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Financial Feasibility Analysis of Asphalt Mixing Plant Investment: A Case Study in Gianyar Regency, Bali

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ABSTRACT: The availability of adequate road infrastructure is crucial for supporting mobility and regional economic growth. In Indonesia, increasing demand for high-performance roads has driven a transition from penetration macadam to hot mix asphalt (HMA). To meet this demand efficiently, reliable production facilities such as Asphalt Mixing Plants (AMP) are essential. This study aims to evaluate the financial feasibility of an AMP investment located in Pering Village, Blahbatuh District, Gianyar Regency, Bali. The analysis uses five financial indicators: Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), Break Even Point (BEP), and Annual Equivalent (AE). Financial data were collected from the company's records of hotmix production and sales during the 2014–2020 period. The results indicate that the AMP project is financially viable. The NPV is Rp. 33.421.961.979, the IRR is 18% higher than the Minimum Attractive Rate of Return (MARR) of 16%—while the BEP was achieved in the 7th month of 2015. The AE value reached Rp. 4.774.565.997 per year, and the BCR was calculated at 1,244. These findings confirm that the investment is profitable and worth pursuing. This study provides practical insights for investors and stakeholders in making data-driven decisions for infrastructure investments, particularly in the road construction sector. Furthermore, the findings are relevant for long-term AMP business development, considering the growing demand for HMA in Indonesia. The shift from penetration macadam to HMA underscores the importance of efficient asphalt production facilities to ensure consistent supply and support sustainable infrastructure development.

Keyword: *Asphalt Mixing Plant; Finansial Feasibility; Hot Mix Asphalt; Infrastructure Investment*

I. INTRODUCTION

The increasing demand for high-quality road infrastructure has driven significant transformations in Indonesia's road construction sector, particularly in the adoption of advanced pavement material technologies. Traditional methods such as penetration macadam have gradually been phased out and replaced by more modern technologies, namely Hot Mix Asphalt (HMA). This hot asphalt mixture has proven to offer superior performance in terms of strength, durability, and resistance to deformation and climate variability [1], [2]. As the demand for higher road quality increases, so does the need for efficient production facilities such as Asphalt Mixing Plants (AMP). AMP play a critical role in supporting asphalt pavement work by consistently producing large volumes of asphalt mixtures that comply with technical specifications.

The strategic role of AMPs in road construction is reinforced by government policies and technical standards that require hot mix asphalt to be produced using certified plants under strict quality control measures [3]. This regulation emphasizes that AMPs are not merely auxiliary production equipment but represent essential infrastructure in ensuring the quality and sustainability of national road projects.

Several studies have attempted to evaluate the financial feasibility of AMP investment using various financial indicators. Some focused on Net Present Value (NPV) and Internal Rate of Return (IRR) [4], [5], while others applied Break Even Point (BEP)[6], Benefit Cost Ratio (BCR)[7], and Annual Equivalent (AE)[8] in long-term infrastructure investment assessments. Although valuable, most of these studies were limited to conceptual frameworks and relied heavily on projected data or theoretical assumptions, which may not fully capture the actual risks and uncertainties in AMP operations.

This study seeks to address that gap by utilizing historical operational and financial data from 2014 to 2020 of an AMP located in Pering Village, Blahbatuh District, Gianyar Regency, Bali. Unlike previous research that was largely model-based, this work applies five financial indicators NPV, IRR, BEP, AE, and BCR[9]—to real-world data, thus offering more evidence-based insights. This approach not only

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strengthens the reliability of the analysis but also contributes novelty by demonstrating how financial feasibility can be more accurately assessed under dynamic and fluctuating market conditions.

Furthermore, by grounding the feasibility analysis in actual performance data, the findings of this study can serve as a practical solution for investors, contractors, and policymakers. It provides a reference for mitigating risks in infrastructure investment, enhancing decision-making in AMP development, and ensuring that road construction projects are both economically viable and technically sustainable.

