of EU grant can be guaranteed with 80% probability to be equal or higher than 20% of eligible expenses.

4.10.2 Simple sensitivity analysis

The simple sensitivity analysis means a change of risk output (NPV for this diploma work) affected by change of one risk input ceteris paribus (considering stable figure of other inputs). The change of risk input can be expressed in percentage, percentiles of probability distribution, absolute values or so. For a purpose of this diploma work, a range of absolute values was used in analysis:

Table no.9: Data range of risk inputs

Risk input	Data range							
Average solar collector effeciency	0,11	0,115	0,12	0,125	0,13	0,135	0,14	
EU grant	0,00	0,08	0,16	0,24	0,32	0,4	0,48	0,56
Amount of solar energy	950,00	970,00	990,00	1010,00	1030,00	1050,00		

With specified date range, the analysis is undergone and results shows that the highest influence on NPV has EU grant risk input. The value of NPV would be – 415 674 CZK if no support from EU were come. On the other side, figure of NPV would reach up to 2 958 888 CZK if the highest possible support were granted. This all is stated considering stable figure of average effeciency (12,33%) and amount of solar energy (991 kWh/m2).

The minor influence on NPV has (still considering given data range) amount of solar energy risk input. The value of NPV ranges between 1 194 025 and 2 046 689. This fact can be also seen in Tornado diagram enclosed in appendix no.3. A marked field of solar energy risk input in this diagram is little compared to the one of EU grant.

4.10.3 Mutual sensitivity analysis

This kind of sensitivity analysis is characterised by mutual effect of change of risk inputs on output (NPV). It takes all risk inputs and their changes in values into consideration and analyses effect on given characteristic of investment effeciency.

Before the sensitivity analysis can be undergone, mutual correlation of risk inputs must be calculated or predicted. This characteristic is usually calculated using time series or detailed data sets. In the case of this diploma work only subjective estimation must replace comprehensive calculation because there are no such a data available. Following table (no.10) represents simple estimation of mutual correlations:

Table no.10: Mutual correlation of risk inputs

@RISK Correlations	Average solar collector efficiency	Amount of solar energy per m2 in South Bohemia (Kwh/m2)	EU grant
Average solar collector efficiency	1		
Amount of solar energy per m2 in South Bohemia (Kwh/m2)	0,3	1	
EU grant	0	0	1

Source: @Risk

No dependence is predicted between both EU grant-average effeciency and EU grant-amount of solar energy while correlation 0,3 is estimated between average effeciency and amount of solar energy.

Appendix no.4 contains overall output of the analysis. First table in the appendix includes basic statistics as minimum, maximum and mean values. Absolute values corresponding to percentile values of probability distribution follows. The value of NPV can be as low as – 1 426 103 and as high as 3 652 605 CZK. However, most likely value of NPV of this investment is 1 552 170 CZK. The value of NPV will move from – 330 to 2 913 514 CZK with 90% probability.

The mutual senstivity analysis also confirmed that risk input EU grant has major effect on NPV figure while amount of solar energy does not influence NPV too much. It is explained by partial correlation coeffiecients between risk inputs and risk output. Partial correlation coefficient between EU grant and NPV is higher (0,780) than the one between amount of solar energy and NPV (0,373).

The third table of appendix no.4 provides with very interesting information. To get values of NPV equal to 2 643 238 (corresponding to 90% percentile) or more, values of risk inputs must be at least 45% (EU grant - 89,3% percentile), 13,2% (Average solar collector effeciency – 85,5% percentile), 1005 kWh/m2 (Amount of solar energy – 75,6% percentile).

5 CONCLUSION

The investment decision and capital budgeting is a sophisticated process full of technical information, data analysis and uncertainty. However, it is highly important for the company because investment activity keeps company competitive and able to generate economic profits in the future.

The investment analysed in this diploma work is in a harmony with company´s business plan and moreover with policy of European Union. This enables company to apply for the support from funds of EU. Without support of EU, investment in solar energy would be still unprofitable because of high initial investment into technology.

