FEASIBILITY STUDY INVESTMENT ANALYSIS ON DISTRIBUTION WATER SUPPLY SYSTEM DEVELOPMENT OF PDAM DELTA TIRTA SIDOARJO FROM MARKETING ASPECT, TECHNICAL ASPECT, AND FINANCIAL ASPECT

Atika Emma Wulandari[1], Endang Chumaidiyah[2], Sinta Aryani[3]
[1,2,3]Program Studi S1 Teknik Industri, Fakultas Rekayasa Industri, Universitas Telkom
[1]atikaemmaa@student.telkomuniversity.ac.id, [2]endangchumaidiyah@telkomuniversity.ac.id,
[3]sintatelu@telkomuniversity.ac.id

Abstract
PDAM Delta Tirta is a Regional Water Company that owned by Sidoarjo Goverment as a regional goverment. In running its business there are several obstacles that are experienced by PDAM Delta Tirta Sidoarjo. One of them is the lack of water distribution capacity for customers. Based on interviews with PDAM Delta Tirta Sidoarjo, PDAM Delta Tirta Sidoarjo plans to expand its business by doing an investment in water supply system development. Based on the problems and business development plan, an incremental feasibility analysis is carried out. The aspects that taking into consideration are market aspect, technical aspect and financial aspect. Based on feasibility analysis conducted shows that PDAM Delta Tirta's business development plan is feasible to be done. This is because the NPV value of business development plan is Rp 134.832.836.204,79, IRR of 9.6% and PBP of 4,730 years. Meanwhile, based on the incremental feasibility calculation, the NPV value is Rp 82,176,572,724.92an IRR of 10.7%. In addition, the sensitivity analysis shows that PDAM Delta Tirta's business investment is sensitive to a decrease in selling price by 6.37% and a decrease in demand by 6.16%.

Keywords : Incremental Feasibility Analysis, Feasibility Analysis, NPV, IRR, PBP, Sensitivity Analysis

1. Background

Humans are very dependent on the availability of water for their life, water are used for drinking, cooking, bathing, needs for agriculture and other needs. As a basic human need, the need for water has increased in line with the population growth in the world. According to MDG's (Millennium Development Goals), the target of service coverage of water for urban residents should reaching 80% and 60% for rural residents.

Then, as we know, economic development is marked by the development of industries, settlements, the expansion of city / regency areas and the increasing need for drinking water. Therefore, investment in infrastructure development such as drinking water supply as an active strategy that can invite both participation of the government and also private investors should be considered.

The Water Supply System in Sidoarjo is managed by PDAM Delta Tirta Sidoarjo in line with Article 33 Paragraph 3 of UUD 1945 and Article 10 of Government Law Number 22 year 1999, which make the water's processing is regulated, held by the government and the authority of managing the water as regional resources are left to the regional government and its agencies which is in the term of water, the implementation of this law was left the water processing to Regional Water Company or known as PDAM.

Table 1. 1 Number of Population

Area	2010	2016	2017
Surabaya	2.771.615	2.862.406	2.874.699
Malang	2.451.997	2.560.675	2.576.596
Jember	2.337.909	2.419.000	2.430.185
Sidoarjo	1.949.595	2.150.482	2.183.682
Pasuruan	1.516.492	1.593.683	1.605.307

According to BPS Data, there are population growth in Sidoarjo from year to year. This population growth will affect the need for water in those area, like the writer said before that the need for water will increasing in line with the population growth. The incresing in the number of population in Sidoarjo even made Sidoarjo as the 4th area that has the largest population in East Java.

Then, according to BPS Data in Table I.2 and Table I.3 of Household's Source of Drinking Water Percentage in East Java, the source of drinking water in this Sidoarjo is not fully reached by the Sidoarjo PDAM and there are still many other sources of drinking water chosen by households such as gallon, pump, and well.

In addition, the management of drinking water by PDAM Delta Tirta Sidoarjo still has a low level of service to the public, it can be seen from the percentage of service coverage areas in Table I.4 Percentage of PDAM Delta Tirta Service Coverage below.

Table 1. 2 Coverage Service Percentage

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Coverage Service %	**30.11%**	**30.76%**	**30.64%**	**31.33%**	**32.16%**	**37.17%**	**37.54%**

As seen from data obtained through the Delta Tirta Sidoarjo PDAM website, the service coverage of Delta Tirta Sidoarjo PDAM to achieve the Sidoarjo people welfare at the end of 2016 was only 37.54% and covered only 38% of Sidoarjo area like illustrated in the Figure I.4.

