

LIFE CYCLE COST ANALYSIS OF THE TRANSIT-ORIENTED DEVELOPMENT CONCEPT IN INDONESIA

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(Received: October 2019 / Revised: October 2019 / Accepted: October 2019)

ABSTRACT

In developing countries, such as Indonesia, cars are still the main means of transportation. This causes several problems in metropolitan areas, such as increases in the urban population, as well as increases in the volume of vehicles, more air pollution, and greater traffic congestion. For light rail transit (LRT), transit-oriented development (TOD) is expected to increase public interest in using trains and reducing the numerous problems associated with the use of cars. However, LRT based on TOD requires a significant financial investment. Therefore, a financial feasibility study is needed to determine if a project is feasible. The initial and operational-maintenance costs were used as a case study, and a literature review was utilized to analyze the amount of money needed to develop TOD in other countries. The dynamic system was the methodology used to determine the amount of revenue. Based on the result of the lifecycle cost (LCC) analysis, internal rate of return (IRR) of the Jabodebek LRT project based on TOD is 9.75% and a total of net present value (NPV) is 190 trillion rupiahs.

Keywords: Financial; Internal rate of return; Net present value; Transit-oriented development

1. INTRODUCTION

The population of Indonesia increases yearly, and this has a significant impact on the need for an adequate transportation system, especially in the country's more populated cities. In developing countries, cars are the main medium of transportation, and this causes several problems, such as urbanization and increases in the number of vehicles, more air pollution, and greater traffic congestion (Berawi et al., 2017).

In Indonesia, the transit-oriented development (TOD) associated with the Jakarta, Bogor, Depok, Bekasi (Jabodebek) light rail transit (LRT) line is expected to increase public interest in using trains as a mode of commuting. TOD entails the development of a high-density area by integrating several mixed-use buildings around transit stations, with an emphasis on integration and accessibility. However, the problem associated with this method is that it requires a significant financial investment. Therefore, a financial feasibility study needs to be conducted to determine if the project is feasible. This study investigated the financial aspects associated with initial, operational, and maintenance costs, in addition to the revenue obtained from the projects at Bekasi Timur Station, Cibubur Station, Ciracas Station, Jaticempaka Station, and from LRT development. Hence, the financial feasibility of the project was analyzed based on the internal

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Permalink/DOI: <https://doi.org/10.14716/ijtech.v10i6.3621>

rate of return (IRR) value using the lifecycle cost (LCC) analysis.

The definition of TOD varies, depending on the way it is practiced in the different countries in which it is applied. According to Wey and Chiu (2013), TOD is defined as the integration of a city's land use and public transportation system, allowing the city's citizens to achieve their daily needs without having to rely on personal transportation. Its application in the development of Jabodebek LRT affords several benefits. It avoids the occurrence of urban sprawl by controlling population growth (Wey & Chiu, 2013), it reduces the use of personal transportation (Wey & Chiu, 2013), it reduces carbon emissions, which is one of the main causes of air pollution, thereby supporting the sustainability of the surrounding environment (Tiwari et al., 2011), and it supports the financial sustainability of several businesses due to numerous factors, such as improved accessibility because the development is based on surrounding transportation facilities (La Greca et al., 2011), increasing the value of real estate property near a transportation facility so the facility becomes a source of potential income for the government and can be used to cover construction and operational costs (World Resources Institute Ross Centre for Sustainable Cities, 2018).

In the field of economics, LCC analysis is used to evaluate the cost of a project associated with its purchase, own, operation, maintenance, and dispose of an object or process. Thus, LCC is a significant consideration in the decision-making process (Fuller & Stephen, 1996). The LCC analysis is conducted over the duration of the project, from its conceptual, design, development, and operational stages to the disposal stages (Blank & Tarquin, 2011). Factors to be considered in calculating LCC are economic age, interest rate, and inflation; toward that end, the initial cost, operational and maintenance costs, and revenue are the components of the analysis (Berawi et al., 2018a). After identifying the LCC components, IRR and net present value (NPV) are calculated to determine if the project is financially feasible. NPV is the difference between income and expenses, where the two components are discounted to the present value. IRR is a discount rate that produces an NPV equal to zero.