II. THEORETICAL FRAMEWORK

Investment in an Asphalt Mixing Plant (AMP) is a capital-intensive activity that requires thorough financial analysis to ensure its economic feasibility. This section presents the theoretical basis of AMP operations and the financial evaluation methods used in infrastructure investment.

Asphalt Mixing Plant (AMP)

Asphalt Mixing Plants (AMPs) function as integrated mechanical and electronic systems designed for the large-scale production of hot mix asphalt (HMA). Within the process, aggregates are heated, dried, and blended with asphalt binder to produce mixtures that conform to technical standards and performance requirements. Based on their mixing methods, AMPs are classified into two main types: batch plants and drum mix plants. Batch plants operate by weighing aggregates precisely and mixing them in cycles, allowing for better quality control and flexibility in adjusting mix proportions. In contrast, drum mix plants perform aggregate heating and asphalt blending in a continuous process, which increases efficiency but offers less precision in quality control.

In Indonesia, batch plants are more commonly adopted because they can accommodate larger production capacities and ensure higher consistency of HMA quality[10]. The choice of AMP type is also influenced by project scale, location, and production demand, making the technology a critical factor in road construction planning. Furthermore, the presence of AMPs directly supports infrastructure development by ensuring a steady supply of asphalt mixtures that meet durability and sustainability standards.

Investment and Capital Budgeting

Capital budgeting is the process of planning and decision-making for long-term capital expenditures, where returns are expected beyond one year. It is essential in evaluating investment feasibility by considering asset life, profitability, and operational risks [11]. Commonly used methods include Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), Break Even Point (BEP), and Annual Equivalent (AE), which provide a comprehensive assessment of project viability [12], [13]. In the case of Asphalt Mixing Plant (AMP) investment, capital budgeting is particularly important because of the large initial capital requirements and long-term operational commitments.

Financial Feasibility Indicators

1. Net Present Value (NPV)

   NPV is the difference between the present value of benefits and the present value of costs. If NPV > 0, the project is considered feasible[14]. This indicator has also been used in AMP feasibility analysis, where a positive NPV demonstrates profitable investment.
2. Internal Rate of Return (IRR)

   IRR is the interest rate at which the NPV equals zero. An investment is considered viable if IRR $\geq$ the Minimum Attractive Rate of Return (MARR)[15]. The use of IRR has been demonstrated in AMP feasibility evaluations, showing its ability to reflect financial viability.
3. Benefit Cost Ratio (BCR)

   BCR is the ratio between the present value of benefits and the present value of costs. If BCR ≥ 1, the investment is feasible. Previous studies have applied BCR as a decision-making tool in infrastructure investments[16]
4. Annual Equivalent (AE)

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AE converts net cash flows into uniform annual amounts, enabling comparison across projects with different durations. AE has been proven relevant in the evaluation of long-term infrastructure investments, especially road projects[17].

5. Break Even Point (BEP)

BEP is the point at which total revenue equals total cost, used to determine the minimum production capacity required to avoid losses[18]. BEP analysis has also been applied to determine the optimal AMP capacity in road infrastructure projects.

These financial indicators are essential tools for assessing AMP investment feasibility, particularly in ensuring long-term sustainability and return on investment.

III. METHODS

This study employs a descriptive quantitative approach to analyze the financial feasibility of investment in an Asphalt Mixing Plant (AMP). The research stages are systematically structured as shown in Figure 1