Figure 1. 1 Maps of Coverage Service

Then, based on Delta Tirta Sidoarjo's target and realization data in 2017-2019 it was found out that the targets set by Delta Tirta PDAM could not be fully realized though based on population data from year to year there are continuous growth in the population of Sidoarjo.

Table 1. 3 Target and Realization

Year	**2017**	**2018**	**2019**
Target	135.071	139.832	145.302
Realization	134.897	136.682	143.583

Based on the explanation above, PDAM Delta Tirta Sidoarjo intends to execute the investment in water supply network development to provide better services to public and to expand scope of Delta Tirta Sidoarjo PDAM's water distribution in Sidoarjo, Surabaya, and Gresik areas. This investment was carried out to reaching the MGD's target of urban resident which is increasing the coverage service to 80% of the area.

However, to achieve the MGD's targets it will requires a big amount of funds. Therefore, the PDAM makes a phased investment in this business. At this stage, the investment of Water Supply System Development will be carried out for the period 2019-2024.

Despite all the explanation above, the investment feasibility analysis must be taken into consideration before making an investment decision because this invesment will requires a lot of funds. Therefore, the writer is interested in conduct "FEASIBILITY STUDY INVESTMENT ANALYSIS ON DISTRIBUTION WATER SUPPLY SYSTEM DEVELOPMENT OF PDAM DELTA TIRTA SIDOARJO FROM MARKETING ASPECT, TECHNICAL ASPECT, AND FINANCIAL" study to measure the feasibility of the investment.

2. Literature Review and Research Methodology

2.1. Feasibility Analysis

Feasibility Study is an activity that studies deeply about the activities or businesses that will be developed in order to determine whether the businesses is feasible or not [1]. In other hand, Subagyo (2007) said that feasibility study is in-depth research about a business idea is worth doing or not. An idea is declared as a feasible if the idea brings great benefits to all stakeholders compared to the negative impacts that will caused [2].

2.2. Feasibility Analysis Aspects

2.2.1. Market Aspect

Market aspect are really important aspect to be analyze in feasibility study because through this aspect the company could identifying and communicating with qualified prospects, planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to satisfy customers by which resources are brought to bear against opportunities and threats. According to Kotler (1997), Market can divided into 3 types:

1. Potential Market is a group of consumers who are quite interested in certain market offers.
2. Available Market is a group who are interested, have an income, and have access to certain market offers.
3. Target Market is a part of available market that meets company's requirements to be pursued or entered by the company. [3]

2.2.2. Technical Aspect

Technical and technology aspect is an aspects that assess a business said to be feasible in terms of operational. Technical and technology used so that during operation there are no fatal mistakes that will make production costs higher and make future losses.

According to Kasmir and Jakfar, the purpose of technical aspect are :

1. Company can choose the right location.
2. Company can determine the layout that suitable with the production process.
3. Company can determine the most appropriate technology to support the production process.
4. Company can determine the best inventory method.
5. Company can determine the quality of the worker that needed by the company for now and future.

So, In technical and technology aspect, things that need to be considered are location, area of production, factory layout, preparation of plant equipment, and the production process or procedure.

2.2.3. Financial Aspect

Financial aspects are aspects that are used to assess the financials of a company as a whole. This aspect is as important as the other aspects, even in some companies this aspect is the main aspect to be analyzed because through this aspect the benefits of the company are clearly illustrated. The method of assessment in financial aspects are including Net Present Value, Internal Rate of Return and Payback Period.

a. Net Present Value

Net Present value is the ratio between Present Value of Net Cash Flow and Present Value of Investment over the life time of investment itself. A positive net present value indicates that the projected earnings generated by a project or investment. Otherwise, the negative net present value indicates that the project earn a losses. The formula used for this method is:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_o$$