2. METHODS

In this research study, the first step was to identify the problems. This was followed by formulating the research questions and identifying the research aims and objectives. Afterward, a literature review was conducted and utilized as a reference for this research study. The literature review revolves around the development of the TOD concept. Analysis of the financial aspects of the LRT project was conducted using the LCC analysis method, with the components acquired through a case study and benchmarking. The revenue of the project was calculated by performing a simulation using the dynamic system model, which also allows for observing the interactions between the project's variables. Data tabulation was used to consider the time value of money, since there is a vast disparity between the current and future value of money due to inflation, interest rates, governmental laws, etc. The factors that affected the calculation are presented in Table 1.

Table 1 Factors affecting the calculations

Factor	Value	Note	Source
Inflation	3.27%	Inflation for the past 3 years	Bank Indonesia
Interest rate	4.96%	Interest rate for the past 3 years	Bank Indonesia

3. RESULTS AND DISCUSSION

3.1. Project Scope

The project discussed in this research is the development of a TOD district for the 1st phase of Jabodetabek LRT. The construction consists of the Cawang-Cibubur line (14.5 km), the Cawang-Kuningan-Dukuh Atas line (11.5 km), and the Cawang-Bekasi Timur line (18.5 km). The Cawang-Cibubur line will consist of four stations. The Cawang-Kuningan-Dukuh Atas line and the Cawang-Bekasi Timur line will each have seven stations.

Development of the TOD concept will be applied to four stations: the Bekasi Timur, Cibubur, Ciracas, and Jaticepaka stations, which will be evaluated using the TOD design concept from research conducted by Berawi et al. (2019). The TOD design concepts for the four stations are presented in Table 2.

Table 2 TOD design concepts for four stations

Category	Area (m ²)			
	Bekasi Timur Station	Cibubur Station	Ciracas Station	Jaticepaka Station
Land Area	50,000	14,075	122,678	53,574
Building Area	45,000	12,300	109,700	47,830
Ground Floor Area	357,500	98,760	769,280	390,554
Building Coverage Ratio (BCR)	90%	87%	89%	89%
Floor-Area Ratio (FAR)	7.15	7.02	6.27	7.29
Residential Area	162,000	45,360	233,280	171,481
Offices	65,000	18,000	127,500	69,678
Hotel	40,500	10,800	80,000	46,867
Commercial Area	45,000	12,300	219,000	85,992
Other	45,000	45,000	109,500	15,662

3.2. Initial Cost

The development of the LRT based on TOD consists of two different construction phases: the construction of the LRT line and the construction of properties located near the four stations. This part of the project began in 2019, and it will be completed in 2024. However, some buildings, such as the mall, the park and ride, the theme park, the water treatment plant (WTP), and the sewage treatment plant (STP) will be completed by 2022. Data were acquired from the 2018 Cost Construction Handbook Indonesia, which was published by Arcadis (2018). The data were used to determine the base cost of the property construction. The data show the range of construction costs based on the function of the buildings in DKI Jakarta. From that range, an average was calculated, which was utilized in this research. The construction cost data are presented in Table 3.

Table 3 Construction Costs for Each Type of Structure

Type of Structure	Construction Cost
Apartments, standard	Rp 10,310,000/m ²
3-star Hotel	Rp 18,076,000/m ²
4-star Hotel	Rp 23,510,000/m ²
Retail/Mall	Rp 9,415,000/m ²
High-rise Offices, standard	Rp 10,045,000/m ²
Park and Ride Basement	Rp 4,610,000/m ²
Theme Park	Rp 47,619,047/m ²

The land price data were obtained from the cities of Jakarta Timur and Bekasi. The land price is Rp 7,900,000/m² for Jakarta Timur and Rp 2,500,000/m² for Bekasi. In addition to the data previously discussed, the professional fees and green building implementation costs were also used in the calculation based on the TOD design concept reported in the literature search (Berawi et al., 2019). The professional fee is assumed to be 2% of the initial cost, and the green building implementation cost is assumed to be 10% of the initial cost. These assumptions are based on previous research (Berawi et al., 2019).