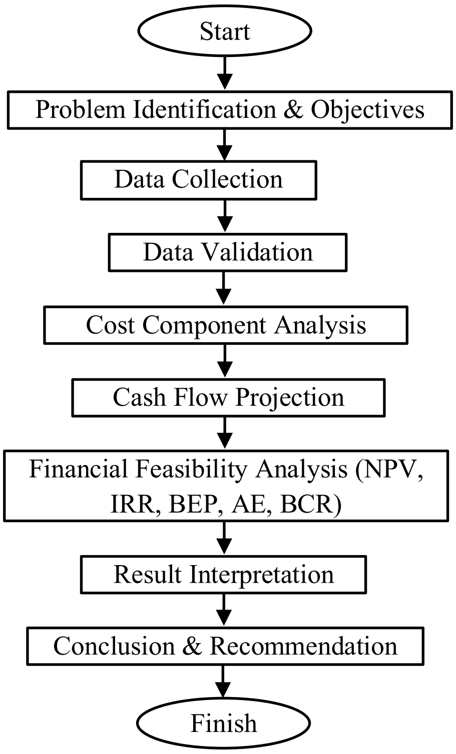

Figure 1. Reasearch Flowchart

This study employs a descriptive quantitative approach to analyze the financial feasibility of investment in an Asphalt Mixing Plant (AMP). The research process involved several systematic stages.

The first stage was data collection, which relied on secondary data such as annual production costs of hot mix asphalt (HMA), supporting components of production, and routine operational and maintenance expenses. Complementary data were obtained through documentation and interviews, including the job mix formula (JMF), fuel calibration for machinery and vehicles, labor wages, acquisition and depreciation of equipment, and raw material consumption and supply[19].

The next stage was data validation, in which all documented and interview-based information was verified using audited company financial reports and official production records to ensure accuracy and reliability. Following validation, a cost component analysis was carried out by classifying AMP operational costs into fixed and variable categories, with key components including fuel, labor, equipment depreciation, and logistics.

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Subsequently, cash flow projection was prepared to capture inflows from hotmix sales revenue, equipment depreciation, and asset sales, as well as outflows covering production expenses, wages, fuel, maintenance, taxes, and other operating costs. These projections were compiled for the period 2014–2020.

The core of the study was the financial feasibility analysis, which applied five well-established indicators: Net Present Value (NPV), Internal Rate of Return (IRR), Break Even Point (BEP), Annual Equivalent (AE), and Benefit Cost Ratio (BCR). For this purpose, the Minimum Attractive Rate of Return (MARR) was set at 16% [15], following the benchmark rate commonly used by the Ministry of Public Works and Housing (PUPR) in evaluating infrastructure investment projects in Indonesia[10].

Finally, the results of the financial indicators were interpreted to determine the feasibility and long-term sustainability of AMP operations. Based on these findings, conclusions and recommendations were formulated to optimize AMP investment and provide guidance for stakeholders in infrastructure development decision-making.

IV. DISCUSSION

This section presents the discussion of the financial feasibility analysis of the AMP, based on cash flow data, operational expenditures, and investment feasibility indicators over the 2014–2020 period.

Raw Material and Fuel Expenditures for AMP Operations

The calculation of raw material and fuel expenditures in AMP operations is based on the Job Mix Formula (JMF), by multiplying material requirements with the total volume of hot mix asphalt produced and the unit price in each year. These costs form the largest portion of variable expenses, making them sensitive to production volume and market price fluctuations. A summary of annual expenditures and production notes for 2014–2020 is presented in Table 1.

Table 1. Annual AMP Operating Expenditures and Production Notes (2014–2020)

Year	Total Expenditure (IDR)	General Remarks
2014	26.412.601.535	Highest production year; high asphalt and fuel consumption
2015	19.868.138.553	Decreased production; lower fuel prices
2016	14.838.874.742	Reduced material needs; early signs of efficiency
2017	17.754.399.602	Increased costs due to rising unit prices of materials
2018	10.590.257.604	Significant drop in production volume
2019	7.804.102.327	Low production; fuel prices began to rise
2020	2.412.847.111	Lowest year, likely due to pandemic impact

Facilities, Infrastructure, and Supporting Operational Costs of AMP

The operation of an Asphalt Mixing Plant (AMP) also requires supporting facilities, infrastructure, and related operational equipment. These components represent a major part of initial capital and fixed costs, influencing long-term financial feasibility. Key items include heavy equipment, vehicles, laboratory facilities, and office infrastructure, all of which ensure production efficiency and quality control. The acquisition costs and depreciation values are summarized in Table 2.

