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Risk assessment research on an electric power project used Monto-Carlo-NPV mothed

Ning Yao*

College of Electrical and Information Engineering, Xuchang University, Xuchang, (CHINA)

E-mail : yaonln@163.com

ABSTRACT

The risk was distinguished in a electric power project in the paper, the main risk factors were analyzed and those factors were changed into the useful parameters for NPV model by using Monte Carlo-NPV mothed, then the main economic indexes of the project such as NPV, IRR were calculated to confirm the project's feasibility and the risk degree. Through the sensitivity analysis of the main economic indicators of NPV, IRR on the various risk factors, the risk factors of greater influence were selected to be managemented and avoided to reduce or avoid enterprise's risk. The results showed that the Monte-Carlo-NPV mothed was a practical and feasible mothed for risk analysis.

KEYWORDS

Electric power project; Risk assessment; Risk factors; Monte Carlo simulation; NPV.

INTRODUCTION

Electric power industry as the support of social and economic development is an important basic industry, and is closely related to the healthy development of national economy. According to statistics, GDP growth of 0.9728%, when electricity consumption increased by 1% [1].In order to adapt to the needs of economic development under the new situation, the state adopts the electric power system reform---factory network separation, several do electricity, electric power investment and management subject show a trend of diversity. With the rapid development of the electric power industry, some projects caused great waste of resources because of lack of democratic, scientific decision, and repeated construction. At the same time, our country electric power is also a huge consumption of resources industry. Under the scarcity of energy and electric power market condition and facing the complicated market environment, the risk may appear at any time. Many projects in our country, because of the risk of loss is shocking, risk is often one of the main reasons for project failure [2]. Therefore, in order to guarantee the interests of investors and help enterprises to reduce or avoid risks, systematic assessment of risks such as the electric power project political policy, environment, technology, construction, market etc. is particularly important.

Because the risk factors and causes of rules of performance differences, evaluation method is different. Model of risk analysis and evaluation the popular mainly qualitative methods (such as subjective scoring method, AHP method, etc.) and quantitative methods(such as Sensitivity analysis method, decision tree method, network diagram, Monte-Carlo, etc.).Domestic research on electric power project risk is more, but there are some shortcomings, mainly in the following aspects.

(1)Focus on qualitative analysis, due to the research of project risk from the aspect of risk classification mainly, quantitative research is few.

(2)Although the Monte-Carlo method was applied to the quantitative analysis of risk factors, but mainly consider the financial index, but neglect the other important risk factors, lack of practical feasibility [2,3].

Based on the above reasons, this article uses the Monte-Carlo NPV method in-depth study and practice of risk in the construction project of a power. Net present value (NPV) as a financial evaluation methods commonly used items, choose it as the output of the evaluation model, can directly see the effect of this project feasibility and risk of Monte-Carlo application model. The net present value is that the project life cycle (calculation period) in eachyear of net cash flow, in accordance with the requirements to achieve the yieldand value of the conversion to the construction period of the early. According to the net present value of positive and negative, determines the size of projectchoice, when $NPV \geq 0$, the program is feasible; Others the program is not feasible.

The calculation of npv according to formula

$$NPV(i) = \sum_{t=1}^{n} \frac{(CIt - COt)}{(1+i)^t} \quad (1)$$

Where *CIt* is the cash inflow in the t year; *COt* is the cash outflow in the t year; NPV is the net present value of the project; *i* is The discount rate.

NPV method as shown in Figure 1.

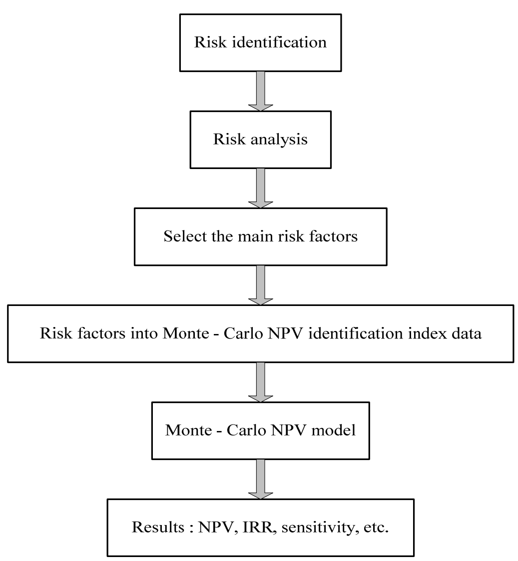

Figure 1 : Monte-Carlo NPV Risk Analysis Model

In Figure 1, IRR is the internal rate of return method. The internal rate of return is the project from start construction to life at the end of each year (calculatedperiod) the present value of the net cash flow and zero discount rate. Profit ratewhich reflects the project provides for the possession of capital energy. The calculation formula is as follows

