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Research Article

SENSITIVITY AND RISK ANALYSIS OF THE ECONOMIC EVALUATION OF INVESTMENT PROJECTS CASE STUDY: DEVELOPMENT PLAN IN SUFIAN CEMENT PLANT

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ABSTRACT
Economic evaluation of investment projects by examining the profitability of the projects in their lifetime is of special important. In this paper, using techniques such as sensitivity analysis and Monte Carlo simulation, we evaluate the possible future profitability of the projects, taking into account possible scenarios. In order to study a real example, the development plan of Sufian cement plant has been selected as a case study. When doing sensitivity analysis against changes in variables such as the discount rate, the amount of initial investment, price, cost of energy consumption and the cost of wages, it is also concluded that sensitivity of NPV to changes in price would be more than the other variables. Also, if an increase of 500% in the cost of energy consumption, the price per ton of cement shall be increased at least up to 35%,this is because the profitability of plan is not decreased, compared with the previous. The results of the risk analysis imply a high risk of the project, with regard to the development plan and also considering possible scenarios for the four selected variables and simulation of cash flow by Monte Carlo simulation in increased energy price.
Classification JEL: C15, C63, D81, G31, G32

Keywords: *Net Present Value, Internal Rate of Return, Payback Period, the Amount of Conversion, Sensitivity Analysis, Risk, Monte Carlo Simulation*

INTRODUCTION
Nowadays with the advancement of technology and the complexity of conditions, the problem of choice and decision-making is associated with difficulties and sometimes for various reasons, decisions, in practice, are not taken correctly.
Hence the need for decision-making is posed based on scientific, technical and engineering evaluation to ensure a correct decision based on the assessment, in confident. This is doubly important in economic activities. Because if the decision is not taken correctly, a missed opportunity will not reversible and in some cases losses will be irreparable. Therefore, before beginning any economic activity, including the creation of a new firm or the development of previously established firms, the need for economic and financial assessment of that activity is delineated based on the profitability or non-profitability to prevent the emergence of possible losses, by complementing this assessment. Given this assessment, if the project was justified by economic evaluations, then the assessment ensured executors a lot to invest in the project and with the peace of mind to continue their activities. Given that economic evaluation is done for the future use and no one can opine with confidence and certainty on the future status of variables such as sales volumes, prices, wages, energy costs, raw material costs etc. and because of that the sensitivity analysis, risk and uncertainty analysis need to find. This sensitivity analysis allows for identifying the factors strongly influencing the profitability of the project and calculating the level of the impact of changes on that. While the probability of each variable is unknown, by simulating the cash flow over the life of the plan, it can examine the level of the impact of possible conditions and achieve the possibility that the level of profitability would be negative under the conditions. This is also known as uncertainty analysis. The evaluations conducted and the results will be reliable only if are based on real information. It is necessary the predicted information of variables of cash flow, without any consideration or manipulation, during its evaluation work has been gathered and this prediction has taken place based only on the basis of past information evolution.

Research Article

Background

On the sensitivity and risk analysis, numerous articles were written in the economic evaluation of projects implemented or under implementation, for example, we mention a few.

In an article titled "Cost-benefit evaluation and sensitivity analysis Sarcheshmeh Copper Complex" written by Dr. M. Lotfalipour and by Sakineh Islami, published by the Journal of Economic Studies, Vol. 4, No. 3, Fall 2007, the author analyzed the activities of the Sarcheshmeh Copper Complex in terms of the cost-benefit of data. For this purpose, two standards, net present value (NPV) and Benefit-Cost Ratio (BCR) were used. The indicators' extraction shows the amount of the net present value of cash flows of 56,846 billion Rials and internal rate of return of 31.5%, in 1991-2001. In2005- 2011, the net present value of the complex is estimated at 5313 billion Rials. Therefore, the activities of Sarcheshmeh Copper Complex have been economically justified. The sensitivity analysis was used to this study to determine the uncertainty effect of each variable on the model and it has come to the conclusion that the most critical parameters in predicting the copper price and the results of the net present value are copper prices and costs, respectively, but any changes in the discount rate had little effect on the net present value. In another article, titled "Economic evaluation and risk analysis at Sungun Copper Mine" written by AR Sayadi, M. Monjazy, Mehrdad Heydari and Mehdi Vahidiand published by the Journal of Mining Engineering in 2007, the author prepared a model using Excel and Comfar software in order to analyze Copper Mine of Sungun economically and financially and in accordance with it, the various scenarios with regard to the expected values of the critical variables were examined. In its following, to analyze the economic and financial risk, Monte Carlo simulation was used to estimate the most likely outcome of the project. Based on the results of the cost analysis, beneficiation and mining companies have been allocated the highest share of 41% and 32% from capital costs, respectively, and the highest share of 52% and 34%, respectively, from operating costs. Internal Rate of Return of the project was estimated 10.16%, considering basic assumptions, especially, copper prices, that the sensitivity of internal rate of return to the price of concentrates would be higher than other factors. In this regard, it is placed a processing plant recovery rate, exchange rate, capital costs, operating costs and mining final slope, on next important levels. Finally, the risk analysis shows that by considering a 90% confidence level, the range of Internal Rate of Return is put on the range less than 19.56%and more than 9.32%.