Values of NPV (1 490 ths. CZK), rentability index (1,26) and IRR (12,6%) symbolize quite possitive effect for the investor. Analysing value of internal rate of return deeply, investor could require yield up to 29,7% from invested capital. On the other side, discounted payback period (almost 12 years) can discourage risk averse investors. It is long time and nobody can precisely predict what happens.

Sensitivity analysis helps to prepare for majority of all possible scenarios of future trend after project execution. It indicates that key role for success of this investment plays the amount of EU grant and solar collector effeciency. Considering the worst figures of all risk inputs of sensitivity analysis together, NPV can be even negative. On the other side, EU grant is the risk factor but the approximate percentage of EU grant is usually known before project execution. No investor would invest in this project without pledge of at least 30% support.

So the most probable effect from this investment considering risk is positive NPV and yield exceeding minimum required rate of return. This concrete investment project can be therefore recommended for execution.

6 LIST OF APPENDIX

7 REFERENCES

[1] Blaha,Z. -Jindřichovská, I.:Jak posoudit finanční zdraví firmy, Management Press 1996

[2] Brealey,-R Myers,S.C.:Teorie a praxe firemních financí, Victoria publisching, 1993.

[3] Doležal, J.-Fireš,B.-Míková,M.:Finanční účetnictví, Grada 1995.

[4] Fotr, J.:Podnikatelský plán a investiční rozhodování. Grada, 1996

[5] Grůnwald, R.:Analýza finanční důvěryhodnosti podniku, Ekopress, Praha, 2001

[6] Křemek,V.-Petráková,I.:Investování, CVUT, 1993

[7] Levy, H. - Sarnat, M.: Kapitálové investice a finanční rozhodování (překlad), 1. vydání, Praha, Grada Publishing, 1999

[8] Lumby, S.- Jones, C.: Corporate Finance - theory and practice, 7th ed., London, Thomson Learning, 2006

[9] Mařík,M.,Moderní metody oceňování podniku, Ekopress, 2001

[10] Neumaierová, I., Neumaier, I.:Výkonnost a tržní hodnota firmy, Grada, 2002

[11] Valach,J.: Investiční rozhodování a dlouhodobé financování, Ekopress, 2001

[12] Wawrosz, P., Zdroje financování podnikatelské činnosti, Sagit, Praha, 1999

[13] Winston, W.: Introduction to Probability Models: Operations Research, Volume II, 4th Edition, Indiana University, 2003

Appendix no.1: Investment effeciency calculation

Annual gains in solar energy from 1m2 of solar collector (kWh/m2)	117
Total dimension of solar collectors (m2)	600

Year	Annual growth	0	1	2	3	4	5	6	7	8
Total annual gains in solar energy	-0,8%	70 171	69 610	69 053	68 501	67 953	67 409	66 870	66 335	65 804

100% Energy into distribution network

year	Annual growth	0	1	2	3	4	5	6	7	8
Annual receipts from selling electricity into energy distribution network	2%	*12,35*	876 777	887 158	897 662	908 291	919 045	929 926	940 937	952 077
Labor	4%	*27 840*	28 954	30 112	31 316	32 569	33 872	35 226	36 636	38 101
Insurance	1%	*58 500*	59 085	59 676	60 273	60 875	61 484	62 099	62 720	63 347
Other operational expense	3%	*25 071*	25 824	26 598	27 396	28 218	29 065	29 937	30 835	31 760
Annual depreciation								1 140 750	1 072 848	1 072 848
EBIT			762 915	770 772	778 677	786 628	794 624	-338 086	-262 102	-253 979
Tax loss			0	0	0	0	0	-338 086	-600 187	-854 166
Tax base			0	0	0	0	0	0	0	0
Earnings before interest after taxes		19% tax	762 915	770 772	778 677	786 628	794 624	-338 086	-262 102	-253 979
Cash flow		(+ depreciation)	762 915	770 772	778 677	786 628	794 624	802 664	810 746	818 869
Discounted cash flow		8,7%	702 127	652 837	606 981	564 321	524 635	487 718	453 377	421 432
Cumulative discounted cash flow			702 127	1 354 963	1 961 944	2 526 265	3 050 900	3 538 618	3 991 995	4 413 427