Table 4 Initial cost of the Bekasi Timur station, Bekasi

Function of Structure	Area (m ²)	Price/m ² (DKI Jakarta)	Price/m ² (Bekasi)	Cost
Land Clearing	50,000	-	Rp 6,000,000.00	Rp 300,000,000,000.00
Apartments	162,000	Rp 10,310,000.00	Rp 11,100,650.09	Rp 1,798,305,315,329.73
4-star Hotel	40,500	Rp 23,510,000.00	Rp 25,312,927.62	Rp 1,025,173,568,462.71
Retail/Mall	45,000	Rp 9,415,000.00	Rp 10,137,014.61	Rp 456,165,657,501.60
Offices	65,000	Rp 10,045,000.00	Rp 10,815,327.86	Rp 702,996,310,672.65
Park and Ride	45,000	Rp 4,610,000.00	Rp 4,963,530.26	Rp 223,358,861,506.36
WTP and STP	2			Rp 50,781,525,197.73
Green Building		10% of initial cost		Rp 450,599,971,347.31
Professional Fees		2% of initial cost		Rp 99,131,993,696.41
Administration		From TOD Financial Feasibility Study		Rp 142,284,721,375.00
Total Cost				Rp 5,254,993,271,163.61

Table 5 Initial cost of the Cibubur station, Jakarta Timur

Function of Structure	Area (m ²)	Price/m ² (DKI Jakarta)	Price/m ² (Jakarta Timur)	Cost
Land Clearing	14,075	-	Rp 8,291,840.00	Rp 116,707,648,000.00
Apartments	45,360	Rp 10,310,000.00	Rp 10,310,363.83	Rp 467,678,103,185.96
4-star Hotel	10,800	Rp 18,076,000.00	Rp 18,076,637.88	Rp 195,227,689,094.95
Retail/Mall	12,300	Rp 9,420,000.00	Rp 9,420,332.42	Rp 115,870,088,764.49
Offices	18,000	Rp 10,043,000.00	Rp 10,043,354.40	Rp 180,780,379,285.66
Park and Ride	12,300	Rp 4,610,000.00	Rp 4,610,162.68	Rp 56,705,000,977.10
WTP and STP	2			Rp 29,421,257,356.28
Green Building		10% of initial cost		Rp 113,296,890,930.82
Professional Fees		2% of initial cost		Rp 24,925,316,004.78
Administration		From TOD Financial Feasibility Study		Rp 49,460,158,827.00
Total Cost				Rp 1,353,661,925,824.50

Table 6 Initial cost of the Ciracas station, Jakarta Timur

Function of Structure	Area (m ²)	Price/m ² (DKI Jakarta)	Price/m ² (Jakarta Timur)	Cost
Land Clearing	122,678	-	Rp 8,291,840.00	Rp 1,017,226,347,520.00
Apartments	233,280	Rp 10,310,000.00	Rp 10,310,363.83	Rp 2,405,201,673,527.78
4-star Hotel	80,000	Rp 18,076,000.00	Rp 18,076,637.88	Rp 1,446,131,030,332.94
Retail/Mall	219,000	Rp 9,420,000.00	Rp 9,420,332.42	Rp 2,063,052,799,953.14
Offices	127,500	Rp 10,043,000.00	Rp 10,043,354.40	Rp 1,280,527,686,606.75
Park and Ride	109,500	Rp 4,610,000.00	Rp 4,610,162.68	Rp 504,812,813,576.65
WTP and STP	2			Rp 86,061,584,281.13
Green Building		10% of initial cost		Rp 871,695,235,151.73
Professional Fees		2% of initial cost		Rp 191,772,951,733.38
Administration		From TOD Financial Feasibility Study		Rp 392,610,155,613.00
Total Cost				Rp 10,269,591,791,578.80

Table 7 Initial cost of the Jaticempaka station, Bekasi

Function of Structure	Area (m ²)	Price/m ² (DKI Jakarta)	Price/m ² (Jakarta Timur)	Cost
Land Clearing	53,574	-	Rp 6,000,000.00	Rp 321,444,000,000
Apartments	171,481	Rp 10,310,000.00	Rp 11,100,650.09	Rp 1,903,550,578,876.90
4-sStar Hotel	46,867	Rp 23,510,000.00	Rp 25,312,927.62	Rp 1,186,340,978,596.09
Retail/Mall	85,992	Rp 9,415,000.00	Rp 10,137,014.61	Rp 871,702,160,441.73
Offices	69,678	Rp 10,045,000.00	Rp 10,815,327.86	Rp 753,590,414,385.36
Park and Ride	15,662	Rp 47,619,047	Rp 47,135,875.13	Rp 738,242,076,349.85
WTP and STP	2			Rp 56,483,239,115.27
Green Building		10% of initial cost		Rp 577,487,020,864.99
Professional Fees		2% of initial cost		Rp 127,047,144,590.30
Administration		From TOD Financial Feasibility Study		Rp 196,597,902,843.00
Total Cost				Rp 6,739,376,471,235.90

Indeks Kemahalan Konstruksi (IKK) 2018 was used to estimate the initial cost of the degree of the expense of construction in a specific city in comparison to another city of reference. The cost of construction was adjusted to the city of reference, and is shown as price/m². The IKK 2018 (Indeks Kemahalan Konstruksi, 2018) values for DKI Jakarta, Jakarta Timur, and Bekasi are 109.27, 104.11, and 112.09, respectively. The results of the calculations for the initial cost of each region are shown in Table 4, Table 5, Table 6, and Table 7.