$$NPV(IRR) = \sum_{t=1}^{n} \frac{(CIt - COt)}{(1+i)^t} = 0 \tag{2}$$

RESEARCH OBJECT

Taking six units of an electric power company as the research object, of which No.1 and 2 units of 2 * 30MW extraction condensing heating units, a pulverized coal furnace after the change of coal water slurry, to assume the task of nearby industrial zone heating, steam heat 60~65t/h; No. 3 and 4 units of 2 * 150MW condensing steam turbine, positive changing fuel oil for coal water slurry; No. 5 and 6 unit of 2 * 300MW coal-fired heating units for the steam to a company, the supply of 160t/h.

No.1 and 2 units, after years of operation, equipment aging, coupled with the high fuel costs, this should be shut down. But considering their heating task this power plant invested a lot of money to renovate and update on the boiler, No.1 and 2 units host demolition, transformation of coal water slurry retention of 2 * 220t/h boiler, the new 1100MW extraction steam turbine.

RISK ANALYSIS

Analysis of the present situation of electric power system and the external economic environment

This project belongs to the oil to coal project, and it is small and medium-sized units, coal consumption is higher. It can meet the demand of local heating temporarily, but in the long run, higher risk to shut down. The risk has been classified to shut down the policy risk.Using expert evaluation method, to invite industry experts to shut down the program policy risk score, the results are shown in Table 1.

TABLE 1 : Assessment on the Close-up Risk with the expert method

Number	Weight	0 to 5 years	5 to 10 years	10 to 15 years	15 to 20 years	20 to 25 years	25 to 30 years	After 30 years
Expert 1	0.1	1						
Expert 2	0.1		1					
Expert 3	0.1			1				
Expert 4	0.1				1			
Expert 5	0.1		1					
Expert 6	0.1			1				
Expert 7	0.1		1					
Expert 8	0.1	1		0				
Expert 9	0.1			1				
Expert 10	0.1			1				
Total		2	3	4	1	0		
Probability		0.2	0.3	0.4	0.1	0	0	0
Cumulative probability		0.2	0.5	0.9	1	1	1	1

Comprehensive scoring by experts, and 1 to 20 years shut down probability distribution as shown in table 1, from the Table 2, due to the policy of shutting down time for the success or failure of the project a greatrelationship, the less time the more risk.

TABLE 2 : Probability of Close-up Risk

Years	Expert scoring	Normal fitting	Years	Expert scoring	Normal fitting
1	0.04	0.017561	**11**	0.08	0.077701
2	0.04	0.024652	**12**	0.08	0.072268
3	0.04	0.037499	**13**	0.08	0.064215
4	0.04	0.042992	**14**	0.08	0.053648
5	0.04	0.058614	**15**	0.08	0.044126
6	0.06	0.063921	**16**	0.02	0.035428
7	0.06	0.072637	**17**	0.02	0.022695
8	0.06	0.078871	**18**	0.02	0.017372
9	0.06	0.082268	**19**	0.02	0.011863
10	0.06	0.082188	**20**	0.02	0.007658

Coal price risk analysis

Coal as the main power generation, its price changes have a direct impact on the project[4]. Because the fluctuation of the electricity and coal price is disproportionate, an impact factor(a) is introduced to offset part of the coal price fluctuation caused by the risk. At present coal price compensation factor a is 0.7. Because of coal costs accounted for the cost of power generation of 60-70%, coal prices caused by price changes as (60-70%)× a . Based on the data, the prediction of the increasing price of coal and electricity shown in Figure 2.

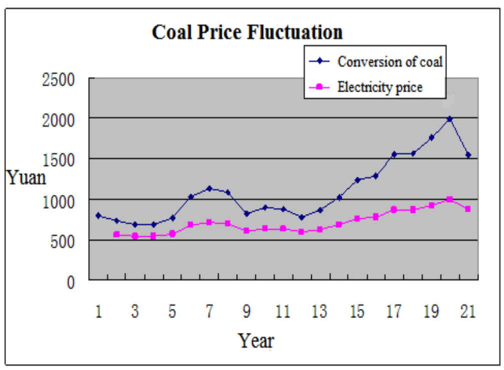

Figure 2 : The prediction of the increasing price of coal and electricity

Analysis of progress and investment risk of construction project

Under normal conditions, the conversion of a 100 mw unit construction cycle is about 15 months. If the project construction coincides with the electric power project construction peak period, it is difficult to guarantee. Time delay effect on the risk of the project greatly. Therefore the risk assessment as the probability of loss of high and medium [6-8].

