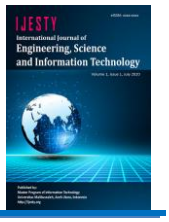
International Journal of Engineering, Science & InformationTechnology (IJESTY)
Volume 3, No. 3 (2023) pp. 38-42
ISSN 2775-2674 (online)
Website: http://ijesty.org/index.php/ijesty
DOI: https://doi.org/10.52088/ijesty.v3i3.463
Research Paper, Short Communication, Review, Technical Paper



Economic Feasibility Analysis of Sawaibu, Indonesia Bay Bridge Construction

Alfred Sanny Talaksoru[1]*, Sri Wiwoho Mudjanarko[1], Muhammad Ikhsan Setiawan[1], Atik Wahyuni[2]

[1]Department of Civil Engineering, Narotama University, Surabaya, Indonesia
[2]Universitas Muhammadiyah Sidoarjo, Indonesia

**Corresponding author Email: alestra.engra@gmail.com*

Manuscript received 24 May 2023; Revised 27 June 2023; Accepted 2 July 2023. Date of publication 28 September 2023

Abstract

Sawaibu Bay Bridge is located in Manokwari Regency and is 300 meters long. The west side is on the Jalan Pahlawan canal, and the east is towards Jalan Siliwangi. This study assesses whether the bridge construction project is feasible and finds alternatives or solutions. The analytical methods used are NPV, BCR, and IRR, which refer to the value of inflation by considering the tourist retribution and travel time analysis. The results will be used to conclude whether the first alternative to the project meets the financial feasibility requirements based on inflation. It shows NPV of 67,061,982,402, BCR 1,096, and IRR 30% ≥ MARR of 10%, which means that the first alternative is feasible to build.

Keywords: *Infrastructure, Sawaibu Bay Bridge, Economic Feasibility Study, Inflation, NPV.*

1. Introduction

Bridges are made to connect roads and cross natural or artificial obstacles [1], [2]. Law Number 38 of 2004, concerning Roads, states the importance of roads, including bridges, as vital transportation infrastructure in the life of the nation and state [3], [4]. Bridges are essential to the road network and the national transportation system to support economic, social, cultural, and environmental activities (Dananjoyo et al., 2020). However, many things must be considered before the construction [5], [6]. One of the things that must be done beforehand is to make a feasibility study. Several aspects are reviewed: technical, environmental, safety, economic, and other elements [7]. Based on previous literature studies and phenomena in the field, this research will conduct a feasibility analysis of the development's economic aspect, measuring the cost of the road structure and its benefits [8], [9]. The study is expected to provide input on whether the construction of the Sawaibu Bay Bridge is feasible.

2. Literature Review

Herma et al., in their research entitled Gayamsari Timur Flood Canal Bridge Planning, Semarang City (2010), state that a feasibility study is essential to determine a better investment choice. The review is carried out from various aspects, namely:
Technical aspects, such as the selection of the type of construction, general requirements, materials, and work, as well as the possibility of gradual and increasing construction work [10], [11];
The management aspect discusses project procedures, including project maintenance [12];
The financial aspect covers the costs for development and further management [13];
The economic aspect discusses the aspects of profit and loss [14]. The observation must consider and study the local community's social and cultural conditions [15], [16]. At this stage, alternative designs can be obtained to choose the most economical plan [17].