The initial cost of the LRT construction with a length of 42.1 km was calculated at a rate of Rp 672,000,000,000 per km. Therefore, its initial cost was Rp 28,291,200,000,000.

3.3. Operational and Maintenance Costs

In calculating the operational and maintenance costs, the assumptions associated with this research were identified. These assumptions were obtained from studies published in academic journals that discussed operational and maintenance costs of several types of buildings. The cost for apartments was obtained through Direktorat Jenderal Cipta Karya (2007). From the standard, it was found that the maintenance and operational cost for an apartment complex is 2% of the initial cost. The costs for a 4-star hotel were obtained from the Best Western Premier Hotel Project; the operational and maintenance cost for a 4-star hotel is 7.5% of the initial cost. For a 3-star hotel, the costs are 30% of the hotel revenue. This percentage is from the book, *Tekno Ekonomi Bertingkat Banyak*, by Hartono Poerbo (1998). The cost of building a mall was obtained from the Hartono Lifestyle Mall project (Setyolelono, 2012). It was found that the maintenance and operational cost for building a mall is 5.5% of the initial cost. The maintenance and operational costs for an office building were obtained from the Niffaro Tower project (Maulanasari & Utomo, 2015). That study reported that the cost is 2.6% of the initial cost. In calculating the operational and maintenance cost of the park and ride, a benchmark analysis of the operational and maintenance costs of several projects in other countries was performed. The places are in Portland, Oregon (Litman, 2011), Boise, Idaho (Litman, 2011), and Edmonton, Calgary, Canada (Strategic Planning Section City of Edmonton, 2009). By adjusting the price to the Indonesian currency, and factoring in inflation and the total length of the LRT project, the cost was calculated to be Rp 10,320,063.11/year/space. Calculation of the operational and maintenance cost was also carried out for the WTP and the Sewage Treatment Plant (STP). The calculation of the estimation cost for the WTP is based on Guo et al. (2013). The STP cost was obtained from a benchmark analysis of a project in Ferrara, Italy.

The LRT and the properties will begin operation in 2024; they will be completed in 2058. Some buildings, such as the mall, the park and ride, the theme park, and the WTP, will begin operation in 2022. The assumptions and calculations are shown in Table 8 and Table 9.

Table 8 Operational and maintenance cost of the Bekasi Timur and Jaticempaka stations

Function of the Structure	Assumption		Price/m ² (Jakarta Timur)	Cost
Apartments	2.00%	from initial cost	Rp 35,966,106,306.59	Rp 38,071,011,577.54
4-star Hotel	7.5%	from initial cost	Rp 76,888,017,634.70	Rp 88,975,573,394.71
Retail/Mall	5.5%	from initial cost	Rp 25,089,111,162.59	Rp 47,943,618,824.30
Offices	2.60%	from initial cost	Rp 18,277,904,077.49	Rp 19,593,350,774.02
Park and Ride	Rp 10,320,063.11	per space	Rp 43,818,991,364.57	Rp 14,764,841,527.00
WTP and STP	Estimation from journal articles	per m ²	Rp 18,204,672,680.40	Rp 19,908,232,531.91
TOTAL			Rp 218,244,803,226.3	Rp 229,256,628,629.47

Table 9 Operational and maintenance costs of the Cibubur and Ciracas stations

Function of the Structure	Assumption		Price/m ² (Jakarta Timur)	Cost
Apartments	2.00%	from initial cost	Rp 9,353,562,063.72	Rp 48,104,033,470.56
4-star Hotel	7.5%	from initial cost	Rp 9,640,983,830.40	Rp 69,797,964,787.20
Retail/Mall	5.5%	from initial cost	Rp 6,372,854,882.05	Rp 113,467,903,997.42
Offices	2.60%	from initial cost	Rp 4,700,289,861.43	Rp 33,293,719,851.78
Park and Ride	Rp 10,320,063.11	per space	Rp 11,981,594,200.25	Rp 95,109,709,000.44
WTP and STP	Estimation from journal articles	per m ²	Rp 10,262,617,024.10	Rp 27,939,251,592.93
TOTAL			Rp 52,311,901,861.94	Rp 387,712,582,700.37

In calculating the operational and maintenance cost of the LRT project, a benchmark analysis of the costs obtained from several projects in the United States (US) was carried out, which was equivalent to Rp 9,876,666,263/km. However, after adjusting the price to the Indonesian currency, and factoring in inflation and the total length of LRT project, the cost was Rp 388,938,427,957/year.

