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TECHNIQUES FOR MANAGING PROJECTS RISK IN CAPITAL BUDGETING PROCESS

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Abstract:
The paper examines capital budgeting process and techniques of risk analysis in the process of selecting optimal project. Corporate manager in process of capital budgeting uses numerous techniques some of them are based on intuition and experience of manager, and some of them are analytic based on sensitive, scenario, decision tree and Monte Carlo method. All methods are used to determinate and to predict risk influence on the projects. Article deals with analytical techniques and real problems that can arise in capital budgeting process. Trough case study in article we analyzed risks that may emerge from different techniques. Conclusion that emerges from analyzing different methods of risk techniques is that only with right combination of these techniques corporate manager could decide correctly to choose optimal capital project.

Key words: Monte Carlo, sensitive method, scenario method, decision tree, NPV, discount rate.

INTRODUCTION

Capital nnvestment decision i.e. capital budgeting is process that includes series of analysis and decision making processes that have long-term impact on company. Any investment conducted for future net cash growth by company's management, regardless investing in intangible or tangible assets we can describe as capital budgeting. Company management has obligations towards company owners to increase company wealth. In today's uncertain and unpredictable global market, where technical, technological and economical development speed is rapidly increasing, selection of optimal process and selection of optimal project is significantly difficult. Rapid speed development of technique and technology has direct impact on process of business production, on business environment i.e. competition, on size of predicted sale and predicted prices of sale for the project i.e. on projects cash flow.

In project selection process, corporate manager uses various criteria and methods in selecting optimal project. Traditional or conventional evaluating capital budgeting

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methods are: present value, net present value, internal rate of return, profitability index and payback period. Limitation of Present Value (PV) criteria by which projects are eligible if PV is higher than investments (PV ≥ I) is averted by Net Present Value (NPV). Main limitation of PV method is that doesn't take in to account initial investment. NPV is most important criteria, but we must be very careful because NPV involves discounting the expected net cash flows from a project at the discount rate that reflects the risk of those cash flows. Discount rate is the sum of risk-free interest rate and risk premium rate (Qizhi, 2009). An alternative approach to NPV is to make the adjustments for risk to the cash flows and to discount the resulting certainty-equivalent cash flows, instead of the expected cash flows, at the risk-free rate of interest (Schwartz & Trigeorgis, 2001). We must emphasize that trough NPV criteria corporate manager can analyze and determinate approximately maximization of company future value. Problem that may emerge using NPV criteria in situations when corporate managers have more potential investment projects but insufficiently capital to finance them all in that cases manager uses internal rate of return (IRR) or profitability index (PI) criteria. Internal rate of return (IRR) criteria is used by corporate manager to terminate discount rate at which projects NPV is equal zero (NPV = 0). Manager's will accept project if internal rate of return is higher or at least equal as cost of capital i.e. interest rate IRR ≥ k. Profitability index (PI) is criteria that indicate ratio of investment to payoff of proposed project. By PI criteria corporate managers are able to rank project by quantity of value created per unit investment. PI is ratio of NPV and initial investment. Project that has PI > 1 is acceptable, and general rule is that higher project PI the desirable project is. Many authors where dealing about significance of traditional capital budgeting methods (for more see Trigeorgis, 1996). Net present value method can be treated as representative method for capital budgeting evaluating, and for all other's it can be sad that they are "inferior with regard to NPV method" (Rovcanin, 2005).

In process of planning capital budgeting corporate manager must take into account risk. Risk is determinate like combination probability of unwonted occurrence and consequences of realization that probability. In capital budgeting process there are two sorts of risk systematic and unsystematic risks for more about risk see (Kazlauskiene & Christauskas, 2007). Also there are many studies that where conducted to examine risk management and possible measures for avoiding risks. Study conducted by Ari Riabacke has shown that manger can and do avoid risks using different techniques. Most of them, one more, emphasized the importance of alternatives b) Collect more information, c) Check different aspects of the problem, and d) Actively work on the problem to reduce risk (Riabacke, 2006).