Total cash flow		**7 281 912**
Initial investment (PV system)		8 357 143
Initial investment (real estate)		360 000
EU grant	35,0%	-2 925 000
Total investment after EU grant		**5 792 143**
NPV		**1 489 769**
Rentability index		1,26

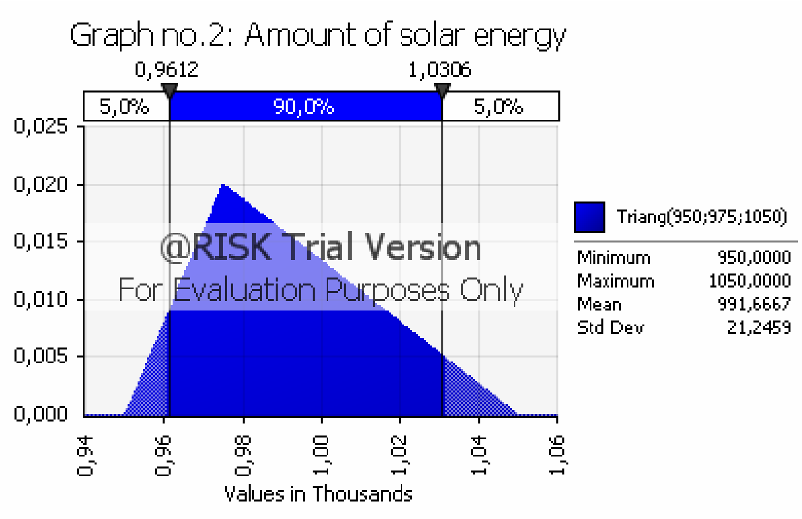
9	10	11	12	13	14	15	16	17	18	19	20
65 278	64 755	64 237	63 723	63 214	62 708	62 206	61 709	61 215	60 725	60 239	59 757

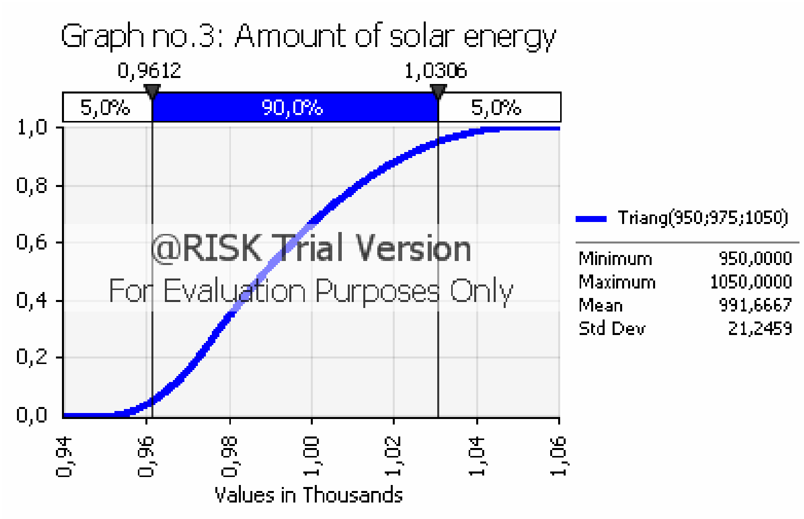
9	10	11	12	13	14	15	16	17	18	19	20
963 350	974 756	986 297	997 975	1 009 791	1 021 747	1 033 844	1 046 085	1 058 471	1 071 003	1 083 684	1 096 514