The project schedule data were analyzed by normal simulation results, as shown in Figure 3.

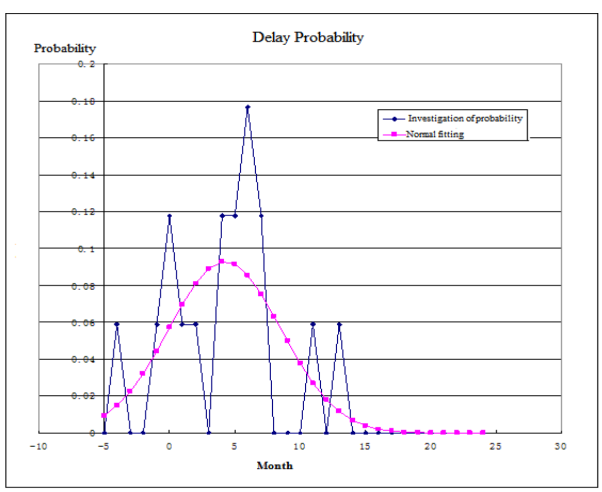

Figure 3 : Probability chart of the project delay time

In addition, because the scale of fixed asset investment continues to expand, the price of building materials and other rising costs,etc, also will become the project investment risk. Coupled with the continuous implementation of new power projects, the contradiction between supply and demand, the use of units hours will be reduced year by year, which has become the impact of risk factors of the project.

In short, the state policy, environment, construction and coal prices affect the risk of the project, due to limited space, other risk factors are no longer a concrete analysis.

PROJECT RISK MODELING AND SIMULATION

The selection of main risk factors

Through the analysis of policy, economy, natural environment, construction, normal operation and other risk factors and their probability distributions, risk assessment as shown in Table 3.

TABLE 3 : Risk Assessment of the Project

Species	Form	Probability	Losses caused	Evaluation method
Political risk	Warfare	Very low	High	Subjective method
	Unrest	Low	Median	Subjective method
Policy risk	Project termination	Median	High	Expert method
Economic risk	Rising coal prices	High	High	Investigation and data analysis
	Price drop	Median	High	Investigation and data analysis
Natural risk	Earthquake, landslide	Very low	High	Investigation and data analysis
	Ttyphoon	Low	Median	Investigation and data analysis
Construction risk	Delays	High	Median	Investigation and data analysis
	Poor quality of construction	Low	Median	Investigation and data analysis
Operation risk	High coal consumption	Median	Median	Investigation and data analysis

In table 3, the probability of each possible risk and may cause the risk of loss has carried on the classification and evaluation, to score the above probability classification definition, very low, low, medium, high, very high score at all levels down to 0, 1, 2, 3, 4. The loss caused by risk can be expressed in their product. If this value is greater than 4, which can be considered a significant risk. Combined with their probability distribution, confirm the risk evaluation model of the main risk factors and its distribution are shown in Table 4.

TABLE 4 : Probability Distribution of the Main Risks

Serial number	Name	Distribution form	Parameters
1	Delays (month)	Normal	(4.325,4.287)
2	Shutting down time (years)	Normal	(8.9,4.79)
3	Coal prices rise (yuan)	Normal	(4.97,13.52)
4	Coal linkage factor	Triangle	(0,0.52,0.89)
5	Coal consumption (g/kWh)	Normal	(379.5,9.58)
6	The annual utilization hours	Normal	(5899,550)
7	Using the number of hours decline rate (%)	Triangle	(0,109,219)
8	Fixed asset investment growth rate (%)	Triangle	(0,4.19,10.1)

Analysis of the results of Monte-Carlo simulation

Based on the above analysis, the main risk factor in Crystal Ball software, carries on 1000000 times of simulation, the output datas as the benchmark rate of return (12%) of the net present value (NPV) and internal rate of return (IRR), etc.

(a) The NPV results analysis

Figure 4 is the net present value analysis of NPV probability map. As can be seen from the graph, the benchmark rate of return is 12%, the net present value (NPV) is greater than zero probability is 82.394%, the average value is 13579.41 (million), variation reached 1.15, indicating that the project risk is relatively large[9,10]. The statistical data are as follows.