Generically known as risk analysis techniques they can be classified into two categories: intuitive and analytical (Smith, 1994). Using analytical techniques like sensitivity analysis, scenario analysis, decision tree and Monte Carlo methods corporate managers are trying to determinate and to predict risks and risks influence on the project. This article deals with analytical categories techniques and real problems which can arise in capital budgeting process.

INTUITIVE AND ANALYTICAL TECHNIQUES OF RISK ANALYSIS

Main problem that arises from capital budgeting process is uncertainty, risk and unpredictability of future sales, prices, inflation, discount rate and future costs. Some

problems that can emerge from capital budgeting process and some techniques and methods to solve these specific problems will be shown trough example of capital project in this article. Suppose that corporate manager have opportunity to invest in unique widget factory. The factory will be built in period of two years, at initial invest (I) of each year 500.000 euro's. It is estimated that factory will produce for 9 years and it is also estimated that it will sale 10 000 products in each year of production at price of 39 euro's and annual costs of 100.000 euros. Predicted discount rate for this project is 15%. Calculating cash flow without concerning time value and calculating NPV in standard way is shown in table 1.

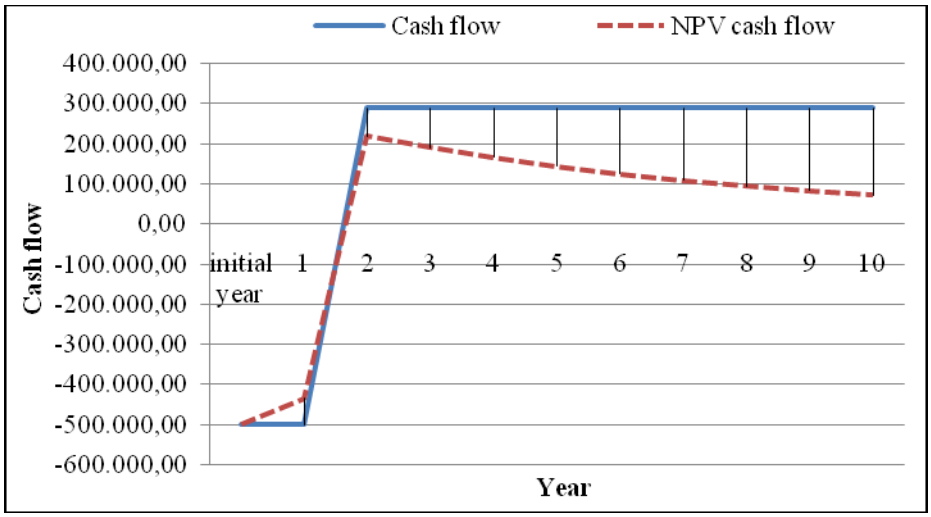
Table: 1: Impact of discount rate on selecting optimal project

Year	Cash flow in euro's	∑ Cash flow in euro's	NPV with 15% discount rate in euro's	∑ NPV with 15% discount rate in euro's
1	-500.000,00	-500.000,00	-500.000,00	-500.000,00
2	-500.000,00	-1.000.000,00	-434.782,61	-934.782,61
3	290.000,00	-710.000,00	219.281,66	-715.500,95
4	290.000,00	-420.000,00	190.679,71	-524.821,24
5	290.000,00	-130.000,00	165.808,44	-359.012,80
6	290.000,00	160.000,00	144.181,25	-214.831,54
7	290.000,00	450.000,00	125.375,00	-89.456,54
8	290.000,00	740.000,00	109.021,74	19.565,20
9	290.000,00	1.030.000,00	94.801,51	114.366,72
10	290.000,00	1.320.000,00	82.436,10	196.802,82
11	290.000,00	1.610.000,00	71.683,57	268.486,38
∑	**1.610.000,00**	-	**268.486,38**	-

Source: author

As we can see from table 1 difference in value between cash flows without concerning time value of money and NPV cash flow is 1.341.513,62 euro's. It is obvious that, from the point of view of time factor, any investor is interested that its investment to be recovered in a shortest possible, or, term of recovery of its investments, as indicator, to be the shortest possible, under certain conditions (Botezatu, 2010). Impact of discount rate to cash flows is over 1 million euro's in period of 11 years. Note that cash flows with times go more by have stronger discrepancy as can be seen in graph 1.

