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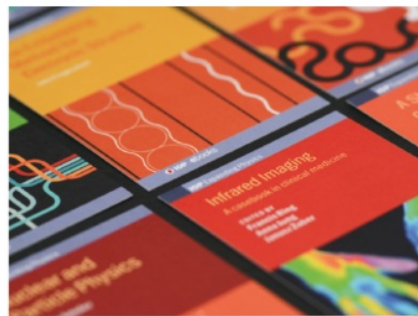
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The use of financial mathematics to evaluate the feasibility of a water conservation project

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Abstract. This study intended to evaluate the feasibility of a water conservation project from a financial mathematics point of view particularly using Net Present Value (NPV). The research took place in a pharmaceutical industry located in Simongan industrial area, Semarang. The research object was investment documents of the water conservation project. The data were gathered using documentation, observation, and interview method. The data were analyzed using B/C (Benefit Cost Ratio). The results showed that by taking the economic life of the 5-year project, without residual values, the PV proceeds reached IDR 251,327,818.80, while the PV outlay was IDR 93,450,000, and the B / C ratio was 2.69. To conclude, the water conservation project is worth building.

1. Introduction

Pharmaceutical industries require water for their production process. Moreover, water is also needed to fulfill various employees' activities during the production process for their sanitation need. The demand for non-production water is directly proportional to the number of employees. The wastewater flowed to a Wastewater Treatment Plant (WWTP) before streamed to water bodies like rivers while the toilet and latrine water is directly disposed to water bodies without being proceeded by the WWTP. Wastewater Treatment Plant have impact on the environmental because it creates the greenhouse gas emission.

Water is a resource, and its utilization has to be optimized so as not to increase production cost. For this matter, companies carry out **eco-efficiency**, which is a combination of economic and ecological efficiency. Eco-efficiency is basically "doing more with less," meaning producing more goods and services with less energy and natural resources. In other words, the concept of eco-efficiency includes eco-economy and eco-ecology. This is in line with [1] who stated that every company/country pays attention to environmental issues

Environmental devastation could not be prevented or avoided yet may be minimized by applying the concept of eco-efficiency which ensures the sustainability of natural resources (materials and energy)[2]. In the industrial world, this concept is possibly applied through saving (efficiency) on the use of raw materials, energy, water, and minimalizing work accident as well as waste which cover the 4-Rs; reduction, reuse, recycling, and recovery.



Consumption of non-production water could be saved by making both direct and indirect appeal on notices stuck on strategic corners. Pipe refinement and water meter attachment are examples of the quickly done thing to minimize water usage. A project is a series of activities planned to obtain benefits from the use of various sources and has a point-to-end. Evaluation of a project aims at assessing the feasibility of ideas and efforts made in the project. This evaluation is exceedingly interesting to be discussed further as it relates to the financial aspect.

Each project requires a feasibility study before being implemented, and this is highly crucial for the development of entrepreneurship [3]. According to [4], project feasibility can be observed through the technical, economic, law, operational, and scheduling aspect. Five points are being referred to as the basis of project feasibility include financial, economic and social, market and marketing, technical, and law. Nonetheless, [5] argued that six significant parts of project feasibility include business strategy, marketing feasibility study, professional feasibility study, financial feasibility study, social and environmental feasibility study, and location feasibility study. Entrepreneurs tend to pay more attention to economic feasibility as it connects to the time of investment return. The value of money in relation to time is very important. Research [6,7] relates to the study of value of time (VOT) related to productive time are traveling. [8,9] emphasized that travel time savings depend on VOT for individuals and/or communities

Financial mathematics provides basic economic feasibility calculation. The project feasibility based on the financial aspect can be analyzed using the Net Present Value (NPV), Internal Rate Return (IRR), Benefit Cost Ratio (BCR), and Payback Period (PP) method [10]. Furthermore, [11] confirmed that NPV is a financial indicator used to determine a project's feasibility. The NPV itself is a deviation between present values of the proceed and outlay at a specific discount rate. Mathematically, it is equated as follows:

$$NPV = \sum_{t=0}^n \frac{A_t}{(1+r)^t}$$

A is the annual proceed, r stands for rate of return, and n represents the length of the project. If the NPV scores positive value, then the investment proposal is feasible. Investment on water conservation project is the outlay. PV (present value) outlay is equal to the obtained cost plus unforeseen expenses emerged during the preparation until the project is ready to be operated.