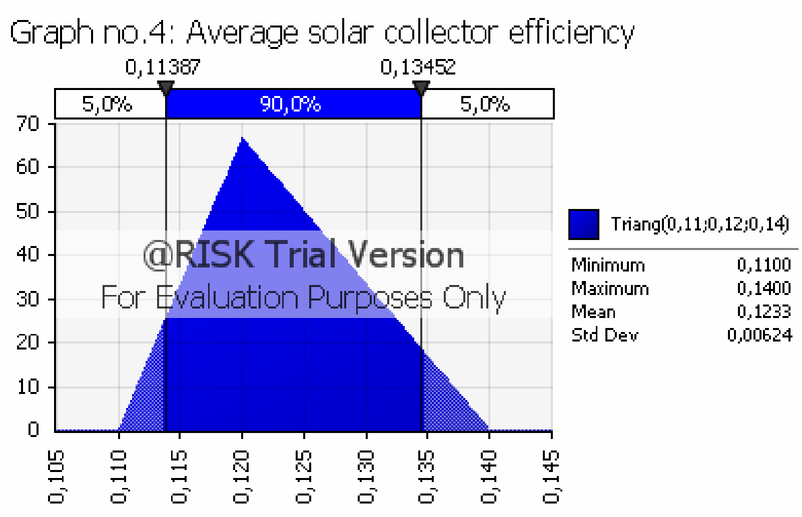
39 625	41 210	42 858	44 573	46 356	48 210	50 138	52 144	54 230	56 399	58 655	61 001
63 981	64 620	65 267	65 919	66 578	67 244	67 917	68 596	69 282	69 975	70 674	71 381
32 713	33 694	34 705	35 746	36 818	37 923	39 060	40 232	41 439	42 682	43 963	45 282
1 072 848	1 072 848										

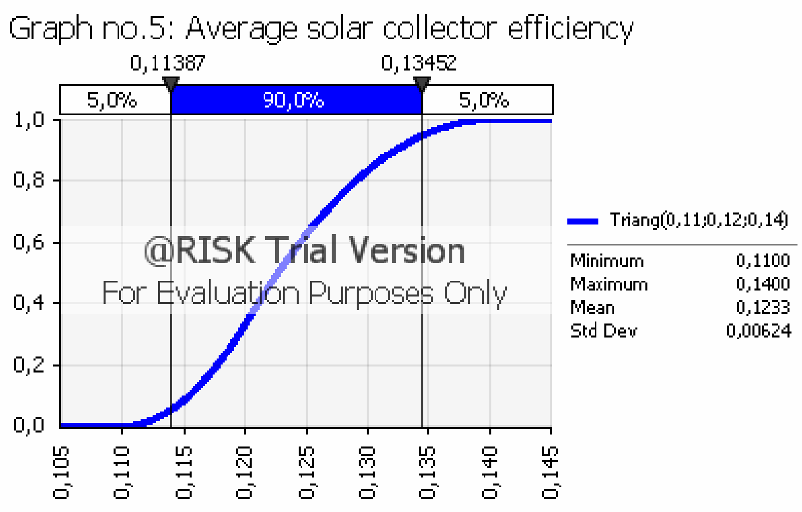
-245 816	-237 617	843 467	851 737	860 039	868 370	876 729	885 113	893 520	901 947	910 392	918 851
-1 099 983	-1 337 599	-494 132	357 605	860 039	868 370	876 729	885 113	893 520	901 947	910 392	918 851
0	0	0	357 605	860 039	868 370	876 729	885 113	893 520	901 947	910 392	918 851
-245 816	-237 617	843 467	783 792	696 631	703 380	710 150	716 942	723 751	730 577	737 417	744 269
827 032	835 232	843 467	783 792	696 631	703 380	710 150	716 942	723 751	730 577	737 417	744 269
391 719	364 081	338 375	289 381	236 707	219 957	204 380	189 893	176 423	163 897	152 250	141 421
4 805 146	5 169 227	5 507 603	5 796 984	6 033 691	6 253 648	6 458 028	6 647 921	6 824 344	6 988 241	7 140 491	7 281 912

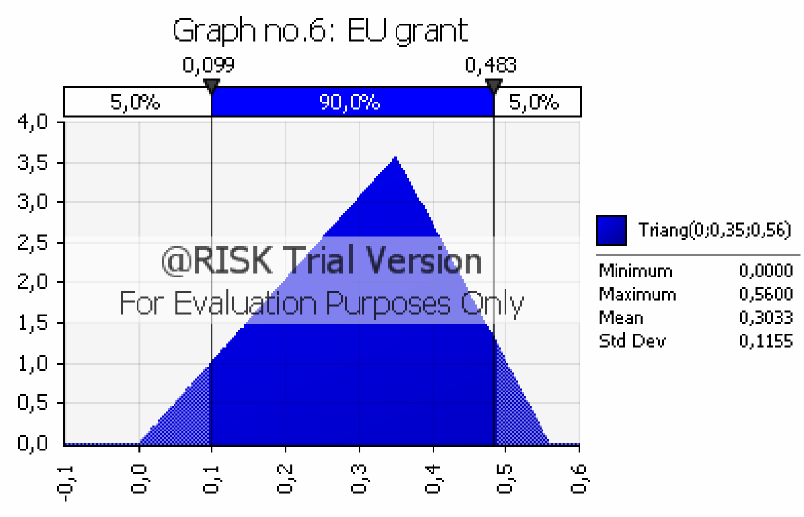
Appendix no.2: Inputs for sensitivity analysis