Theoretical Context of Sensitivity and Risk Analysis

Measuring the risk that has been mixed the future value of cash flows in each project and making its involvement in determining the net present value (NPV) of the project are considered as the project requirements. There are different ways to show the effect of risk on the quantitative value of the NPV and other investment decisions. The followings are some of them.

Sensitivity Analysis

One of the methods in examining acceptance or rejection of the project would be the sensitivity analysis and calculation of the project break even points. When analyzing the break even points which are a special case of sensitivity analysis, a picture of the project's risk level is embodied in the minds of decision makers in order for proper decisions to accept or reject the project. In its followings, the implications of these methods and techniques to analyze and calculate them will be discussed.

There are many ways to analyze the sensitivity of the project. One would be the projects evaluated by various scenarios that the selected variables take appropriate values based on these scenarios in pessimistic and optimistic and or most likely, and based on each situation the values to NPV and IRR of the project are calculated. The results from NPVs will show that which parameters have a great impact on the results of the project evaluation. After that, the project manager can make proper decisions for further efforts to predict accurately the variables or prevent the project due to its high risk.

Sensitivity Analysis Definition

Sensitivity analysis is an analytical method for risky projects using an estimation of NPV for each of the situations that the project's intended parameters take the values of optimistic, pessimistic, or most likely (Dayananda, 2002). When performing sensitivity analysis if we with some change in a particular variable (change in only one variable at a time)want to understand the effect of that variable changing on the NPV

results, it is necessary other variables to have their own constant values of expectation (most likely). This method is used for this purpose of identifying influencing variables on the net present value estimation of the projects. Sometimes sensitivity analysis is so-called to method of "scenario analysis" and the analysis of "What-if?

Switching Values

To do sensitivity analysis, it is required to calculation of the switching values. The switching values of a variable is the amount of change that makes the project NPV equal to zero and or the project IRR equal to the discount rate. Usually the switching values would be expressed as a change percentage in the variable which causes NPV of the project equal to zero. In addition, it is specified the variables which have the greatest impact on the value of the project output. To calculate the switching values, single-dimension change in variables in order to assess their impact on the NPV and IRR is considered. That is, when changing any of these variables, other variables get assumed constant and given this assumption, the necessary change, in percent, for each variable is calculated that NPV to be equal to zero and IRR to equal to the discount rate.

The Steps of Sensitivity Analysis Implementation

1. The calculation of the net present value of the project using the most likely values (expectation) estimated for each variable.
2. Selection of the specific variables that in project manager' opinion will have a profound impact on the results of the project.
3. Prediction of values of optimistic, pessimistic and most likely to these variables over the life of the project.
4. Re-calculation of the net present value of this project for each of these three levels of variables' values. It should be noted that when using a certain amount (optimistic, pessimistic, or most likely) of each variable to calculate the net present value of the project, the value levels of other variables are considered likely.
5- Determination of change limits in the project's net present value at the range of level of pessimistic and optimistic value for each variable
6. Identifying critical and very effective variables in the evaluation of the project.

Sensitivity analysis using spreadsheets with the appropriate change of variables is implementing in a given moment. Doing so, many of the calculations of the project analysis will be reduced. Using the scenario function, Excel software is used for this purpose.

NPV's Changes Curve

NPV's changes curve demonstrates NPV sensitivities versus the changes in the different variables; and the curve can be used to identify the key factors influencing the NPV. It is necessary to draw NPV's changes curve that the change percentage in the variables be plotted against the values of these changes. Plotting the results of this table in a curve so that the horizontal axis as the variables' changes in percent and the vertical axis as NPV's value obtained, the NPV curve will be drawn. On this curve, each of the more sloping charts the relevant variable will have a greater impact on the NPV's value on the NPV's value of project. In other words, the NPV of the project would be more sensitive to this variable.

Risk Analysis or Monte Carlo Simulation

A simple application of the simulation is to evaluating investment projects that are exposed to high levels of uncertainty. So the probability distribution is related to a series of exogenous variables that are out of control which determine annual net cash flow. Unrealistic sampling of the probability distribution is done by a computer to determine the probability distribution. The distribution (i.e. the probability distribution of NPV or IRR) with partial information is provided to decision makers obtain the appropriate decision, in case, accepting or rejecting the project (Dayananda, 2002).

Monte Carlo Methods Description

Under Monte Carlo method, the variables would be randomly obtained by computer based on the probability distribution which is determined to them, which are effective on the process of the cash flow calculation. Computers do this thing by using the random number generated by the function of Rand () in

Excel and the type of probability distribution which was determined to these variables. Given the annual cash flow, the value of NPV and IRR of the project are also determined. This is repeated many times to determine the probability distribution of NPV or IRR accurately. Drawing NPV and IRR's probability distribution on the charts and NPV cumulative frequency distribution chart, the various analyzes were carried out on the rejection or acceptance of the project.