Graph 1: Discrepancy of Cash flow and NPV cash flows



Source: author

Vertical lines between full and dashed line represent cash flow difference. From graph 1 manager can see difference and impact that arises from discount rate. As we can see from graph 1 the difference between regular cash flow and NPV cash flow is increasing as we look to right on X-axis i.e. on time horizon. Impact on progression of cash flow discrepancy have discount factor $(1+k)^n$ i.e. difference between regular cash flow and NPV cash flow emerges from discount rate. Higher discount rate signifies higher divergence factor between cash flows.

More about discount rate impact on cash flows is presented in table 2. In capital budgeting process one of most important things is discount rate determination. There are few models and methods for discount rate determination i.e. cost of capital determination like WACC and CAPM. Cost of capital depends on the structure of the collected capital, which is necessary to start the investment project (Ivanovic, Karanovic, & Bogdan, 2010). Weighted average cost of capital (WACC) is rate of return that must be earned on asset in order to provide an expected return to all suppliers of funds equal to what they could expected from alternative investment opportunities of equal risk. Other way to express WACC is trough formula $WACC = \sum_{j=1}^{n} w_j k_j$, where w_j represents proportion of capital coming from source i, k_j is required rate of return for source i, and n represents number of different sources of capital used. Likewise in process of determination of cost of capital it is necessary to determinate cost of single component of capital (for more see Seitz & Ellison, 2005).

Capital asset pricing model (CAPM) or expected return rate on capital assets (r) represents sum of free-risk rate (r_f), such as interest arising from government bonds and product of beta coefficient or sensitivity of the expected excess asset returns to the expected excess market returns, or also $\beta_j = \frac{Cov\,(r_j r_m)}{Var\,(r_m)}$, and market premium that represents difference between of expected rate of return and risk-free rate of return. The biggest deficiency in beta coefficient is that coefficient itself is not constant. (Bogdan,

Baresa, & Ivanovic, 2010) CAPM model we also can write as mathematical expression $r = r_f + \beta(r_m - r_f)$.

Investors will not take on additional risk unless they expected to be compensated with additional return. Additional risk is represented trough high discount rate i.e. cost of capital. Presentation of NPV cash flow sensitivity on discount rate of reviewed capital project is given in table 2. With regard to sensitivity of NPV cash flow on discount rate investor should be very caution about risk-return tradeoff.

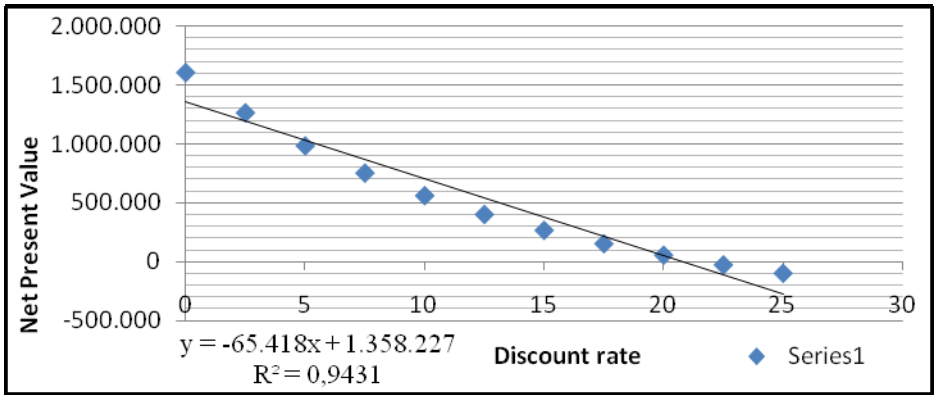
Table 2: NPV cash flow sensitivity on discount rate and regression calculation