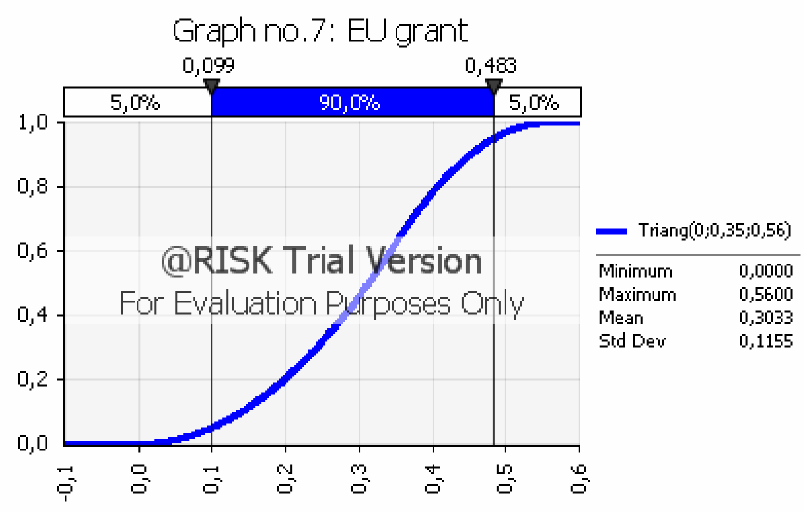





Graph no.4: Average solar collector efficiency
0,11387
0,13452
5,0%
90,0%
5,0%
70
60
50
40
30
20
10
0
0,105
0,110
0,115
0,120
0,125
0,130
0,135
0,140
0,145
@RISK Trial Version
For Evaluation Purposes Only
Triang(0,11;0,12;0,14)
Minimum 0,1100
Maximum 0,1400
Mean 0,1233
Std Dev 0,00624


Graph no.5: Average solar collector efficiency
0,11387
0,13452
5,0%
90,0%
5,0%
1,0
0,8
0,6
0,4
0,2
0,0
0,105
0,110
0,115
0,120
0,125
0,130
0,135
0,140
0,145
@RISK Trial Version
For Evaluation Purposes Only
Triang(0,11;0,12;0,14)
Minimum 0,1100
Maximum 0,1400
Mean 0,1233
Std Dev 0,00624


Graph no.6: EU grant
0,099
0,483
5,0%
90,0%
5,0%
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
-0,1
0,0
0,1
0,2
0,3
0,4
0,5
0,6
@RISK Trial Version
For Evaluation Purposes Only
Triang(0;0,35;0,56)
Minimum 0,0000
Maximum 0,5600
Mean 0,3033
Std Dev 0,1155