A Kind of the Common Probability Distribution of Monte Carlo Simulations and How to use them

As previously mentioned, depending on the selected probability distribution, different data is required to calculate the effective variables in the process of cash flow by the computer. The probability distributions which are common in Monte Carlo simulations include: the triangular, normal, log-normal, uniform, beta probability distributions that depending on how to distribute the variables' values, one of the probability distributions was employed to generate random values. If the probability on the contingency of values less than the minimum amount and higher of the maximum value of the variable is equal to zero, and if it is most likely to have the contingency some of the variables that are ranged between the minimum and maximum values, compared with the remaining values of the variable, the variable is of a triangular probability distribution. By selecting a triangular probability distribution, it is crucial that high, low and most likely levels be specified for each of the variables that by using the values levels and the random number generated in the range of zero to 1 by conditional formula (1), the computer determined randomly the amount of each of these variables in different years of cash flow.

$$y=\begin{cases} a+\sqrt{r(c-a)(b-a)} & : \ r \le d \\ c-\sqrt{(1-r)(c-a)(c-b)} & : \ r > d \end{cases} \quad (1)$$

It is natural that most of the random values will vary, generated around the value of "Most likely. This formula denotes the variables' low levels, "most likely" levels and high levels as a, b and c, respectively. In addition, r is the random number is generated for each variable in different years and d is obtained from $d=\frac{b-a}{c-a}$.

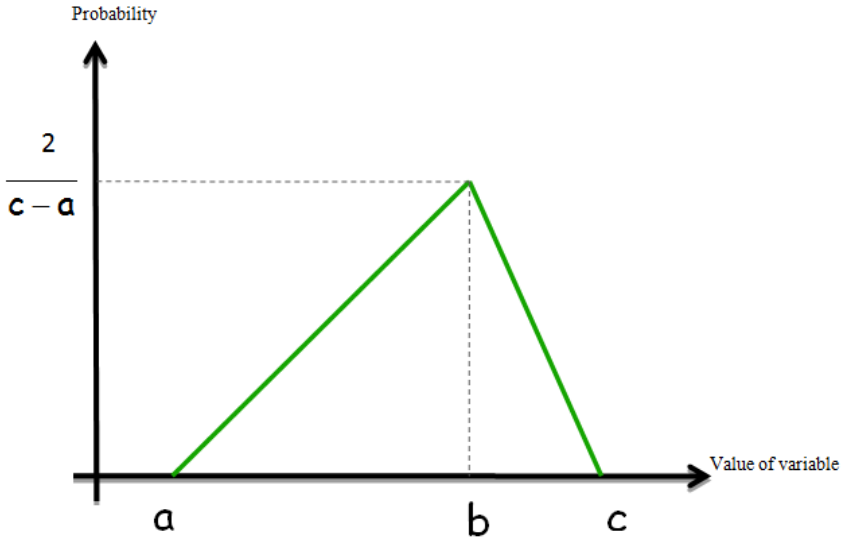

Figure 1: Triangle distribution

If the variable's values distribution is according to the normal probability distribution and with the Urceolate-shaped, to calculate the variables' random values based on this probability distribution, it is necessary the average value of the variable and its standard deviation be known. NORMINV function in Excel was generated by using the random number in the range of zero and its mean value of the variable and standard deviation generate the random values for each variable based on the normal distribution. By

identifying variables' values during different years of cash flow, NPV of the project will be achieved. This will be repeated many times NPV's probability distribution curve and its relative frequency distribution to be drawn, by calculating the NPV's value of each of these iterations. Log-normal probability distribution similar to normal probability distribution requires only average or mean value and standard deviation of variables. LOGNORMDIST function in Excel is used to generate random values of variables based on log-normal probability distribution.

If the probability of variable's values is the same between the minimum and maximum values, the uniform probability distribution is used to obtain random values of the variables. The uniform probability distribution is only dependent on the minimum and maximum values of the variable. Knowing these values and by using the random number generated in the range of zero to one, it can be determined the random value of the variable by the formula $y = a + r(b-a)$ in that the minimum and maximum amount were denoted by a and b, respectively. In this case, all random numbers generated have the contingency $\frac{1}{b-a}$ that is ranged in interval (a, b).

About the probability distribution of Beta, also knowing the relevant parameters including the random number generated and too, α and β values and lower and upper bounds of the variable, the random variable can be achieved by the BETADIST in Excel. If the generating function of random variables based on probability distribution is available in Excel, the function is used to produce these values. Otherwise, like the triangular probability distribution, it should be provided the methods and formulas for generating random value of a variable in Excel. About other probability distributions, the method is similar, except are the parameters needed. Since the distribution of standard probabilities used in Monte Carlo simulation would be the cases to that we referred and explained how to use them, we will stick to the same amount.