Discount rate in %	NPV	xy	x^2	Regression value
0	1.610.000	0,00	0	0,00
2,5	1.267.367	3.168.417,08	6,25	1.194.679,90
5	986.922	4.934.610,89	25	1.031.128,05
7,5	755.700	5.667.748,17	56,25	867.571,20
10	563.743	5.637.426,42	100	704.009,35
12,5	403.343	5.041.783,94	156,25	540.442,50
15	268.486	4.027.295,70	225	376.870,65
17,5	154.447	2.702.824,74	306,25	213.293,80
20	57.484	1.149.671,43	400	49.711,95
22,5	-25.386	-571.187,95	506,25	-113.874,90
25	-96.554	-2.413.851,29	625	-277.466,75

Source: author

From collected and calculated data we can determinate Pearson's coefficient correlation (r) between discount rate and NPV cash flow. Pearson's coefficient of correlation measures dependence between two quantities. So, the correlation from table 2 for eleven examples of discount rate is -0.97115278, it significate almost perfectly negative relationship. From which we can conclude that small growth of discount rate reflect negative and decreases NPV Cash flows.

Graph 2: Discount rate and Net Present Value with regression trend



Source: author

From diagram analysis it is obviously that with increasing discount rate there is tendency of decreasing NPV. Diagram reflects that relation between discount rate and NPV can be expressed by linear regression, which is calculated in table 2. From simple regression trend we can determine almost perfect negative relation between discount rate and NPV. In observed model from calculation and graph 2 we may draw conclusion that with increasing of discount rate NPV is decreasing. Regression coefficient is -65.418 and represents linear value of decreasing NPV if variable discount rate is increase for 1 percent.

Additionally, cash flows project doesn't reflect just on change of discount rate. Cash flows height depends on many factors like price, sale and expenses. Impact of sale, price and expenses is shown in table 3.

Table 3: Cash flow sensitivity to price, numbers of soled products and costs

Number	Sale price in euro	NPV at discount rate 15%	Unit Sales at Price of 39 euro's	Costs	NPV at discount rate 15%	IRR
1.	49	683.407	11.000	90.000	471.797	0,262960
2.	48	641.915	10.900	90.100	455.201	0,259321
3.	47	600.423	10.800	90.200	438.604	0,255663
4.	46	558.931	10.700	90.300	422.007	0,251985
5.	45	517.439	10.600	90.400	405.410	0,248286
6.	44	475.947	10.500	90.500	388.813	0,244566
7.	43	434.455	10.400	90.600	372.216	0,240825
8.	42	392.962	10.300	90.700	355.620	0,237062
9.	41	351.470	10.200	90.800	339.023	0,233276
10.	40	309.978	10.100	90.900	822.426	0,597033
11.	39	268.486	10.000	100.000	268.486	0,216924
12.	38	726.994	9.900	100.100	251.890	0,213011
13.	37	185.502	9.800	100.200	235.293	0,205108
14.	36	144.010	9.700	100.300	218.696	0,205108
15.	35	102.518	9.600	100.400	202.099	0,201115
16.	34	61.026	9.500	100.500	185.502	0,197095
17.	33	19.534	9.400	100.600	168.905	0,193046
18.	32	-21.958	9.300	100.700	152.309	0,188967
19	31	-63.450	9.200	100.800	135.712	0,184858
20.	30	-104.942	9.100	100.900	119.115	0,180717
21.	29	-146.434	9.000	101.000	102.518	0,176545
correlation	**-0,971152**		**0,737208**	**-0,802819**		

Source: author calculation

From cash flows sensitivity to prices, number of soled products and costs calculated in table 3 it is obviously that beside discount rate impact on NPV that great impact have price of sold product, number of sold product and costs. Obviously there is correlation between number of soled products and costs. Higher number of soled