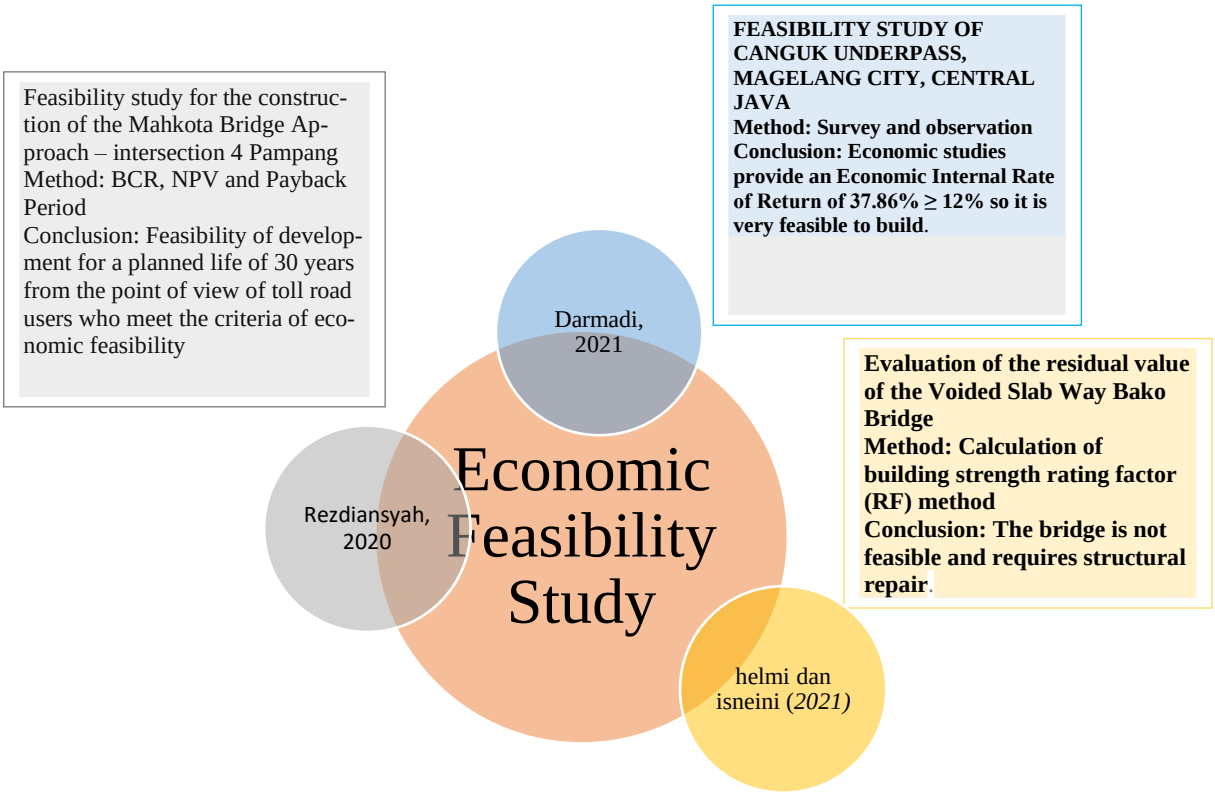


Fig 1. Journal Review

This economic feasibility study research focuses on the benefits of having tourist attractions around the Sawaibu Bay bridge and saving travel time.

3. Method

The location is on the first alternative bridge route, from the Jalan Pahlawan Canal's west to the Jalan Siliwangi's east side.

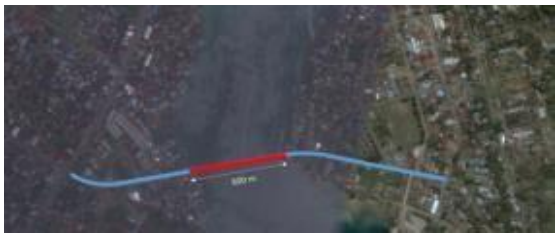


Fig 2. Research sites

Data Sources and Research [18] Implementation

Secondary data is a literature study on the analysis of economic feasibility studies [19], [20]. In contrast, primary data are traffic, vehicle growth, a willingness to pay for tickets, and a travel time savings survey.

Some of the assumptions used to calculate the economic costs and benefits of the construction of the Sawaibu Bay Bridge are as follows:

1. The analysis period is 35 years, from 2022-2061
2. The length of the road sections compared are regular roads (without bridges) and through bridges connecting the fish market with the Sanggeng port. The road is 3 km, and the bridge is 300 m long.
3. The inflation rate is 5%, 365 days per year, the average number of passengers is 3.72 people/vehicle, the average speed is 50-60 km/hour, vehicle growth after 2050 is 4.8%, and per capita income was 48.7 million/year in 2017. In addition, the number of hours worked is 2,112 per year, and the number of people per hour is 23,052/person/hour.