4. Sensitivity analysis of the development project of Sufian cement plant

In order to implement the single-dimension sensitivity analysis of the development project, we have selected five key variables among the components of cash flow and by sensitivity analysis of NPV against the variations of these variables, the most important and the most profitable projects will be identified. In this way, when the switching value of each of the variables is less, the project profitability will be more sensitive to the changes in the variable compared with the rest. Table 1 shows the variations of -40% to +40% of these variables, along with the amount of variation in NPV calculated and written.

Table 1: Sensitivity analysis of NPV

Consumption energy cost	Wages cost	Price	Initial investment	Discount rate	Change in percent
535934.3	679575.8	-2204666.7	1153967.9	841426.4	-40%
491206.3	598937.4	-1564244.5	954731.5	706210.2	-30%
446478.3	518299.0	-923822.2	755495.1	581002.1	-20%
401750.3	437660.7	-283400.0	556258.7	464880.2	-10%
357022.3	357022.3	357022.3	357022.3	357022.3	0%
312294.3	276383.9	997444.5	157785.9	256693.3	10%
267566.3	195745.5	1637866.8	-41450.5	163235.1	20%
222838.3	115107.2	2278289.0	-240686.9	76057.3	30%
178110.3	34468.8	2918711.3	-439923.3	-5370.7	40%

If the NPV values obtained from these changes are plotted for a specific discount rate against the change percentage in the variables, you can observe the sensitivity of NPV to the change in each of the variables compared to other variables. In this way, each of the variables are with a more sloping curve than the other variables of the chart, the NPV's value is more sensitive to changes in that variable. As the curve plotted in Figure 2 is observed with a discount rate of 18%, given that the price chart is more inclined

than other charts, therefore NPV' value will be more sensitive to the changes in the value of this variable than others. After the variable of price, the NPV's value is more sensitive to the changes in the initial investment and then in discount rates and next in wages and at last in the cost of energy consumption.