3.4. Revenue Assumptions

The dynamic system, obtained from the development of the properties near the LRT project, was used to calculate the revenue of the TOD design concept for each type of structure. Based on architectural standards (Chiara & Callender, 1983; Neufert & Neufert, 2000), every type of structure has a characteristic called an effective space, which is the percentage of an area used as a housing unit. For the park and ride, space was used for vehicles to move in two directions with a walking path for pedestrians. The area of space per unit was also determined according to the guidebook for commercial buildings. The area of one office unit is 40–150 m² and the area surrounding the studio apartments is about 21–45 m². The number of units per structure-function is calculated based on the amount of area per unit. The number of units for each structure-function in each of the regions is shown in Table 10.

Furthermore, it was ascertained if the units were to be sold or rented. This requires an assumption of the number of units that were rented and/or sold; that information was obtained from the Agung Podomoro Land Annual Report (Agung Podomoro Land Tbk, 2018). The selling price per unit, which was based on the data from the Agung Podomoro report, reflects the selling price of the apartment, mall, and office units in terms of a percentage of the initial cost of the project.

Table 10 Number of units in each region

Type of Structure	Effective Space	Area Per Unit	Bekasi Timur	Cibubur	Ciracas	Jaticempaka	Source
Apartments	80%	28 m ²	4,629	1,296	6,666	4,900	(Marlina, 2008)
Hotel	85%	26 m ²	1,325	354	2,616	1,533	Hotel Aston
Mall	90%	81 m ²	500	137	2,434	956	(Chiara & Callender, 1983)
Office	85%	100 m ²	553	153	1,084	593	(Marlina, 2008)
No. of Cars	45% for car 30% for motorcycle	11.5 m ² for car 1.5 m ² for motorcycle	1,913	523	4,783	-	Permen PUPR No.22/PRT/M/2018

To obtain information about the hotel prices, a benchmark analysis was performed in the same district; however, for some the structures, there are retribution fees to operate the buildings. Information about the parking fees were obtained from the laws enacted in DKI Jakarta (Peraturan Gubernur Provinsi DKI Jakarta Nomor 31 tahun 2017) and Bekasi (Peraturan Daerah Kota Bekasi Nomor 17 tahun 2017). Information on the water fee was obtained from the regulation of PDAM (Peraturan Gubernur Provinsi DKI Jakarta Nomor 91 tahun 2017), Rp 12,550/m³. The theme park fee was obtained by benchmarking the Trans Studio Mini Project in Indonesia (Rp 100,000/tickets).

Table 11 Margins from each function of the structures

Type of Structure	Margin	Category
Apartments	150%	Sell
Hotel	-	Rent
Mall	15%	Rent
Office	5%	Rent

In the TOD areas, the property values vary based on the property's distance to the nearest transit station; the properties closest to the station have a higher value. The percentage of the price increase is known as Hedonic Price Modelling (HPM) (Berawi et al., 2018b). The HPM coefficients obtained from Zhang and Xu (2017) are presented in Table 12. Based on the assumptions presented above, the prices of the real estate properties for each type of structure can be calculated (Table 12).

Several other assumptions were used to obtain data on the revenue, building occupancy, and yearly rate of increase in the price of property. Occupancy data were obtained from the Property Market Report Colliers 2018 in Jakarta and Bekasi (Colliers International, 2018). The data for the yearly rate of increase in property price were obtained from *Indeks Harga Properti Komersial Bank Indonesia* (Bank Indonesia, 2018).

In developing Jabodebek LRT, the assumptions used to obtain revenue were based on the sales of train tickets, ridership, and passenger growth rate. The ticketing fee is stated in the government's laws as Rp 12,000/ticket, with four stations utilizing the TOD concept and 14 not using the concept. Determination of LRT ridership is based on the trip generation calculation. The passenger growth rate is apparent at 2.5%, and it is used to conduct a benchmark analysis of other LRT projects in MRT Hongkong (MTR Corporation, 2018). Table 14 displays the number of LRT commuters for different stations.