Table 2. Acquisition Costs of Supporting Equipment for AMP

No	Equipment	Acquisition Value (IDR)		Useful Life (Years)	Depreciation Rate
1	Mitsubishi Genset 500 KVA	IDR	479.016.200	8	25% (Declining Balance)
2	Nigata FPB 5 W Asphalt Finisher	IDR	380.750.000	8	25% (Declining Balance)
3	Bomag Vibratory Roller	IDR	540.000.000	8	25% (Declining Balance)
4	Airman Compressor	IDR	175.000.000	8	25% (Declining Balance)
5	Sakai Road Roller TS 600 C	IDR	378.000.000	8	25% (Declining Balance)
6	Caterpillar 926E Wheel Loader	IDR	676.000.000	8	25% (Declining Balance)

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7	Sakai TS200 Tyre Roller	IDR	650.000.000	8	25% (Declining Balance)
8	Asphalt Distributor	IDR	75.000.000	8	25% (Declining Balance)
9	Weighbridge	IDR	180.000.000	8	25% (Declining Balance)
10	Shantui SL30W Wheel Loader	IDR	530.000.000	8	25% (Declining Balance)
11	AMP SSAP 1,000	IDR	2.217.501.175	8	25% (Declining Balance)
12	Vehicles	IDR	6.115.073.638	8	25% (Declining Balance)
13	Laboratory Equipment	IDR	373.486.000	4	50% (Declining Balance)
14	Office	IDR	546.710.979	20	5% (Straight Line)
Total Initial Capital		**IDR**	**13.316.537.992**		

Profitability Analysis

This study evaluates the profitability of AMP investment using five financial indicators: Net Present Value (NPV), Internal Rate of Return (IRR), Break Even Point (BEP), Annual Equivalent (AE), and Benefit Cost Ratio (BCR). These indicators are widely recognized in infrastructure economics as reliable measures of project feasibility in terms of profit potential, capital recovery efficiency, and long-term operational viability. The use of multiple indicators ensures a comprehensive evaluation, since each captures different financial aspects: NPV and IRR reflect value creation and return rate, BEP identifies the minimum revenue required to recover costs, AE expresses annualized profitability, and BCR compares overall benefits to costs.

In this study, these indicators are applied to actual operational and financial data of the AMP from 2014 to 2020, enabling a realistic assessment rather than relying on projections alone. This approach provides more accurate insights into the project's financial sustainability and resilience under real market conditions. A summary of annual financial performance, including revenue, cost, net cash flow, and profitability percentage, is presented in Table 3, which forms the basis for subsequent feasibility analysis and interpretation.

Table 3. Calculation of Net Cash Flow

Year	Total Revenue (IDR)	Total Cost (IDR)	Net Cash Flow (IDR)	Profit (%)
2014	26.639.042.405	43.349.571.159	-16.710.528.755	-62,73
2015	24.204.092.466	24.242.585.350	-38.492.884	-0,16
2016	46.094.672.084	18.606.366.529	27.488.305.555	59,63
2017	34.040.480.424	21.360.721.773	12.679.758.651	37,25
2018	20.365.080.357	14.240.678.114	6.124.402.243	30,07
2019	14.255.083.894	10.882.184.952	3.372.898.942	23,66
2020	4.692.997.170	4.187.378.943	505.618.227	10,77

Net Present Value (NPV)

This analysis utilizes the actual revenue data of the company from 2014 to 2020, with expenditures converted based on the figures presented in Table 3. (Net Cash Flow Calculation). In this study, the NPV (Net Present Value) is derived without applying a discount factor to adjust the cash flows to their present value. Instead, the calculation is based directly on the cumulative Net Cash Flow (∑NCF) throughout the evaluation period.