2. Methods

The research took place at a pharmaceutical industry situated in the Simongan industrial area, Semarang. A survey approach was adopted. The study focused on the water conservation project developed by the company. The research subject was the manager and staffs of the Environmental Division.

The research was done using observation, interview, and documentation method. The observation and interview were carried out both during the campaign of water saving and water network refinement. Further, the documentation referred to either the assembly agreement or financial records related to the investment on the water conservation project as triangulation materials. The data were analyzed descriptively using B/C method.

3. Results and Discussion

The pharmaceutical industry saves water through three programs; (1) replenishment of water meter in 23 spots having an investment value equal to Rp 48.450.000; (2) replacing old pipelines with an investment value of Rp 45.000.000; (3) water saving campaign (publication to all divisions regarding the water use policy and the details of water use at each division). Every pipeline is equipped with water meter as seen in Figure 1.



Figure 1. Water network in a pharmaceutical company

The investment value inculcated by the company to save water reaches Rp 93.450.000. This amount of investment was then compared to the benefits obtained by society during the project's economic life. The company performs a water saving program. The average initial water use before the program was 10.000 m³/month. After the campaign run, it saved the monthly average up to 4.250 m³ (the year 2008). Therefore, the company decreased the rate of water use as many as 5.750 m³/month. If a family's average water consumption is 15 m³/month, then the water saved by the company can be used by 383 families.

Water saving could also be converted into rupiah. The Semarang's local water company or commonly referred to as PDAM (Perusahaan Daerah Air Minum) rate is progressive. The first use of 10 m³ is charged with Rp 1,535 per m³, the second 10 m³ is subject to Rp 2,120 per m³, and the remaining usage is subject to Rp 3,455 per m³. Thus, every customer who consumes 15 m³ of water will be liable to Rp. 25,950. By taking 50% from the PDAM, the savings made by the reach Rp. 4,971,340 per month or Rp. 59,656,080 per year. The advantages got by society is equal to Rp 59.656.080/year. By taking 6% of the annual discount rate, the feasibility of the project was studied using the NPV method and the calculation is presented in Table 1.

Table 1. The Calculation of Project's Feasibility

Year	<i>Proceed</i>	DF=6%	<i>PV Proceed</i>
1.	59.656.080	0,943396228	56.279.320,85
2.	59.656.080	0,890154887	53.103.151,15
3.	59.656.080	0,839768761	50.097.312,39
4.	59.656.080	0,792234680	47.261.615,45
5.	59.656.080	0,747391028	44.586.418,96
Amount			251.327.818,80

As displayed in Table 1, the first year of investment was returned by Rp 56.279.320,85 so that the uncovered investment was 37.170.679,15. The second years proceed reached Rp 53.103.151,15, or more prominent than the uncovered investment. Therefore, the deficit could be overcome within eight months and twelve days. In other words, the company's investment for water saving which amounts to Rp 93.450.000.000 was returned in just one year eight months and twelve days.

By taking a 5-year economic life of the project, without residual value, the PV proceed reaches IDR 251,327,818.80, while the PV outlay is IDR 93,450,000. By using the formula (3.3.), obtained was the B / C ratio of Rp. 2,69 and the project of saving water use are feasible because the B / C ratio is more

than 1. This is in line with [11], who revealed that a project is financially feasible if the income generated can cover the costs incurred, thus provide an adequate return on investment.

4. Conclusion

Based on the description of the results and discussion, it concludes that the water conservation project is feasible as the B / C reaches 2,69.

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