Annotation

NPV : Net Present Value
C_t : Cash Flow for t period
C_0 : Investment value for 0 period

r : Discount rate (MARR) (%)
NPV > 0, Accept the business/project

b. Internal Rate of Return

This method is used to find the interest rate that equal with the present value of expected cash flows in the future, or cash receipts by issuing an initial investment. Investment of business plans are feasible if the Internal Rate of Return level of the business plans exceeds the minimum rate of return required by investors. The formula used for this IRR method is:

$$IRR = i_1 + \frac{NPV1}{N\square V1 - NPV2} \times (i_1 - i_2)$$

Annotation

IRR : Internal Rate of Return
i_1 : Interest Rate (NPV +)
i_2 : Interest Rate (NPV -)
NPV $_1$: Net Present Value > 0
NPV $_2$: Net Present Value < 0
If IRR > Interest Rate (MARR), Accept the business/project
If IRR < Interest Rate (MARR), Reject the business/project

c. Payback Period

The payback period refers to the amount of time it takes to recover the cost of an investment. The criteria using this method is if the payback period is shorter than the maximum payback period, the project is declared as an eligible project for implementation. The formula used for this method is:
Payback Period if the Cash Flow is different for each period:

$$Payback\ Period = n + \frac{(a-b)}{(c-b)} \times 1\ year$$

Annotation
n : The last period where the cash flow still negative
a : Total of Investment
b : Cummulative total of cash flow on n period
c : Cummulative total of cash flow on n+1 period

Payback Period if the Cash Flow is same for each period:

$$Payback\ Period = \frac{Investment}{Net\ Cash\ Flow} \times 1\ year$$

2.3. Sensitivity Analysis

Based on Daellenbach HG (1994), sensitivity analysis explores how the optimal solution response to changes in input parameters. Sensitivity analysis aims to see what will happen with project or business if there is an error or change in the calculation of costs or benefits [4].

2.4. Research Methodology

When conducting a research, a conceptual model is needed to find out the related relationship between theory and concepts used from the problem under study. In addition, the conceptual model is used to identify the research process to provide solutions to all related problems during the research.

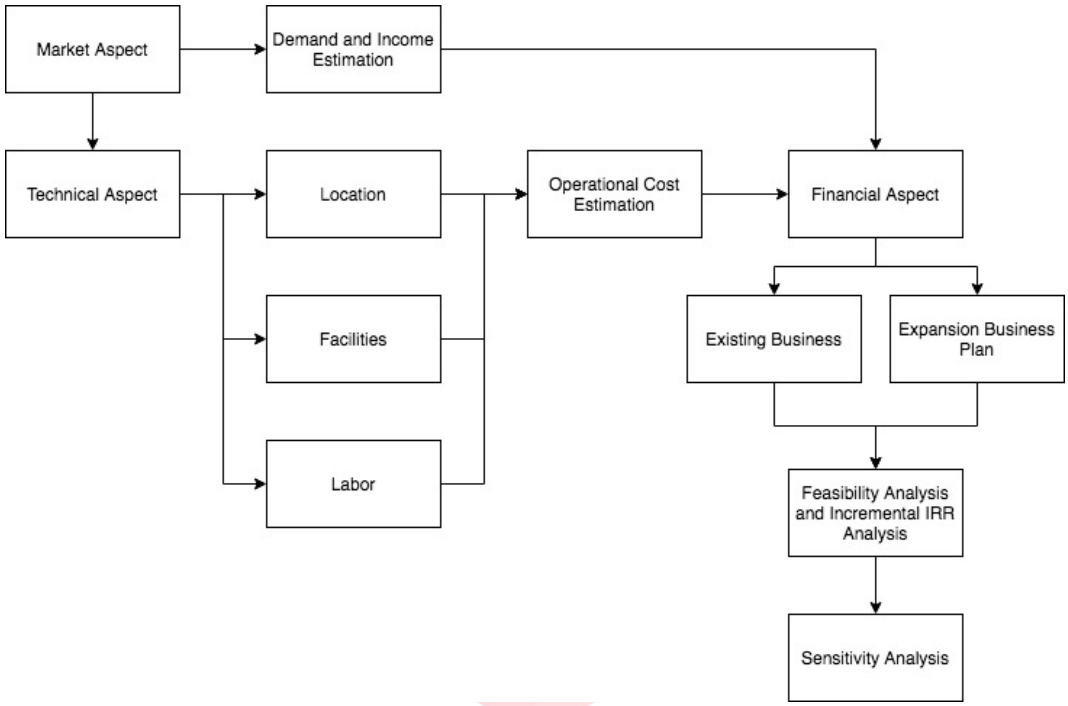

Figure 2. 1 Research Methodology

The conceptual model above explains the aspects that are influential and needed to analyze the feasibility of a business. These aspects are market aspects, technical aspects, and financial aspects. Market aspects are then divided into potential markets, available markets, and target markets. By analyzing the potential market from water supply system development of PDAM Delta Tirta Sidoarjo, we will get the possibility of a number of markets interested in the services offered. After that analyzing the available market to find out the number who are willing to get an offer to the PDAM. Then proceed with analyzing the market which will generate the number of demand. Furthermore, the amount of demand in the market aspect is used to calculate operational costs and capital expenditure. The data that has been obtained from the analysis of market aspects and technical aspects will then be processed in the financial aspect, where the data will be converted into a cash flow statement. The results of the report can visualize financial projections and investment returns using NPV, IRR, PI, BEP, and PBP calculations. In addition, sensitivity analysis is also taken into consideration in water supply system development of PDAM Delta Tirta Sidoarjo.

