Research article

STRATEGIC EVALUATION AND ECONOMIC IMPACT OF FIBRE OPTIC INFRASTRUCTURE

Nurwan Reza Fachrurrozi, Syifa Nurgaida Yutia, Yus Natali, Jose Januario dos Reis Costa, and Taufik Hidayat

Abstract. Metrolink, LDA as the largest telecommunications company in Timor-Leste, is continuously investing to grow its company and serve the growing needs of its customers with a profit-oriented vision. This research aims to find out the viability of the investment plan that will be implemented at Metrolink, LDA. The investment plan is the construction of a project in Silawan-Batu Gade-Liquica-Dili that is to expand the network. With a total investment of USD 3,000,000 coming from equity at an interest rate of 9% in 2023. Capital budgeting is a process in which a company analyses a project and decides which projects will be included in its financial budget. The type of research that is conducted is descriptive research and this research will perform qualitative analysis to analyse the problems that occur. While the data is in the form of quantitative data. Evaluation of investment eligibility on the project This uses capital budgeting techniques which it uses to find out whether or not an investment proposal is eligible. With the payback period analysis tool, net present value. The two analytical tools are also used by Metrolink, LDA to measure whether the project is adequate or not. From the results of the analysis and the plan of the project Silawan-Batu Gade-Liquica-Dili. Obtained a payback period of 2 years 7 months from the target Metrolink, LDA is 5 years, Net Present Value of USD 3.358.050 of the target that is defined Metrolinks, the result is positive. It shows that the financial investment plan project is not worthy to be implemented.

Keywords*:* techno-economic; inland; aerial; net present value; payback period; Timor Leste.

Authors:

Nurwan Reza Fachrurrozi
School of Applied Science, Telkom University, Jakarta, Indonesia
E-mail: nurwan@telkomuniversity.ac.id
https://orcid.org/0000-0003-1856-5280

Syifa Nurgaida Yutia
Department of Information Technology, Telkom University, Jakarta, Indonesia
E-mail: syifagaida@telkomuniversity.ac.id
https://orcid.org/0009-0009-5042-8981

Yus Natali
School of Applied Science, Telkom University, Jakarta, Indonesia
E-mail: yusnatali@telkomuniversity.ac.id
https://orcid.org/0000-0003-1797-2538

Jose Januario dos Reis Costa
Metrolink CEO, Lda, Timor Leste
E-mail: jose.januario@metrolink.tl
https://orcid.org/0009-0000-9870-4089

Taufik Hidayat
Department of Electrical Engineering, Universitas Indonesia, Depok, Indonesia
E-mail: taufik.hidayat23@ui.ac.id
https://orcid.org/0000-0003-0230-9872

Corresponding author: Nurwan Reza Fachrurrozi, nurwan@telkomuniversity.ac.id

1. Introduction

Technological advances in the telecommunications sector increase society's needs and provide better information and data. The Lafaek Network Cable Project aims to improve telecommunications infrastructure in Timor-Leste, connecting cities via optical broadband cables from Inland Underground, and Inland-Aerial. The name ma Lafaek is taken from the traditional mythology of the Timorese people which is still considered sacred by the Timorese people [1]. The story is about a little crocodile who befriended a little boy, and how they both came to an agreement: the little crocodile wanted to find more food – rather than just living in a small swamp – and the little boy decided to look for food. help the crocodile find food. So, their journey began. They sailed across the vast ocean in search of food until the little crocodile grew into an adult. The crocodile then promised the little boy that he would turn himself into a large island (mainland) so that the boy and his descendants could live a decent life. As a result, the island of Timor was created.

The population in Timor Leste will be around 1.36 million people in 2023 [2]. In this case, the Metrolink project, Lda was very careful in calculating its financial report to avoid the risk of uncertainty on the project. Metrolink, Ltd. uses two methods in reducing the risk of uncertainty, namely by calculating the NPV method and payback period. With both methods, it can be seen whether the Silawan–Batu Gade–Liquica–Dili project is worth running or not. Metrolink, Lda. in 2020 develops a network in Silawan–Batu Gade–Liquica–Dili. Here's the background:

1) The population of Timor-Leste is about 1.31 million by 2020.
2) In this case, the aim of the project Silwan–Batu Gade–Liquica–Dili is to increase the sales of Metrolink, Lda namely by determining new revenue for Metrolink, Lda. This project can increase the revenue of Metrolink, Lda.
3) Increase the level of service guarantee (SLG) to the consumer of the quality of the network given. Since the network quality given was less than the maximum, then Metrolink, Lda wanted to improve in terms of the service level of guarantee for its customers [3-5].
4) To meet the service needs of the Internet in the area. Since there is a lack of Internet network service, then from that Metrolink, Lda built this project to hold its Internet service.
5) Meeting the telecommunications needs of companies, since in the region of Timor-Leste many companies use the Internet via Satellite & Transmission Microwave in terms of the network, concerning lots of interference & speed, for the lack of it, it needs better networks.

Figure 1 shows a 2020 SLG summary that begins the promised SLG as an overview of the 2020 SLG/service level guarantee which is lower than the promised SLG of 99.0%.

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20
—— SLA	95.93	96.21	98.69	80.01	96.45	83.72	99.01	95.95	93.58
—— Threshold	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00	99.00
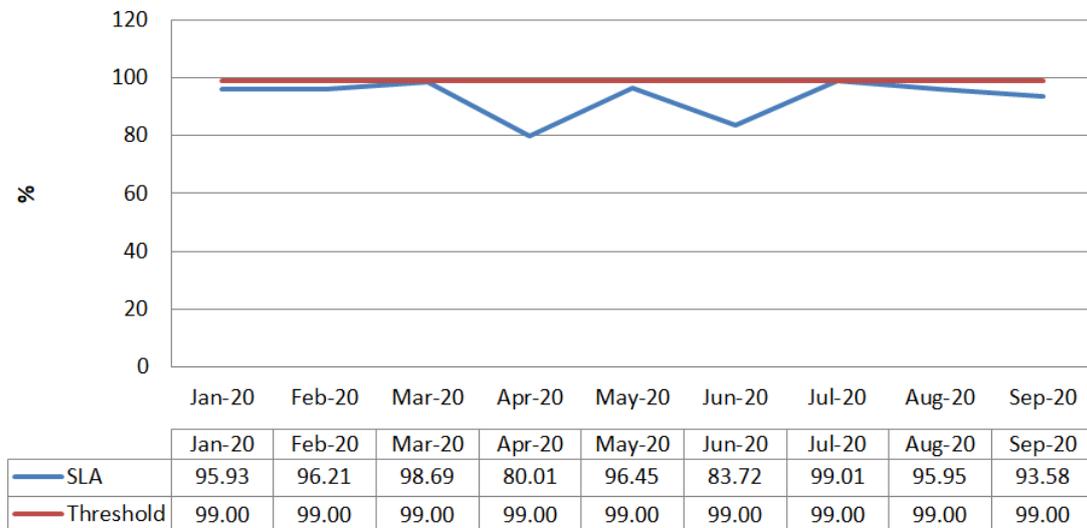
Figure 1. Service Level Agreement Metrolink, Lda
Source: developed by the authors.

Society's need for Internet and data communications is increasing rapidly with the development of information technology today. Therefore, the infrastructure to support this must be created for data communication to provide information to society needs to be established. Capital Budgeting is the process by which a company analyses projects and decides which projects to include in its capital budget [6]. The type of analysis that will be carried out is descriptive analysis which is carried out qualitatively to assess the problems that occur. Even though this data is data that can be measured (numbers). To assess the feasibility of investing in the Silawan–Batu Gade–Liquica–Dili project using the Capital Budgeting technique which is used to test whether or not an investment proposal is feasible using Payback Period, Net Present Value analysis tools. These two analytical tools are also used by Metrolink, Lda to measure whether or not the project is financially feasible to implement. Metrolink, Lda is a major internet service provider in Timor Leste, investing in infrastructure development to meet customer needs and ensure profitability. The company avoids short-term commitments and invests in operational projects, ensuring timely completion of new projects and reducing costs. To achieve this, Metrolink must implement a systematic capital budgeting strategy.

The author defines the issue as follows in light of the problem's background:
1. How is the payback time approach used to determine an investment's eligibility for the Silawan-Batu Gade-Liquica-Dili project?
2. How does the NPV technique evaluate an investment's eligibility for the Silawan-Batu Gade-Liquica-Dili project?