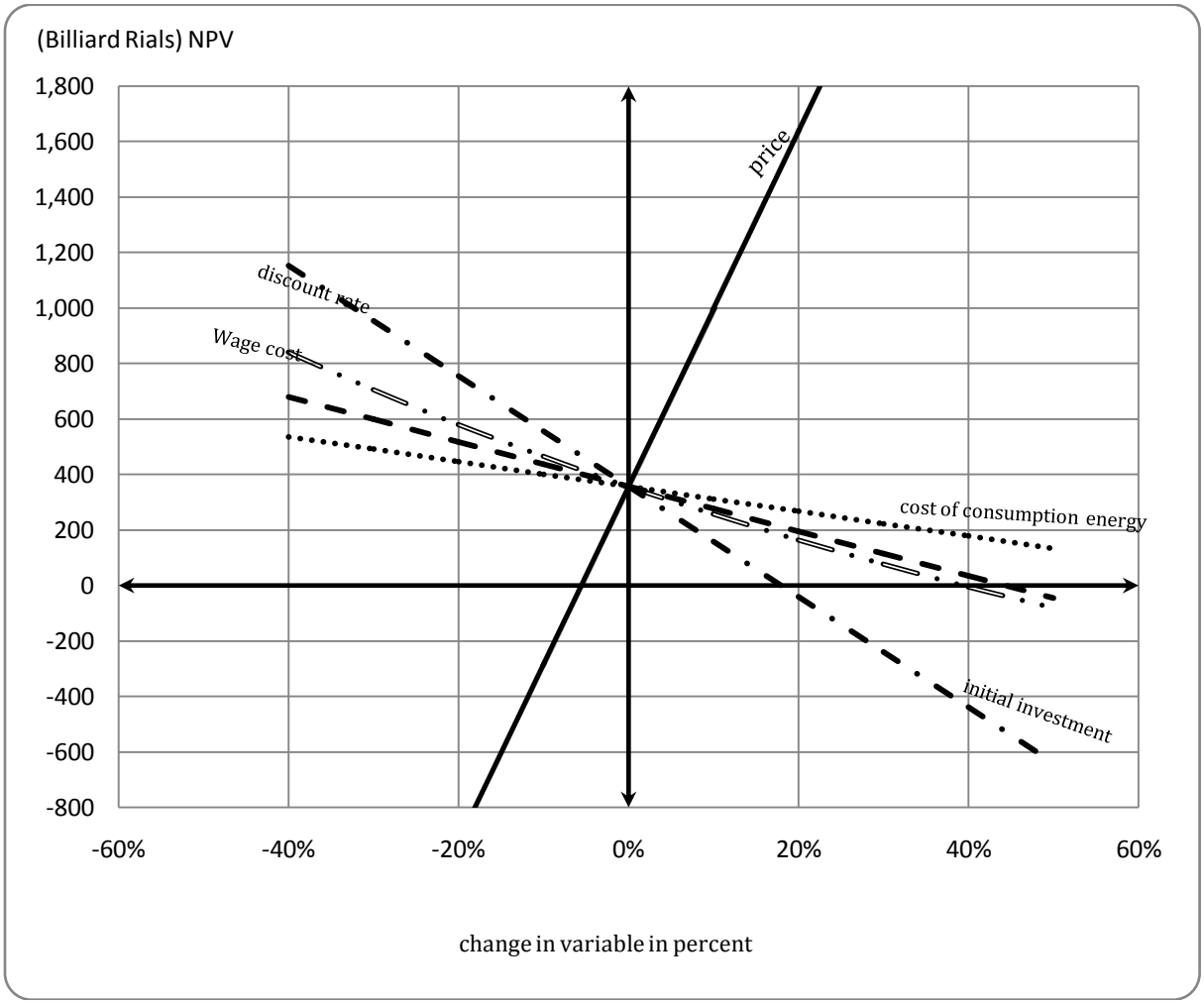

Figure 2: NPV's changes curve

In order to analyze the two-dimension sensitivity of the development plan, we selected variables "electrical energy" and "price", of the 5 mentioned variables. This is because of that the profitability of the project is more sensitive to changes in price than other variables, in conditions of increased energy prices and reduced profitability as a result of it; it can be compensated the reduced profit, by increasing the variable price. Therefore, simultaneously taking into consideration the changes in these two variables and assuming other variables to have constant value; the NPV's outcome is calculated for those changes. Similarly, for other variables, provided that it is reasonably practicable that they are changed simultaneously, the sensitivity analysis can be attempted.

NPV Sensitivity Analysis for Changes in Energy Costs and Price

Table 2 indicates changes in the cost of energy vertically and unit sales price changes horizontally during 6-year evaluation period. In this table, the NPV sensitivity for changes, at the same time, in these two variables were calculated and written. NPV's value for the discount rate of 18%was estimated 357,022.3 million Rials; and written in the upper right corner of the table. It should be noted that the NPV's values calculated for changes in these tow variables was achieved when taking the discount rate of 18% into account and other variables are assumed to be constant.

Table 2: Two-dimension sensitivity analysis of NPV against the changes in both the time of consumption energy costs and price

The level of increase in the selling price per ton									
40%	**35%**	**30%**	**25%**	**20%**	**15%**	**10%**	**5%**	**0%**	
2918711.3	2598500.2	2278289.0	1958077.9	1637866.8	1317655.7	997444.5	677233.4	357022.3	0%
2695071.3	2374860.1	2054649.0	1734437.9	1414226.8	1094015.6	773804.5	453593.4	133382.3	50%
2471431.2	2151220.1	1831009.0	1510797.9	1190586.7	870375.6	550164.5	229953.3	-90257.8	100%
2247791.2	1927580.1	1607368.9	1287157.8	966946.7	646735.6	326524.4	6313.3	-313897.8	150%
2024151.2	1703940.0	1383728.9	1063517.8	743306.7	423095.5	102884.4	-217326.7	-537537.8	200%
1800511.1	1480300.0	1160088.9	839877.8	519666.6	199455.5	-120755.6	-440966.8	-761177.9	250%
1576871.1	1256660.0	936448.9	616237.7	296026.6	-24184.5	-344395.7	-664606.8	-984817.9	300%
1353231.1	1033019.9	712808.8	392597.7	72386.6	-247824.6	-568035.7	-888246.8	-1208457.9	350%
1129591.0	809379.9	489168.8	168957.7	-151253.5	-471464.6	-791675.7	-1111886.9	-1432098.0	400%
905951.0	585739.9	265528.8	-54682.4	-374893.5	-695104.6	-1015315.8	-1335526.9	-1655738.0	450%
682311.0	362099.8	41888.7	-278322.4	-598533.5	-918744.7	-1238955.8	-1559166.9	-1879378.0	500%
458670.9	138459.8	-181751.3	-501962.4	-822173.6	-1142384.7	-1462595.8	-1782807.0	-2103018.1	550%
235030.9	-85180.2	-405391.3	-725602.5	-1045813.6	-1366024.7	-1686235.9	-2006447.0	-2326658.1	600%

Increased cost of consumption energy

As evident in Table 2, if a 600% increase in energy costs and assuming other constant variables of the actual cost, the NPV's value will be positive if the price increases up to 40% and if consumption energy cost increases up to 500% with35% increase in the price, it will reach 362,099.8 million Rials, and in this case, this amount is equal to the amount of NPV before the changes (357,022.3 million Rialls). In other words, by 35% increase in the price, 500% increase in the consumption energy costs does not affect the profitability of the project.

Risk Analysis of Development Plan

Among the cash flow variables, we selected four ones affected by the implementation of economic development plan for risk analysis, include: sales volumes, prices, wages and energy. For variable sales volume, considering increase in price and probability of decrease in this variable and given the amount of production capacity that was 1.55 million tons in 2010, and for years afterwards because of the operation of production lines 3 and 4, 2,402,400 tons is expected, we assumed the amount of sales not to go lower than 1.55 million tons and upper than 2.4 million tons and it is more likely to be 2.3 million tons. Also, considering the likely increase after implementing the economic development plan, we assumed the variable cost of wages payable to be minimum of 600,000 Rials and the maximum of 1,000,000 Rials per ton; and 750,000 Rials per ton in "most likely" state. The variable cost of wages payable, due to affected by the price rises, to a slight increase compared to the projections by source-and-use table; has been assumed 150,000 million Rials in "optimistic" and 280,000 million Rialsin "pessimistic" and 220,000 million rials in "most likely". The most significant variable affected by the implementation of economic development is the cost of consumption energy, which, about 600-500% increase compared to projections by source-and-use table, is assumed a minimum of 300,000 million Rials and a maximum of 1,000,000 million Rials and 700,000 million Rials in "most likely" state.