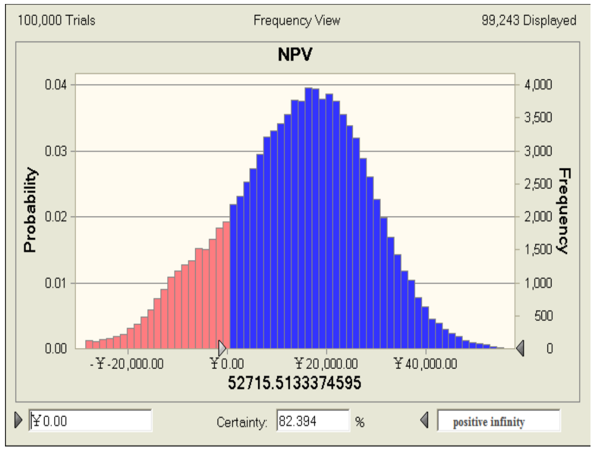

Figure 4 : Probability chart of the project NPV

Forecast:	NCF(net cash flow)
Statistic	Forecast values
Trials	100,000
Mean	￥13,579.41
Median	￥14,924.27
Standard Deviation	￥15,104.68
Variance	￥225,498,798.36
Skewness	-0.6871
Kurtosis	5.31
Coeff. of Variability	1.15
Minimum	'-￥-146,792.70
Maximum	￥87,892.80
Mean Std. Error	￥48.36

The results of sensitivity analysis as shown in Figure 5. Can be seen from the graph, the main factors that affect the project NPV is project closing time, prices, time delay, the number and the coal linkage factor in turn. The national energy policy directly affect the project success, as coal is very big.

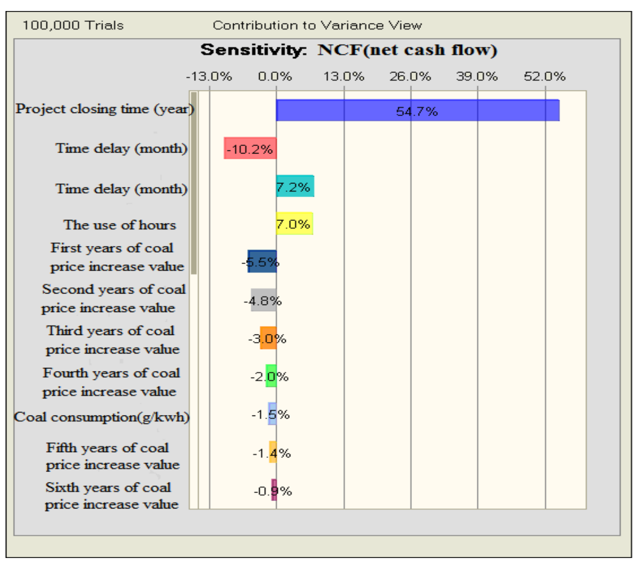

Figure 5 : Sensitivity of the project NPV

Figure 6 is trend of the project NPV, it can be seen from the picture of net cash flow risk caused by the dispersion is very big. Risk influence can not be underestimated.

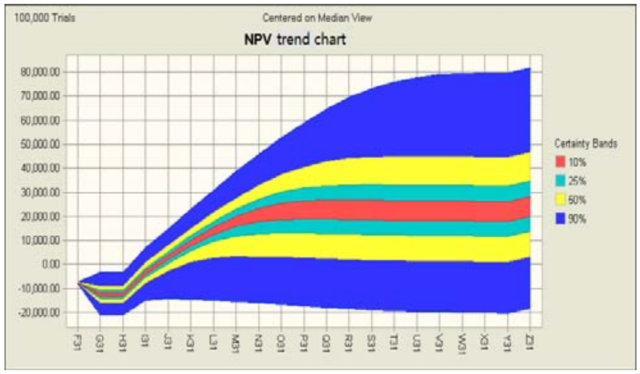

Figure 6 : Trend of the project NPV

(b) The IRR results analysis

Figure 7 is the IRR probability distribution. Seen from the figure, the probability of IRR is greater than 12% of the benchmark yield is 95.532%, the internal rate of return (IRR) value is 50.85%, variation is 0.523, the internal rate of return estimates the risk is bigger also[11].

IRR sensitivity analysis are shown in Figure 8. From the figure, the first factor influence the project IRR is delaying the risk (accounted for 66.2%), the second factor is the annual utilization hours, the third factor is the project closing time, the final is coal prices rose during the first and second years. The project has a great relationship with the level of project management, the early production, the greater the benefits.