The goal of this study is to
1. determine whether or whether the investment plan for the project Silawan-Batu Gade-Liquica-Dili uses a payback period technique,
2. use the NPV approach to determine whether or not the investment plan for the Silawan-Batu Gade-Liquica-Dili project is worthwhile.

Concerning the applicability of this research:

1. By applying information learned in lectures, this research can provide understanding and expertise on the evaluation of a company's investment suitability.
2. The anticipated outcomes of this study will serve as input, a basis for thought, and a means of assessment for the application of the completed investment eligibility analysis.
3. The written work's findings can be utilized to further understand and provide references to related studies.

The framework of thought of this writing includes the biggest telecom provider in Timor-Leste, Metrolink, LDA, which is constantly investing in the expansion of its business to meet the expanding demands of its clientele while also turning a profit. Businesses are compelled to make money from ongoing initiatives with a finite amount of running time since they cannot expand or even live for a long time without new ideas and projects. The race to find new, lucrative projects is fierce; once one is identified, rivals enter the market and drive down prices and profits. A business needs a methodical approach to develop capital budgeting initiatives because of this. This research is aimed at analysing the viability of the investment plan for the development of the Timor-Leste fibre optic backbone network that will be implemented by Metrolink, Lda. This investment plan with a total investment of USD 3,000,000 at a rate of interest of 9%. With the analysis tool Payback Period, Net Present Value. Two such analytical tools are also used by Metrolink, LDA to measure the suitability or not of the project. Figure 2 shows the current broadband infrastructure Alor–Husbuk–Dare Via Microwave.
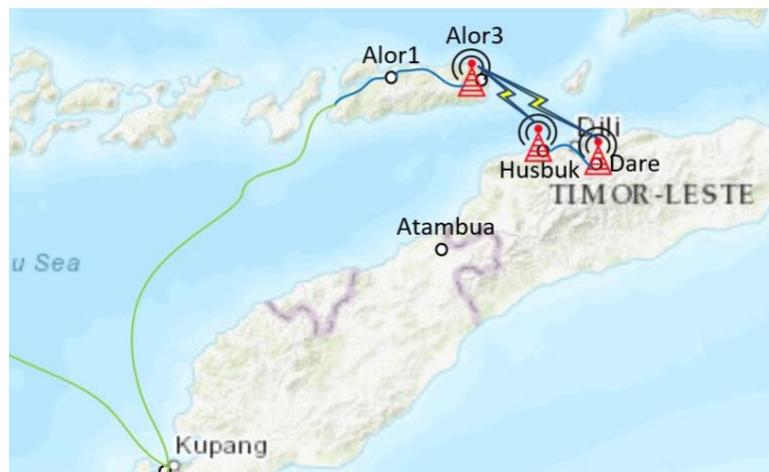
Figure 2. Current Broadband Infrastructure Alor – Husbuk – Dare Via Microwave
Source: developed by the authors.

Figure 3 shows a plan map of Phase I & Phase II projects (Inland & Aerial).
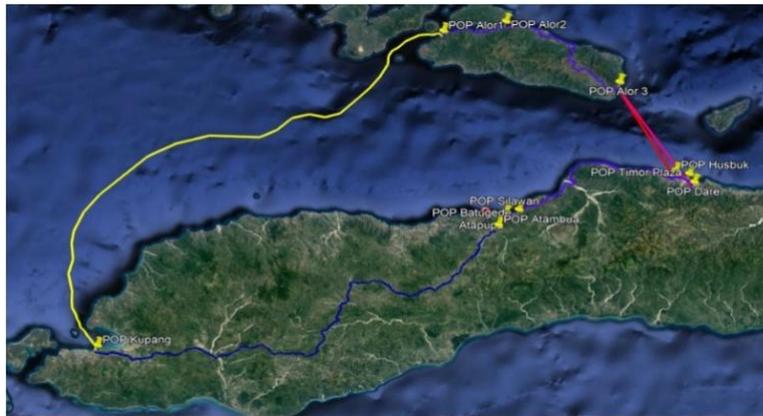
Figure 3. Topology Overview Phase I & Phase II
Source: developed by the authors.