Table 4. NPV Value

Year	Net Cast Flow (NCF)
2014	(16.710.528.755)
2015	(38.492.884)
2016	27.488.305.555

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2017	12.679.758.651
2018	6.124.402.243
2019	3.372.898.942
2020	505.618.227
∑NCF=NPV	**33.421.961.979**

Based on the theoretical framework discussed in the previous chapter, an investment is considered feasible if the NPV > 1 or has a positive value. In this case, the calculated NPV is IDR 33.421.961.979, which is greater than 1, indicating that the investment is financially viable and worth continuing.

Internal Rate Of Return (IRR)

The IRR is calculated at the point where NPV equals zero, based on annual Net Cash Flow performance. Since the data reflects historical values, the calculation uses actual NCF without applying a discount factor, and is performed using Microsoft Excel.

Table 5. IRR Value

	Year	**Net Cast Flow (NCF)**
	A	B
1	Initial Investment Value	(13.316.537.992)
2	2014	(16.710.528.755)
3	2015	(38.492.884)
4	2016	27.488.305.555
5	2017	12.679.758.651
6	2018	6.124.402.243
7	2019	3.372.898.942
8	2020	505.618.227
	IRR = IRR(B1:B8)	**18%**

The IRR is calculated at the point where NPV equals zero, using historical Net Cash Flow (NCF) data without discounting. The result shows an IRR of 18%, exceeding the Minimum Attractive Rate of Return (MARR) of 16%. This indicates that the AMP investment generates returns above the required benchmark and is financially feasible for continuation.

Break Event Point (BEP)

The analysis examines the relationship between the company's total revenue and total expenditure from 2014 to 2020 to assess the financial performance and operational efficiency of the investment.

Table 6. Break Even Point (BEP) Calculation

Year	Revenue	Cost	Profit	Cumulative Revenue	Cymulative Expenditure
2014	26.639.042.405	43.349.571.159	(16.710.528.755)	26.639.042.405	43.349.571.159
2015	24.204.092.466	24.242.585.350	(38.492.884)	50.843.134.871	67.592.156.510
2016	46.094.672.084	18.606.366.529	27.488.305.555	96.937.806.955	86.198.523.039
2017	34.040.480.424	21.360.721.773	12.679.758.651	130.978.287.379	107.559.244.811
2018	20.365.080.357	14.240.678.114	6.124.402.243	151.343.367.736	121.799.922.926
2019	14.255.083.894	10.882.184.952	3.372.898.942	165.598.451.630	132.682.107.878
2020	4.692.997.170	4.187.378.943	505.618.227	170.291.448.800	136.869.486.821

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Total	170.291.448.800	136.869.486.821	33.421.961.979	792.631.539.775	696.051.013.143