4. Analysis and Discussion

4.1. Financial and Economic Projections of Receipts for Tourist Visits Around the Sawaibu Bay Bridge

The questionnaire contains questions about willingness to pay if the Sawaibu Bay bridge becomes a tourist location. The answers indicate that people are willing to pay an average of Rp. 5000, -. This amount is the income originating from user fees.

Table 1. Financial projections based on receipts for tourist visits

Year	Total population	Total Tourists	Retribution (IDR)	Full Benefit (IDR) in Million	
				Financial	Economy
2022	177,616	8,881	5,000	44.404	43.9711
2023	182,057	9,103	5,000	45.514	45.0704
2024	186,608	9,330	5,000	46.652	46.1971
2025	191,273	9,564	5,000	47.818	47.3520
2026	196,055	9,803	5,000	49.014	48.5359
2027	200,956	10,048	5,000	50.239	49.7492
2028	201,358	10,068	5,000	50.340	49.8487
2029	201,761	10,088	5,000	50.440	49.9484
2030	202,164	10,108	5,000	50.541	50.0483
2031	202,569	10,128	5,000	50.642	50.1484
2032	202,974	10,149	5,000	50.743	50.2487
2033	206,019	10,301	5,000	51.505	51.0025
2034	209,109	10,455	5,000	52.277	51.7675
2035	212,245	10,612	5,000	53.061	52.5440
2036	215,429	10,771	5,000	53.857	53.3322
2037	218,661	10,933	5,000	54.665	54.1322
2038	221,940	11,097	5,000	55.485	54.9441
2039	225,270	11,263	5,000	56.317	55.7683
2040	228,649	11,432	5,000	57.162	56.6048
2041	232,078	11,604	5,000	58.020	57.4539
2042	235,560	11,778	5,000	58.890	58.3157
2043	239,093	11,955	5,000	59.773	59.1904
2044	242,679	12,134	5,000	60.670	60.0783
2045	246,320	12,316	5,000	61.580	60.9795
2046	250,014	12,501	5,000	62.504	61.8942
2047	253,765	12,688	5,000	63.441	62.8226
2048	257,571	12,879	5,000	64.393	63.7649
2049	261,435	13,072	5,000	65.359	64.7214
2050	265,356	13,268	5,000	66.339	65.6922
2051	269,336	13,467	5,000	67.334	66.6776
2052	273,376	13,669	5,000	68.344	67.6778
2053	277,477	13,874	5,000	69.369	68.6929
2054	281,639	14,082	5,000	70.410	69.7233
2055	285,864	14,293	5,000	71.466	70.7692
2056	290,152	14,508	5,000	72.538	71.8307
Year	Total population	Total Tourists	Retribution (IDR)	Full Benefit (IDR) in Million	
				Financial	Economy
2057	294,504	14,725	5,000	73.626	72.9082
2058	298,922	14,946	5,000	74.730	74.0018
2059	303,405	15,170	5,000	75.851	75.1118
2060	307,957	15,398	5,000	76.989	76.2385
2061	312,576	15,629	5,000	78.144	77.3821

4.2. Economic Benefits Due to Travel Time Savings

Travel time savings are the difference between travel time with the condition of a bridge and without a bridge.
Calculation of Economic Benefits due to Travel Time Savings
Assuming that the average hourly vehicle speed through the Teluk Sawaibu Bridge and regular roads is 50-60 km/hour. The average travel time per vehicle is 0.0060, the average travel time is 0.06, the road length is 0.3 km, and the bridge is 0.3 km. Travel time savings are calculated based on the multiplication of the volume of vehicles in a year with the difference in travel time if you go through the regular road and the Teluk Sawaibu Bridge. Then, the time-saving (hours) result is multiplied by the value of people per hour (IDR/person/hour) of Rp. 23,052/hour. Finally, researchers multiplied the result by the average number of passengers in 1 vehicle (person) of 3.39 to obtain total travel time savings, as shown in the following table.