Table 3: Assumed values of four selected variables based on triangular probability distribution

State variable	**Pessimistic**	**Most likely**	**Optimistic**
Sales volume (ton)	1,550,000	2,300,000	2,400,000
Price (per ton)	0.6	0.75	1
Wage payable	280,000	220,000	150,000
Cost of consumption energy	1,000,000	700,000	300,000

It should be noted, in Table 3, that variable sales volumes was in ton and other variables are based on a million of Rials. At the Excel spreadsheet, by selecting a triangular distribution for selected variables, and using a random number generated in interval (0,1)and a formula used by a triangular distribution to calculate the amount of random variables, we calculated operating cash flow in 4000 repetition during the six-year operation through the relationships referred to in the section of evaluation of the project based on

the net present value. Then we calculated the project's NPV is calculated using cash flow and the amount of the initial investment of 1,992,364 million Rials and a discount rate of 12% in each of 4000 repetition. Table 4 shows the portion of the cash flows of the plan calculated and along with NPV's values. It is necessary to note that in calculating NPV, year 2010 was considered as the baseline year i.e. year zero.

Table 4: 7 repetitions of cash flow simulationand their NPV values

Year	Repetition 1	Repetition 2	Repetition 3	Repetition 4	Repetition 5	Repetition 6	Repetition 7
1389	434316	369654	567721	307817	342070	68960	-132897
1390	-425918	-78452	16812	-98253	-127175	-193121	207842
1391	-116631	152857	-197179	407076	56016	-110521	-437904
1392	-230266	20351	-206105	-185909	297301	146626	-196074
1393	108559	104651	-124747	-202970	-45367	-602905	-9749
1394	-20837	-460880	-492998	-54499	-40823	-350376	-497619
NPV	**-2138040.91**	**240941.61**	**-80178.39**	**252367.79**	**432794.46**	**-669180.46**	**-724538.63**

Specifying the NPV's values of the 4000 repetitions, the probability distribution and cumulative relative frequency distribution were obtained as shown in Table 5.

Table 5: Frequency distribution of NPVs

Interval center	Interval	Frequency	Relative frequency	Cumulative relative frequency
-1750000	-1700000	1	0.00025	0.00025
-1650000	-1600000	0	0	0.00025
-1550000	-1500000	0	0	0.00025
-1450000	-1400000	0	0	0.00025
-1350000	-1300000	0	0	0.00025
-1250000	-1200000	4	0.001	0.00125
-1150000	-1100000	8	0.002	0.00325
-1050000	-1000000	12	0.003	0.00625
-950000	-900000	18	0.0045	0.01075
-850000	-800000	30	0.0075	0.01825
-750000	-700000	54	0.0135	0.03175
-650000	-600000	72	0.018	0.04975
-550000	-500000	110	0.0275	0.07725
-450000	-400000	116	0.029	0.10625
-350000	-300000	151	0.03775	0.144
-250000	-200000	182	0.0455	0.1895
-150000	-100000	231	0.05775	0.24725
-50000	0	246	0.0615	0.30875
50000	100000	284	0.071	0.37975
150000	200000	305	0.07625	0.456
250000	300000	325	0.08125	0.53725
350000	400000	307	0.07675	0.614
450000	500000	279	0.06975	0.68375
550000	600000	260	0.065	0.74875
650000	700000	221	0.05525	0.804
750000	800000	184	0.046	0.85
850000	900000	169	0.04225	0.89225
950000	1000000	144	0.036	0.92825

1050000	1100000	98	0.0245	0.95275
1150000	1200000	60	0.015	0.96775
1250000	1300000	47	0.01175	0.9795
1350000	1400000	31	0.00775	0.98725
1450000	1500000	20	0.005	0.99225
1550000	1600000	15	0.00375	0.996
1650000	1700000	3	0.00075	0.99675
1750000	1800000	4	0.001	0.99775
1850000	1900000	7	0.00175	0.9995
1950000	2000000	0	0	0.9995
2050000	2100000	2	0.0005	1
2150000	2200000	0	0	1
Total		**4000**	**1**	

Using Table 5, the relevant charts to the cumulative frequency distribution of the probability distribution of NPV can be draw. Based on these charts, we can see the risk level due to the increased energy price and contrive the necessary measures in order to reduce the amount. Also changing the assumptions about the values of selected variables, the risk reduction was observed as a result of these changes and it was tried to increase profitability and reduce its risk. The chart of the probability distribution of the NPV is drawn based on the discount rate of 12%, as follows. In this chart, the vertical axis is made up data from frequency columns in Table 5 and the horizontal axis, of data form the interval center column.