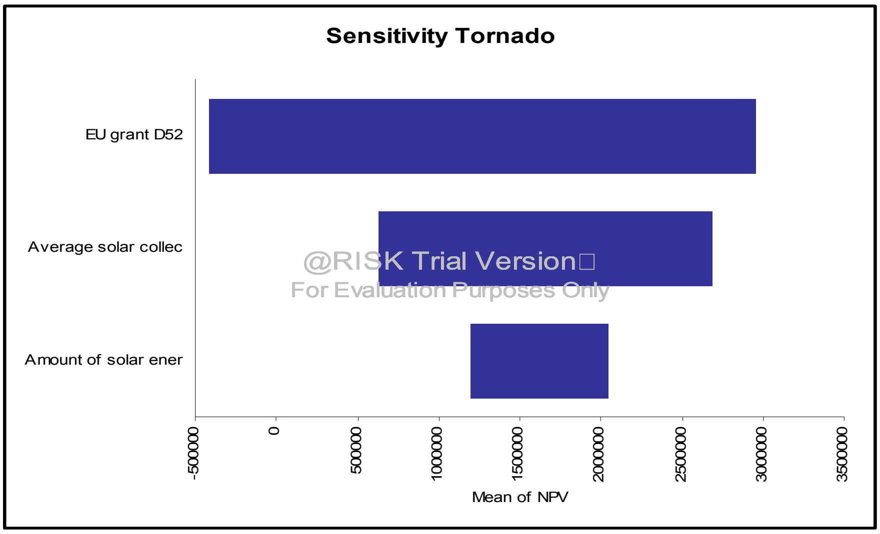

Graph no.7: EU grant
0,099
0,483
5,0%
90,0%
5,0%
1,0
0,8
0,6
0,4
0,2
0,0
-0,1
0,0
0,1
0,2
0,3
0,4
0,5
0,6
@RISK Trial Version
For Evaluation Purposes Only
Triang(0;0,35;0,56)
Minimum 0,0000
Maximum 0,5600
Mean 0,3033
Std Dev 0,1155

Appendix no.3: Simple sensitivity analysis-data range

Analysis	Value of input	Value of output
Average solar collector efficiency	0,11	632 937
	0,115	977 096
	0,12	1 320 667
	0,125	1 663 657
	0,13	2 006 070
	0,135	2 347 964
	0,14	2 689 355

Analysis	Value of input	Value of output
EU grant	0,00	-415 674
	0,08	132 062
	0,16	666 184
	0,24	1 183 606
	0,32	1 680 060
	0,4	2 149 487
	0,48	2 581 947
	0,56	2 958 888

Analysis	Value of input	Value of output
Amount of solar energy	950,00	1 194 025
	970,00	1 364 844
	990,00	1 535 524
	1010,00	1 706 046
	1030,00	1 876 435
	1050,00	2 046 689

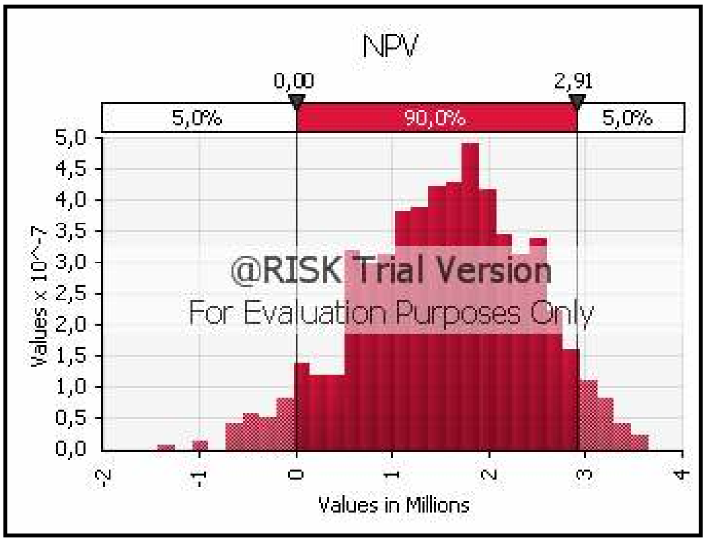


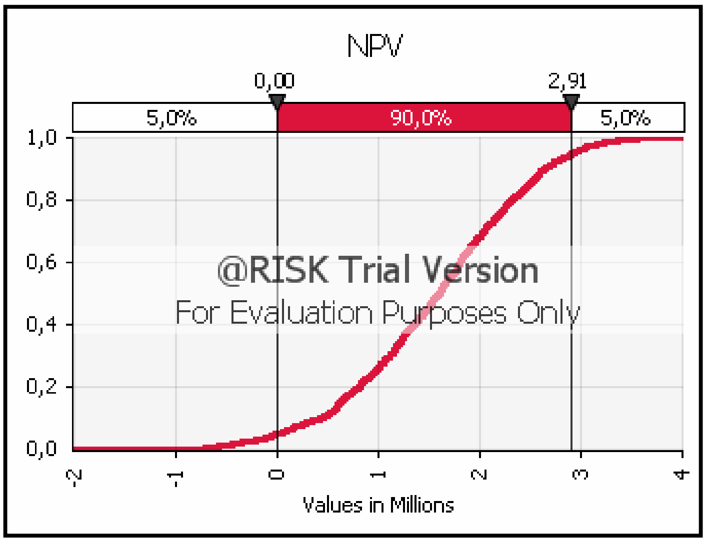
Appendix no.4: Results of mutual sensitivity analysis