2. Literature Review

Metrolink, LDA is the largest internet service provider company in terms of backbone infrastructure availability in Timor Leste and will invest in developing its company to meet increasing customer needs while making a profit. Companies cannot grow or even survive for long without new projects and ideas; instead, they are obliged to take advantage of existing projects with a limited operational period. Without new projects and ideas, companies cannot grow or even survive for long, companies are forced to generate profits from existing projects with a limited operational life. Coming up with ideas for profitable projects is very, very difficult. Competition is rapid for profitable new projects, and once discovered competitors rush in, driving down prices and profits. For this reason, a company must have a systematic strategy to produce capital budgeting projects. [7, 8] explains that the decision to make large-scale investments in the hope of obtaining long-term profits often has a significant impact on the company's survival. This is caused by a tainted future condition with uncertainty, or in other words the future is full of risks. Uncertainty can be reduced by knowing the probability or estimate of the benefits that the project will achieve in the future. In addition, considering these circumstances, companies must be very considerate and careful when creating investments. From the implementation side, the evaluation process for infrastructure development proposals will be carried out by Metrolink, LDA for each project development in Silawan-Batu Gade-Liquica-Dili. The main thing is that errors in evaluation and decision-making on a project will have an impact on the survival of the company. Therefore, choosing the right investment feasibility analysis model is very important for this company. Capital Budgeting, according to [9-12] is the entire process of analysing projects and choosing which projects will be included in the capital budget by stating the importance of Capital Budgeting as one of the most crucial functions among all other functions that must be carried out by the financial manager and his staff because the results of Capital Budgeting decisions will last for years. Kasmir and Jakfar contend [13] that wisdom must be exercised with great caution and evaluation, accounting for all potential future outcomes. This is due to the perception that the future is unpredictable, or, to put it another way, full of risks. Understanding the potential outcomes or anticipated returns from the next project might help to minimize uncertainty. Additionally, the business must make investments with due diligence and deliberation in such circumstances. According to Brealey Myers Marcus [14], a company's ability to survive is frequently greatly impacted by the

decision to make a sizable investment with the expectation of long-term financial advantage. Consequently, one of the most crucial prerequisites before making an investment decision is to assess the financial factors targeted at optimizing the firm's value.

Finally, the Capital Budgeting decisions made by a company will determine its strategic direction, because every movement towards a new product, service, or market must begin with capital expenditure first. In this case, the Metrolink project, LDA, calculates its financial statements very carefully to avoid the risk of uncertainty in this project. Metrolink LDA uses three methods to reduce the risk of uncertainty, namely by calculating the NPV method, Payback period, and feasibility studies. With these three methods, it can be seen whether the Silawan-Batu Gade-Liquica-Dili project is useful or not [10, 15-17]. The latest developments in telecommunications technology have increased data transfer speeds with good results. Timor-Leste is a country that still needs to increase its bandwidth and data speed, considering the importance of the Internet in the country's development. In this research, the underwater network design makes it possible to connect the two governments of Indonesia and Timor-Leste using the East Palapa ring. This will create bilateral relations between the technology sectors of the two countries. This study proposes two methods to consider cost-effectiveness and parameters. The first two-way proposal is from Korana, Alor Island, East Nusa Tenggara, Indonesia, to Dili, Timor-Leste, and the second is from Dili, Timor-Leste by Sea Banda. The parameters used are power link and rise time budget as mathematical data combined with simulation results. The proposed results show a total loss of 17.60125 dB and 18.58875 dB and a total dispersion of 70.7535 ps and 73.7644 ps. It can be concluded that the proposed design is very feasible [18, 19]. In addition, with the development of communications technology in recent years, the need for high-speed data transmission has increased significantly. To meet this need, the Indonesian government launched the Palapa Ring under the coordination of the Ministry of Communication and Information. As part of this research, a fibre optic network to connect the two islands of Bangka Bulitung. Based on the power link budget and rise time analysis, the proposed route requires EFDA amplifiers to increase maximum loss. The proposed route does not exceed the maximum allowable creep limit, namely (233.33 ps), which means the proposed design is feasible [20]. Next, Palapa Ring is a large telecommunications company in Indonesia.

