

Application of NPV and IRR for One Project in Tianchang City

Yuchen Qian¹, Nuo Xu², Wei Yang^{3,a,*} and Xiao Yao⁴

¹Jinan University, Guangdong Province, China

²Zhejiang University City College, Zhejiang Province, China

³Macau University of Science and Technology, Macao, China

⁴Shanghai University, Shanghai, China

a. 1909853mb011030@student.must.edu.mo

*corresponding author

Abstract: NPV and IRR assessment methods currently play a key role in the financial investment field. This paper selects the cash flow data of the first year of the project ‘The seventh round market operation project of Urban Environmental Health Service (East District) of Tianchang City’, that is, the cash flow statement for 12 months in 2021. With a planning period of four years, the project has been in operation for more than a year, but it lacks project evaluation. Therefore, we chose the NPV and IRR methods to evaluate the project to provide a reference for the subsequent project development of the company. The results suggest that this project is not performing well and deserve further investigations.

Keywords: NPV, IRR, Investment Appraisal, Cash flow.

1. Introduction

In the process of China's rapid development in recent years, the significance of environmental issues has become increasingly prominent, and has become one of the most severe challenges facing China. Tang described that under the current environmental situation in China, polluted air, soil and water resources have a great impact on the quality of life of people and have further negative effects on China's national security and international image [1]. Zhang proposes that while making use of natural resources to pursue profits, enterprises should also take on the basic responsibility of ecological and environmental protection to achieve lasting and sustainable development [2]. Corporate environmental protection is the responsibility and conscience of an enterprise to protect the environment while pursuing economic benefits. Moreover, Liu states that the fulfillment of environmental protection obligations by enterprises also has corresponding benefits: it is conducive to improving the competitiveness of enterprises and products in the market; It helps to implement cleaner production and prevent pollution; Help enterprises save energy and reduce consumption and cost. Environmental protection has been given high priority in all parts of China [3].

This paper involves a company contracting environmental sanitation services in Tianchang City. The company responsible for the project is Jinlv Environmental Technology Co., LTD., which was founded in 1996, started with the sanitation equipment manufacture. After 20 years of development, it has become the biggest specialized enterprise which engaged in the research and development, production and sales of sanitation trash equipment. It is also one of the largest domestic enterprises

in the field of research, development, production and sales of sanitation equipment. The name of the project applied in this report is 'The seventh-round market operation project of Urban Environmental Health Service (East District) of Tianchang City'. The cooperation model of the paper is a market-oriented project with a four-year operation period which from January 1, 2021, to December 31, 2024. The object of this paper is the cash flow in the first year of this project. It has a total operating area of 3,126,073.90 square meters, including 2,301,007.21 square meters of manual cleaning and cleaning area. The mileage of mechanical washing and cleaning is 415.79 km/day, and the mileage of mechanical cleaning and watering is 255.9 km/day.

The service contents are as follows: First, cleaning includes main and secondary roads, back streets and laneways, urban and rural areas, garden squares and ditches, canals and rivers; Road cleaning includes manual cleaning, mechanical cleaning, mechanical watering and guardrail cleaning. Second, collection and transfer of household garbage in cleaning areas and residential areas to designated places. Third, "psoriasis" cleaning: the ground, walls, billboards, signs, poles, trees and other facilities facade "psoriasis" cleaning. Forth, pipe maintenance of public toilets: management and cleaning of 30 public toilets, installation equipment and facilities, decoration and decoration facilities in public toilets should be kept intact, clean and updated in time, and the interior wall coating should be updated once a year before October. Fifth, cleaning and transportation of building decoration waste.

Furthermore, the project configuration of the project has a total investment of 15.4652 million yuan, and it is equipped with 96 sanitation vehicles of various types. The project has a total of 440 personnel, including 388 cleaning personnel, 44 drivers and 8 management personnel. The total salary of the staff in 4 years is 68,328,205 YUAN. The salary of all personnel shall be calculated by 5% annual increment.

Finally, the total contract funds of this project for four years are RMB 108,753,010.00, including the reserved fund of RMB 25,200.00 / year, a total of RMB 100,800.00 for four years. However, this paper only studies the cash flow in the first year. In the first year, the company pays party B contracting funds of 23,411,774.00 yuan, with an average of 1,950,981.17 yuan per month.

Currently, the project operated for more than year, however, the project evaluation is missing. Thus, adopting feasible methods to evaluate the project raises our great interests, and in this paper, NPV and IRR approaches are selected for this project. This result shows that according to NPV and IRR methods, this project has a negative return in the first year, but whether the project should be accepted or not requires to observe the cash flow in the following three years.

2. Data

The project data we have selected is directly derived from the company's internal, which is the cash flow statement of Jinlv Environmental Technology Company from January to December 2021. The cash flow statement reflects the impact of business operations, investments and financing activities on changes in monetary funds, and is suitable to calculate and analyze NPV and IRR. The main source of cash flow inflow for the project is operating income, including cash received from sales of goods and services rendered. The cash outflow includes the following parts: selling expenses; Administrative expenses; Research and development expenses; And finance expenses, such as staff salaries paid in cash, expenses for goods purchased, and taxes. The Table 1 describes some basic information of this program.