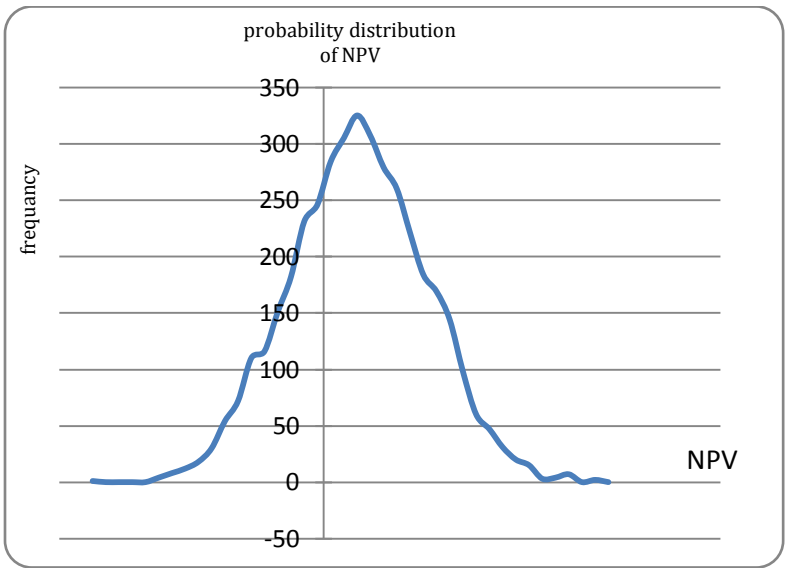

Figure 3: Values distribution of NPV in 4000 repetitions of simulation

As seen in Figure 3, with the above assumptions to the levels of variables' amounts after energy price increases, among randomly calculated 4000 NPVs based on simulated cash flow during the 6 years of operation period, the 325 NPV of maximum frequency have been in the range of 200,000 to 300,000 million Rials. This amount has been markedly reduced compared to the amount obtained for the NPV with discount rate of 12% regardless of the price rises is equivalent to 750,121.6 million Rials. In the 989 repetitions out of the 4000 repetitions, the NPV has been negative, which indicates a high risk under existing conditions.

Cumulative frequency distribution chart of the NPV is based on the data from cumulative relative frequency columns and columns of intervals center will be drawn as follows; due to the nature of calculating the cumulative relative frequency, the values of the vertical axis represents the probability that

the NPV is obtained which is corresponding to the probability on the horizontal axis or lower than that NPV. For example, at the probability of 0.85, the value of NPV obtained will be lower than750,000 million Rials. The features of this chart is always smaller than 1 due to showing the contingency, and at the maximum NPV is obtained from the simulation, the cumulative frequency will be equal to one. In other words, given the possibility of 100% and with given conditions, the value of NPV will be less than this. In this way, it can be achieved the probability that NPV becomes negative, reflecting the risk of the plan under the given conditions for the selected variables.

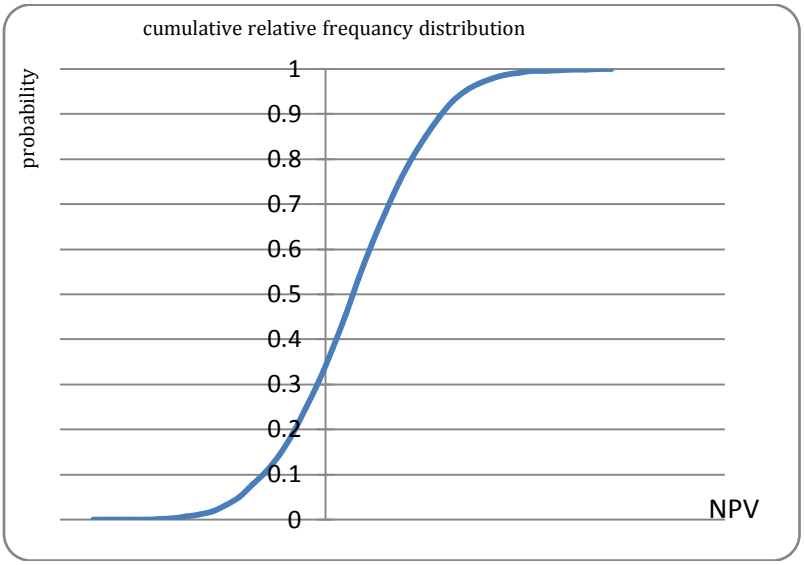

Figure 4: (CDF) cumulative frequency distribution curve of NPV

As seen in Fig.4,meantime the 4000 repetitions of the cash flow simulation, with probability of about 0.34, the NPV's value was obtained by negative discount rate of 12%. Another important result is that under the simulation with discount rate of 12%, NPV's result will be lower than 1,700,000 million Rials.

Conclusion and Recommendations

The main reason for this simulation is to evaluate the effects of energy price increases on the profitability of the development plan in Sufian cement and accordingly other variables influenced by the energy price increase are also selected and their assumed values are supposed based on a triangular probability distribution.