Table 12 Prices of the properties

Location	Type of Structure	Category	Catchment Area (m)	HPM Coefficient	Price
Bekasi Timur Station	Apartments	Sell	100–200	0.064	Rp 631,712,102.30
		Retribution			Rp 20,000/m ² /month
	Hotel	Retribution	0–100	0.083	Rp 725,165/day
		Mall			Rent
	Offices	Retribution	0–100	0.094	Rp 102,440/m ² /month
		Rent			Rp 230,979,407/33/year
Cibubur Station	Apartments	Sell	0–100	-0.002	Rp 602,099,113.39
		Retribution			Rp 20,000/m ² /month
	Hotel	Retribution	0–100	0.083	Rp 401,155/day
		Mall			Rent
	Offices	Retribution	0–100	0.094	Rp 135,000/m ² /month
		Rent			Rp 216,699,420.78/year
Ciracas Station	Apartments	Sell	200–300	0.066	Rp 650,947,414.12
		Retribution			Rp 20,000/m ² /month
	Hotel	Retribution	100–200	0.061	Rp 393,000/day
		Mall			Rent
	Offices	Retribution	100–200	0.063	Rp 135,000/m ² /month
		Rent			Rp 213,160,182.06/year
Jaticempaka Station	Apartments	Sell	100–200	0.064	Rp 640,117,924.55
		Retribution			Rp 20,000/m ² /month
	Hotel	Retribution	0–100	0.083	Rp 725,165/day
		Mall			Rent
	Offices	Retribution	0–100	0.094	Rp 102,440/m ² /month
		Rent			Rp 224,409,811.32/year
		Retribution			Rp 59,544/m ² /month

Table 13 Margins from each function of the structures

Type of Structure	Category	Occupancy	Yearly Rate of Increase of Property Price
Apartments	Sell	84%	5.94%
	Retribution	100%	4.96%
Hotel	Rent	62%	8%
Mall	Rent	84%	4.39%
	Retribution	100%	4.96%
Offices	Rent	79%	7.23%
	Retribution	100%	4.96%

Table 14 Number of LRT commuters

Location	Concept	Number of Daily Riders (Ridership)
Bekasi Timur Station	TOD	14,538
Cibubur Station		7,163
Ciracas Station		37,380
Jaticempaka Station		20,301
Other Stations		45,058
	Non-TOD	

3.5. Revenue

The revenue assumptions from the development of LRT and its surrounding properties were inputted into a dynamic system model. Based on the above assumptions, a dynamic system model was made for each structural function. From the model, the NPV of each function is identified. Table 15 shows the NPVs for different structures.

Table 15 NPV for each function of the structures in each region

Type of Structure	Time Period	NPV
Apartments	2024–2058	Rp 10,902,692,431,597.10
Hotel	2024–2058	Rp 60,876,887,601,063.70
Mall	2022–2058	Rp 38,023,810,524,887.90
Offices	2024–2058	Rp 26,035,783,064,615.60
Park and Ride	2022–2058	Rp 6,338,949,278,794.33
Theme Park	2022–2058	Rp 6,736,469,802,649.18
WTP	2022–2058	Rp 1.609.695.849.557,21
LRT	2022–2058	Rp 41,109,405,822,615.10

3.6. Internal Rate of Return

After analyzing the LCC component, in the form of development, operational and maintenance costs, as well as the revenue components, a cashflow project was designed. This began in 2019, and it will continue until 2058. The IRR calculation was conducted to determine return of investmen if the Jabodebek LRT development project with the TOD concept is conducted. The IRR of the project was 9.75%.

4. CONCLUSION

By performing an LCC analysis of the development project for the Jabodebek LRT based on TOD, the total of the initial cost is 57 trillion rupiahs. Furthermore, a total of the project's operational and maintenance costs are 152 trillion rupiahs and its revenue was found to be 562 trillion rupiahs for 40 years. Based on the results of the LCC analysis, IRR of the Jabodebek LRT project based on TOD is 9.75% and a total of NPV is 190 trillion rupiahs.

5. ACKNOWLEDGEMENT

This research was supported by research grants from the Ministry of Research and Higher Education, Republic of Indonesia (Kemristekdikti) under grant no NKB-1784/UN2.R3.1/HKP.05.00/2019.

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