Through visualizing the data, we can discover that there are three data types, current amount, current year cumulated amount and prior year cumulated amount. As we can see that cash inflows and outflows mainly occur in current amount and current year cumulated amount, not in prior year cumulated amount. That is because this project started at 2021, only the data in 2021 is available.

Furthermore, the cash flow mainly from operating activities, which depends on the profitability of our project. The cash received from the sale of goods and the provision of labor services is the largest

cash inflow, and the cash paid to and for the employees is the largest cash outflow. On the basis of the above, we will calculate, compare, and analyze NPV and IRR.

Table 1: Basic information of the selected program.

CASH FLOWS STATEMENT 2021 (Partly)		
Project	Current Amount	Current Year Cumulated Amount
Cash Flow from Operating Activities		
Cash from selling commodities or offering labor	0	0
Refund of tax and fee received	0	0
Other cash received related to operating activities	200,000.00	200,000.00
Cash Inflow Subtotal	200,000.00	200,000.00
Cash paid for commodities or labor	139,776.93	139,776.93
Cash paid to and for employees	15,180.61	15,180.61
Taxes and fees paid	154.63	154.63
Other cash paid related to operating activities	473,400.00	473,400.00
Cash Outflow Subtotal	628,512.17	628,512.17
Cash flow generated from operating activities Net Amount	-428,512.17	-428,512.17
.....
Net Increase Of Cash and Cash Equivalents	2,169,638.08	3,076,354.96
Plus: cash equivalents' beginning bal	1,456,353.26	549,636.38
Cash ending bal	3,625,991.34	3,625,991.34

3. Method

3.1. Net Present Value

Net Present Value (NPV) is one of the most common capital budgeting methods, which tells the net amount by which the benefits from a capital. NPV method is used to help calculate the value of an investment, project, or any series of cash flows. According to existing investigations [4-9], it is the most basic and reliable tool underlying cooperate finance, because it takes into account all revenues, expenses and cost of capital associated with free cash flow (FCF) investments [10]. The NPV equation can be expressed as:

$$NPV = PV(\text{project's future cash flows}) - PV(\text{Cost of the project}) \quad (1)$$

Or

$$NPV = NCF_0 + \frac{NCF_1}{1+k} + \frac{NCF_2}{(1+k)^2} + \dots + \frac{NCF_n}{(1+k)^n} \quad (2)$$

In the above two equations, NPV mean the net present value, PV refers to present value, NCF_t indicates the net cash flow in period t, and the NCF₀ is the initial investment in the project, k is the discount rate, also means the cost of capital. To calculate the project's NPV, we first apply the formula (2) by adding the NCF in each period and plugging the discount rate.

3.2. Internal Rate of Return

The internal rate of return, briefly the IRR, is an alternative and supplement to the NPV method. IRR also involves discounting the cash flows from a project, namely, account for the time value of money. We always define the IRR as the discount rate that used in NPV formula, at the same time, the internal rate of return also indicates the project's ability to withstand risk. There is a limit to the use of IRR, which represents the expected rate of return of the investor for the project investment itself, that is, the calculation premise is that each income is unknown. Before project investment, investors can make a certain estimate of the future annual project income. The relationship between IRR and NPV is the formula of IRR:

$$NPV = \sum_{t=0}^n \frac{NCF_t}{(1+IRR)^t} = 0 \quad (3)$$

In the above equation, NPV also refers to the net present value, but is known in this method, as 0. NCF_t still indicates the net cash flow in period t, only the discount rate is change into the IRR. We should know there is a limitation in IRR, the NCF is the expected net cash flow, not the real cash flow in the project. To calculate the IRR, we use the trial and error method, we begin by doing some estimate in IRR, and calculate the NPV until closer to 0. Well, this method is only we will use in the paper, more often, we use the financial calculator to get the answer more quickly.

4. Result

First of all, we use the NPV method to calculate and evaluate the feasibility of the project. According to the calculation formula of NPV, we can get the following results in Table2.

Table 2: Some basic results of NPV method.

Interest rate= 4.9%			
Time (month)	Cash flow	Discount rate	Present value of cash flow
0	-15,465,520	1.0490	-15,465,520
1	-428,512.17	1.0490 ¹	-408,495.87
2	93,675.17	1.049 ²	85,128.21
3	303,440.90	1.049 ³	262,874.01
4	861,643.15	1.0490 ⁴	711,582.87
5	834,737.37	1.0490 ⁵	657,161.96
6	776,837.88	1.0490 ⁶	583,011.96
7	317,163.91	1.049 ⁷	226,910.89
8	-355,969.76	1.049 ⁸	-242,777.93
9	-1,496,299.57	1.049 ⁹	-972,834.93
10	2,169,638	1.049 ¹⁰	1,344,721.65
11	496,282.30	1.049 ¹¹	293,223.26
12	-1,742,474.29	1.049 ¹²	-981,432.69
NPV			-13,906,446.61

Among them, the cash flow generated at the initial stage -15,465,520, it refers to the total capital invested by the company at the beginning of the period, which is also the main reason for NPV < 0.