products means lower costs especially variable costs. We must emphasize that number of soled products and costs are inversely proportional, also the costs in our example are not divided in variable and fixed costs. In this example for simplicity of calculating costs are presented as one variable. Analyzing data's from left side of table 3, observing resizing price and impact on NPV, trough calculating correlation between these two values conclusion is that correlation is almost negative perfect i.e. -0,971152. Almost negative perfect correlation between price and NPV suggests that decreasing NPV follows with increasing of price and vice versa. Data on the right side of table signify that with diminishing number of soled products costs growth proportionally inversely, fall of 1.000 products increase costs for 100 euro's. Between number of soled products and NPV there is tight positive correlation (0,737208), which indicate that increasing number of soled products reflects positively on NPV i.e. NPV is also increasing. Correlation between costs and NPV is very strong and expected proportionally inverse. Also analyzing IRR from table 3 we can see that with increasing NPV and IRR is increasing, from that we conclude that higher projects NPV can suffer discount rate i.e. cost of capital.

Corporate managers from presented correlations between differently values in time of uncertainty may be confused and very unsecured what values to use as base values in process of selection process. The distributions could be relativity "tight", reflecting small standard deviations and low risk, or they could be "wide", denoting a great deal uncertainty about the actual of the variable in question and thus a high degree of stand-alone risk (Brigham & Ehrhardt, 2008). For risk determination and risk decrease corporate manager may use techniques for assessing a project's stand-alone risk like sensitivity analysis, scenario analysis, Monte Carlo simulation and decision tree analysis. Many authors where dealing with standard-risk techniques and their usage in practice for more see Kester (Kester, 1999) and Borunen (Brounen, De Jong, & Koedijk, 2004).

TECHNIQUES FOR DETERMINATION STAND-ALONE RISK AND UTILISATION IN PROCESS OF SELECTING THE OPTIMAL PROJECT

First obligation of corporate managers is maximization of owner's wealth but at the same time insuring them from unwanted risks. One of the techniques for determination risks is sensitivity analysis. Sensitivity analysis is a technique that indicates how much NPV will change in response to a given change of an input variable, while other thing held constant. For sensitivity analysis implementation corporate manager need's to determine base values of input variables. A base value represents most likely values and that corporate manager is expecting to occur. When base value's are determine next step is to test net present value cash flows sensitivity on variable variation for a few percentage or few (thousands) units above or below base value, holding other variable constant. We must emphasize that values could be changed under correlation, like costs and number of soled products. Sensitivity analysis is used for projects resistivity determination on market, technical-technological, organizational, and institutional changes that may occur in future but now in time of projects selections process they are hardly perceived.

Trough sensitivity analysis corporate managers can perform net present breakeven analysis. By breakeven analysis managers can find level of inputs under which they

determines NPV of zero or around zero. In table 2 and 3 it is illustrated sensitivity analysis of discount rate, costs, and number of soled products and cost.

Table 4: Breakeven Analysis

Sensitivity of	Sales Price	Unit Sales	Costs	Discount rate	NPV
Base value	**39,00**	**10.000**	**100.000**	**15%**	**268.486,38**
Sales price	32,53	10.000	1000.00	15%	33,00
Soled products	39,00	8.383	101.617	15%	106,00
Discount rate	39,00	10.000	100.000	21,69	76,96

Source: author calculation

If we analyze table 4 we can draw conclusion that sale price level of 32,53 euro's is breakeven point for this project, under condition that all other values stay at same base value level. Other breakeven levels of other values are given in table 4. Breakeven analysis helps corporate managers as guidance to which level of changes for one input project is profitable or at least acceptable.

If corporate manager extended sensitivity analysis with probability distributions of the inputs he is extracting scenario analysis. Scenario analysis estimates probabilities of changes in values not just of one value but more then on variable at once. Scenario analysis if often used to analyze possible future scenarios by considering possible best, worst, and average outcomes (Sherman, Siebers, & Menachof, 2010). Scenario analysis for example of widget factory is given in table 5.