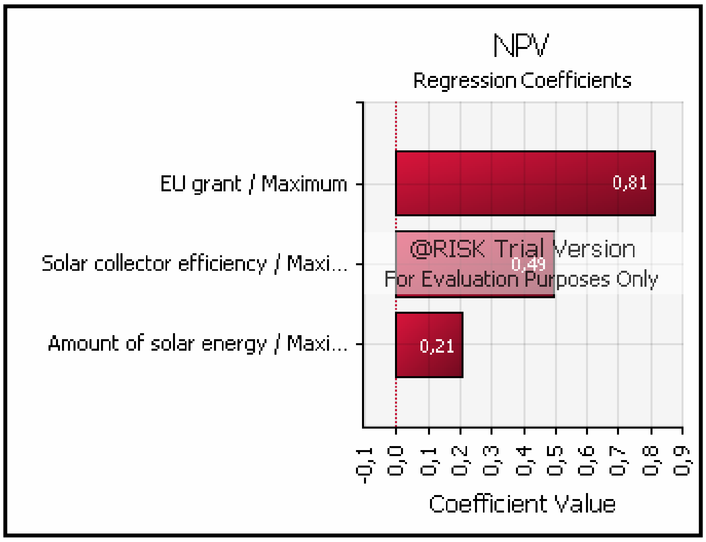
Summary Statistics for NPV			
Statistics		Percentile	
Minimum	-1 426 103	**5%**	-330
Maximum	3 652 605	**10%**	445 882
Mean	1 552 170	**15%**	621 464
Std Dev	869 119	**20%**	809 919
Variance	7,55368E+11	**25%**	965 444
Skewness	-0,238052805	**30%**	1 115 745
Kurtosis	2,761164693	**35%**	1 235 677
Median	1 607 528	**40%**	1 355 400
Mode	1 612 865	**45%**	1 480 656
Left X	-330	**50%**	1 607 528
Left P	5%	**55%**	1 710 831
Right X	2 913 184	**60%**	1 809 329
Right P	95%	**65%**	1 915 441
Diff X	2 913 514	**70%**	2 047 502
Diff P	90%	**75%**	2 172 273
#Errors	0	**80%**	2 312 671
Filter Min	Off	**85%**	2 488 574
Filter Max	Off	**90%**	2 643 238
#Filtered	0	**95%**	2 913 184

Regression and Rank Information for NPV		
Name	**Regr**	**Corr**
EU grant	0,812	0,780
Average solar collector efficiency	0,494	0,535
Amount of solar energy	0,209	0,373

Name	**NPV Percentile**	**NPV Percentile**	**NPV Percentile**
	>75%	<25%	>90%
EU grant	0,844	0,143	0,893
Average solar collector efficiency	0,775	0,299	0,855
Amount of solar energy	0,714	-	0,756


NPV
0,00
2,91
5,0%
90,0%
5,0%
Values x 10^-7
5,0
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
@RISK Trial Version
For Evaluation Purposes Only
-2
-1
0
1
2
3
4
Values in Millions


NPV
0,00
2,91
5,0%
90,0%
5,0%
1,0
0,8
0,6
0,4
0,2
0,0
@RISK Trial Version
For Evaluation Purposes Only
-2
-1
0
1
2
3
4
Values in Millions


NPV
Regression Coefficients
EU grant / Maximum
0,81
Solar collector efficiency / Maxi...
0,49
@RISK Trial Version
For Evaluation Purposes Only
Amount of solar energy / Maxi...
0,21
-0,1
0,0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
Coefficient Value