3. Discussion

3.1. Market Aspect

After collecting and processing tha data, it was found out that the potential market for PDAM Delta Tirta was 71.8%. Meanwhile, the available market was 59.8% and the target market was 18.8%. Based on this data, it can be found out that the target market of PDAM Delta Tirta is 24,594 households from the total 718.945 households in Sidoarjo. So, the average customer growth of PDAM Delta Tirta used for predicted the number of demand in the next 5 years. The data on Table 3. is a demand projection for the next 5 years.

Table 3. 1 Customer Projection

	Year					
	2019	2021	2022	2023	2024	2025
Previos Customer	135,318	135,318	135,318	135,318	135,318	135,318
New Customer Segment		24,594	25,323	26,075	26,849	27,645
Total Customer	135,318	159,912	160,641	161,393	162,167	162,963

3.2. Technical Aspect

The technical aspects carried out in this study consist of analysis of the production and distribution processes in PDAM Delta Tirta business are described in the form of flow diagrams starting from the water production process, water distribution process, new customer registration and water payment process. The flow diagram

is drawn to find out how long it takes for each process so the number of workers that needed can be calculated as shown in the table of worker needs below.

Table 3. 2 Number of Labor Needed

Total PDAM Delta Tirta Labor	
Year	Number of Labor Needed
2021	571
2022	566
2023	570
2024	570
2025	571

Then, it also takes into account the production and distribution needs of a number of increased customers each year as illustrated in table 3. which is the basis for calculating the increase in production and distribution capacity in a number of locations such as Candi, Porong, Jambon, and Waru.

Table 3. 3 Volume of Production and Distribution Needed

Production and Distribution Volume Needed								
No		Unit	Year					
			2019	2021	2022	2023	2024	2025
1	Production and Distribution Volume/Year	m3/day	112,815	133,319	133,928	134,554	135,199	135,864
		m3/year	41,177,646	48,661,549	48,883,630	49,112,300	49,347,756	49,590,200

By increasing the production and distribution capacity, an investment of Rp 1.113.663.681.359. This investment required the total cost of proposed project, cost of existing investment, and working capital.

3.3. Financial Aspect

In running its business expansion, PDAM Delta Tirta needs funds consisting of total fixed investment, existing investment, and working capital that approximately around Rp. Then after that, the calculation of estimated revenue is calculated based on the amount of water sold and the installation of new water installation of new customers. The following is a graph of PDAM Delta Tirta revenue estimation.

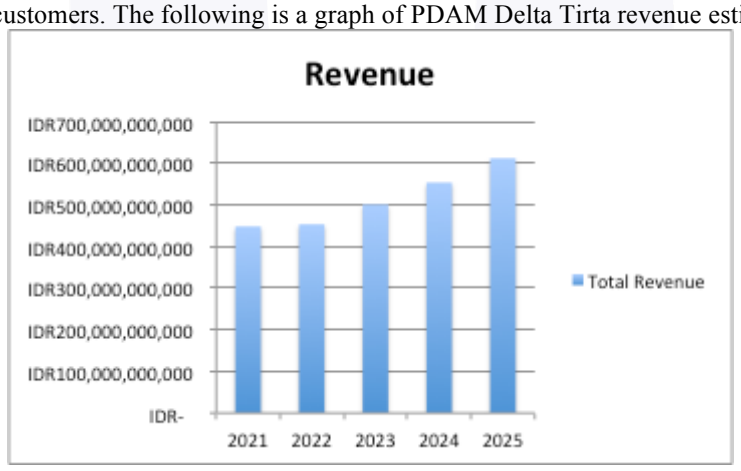

Figure 3. 1 Revenue Projection

Then,the company should calcultaing the amount of project income to find out whether the business project is experiencing a gain or loss. The following is a graph of earnings after tax on PDAM Delta Tirta business expansion project each year for the next 5 years.