Table 5: Scenario analysis

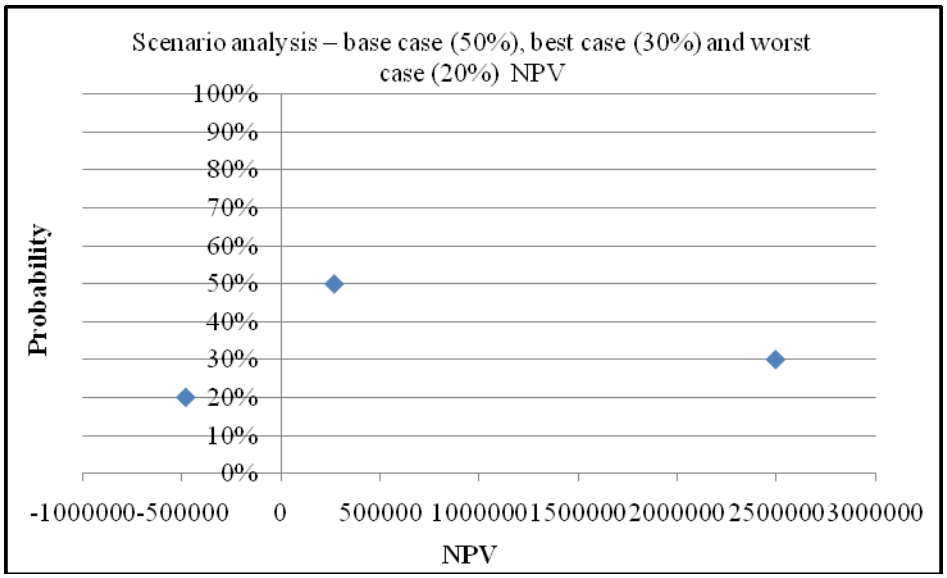
Scenario	Probability	Sales Price	Unit Sales	Costs	Discount rate	NPV
Worst	20%	31,2	8.000	120.000	20,00%	-481.322,28
Base	50%	39	10.000	100.000	15,00%	268.486
Best	30%	50,7	13.000	70.000	10,00%	2.496.156,91
					Expected NPV	786.825,80
					Standard deviation	1.098.706,00
					Coefficient of variation	1,40

Source: author calculation

The base and worse case indicate that if product is successful all combinations of values and variables will be high and will result in very high NPV, almost 2.5 million euro's. However, if product turns unsuccessful then the NPV will be -481 thousand's of euro. The graph 3 shows mangers that this is risky project, because the wide range of possibilities. When the scenarios net present values are calculated corporate manager can determine expected NPV, standard deviation and coefficient of variation. From he is able to compare coefficient of variation with average coefficients of existing

projects. Limitation of scenario analysis is evident in limited number of possible vital values essential for formatting net present value and internal rate of return.

Graph 3: Scenario analysis – base case (50%), best case (30%) and worst case (20%) NPV (in thousands)



Source: author

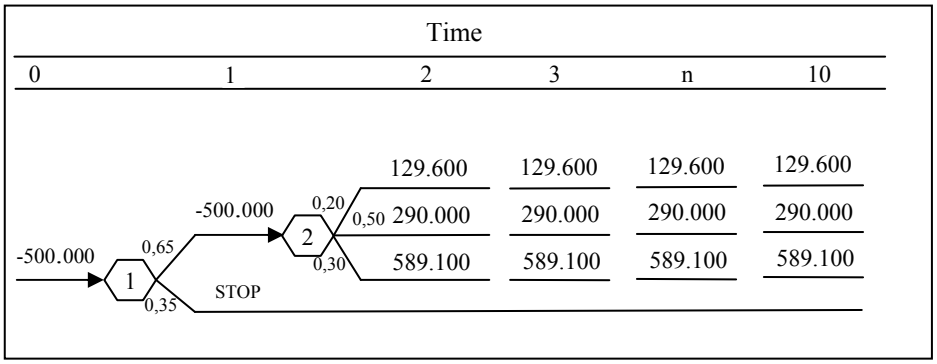
Monte Carlo simulation is upgraded scenario analysis, and also ties together sensitive and probability distribution. For implementation of Monte Carlo simulation corporate managers are using computers and software programs. In simulation analysis software calculate 1.000 NPV's based on random pick of key values. Next step after software calculates random 1.000 net present values, is calculating mean and standard deviation. The mean or also average value corporate manager is using to measure projects expected net present value. By coefficient of variation i.e. standard deviation manager measure projects risk. Monte Carlo simulation provides more precisely results of standard deviation and mean then sensitivity analysis because sensitivity analysis uses limited number of cases. A recent study (Pike & Ho, 1991) noted that, although many managers were familiar with Monte Carlo simulation as a form of risk analysis, comparatively few used it. Since the technique has hitherto required access to specialized computing facilities this is not surprising (Smith, 1994).