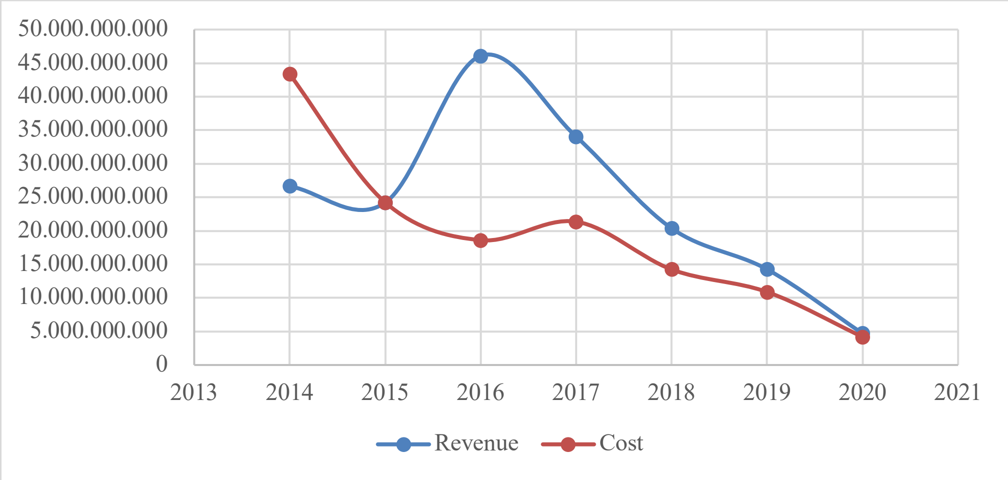

Figure 2. Annual Revenue and Cost Chart

Based on Table 6. of the Break-Even Point (BEP) Calculation and Figure 1. showing the annual revenue and cost graphit is evident that the AMP experienced losses during the 2014–2015 period. However, in 2016, the plant began to reach the break-even point. The BEP value is calculated as follows:

$TR_{2015} = 50.843.134.871$
$TC_{2015} = 67.592.156.510$
$TR_{2016} = 96.937.806.955$
$TC_{2016} = 86.198.523.039$

Equation I:

- $\frac{x-x1}{x2-x1} = \frac{y-y1}{y2-y1}$
- $\frac{x-15}{16-15} = \frac{y-\ 50.843.134.871}{96.937.806.955-50.843.134.871}$
- $\frac{x-15}{1} = \frac{y-\ 50.843.134.871}{46.094.672.084}$
- $46.094.672.084\text{x} - \ 691.420.081.261 = \text{y} - 50.843.134.871$
- $46.094.672.084\text{x} - \text{y} = \ 640.576.946.390$

Equation II:

- $\frac{x-x1}{x2-x1} = \frac{y-y1}{y2-y1}$
- $\frac{x-15}{16-15} = \frac{y-\ 67.592.156.510}{86.198.523.039-\ 67.592.156.510}$
- $\frac{x-15}{1} = \frac{y-\ 67.592.156.510}{18.606.366.529}$
- $18.606.366.529\ \text{x} - \ 279.095.497.931\ = \text{y} - 67.592.156.510$
- $18.606.366.529\ \text{x} - \text{y} = \ 211.503.341.421$

Substitute Equation I and Equation II.

- $46.094.672.084\ \text{x} - \text{y} = 640.576.946.390$
- $\underline{18.606.366.529\ \text{x} - \text{y} = 211.503.341.421}$
- $27.488.305.555 \qquad 429.073.604.969$

$$\text{x} = \frac{429.073.604.969}{27.488.305.555}$$

$$\text{x} = 15{,}61$$

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The value of x is inserted into both Equation I and II.

$$46.094.672.084 \ \text{x} \ (15{,}61) - y = 640.576.946.390$$

$$719.506.230.792 - y = 640.576.946.390$$

$$y = 719.506.230.792 - 640.576.946.390$$

$$y = 78.929.284.402$$

The coordinate point (x, y) is (15,61; 78.929.284.402)

The Break-Even Point (BEP) analysis provides insight into the point at which the Asphalt Mixing Plant (AMP) in Gianyar Regency was able to recover its costs. In 2015, the AMP recorded a total cost of approximately IDR 50.84 billion and generated revenue of IDR 67.59 billion, resulting in a positive net cash flow. The BEP was achieved in the 7th month of 2015, with a cumulative revenue of IDR 78.93 billion, confirming that operational and investment expenses were recovered within the first year of operation. In 2016, both revenue and cost increased, with costs reaching approximately IDR 86.20 billion and revenues rising to IDR 96.94 billion. The continued surplus beyond the BEP indicates sustained financial feasibility and validates the AMP's capacity to generate profits after cost recovery. These results emphasize that AMP investment can achieve rapid cost recovery and provide long-term profitability under consistent production conditions. The comparison of costs and revenues, along with the BEP point in 2015, is presented in Figure 3.