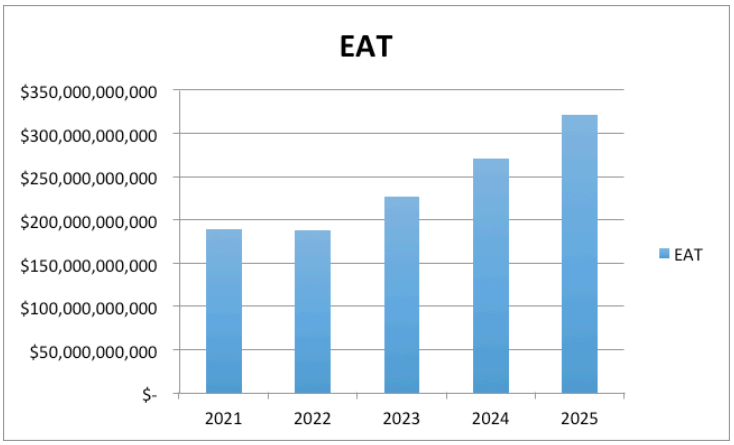

Figure 3. 2 Earning After Tax

Furthermore, a business feasibility analysis is carried out to determine whether the business development planned by PDAM Delta Tirta is feasible or not. The determination of the feasibility aspect is done by calculating the Net Present Value, Internal Rate of Return, and Payback Period. The following is the calculation result of the financial multiplication of the Delta Tirta PDAM business development project.
The results of the feasibility calculation of the PDAM Delta existing business are:
NPV : Rp 52.455.744.288,69
PBP : 4.703 years
IRR : 8.7%
While, the results of the feasibility calculation of the PDAM Delta business expansion plan are:
NPV : Rp 82,176,572,724.92
IRR : 10.7%
And the results of the incremental feasibility calculation of the PDAM Delta business expansion plan are:
NPV : Rp 134.832.836.204,79
PBP : 4.730 years
IRR : 9.6%

3.4. Sensitivity Analysis

In this research, a sensitivity analysis was conducted by calculated the sensitivity in selling prices decrease and decreasing in demand. Where the results of sensitivity analysis calculation are 6.37% in selling prices decrease and 6.16% in demand decrease.

4. Conclusion

Based on the research conducted, it can be conclude that the market characteristics of PDAM Delta Tirta Sidoarjo are households in Sidoarjo, East Java. Where the potential market is 71.8% of the total households in Sidoarjo, the availaible market is 59.8% of the total potential market, and the target market is targeted at 18.8% according to the market share of PDAM Delta Tirta Sidoarjo compared to other water companies. Then for the technical aspects of this business plan it can be said the business is feasible because the production and distribution facilities, the number of workers, and the operational equipment needed are in accordance with the estimated demand which is calculated with a total of investment cost is Rp 1,113,663,681,359 by considering the initial investment. Furthermore, in this study several components taking into consideration for financial aspect are investment costs, operational costs, production and distribution costs, income statement, and cash flow. Where, all these components then processed into NPV, PBP, and IRR values that show the feasibility of the business. The results of the feasibility calculation of the PDAM Delta existing business are:
NPV : Rp 52.455.744.288,69
PBP : 4.703 years
IRR : 8.7%
While, the results of the feasibility calculation of the PDAM Delta business expansion plan are:
NPV : Rp 82,176,572,724.92
IRR : 10.7%
And the results of the incremental feasibility calculation of the PDAM Delta business expansion plan are:
NPV : Rp 134.832.836.204,79
PBP : 4.730 years
IRR : 9.6%

Futhermore, in this study, a sensitivity analysis was also carried out where the analysis of sensitivity that used are sensitivity of selling price decrease and sensitivity of market demand decrease. Where, the result that obtained from the this research are the sensitivity of selling price decrease is 6.37% and sensitivity of market demand decrease is 6.16%.

5. Reference

[1] Jakfar, S.E., M.M, & Dr. Kasmir, S.E., M.M. (2015). *Studi Kelayakan Bisnis.* Jakarta: PRENADA MEDIAGROUP.
[2] Ahmad Subagyo, S. M. (2008). *Studi Kelayakan: Teori dan Aplikasi.* Indonesia: PT Elex Media Komputindo.
[3] Kotler, P., & Keller, K. L. (2016). *Marketing Management 15th Edition.* London: Pearson Education Limited.
[4] Daellenbach, H. G. (1994). *Systems and Decision Making : A Management Science Approach.* United Kingdom: John Wiley & Sons, Ltd.