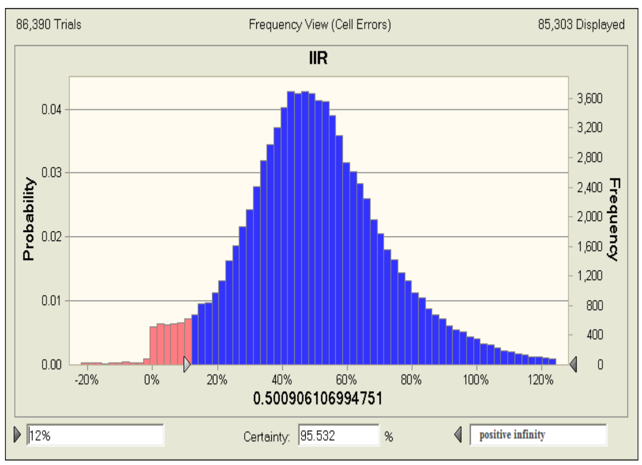

Figure 7 : Probability of the project IRR

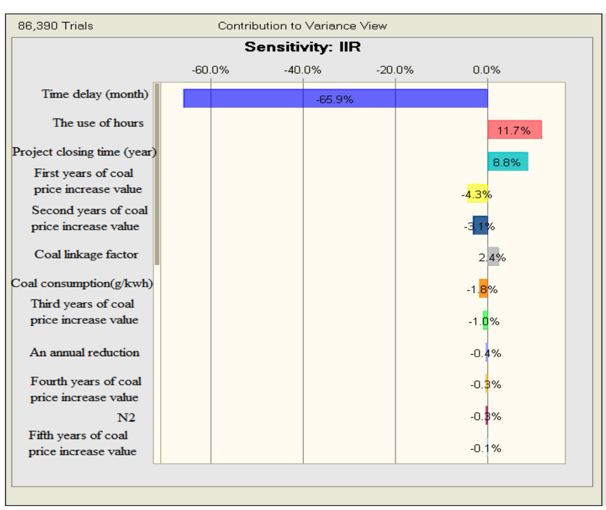

Figure 8 : Sensitivity of the project IRR

Results show that by Monte Carlo - NPV method to project the main risk factor into the NPV model can use parameters, calculation program of the main economic indicators (NPV, IRR etc.). Based on the NPV and IRR sensitivity analysis of main economic indicators of various risk factors, proves that Monte Carlo - NPV method is a relatively close to the practical method of risk analysis.

CONCLUSION

Through the simulation of the project risk in the article, the results of NPV and IRR variation coefficient are bigger, show that the project uncertainty is larger and the risk is bigger. In order to reduce or avoid the risk, the company should pay attention to the following aspects.

(1) To strengthen the study of the national macro-control policy, try to avoid project has just launched the unfavorable situation of being closed down.

(2) To speed up the construction progress of the project, and put into production as soon as possible, so the smaller risk, short recovery period.

(3)To strengthen the coal contract management and business negotiation, as far as possible to reduce the cost of coal.

(4) To increase the utilization hours of unit.

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REFERENCES

[1] MA Xin, ZHU Yaxing and LI Xiaobo, “Study on the relationship between China’s ecectric power industry and economic growth”, Statistics and decision, 2007, pp.98-99.

[2] LIU Jinlan, HAN Wenxiu and LI Guangquan, “The method and application of risk analysis for large engineering project”, System engineering theory and practice, 2003, pp. 36-38.

[3] Yu Jianxing, Engineering project risk identification, Project Manager Union, 2005.

[4] ZHU Feng, The research on management of coal risk in power enterprise, North China Electric Power University Master Paper, 2006.

[5] Beijing century future Cci Capital Ltd, Analysis report of China’s thermal power industry, 2006.

[6] ZHAO Lianjiang, “The risk research and countermeasures of EPC in power engineering”, Theoretical research on city construction, 2012, pp.1-3.

[7] Xiong Wei, “The investment risk of the power industry and and its prevention countermeasures”, Economic research reference, 2005, pp.34-35.

[8] Fan Tiegang and Zhang Yongchuan, “The risk in the electricity market and its recognition”, Electric power construction, 2000, pp.5-7.

[9] Billinton R, Li W.Y. “Reliability Assessment of Electric Power System Using Monte Carlo Methods”, New York and London：Plenum Press, 1994, pp.209-254.

[10] Feng Yongqing, Zhang Boming and Wu Wenchuan,etc. “Power system operation risk assessment based on credibility theory”, Automation of electric power systems, 2006, pp.15-17.

[11] Microslaw M.Hajdasinski. “Comments on “Using Heuristics to Evaluate Projects: The Case of Ranking Projects by IRR””,The Engineering Economist, Winter 1997,Volume 42,No 2, pp.163-165.