Projects that have cost's i.e. expenditures distributed over first several years of projects have advantage of opportunity to reduce risk by using basic decision tree. Information's received on end of first year manager use to reevaluate decisions about project. Manager can decide to invest new unplanned funds and continue with the project or can decide to terminate the project because it's unprofitable.

In our example structure of the first and the second year of project are purely expenditures. As we mentioned the factory will be built in period of two years. At first year of projects it's necessary to conduct a study of the market potential for unique widgets and it's necessary to conduct study of terrain and traffic studies all studies

costs 500.000 euro's. A corporate manager estimate, on information's given by other executive manager's, probability of studies successfulness and probability that project will produce favorable results. Manager estimates that there is 65% probability that first stage of project will show that project is successful and 35% probability that project will give negative consequence. The second year of project is reserved for building a plan at costs of 500.000 euro's. In stage when factory is build management can predict projects generation of best, worse and base net cash flows. Predicted cash flows we all ready detriment in table 5 Scenario analysis as best, worst and base values.

Graph 4: Widget Factory; Decision Tree Analysis



Source: author

From analyzing graph 4 corporate managers can perceive risk level and probability of developing unwonted case. Octagons in graph represents end of year and for manager they are critical points at which they have to bring crucial decisions for project or which they could expect outcomes. Octagons represents nodes in decision tree analysis, in practice there are two sorts of nodes first one is decision nodes like our node 1, and outcome nodes like in our example second node. To conduct full decision tree analysis we must calculated joint profitability, NPV and ponder of joint profitability and NPV. The calculation is given in table 6.

Table 6: Decision tree analysis and calculating expected NPV of the project

0 year	%	1 year	%	n year	Joint Probability	NPV	Ponder of Joint Prob. x NPV
			0.20	**129.000**	0.130	-399.535	-51.940
		-500.000	0.50	**290.000**	0.325	268.486	87.258
	0.65		0.30	**589.100**	0.195	1.509.513	294.355
-500.000	0.35				0.350	-500.000	-17.500
					1.000	Expected NPV	312.173

Source: author

With ponder of joint probability and NPV managers can determine expected NPV based on expectations from graph 4. With decision tree analysis and with cost of capital of 15% we calculated that expected NPV is 312.173 euro's. Using tree decision analysis managers could detect risk, type of risk and time of appearing time in project.

CONCLUSION

Corporate manager have obligation to owners i.e. stockholders to increase company's profitability i.e. long-term profitability. Successful capital projects are fundament of efficient company. Main problem that emerges from capital budgeting is risk and insecurity. Regard to characteristic of capital projects; long period of time implementing and long period of project life, risk and insecurity is very high. Using just traditional methods and techniques managers can't determine with certainly risk. Combining traditional methods and techniques for determination risk process of selecting optimal projects manager can get much better and stronger projects calculations. Using scenario, sensitivity, Monte Carlo and decision tree analysis manager can get better decisions. Enumerate techniques provide miscellaneous information that manager can use in decision process.

In paper trough example of widget factory its argument that using techniques for risk determination manager can perform better because from stand-alone risk techniques they get information's necessary for risk analysis. Trough risk analysis manager could predict cash flow values, and could predict how different decisions affect on project values. In addition to traditional techniques methods like scenario, sensitivity, decision tree and Monte Carlo provide additional view on possible variables that have impact on profitability of project. Using these methods corporate managers can decide with better about acceptance or rejection of the project, because all methods are observing and using in the account risk and probability. For conclusion we determine that successful selection of optimal project can't be conducted without implementation of at least two or more of techniques for risk managing in capital budgeting.

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