Table 2. Travel time savings on regular roads and Sawaibu Bay Bridge

Year	Vehicle volume (vehicles per year)	Travel time savings (hours)	Travel time savings (IDR)	
			Financial	Economy
2022	21,951,596	1,185,386.18	101,925,404,091	89,694,355,600
2023	22,171,112	1,197,240.05	102,944,658,317	90,591,299,319
2024	22,392,823	1,211,846.89	104,200,627,446	91,696,552,153
2025	22,616,752	1,223,965.4	105,242,637,304	92,613,520,827
2026	22,842,919	1,236,205.03	106,295,061,257	93,539,653,906
2027	23,071,348	1,248,567.07	107,358,010,986	94,475,049,667
2028	23,302,062	1,263,688.75	108,658,248,184	95,619,258,402
2029	23,348,666	1,266,216.12	108,875,564,102	95,810,496,410
2030	23,395,270	1,268,743.49	109,092,880,020	96,001,734,418
2031	23,441,875	1,271,270.91	109,310,200,601	96,192,976,529
2032	23,488,479	1,276,355.09	109,747,363,000	96,577,679,440
2033	23,535,083	1,278,887.53	109,965,115,120	96,769,301,306
2034	23,582,153	1,281,445.3	110,185,044,575	96,962,839,226
2035	23,629,223	1,284,003.06	110,404,974,030	97,156,377,146
2036	23,676,293	1,289,042.62	110,838,300,289	97,537,704,254
2037	23,723,363	1,291,605.32	111,058,653,990	97,731,615,511
2038	23,770,433	1,294,168.02	111,279,007,691	97,925,526,768
2039	23,817,974	1,296,756.36	111,501,566,334	98,121,378,374
2040	23,865,515	1,301,755.36	111,931,405,357	98,499,636,714
2041	23,913,056	1,304,348.51	112,154,376,910	98,695,851,681
2042	23,960,597	1,306,941.65	112,377,348,463	98,892,066,647
2043	24,008,138	1,309,534.8	112,600,320,016	99,088,281,614
2044	24,056,154	1,314,496.99	113,026,993,503	99,463,754,283
2045	24,104,170	13,17,120.72	113,252,594,990	99,662,283,592
2046	24,152,187	1,319,744.5	113,478,201,176	99,860,817,035
2047	24,200,203	1,322,368.24	113,703,802,663	100,059,346,344
2048	24,248,219	1,327,270.93	114,125,361,158	100,430,317,819
2049	24,296,715	1,329,925.45	114,353,609,819	100,631,176,641
2050	24,345,212	1,332,580.03	114,581,863,186	100,832,039,604
2051	24,393,708	1,335,234.54	114,810,111,847	101,032,898,426
2052	24,442,205	1,340,107.1	115,229,078,685	101,401,589,243
2053	24,490,701	1,342,766.02	115,457,705,742	101,602,781,053
2054	24,980,515	1,369,621.34	117,766,859,762	103,634,836,591
2055	25,480,125	1,397,013.75	120,122,195,543	105,707,532,078
2056	25,989,728	1,427,232.52	122,720,555,853	107,994,089,151
2057	26,509,523	1,455,777.2	125,174,969,048	110,153,972,762
2058	27,039,713	1,484,892.71	127,678,466,257	112,357,050,306
2059	27,580,507	1,514,590.55	130,232,034,354	114,604,190,232
2060	28,132,117	1,547,266.44	133,041,669,248	117,076,668,939
2061	28,694,759	1,578,211.75	135,702,501,025	119,418,200,902

4.3. Economic and Financial Feasibility Analysis

The final stage of calculating the benefits and costs is to evaluate the economic and financial feasibility based on several criteria. The evaluation criteria are NPV, BCR, and IRR.

• NPV

NPV = (ΣPV Revenues) - (ΣPV Expenses) = 67061982402

Requirement: NPV > 0
Conclusion: Feasible Investment
• BCR
BCR = P Revenues/ P Costs = 1.096
Requirement: BCR > 1
Conclusion: Acceptable Investment
• IRR
IRR = i1 - NPV1 (i2-i1)/(NPV2-NPV1) = 30 %
Requirement: IRR >MARR
= 30 % > 10%
Conclusion: Acceptable Investment

5. Conclusion

Economic analysis in the Feasibility Study of the Construction of the Sawaibu Bridge shows that the first alternative meets the requirements for the feasibility of the financial aspect based on inflation, with the NPV of 67,061,982,402, BCR 1,096, and IRR of 30% ≥ MARR of 10%. This means Alternative 1 Sawaiibu Bay Bridge is feasible for building a building.