This simulation can be implemented for each other, too, in order to explain the effect of making the subsidies targeted and the results were analyzed. The results obtained from Fig. 3 and 4 can be summarized that assuming the mentioned values from Table 3 by 4 variables and assuming others to be fixed under the changes and taking their values based on the predicted source-and-use table during 6 years of operation period, the profitability of the plan would be high risk and by 4000 simulations on the cash flow modeling projects, we concluded that the probable NPV's value with discount rate of 12% will decrease up to 67% and the probability would be at 0.34 level that the net present value at the discount rate of 12% is negative, and if these conditions, the return on investment period will increase. The results they achieved in the sensitivity analysis section indicated that the significant cash flow variables which were selected for sensitivity analysis, the variable price is most effective on NPV's result. Therefore, when increasing variable actual costs and decreasing profitability of the plan, with a slight increase in price, the NPV could be compensated which has been decreased. The second variable that the NPV has been much more sensitive to its changes than other variables was the variable initial investment. The results of the sensitivity analysis showed that in case of reduction of capital costs of the plan during the start-up, the plan's profitability increased significantly. For example, only 10%reduction of the initial investment, we have the 55.8% increase in NPV that it reached 556,258.7 million Rials.

The next variable the NPV is more sensitive to its changes was the discount rate. Since this analysis was performed taking into account the 18% discount rate, if the average bank interest rate for the financing of this project is a large difference in this rate, the NPV will vary significantly. As can be seen in Fig. 2, the chart of the variable energy costs and the wage on the curve of changes are relatively low sloped and this shows that NPV's value is much less sensitive to changes in these two variables. However, given that the targeted subsidies plan, the price of energy will be increased significantly, these two variables have been greatly important and the value of NPV will reduce significantly.

Since the company's production capacity is limited and there is no possibility of the sale of the product higher than the produced, in order to compensate for the decline in profitability as a result of the energy price increase, it is necessary energy saving be under way as possible as extreme. This can be done by several ways. The efficient management of energy consumption by applying some rules to prevent the waste of energy is one of the solutions that can help reduce fuel consumption costs. Increasing labor productivity or modified production technologies would be of other solutions that the savings in fuel consumption is possible, by using them. We recommend that in future work, the effects be investigated, of increasing labor productivity and efficient management and technology modification on production costs whether in the cement industry or in any other industry.

REFERENCES

Belli P, Anderson JR, Barnum HN, Dixon JA and Tan JP (2001). Economic Analysis of Investment Operations. Analytical Tools and Practical Applications, WBI, World Bank, Washington D.C., First Printing.

Bidabadi B (2009). *Iranian Cement Prices Economy*, Amirkabir University of Technology, Fars and Khuzestan Cement Public Company.

Blank T and Lylend A Tarkouein, translated by Ali Zeytoun Nezhad Mousavian (2010). The principles of engineering economy (economic evaluation of industrial projects); Avay Noor.

Dayananda Don, Irons Richard, Harrison Steve, Herbohn John and Rowland Patrick (2002). *Capital Budgeting (Financial Appraisal of Investment Projects)* (Press syndicate of the University of Cambridge) First Published.

Dehmardeh N (2008). Evaluating the economic plans (engineering economics approach), the development of basic sciences.

European Commission, Directorate General Regional Policy (2008). Guide to: COST-BENEFIT ANALYSIS of investment projects.

Handbook for the Economic Analysis of Water supply projects; Chapter 7: SENSITIVITY & RISK ANALYSES

Heidari Moutlagh F (2005). *Evaluating the Development of Cement Factories Economically (Case Study: Cement Plant of Dorud)*, Islamic Azad University, Science and Research Branch, Faculty of Management and Economics.

Institute for Transport Studies, University of Leeds (2003). Toolkit for the Economic Evaluation of World Bank Transport Projects. Available: http://www.its.leeds.ac.uk/projects/WBToolkit/Note2.htm.

Jafarisamimy A, Hosseini M and Ehsanfar MH (2008). *Principles of Engineering Economics (Assessment of Economic Projects)*, 1st edition. industrial training institutions of Mazandaran.

Oskonezhad M (2009). *Economic Engineering*, 33 edition, Amirkabir University of Technology.

Philippines Manila (2002). Handbook for integrating risk analysis in the economic analysis of projects. Asian Development Bank.

Radpour M and AbdoTabrizi H (2009). *Measurement and Management of Market Risk* (Aghah).

SCC (No Date). Soufian Cement Co. Available: www.soufiancement.com.

Seyed Houseini M (2008). *Decision Analysis, Economic Engineering*, 1st edition, University of Science and Technology.

Spreadsheet Sensitivity Analysis (No Date). FRF - 10/98, Available: http://www.soton.ac.uk/ ~jps7/D8%20website/sensitivity%20analysis.pdf.

The cement industry website www.cement.ir
The cement industry website www.cementgroup.ir
Tofigh F (2006). Planning in Iran and its future vision. High Educational and Research Institute of Management and Planning.
Tofigh F (No Date). Notes for book, under being prepared, on the plan assessment: profitability, risk and optimize selection.