The discount rate of 4.9% is calculated by selecting the median discount rate of urban enterprises in 2022. The monthly cash flow data is extracted from the net increase in cash and cash equivalents in the cash flow statement of the enterprise. From the above table, we can conclude that the NPV value in 2022 is $-13,906,446.61 < 0$, so from the perspective of NPV, the cash flow in the first year was bad.

Then we evaluated the project through the IRR method. According to the calculation formula of IRR, we get the value of IRR is -24%. This data means that when the value of IRR is positive, no matter how this project cannot make a profit, only when the average discount rate of these 12 months is -24%, it is possible to choose this investment project. The IRR of 24% also indicates that when the average monthly cash inflow is 150756.34 yuan, only in this way can the project achieve the balance of revenue and expenditure in the first year. Therefore, cash flow was negative for the company in the first year of implementing the program.

5. Discussion

But we also note that this is only the first year of the project, and it would be too hasty to reject the whole plan based on the results of the first year. At the same time, we can notice that the main reason for $NPV < 0$ is that the initial investment of the project is too large, and due to time reasons, the investment cannot be well allocated to the whole project cycle. Therefore, we believe that we cannot simply judge the quality of the project by the results of the first year. At the same time, it also reflects the defects of NPV and IRR evaluation methods, which are mainly reflected in two aspects:

1. The NPV approach is risk-averse [11]: it equates uncertainty with risk. The discount rate will be higher when the degree of uncertainty increases, and the selection of discount rate has a great subjective color, which makes the evaluation value of the project greatly affected. Here we only select the median of the past year to get the results.

2. They ignore the management flexibility in investment projects and think that the investment decisions are one-time, either to invest immediately or to give up immediately and not to consider later. Enterprise managers ignore the management flexibility of investment projects. They just passively accept or reject a project and consider the investment decision as one-off. They either invest immediately or give up immediately without considering the future [12]. In the process of project operation, managers are often in a passive position, unable to flexibly make timely adjustments to the investment according to future changes. Therefore, we believe that it is necessary and valuable to change the implementation time and process of the project through flexible implementation methods. For example, in this project, it is possible to achieve $NPV > 0$ before the end of the project, but the NPV method does not recommend investors to do so at the end of the first year.

6. Conclusion

In this article, we evaluate a project of the company contracting environmental sanitation services in Tianchang City through NPV and IRR method, using the data from the cash flow statement. In the end, it was concluded that the project would lose money whether it was analyzed by using NPV or IRR methods, providing predictive support for the company to make investment decisions.

In the future, we can further consider why the company will continue to choose the project in this case. We can not only use other evaluation methods to calculate the data, but also consider other aspects in addition to revenue, such as corporate image, market share, etc.

References

- [1] Tian L.: Introduction to enterprise environmental management. *Journal of new technology and new products in China*, 12, 131-132 (2019).

- [2] Zhang X.: *Talk about the importance of the construction of enterprise culture of environmental protection. Journal of environment and development*, 29 (01), 101-104(2017).
- [3] Liu Y.: *Research on the impact of corporate social responsibility and government subsidies on corporate environmental protection investment. Changzhou university* (2021).
- [4] Li C., Wang J., Li L.: *Risk Transmission Relationship between NPV and IRR in Economic Evaluation of Project Management. Journal of Technology Economics*, 27(8), 4(2008).
- [5] Smit H., Trigeorgis L.: *Strategic NPV: Real options and strategic games under different information structures. Strategic Management Journal*, 38(13), 2555-2578(2017)
- [6] Dai H, Li N, Wang Y.: *The Analysis of Three Main Investment Criteria: NPV IRR and Payback Period. Atlantis Press*, 185-189(2022)
- [7] Huang J, Tong J, Wang P.: *Application and Comparison of NPV and IRR Methods in the Company Investment Decision. Atlantis Press*, 71-78(2022)
- [8] Cheng C, Kite D, Radtke R.: *The applicability and usage of NPV and IRR capital budgeting techniques. Managerial Finance*, (1994)
- [9] Yan R, Zhang Y.: *The Introduction of NPV and IRR. Atlantis Press*, 1472-1476(2022)
- [10] Brealey. R., Myers, S., Allen, F.: *Principles of corporate finance (Twelfth edition.)*. New York, NY: McGraw-Hill/Irwin(2017).
- [11] Xu M, Zhang Z.: *Evaluation of R&D investment using real Option Theory. Systems Engineering*, 019(001), 10-14(2001)
- [12] Zhou Q, Zeng D.: *Flexible value of collaborative R&D investment: Based on real Options. Systems Engineering*, 22(5), 4(2004)