The goal is to connect all major islands with a fibre optic network. The investment value will reach IDR 1 trillion. Feasibility analysis is needed to optimize. Capital budgeting techniques are used to assess the feasibility of investments. Feasibility analysis, capital budgeting analysis with Payback Period, NPV, and IRR for preparing. Focus on the western Palapa annular section. Population data from the Central Statistics Agency (BPS), an IRR of 35% indicates feasibility [10, 15]. Next OTN (Optical Transport Networks), the emergence of next-generation networks has revolutionized modern networking practices with enhanced service capabilities and various new use cases. Coupled with the increase in the number of connected devices in 5G and beyond (5G+), network traffic is expected to become increasingly diverse and massive. Optical Transport Networks (OTNs) with Dense Wavelength-Division Multiplexing (DWDM) are deployed to handle large amounts of data exchange between the 5G+ core and external data networks. To prepare for increased traffic, Network Operators (NOs) must develop and expand their existing backbone networks, which requires large capital investments [21].

3. Research Method

Payback Period is one of the company's calculation methods for calculating how long it takes to return the capital invested in a project. [9] According to Brigham & Houston, the Payback Period is "Payback period is the time required for the net income of an investment to cover costs." Meanwhile, according to [22], "The payback period is the time required for the net income of an investment to cover its costs. The payback period was the first formal method used to evaluate capital budgeting projects. Minimum acceptance criteria and ratings are determined by management. So, the payback period is the time required for the company to return the initial investment.

$$PP = \frac{Invesment \times 12}{Net\ Cash\ Flow} \qquad (1)$$

where payback period benefits (easy to understand; bias towards liquidity; very suitable for short and medium-term projects); disadvantages of the payback period (ignores cash flows that occur after the payback period; bias when applied to long-term projects); PP – the payback period evaluation criteria are:
- If the Payback period < maximum time, then the project proposal can be accepted.
- If the Payback period > maximum time, then the project proposal is rejected.

Although the repayment method has significant shortcomings as a ranking criterion, it can provide information about how long it will take for funds to be distributed to a project. The shorter the payout period, the greater the project's liquidity (assuming all other factors remain constant).

Net Present Value (NPV) is a calculation method for determining If a company's project is feasible or not. If the NPV is less than 1 then the company's project is said to be not feasible; If the NPV is greater than 1 then the company's project is said to be feasible. The definition of NPV according to Net Present Value (NPV) Brigham & Houston states that "NPV is a method of ranking investment proposals using NPV which is equivalent to the present value of future net cash flows, discounted at cost capital." Another definition according to [23], "NPV is a capital budget decision criterion which is determined from the present value of free cash flow after deducting taxes and initial expenditure." So NPV is a method used by companies to make decisions by determining whether the NPV is greater than one or less than one.

$$\sum_{n=1}^{n} \frac{CFI_n}{(1-r)^n} - I_o \qquad (2)$$

where CFI_n is an annual cash flow from investment from year 1 to year n; r is a discount rate used to find the present value; n is a project period.

The type of analysis used in this analysis is descriptive analysis. According to Dr. H. Moh. Pabundu Tika [24], Descriptive analysis aims to describe what is happening. The following is an attempt to characterize, record, analyse, and report current or existing conditions. According to Basuki in the book [25], A case study is "an in-depth study of certain events, environments, and situations that make it possible to reveal or understand something".

3.1 Variable Operational Analysis & Population and Sample

According to Sugiyono [26], Variability is an attribute, trait, or value of a particular individual, object, or variation of activity that a researcher determines to study. This methodology is built to correct the needed data for the two-factor model and three-factor model. The project uses two variable feasibility study analyses, namely payback period and net present value, as shown in Table 1.

Table 1. Operation Variables

Variable	Sub Variable	Indicator	Scale
Feasibility Study Analysis	Payback Period	$PP = \frac{Invesment \times 12}{Net\ Cash\ Flow}$	Nominal
	NPV	$\sum_{n=1}^{n} \frac{CFI_n}{(1-r)^n} - I_o$	Nominal

Source: developed by the authors.

The population in this analysis is all Metrolink, Lda financial investment proposals. According to Sugiyono [27], the population is defined as " A generalized area consisting of objects/subjects that have certain qualities and characteristics that are determined by analysis to be studied and then conclusions are drawn." also defines the sample as part of the number and characteristics of the population. An example is the Silawan–Batu Gade–Liquica–Dili project. Sugiyono explains that purposive sampling is a sampling technique that takes into account certain considerations. This sample is more suitable for qualitative research and financial reports.