References

[1] G. G. de Oliveira, Y. Iano, G. C. Vaz, E. L. Chuma, P. D. M. Negrete, and J. C. M. Negrete, "Structural analysis of bridges and viaducts using the IoT concept. An approach on dom pedro highway (Campinas-Brazil)," in *Brazilian Technology Symposium*, 2021, pp. 108–119.
[2] R. Yadav, "A Study on Construction Challenges of Bridges in The Hilly Areas."
[3] C. OLIVIA, "Effects Of Eastern Bypass Nairobi Road Construction Project on Economic Growth in Kenya," 2017.
[4] R. A. Dananjoyo, A. Aminullah, and A. S. B. Nugroho, "Penerapan Metode Life-CycleCost dalam Perhitungan Evaluasi Ekonomi Jembatan untuk Penetuan Prioritas Penanganan Jembatan," *J. Teknosains*, vol. 9, no. 2, pp. 165–178.
[5] P. Herma, P. Ardiyanto, S. Soemarsono, and T. Muhamad, "TUGAS AKHIR: PERENCANAAN JEMBATAN BANJIR KANAL TIMUR GAYAMSARI KOTA SEMARANG," Diploma in Civil Engineering, 2010.
[6] R. Pal *et al.*, "Public health crisis of road traffic accidents in India: Risk factor assessment and recommendations on prevention on behalf of the Academy of Family Physicians of India," *J. Fam. Med. Prim. care*, vol. 8, no. 3, p. 775, 2019.
[7] M. Rezdiansyah, "Studi Kelayakan Pembangunan Jalan Pendekat Jembatan Mahkota--Simpang 4 Pampang," *KURVA Mhs.*, vol. 11, no. 2, pp. 491–499, 2021.
[8] D. A. Sumantri, M. Helmi, and M. Isneini, "EVALUASI NILAI SISA KAPASITAS JEMBATAN VOIDED SLAB WAY BAKO I BERDASARKAN PERATURAN PEMBEBANAN SNI 1725-2016 dan PPJJR No. 12/1970," *REKAYASA J. Ilm. Fak. Tek. Univ. Lampung*, vol. 25, no. 1, pp. 1–4, 2021.
[9] G. Evans, "Measure for measure: Evaluating the evidence of culture's contribution to regeneration," *Cult. urban Regen.*, pp. 116–140, 2020.
[10] S. Attia, *Net Zero Energy Buildings (NZEB): Concepts, frameworks, and roadmap for project analysis and implementation*. Butterworth-Heinemann, 2018.
[11] R. Naboni and I. Paoletti, *Advanced customization in architectural design and construction*. Springer, 2015.
[12] J. R. Meredith, S. M. Shafer, and S. J. Mantel Jr, *Project management: a strategic managerial approach*. John Wiley \& Sons, 2017.
[13] L. Rodić and D. C. Wilson, "Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries," *Sustainability*, vol. 9, no. 3, p. 404, 2017.
[14] E. Talalasova, "Profit or Loss?".
[15] C. Bell and H. Newby, *Community studies: An introduction to the sociology of the local community*. Routledge, 2021.
[16] R. Derakhshan, M. Mancini, and J. R. Turner, "Community's evaluation of organizational legitimacy: Formation and reconsideration," *Int. J. Proj. Manag.*, vol. 37, no. 1, pp. 73–86, 2019.
[17] R. S. Heralova, "Life cycle costing as an important contribution to a feasibility study in construction projects," *Procedia Eng.*, vol. 196, pp. 565–570, 2017.
[18] A. J. Veal, *Research methods for leisure and tourism*. Pearson UK, 2017.
[19] S. G. Mungodla, L. Z. Linganiso, S. Mlambo, and T. Motaung, "Economic and technical feasibility studies: technologies for second generation biofuels," *J. Eng. Des. Technol.*, vol. 17, no. 4, pp. 670–704, 2019.
[20] H. Lamberts-Van Assche and T. Compernolle, "Economic feasibility studies for carbon capture and utilization technologies: a tutorial review," *Clean Technol. Environ. Policy*, pp. 1–25, 2022.