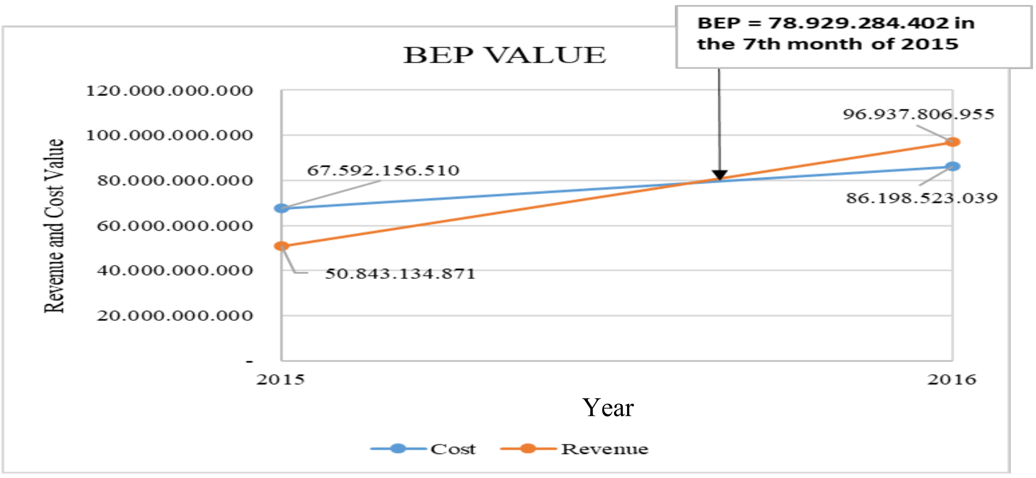

Figure 3. Break-Even Point Graph of the AMP in Gianyar Regency

***Annual Equivalent* (AE)**

The Annual Equivalent (AE) represents the uniform distribution of revenue and expenditure over the project's lifetime, providing an average annual profitability measure of the investment.

Table 7. Break-Even Point Graph of the AMP in Gianyar Regency

Year	Revenue (*Cash in*)(Rp)	Cost (*Cash out*)(Rp)
2014	26.639.042.405	43.349.571.159
2015	24.204.092.466	24.242.585.350
2016	46.094.672.084	18.606.366.529
2017	34.040.480.424	21.360.721.773
2018	20.365.080.357	14.240.678.114
2019	14.255.083.894	10.882.184.952
2020	4.692.997.170	4.187.378.943
Average	**24.327.349.829**	**19.552.783.832**
AE		**4.774.565.997**

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The AE analysis shows the average annual profitability of the AMP operation by comparing average revenue and average cost over the project period. The calculated AE value of Rp 4,774,565,997 indicates that the investment generates positive annual returns, confirming its financial feasibility.

Benefit Cost Ratio (BCR)

BCR is the ratio between total revenue and total expenditure. $BCR = \frac{170.291.448.800}{136.869.486.821} = 1,244$

The BCR represents the ratio between total benefits and total costs. With a value of 1.244, the result demonstrates that total revenues exceed expenditures, reinforcing that the AMP project is financially feasible and profitable.

V. CONCLUSION

Based on the evaluation results, the following conclusions can be drawn, the financial feasibility analysis of the Asphalt Mixing Plant (AMP) investment, which has been operational from 2014 to 2020, indicates that the project is financially viable and should be continued. This conclusion is supported by the fulfillment of several feasibility criteria, including:

1. Net Present Value (NPV) of Rp. 33.421.961.979, indicating profitability (criterion: NPV > 0).
2. Internal Rate of Return (IRR) of 18%, exceeding the Minimum Attractive Rate of Return (MARR = 16%), suggesting the project is financially acceptable.
3. Break-Even Point (BEP) occurred in the 7th month of 2015, when cumulative revenue reached Rp. 78.929.284.402.
4. Annual Equivalent (AE) reached Rp. 4.774.565.997, indicating consistent and significant annual profit.
5. Benefit Cost Ratio (BCR) of 1,244, which exceeds the threshold of 1, confirming that the AMP operation is financially feasible.

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