3.3 Data Analysis Techniques, Data Collection Stage and Analysis Stage

In this analysis, qualitative analysis will be carried out to analyse the problems that occur. Meanwhile, the data is in the form of quantitative data (numbers). Qualitative analysis is used to analyse existing investment feasibility analysis model calculations by identifying, and analysing approaches, and creating tables and figures. Qualitative methods are best suited for developing theories based on collected data in the field. [28] Data in the form of numbers is analysed by applying them to various appropriate formulas. Capital budgeting techniques are used to determine whether an investment proposal should be accepted or rejected. Is carried out on the number of Joint Boxes, NOC. Information collected comes from Metrolink, Lda. From this data, it can be estimated the amount of capacity that will be used as a sensitivity analysis for calculating income. The next step is to assemble information on the investment value of CAPEX and OPEX which are important factors that influence performance and smooth implementation. This stage aims to analyse the economic aspects of implementing technology. The technology used is DWDM on the Silawan – Batu Gade – Liquica – Dili Fiber Optic Cable Backbone Network and the investment aspects discussed at this stage are the economic aspects of NPV and Payback Period, which are taken from the data analysed for this project as well as estimates of demand and capacity growth.

3.6 Geographical and Technological Aspects, Network Capacity and Technology, Active Device

The following applies to backbone infrastructure implementation technologies:

- Fibre optic cable backbone network infrastructure via land and air in the Silawan – Batu Gade – Liquica – Dili area.
- Capacity design, FO OSP
- Equipment is in use

FOCS Silawan – Batu Gade – Liquica – Dili has a capacity of 200 Gbps this capacity is provided by a DWDM-based transmission network that operates at a wavelength of around 1550 nm. The network model that will be applied in this project is a point-to-point fibre optic link network model. This network model is flexible enough to handle single-path linear networks topologically without requiring complicated and expensive "cross connections " or expensive ROADMs (Reconfigurable Optical Add Drop Multiplexers). The Optical Transport Network (OTN) multiplexer is used as an Add Drop Multiplexer because it can handle various types of traffic, both TDM and Ethernet (IP), and is also cheaper than SDH Add Drop which is not as flexible and is rarely used [29]. In this case, Figure 4 and Figure 5, respectively, show a point-to-point optical fibre link network model of an active device per segment that does not use ROPA.
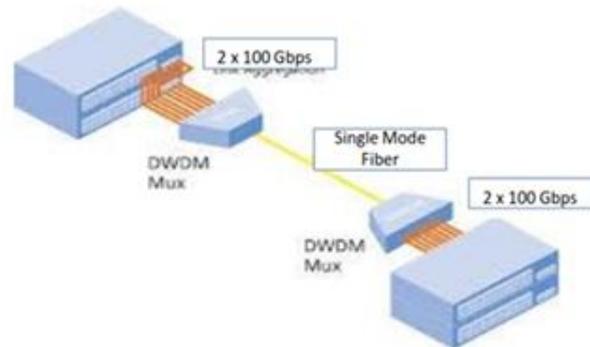

Figure 4. DWDM to handle 2 x 100 Gbps Data Traffic
*Source:* developed by the authors.
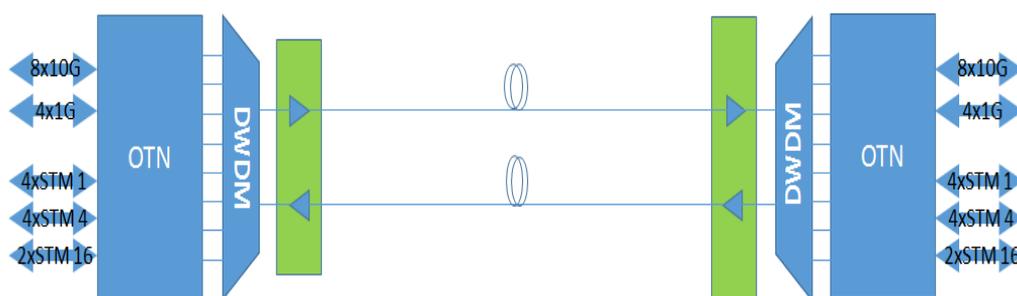
Figure 5. Point-to-point Fibre Optic Link Network Model
Source: developed by the authors.

OTN in this case provides several kinds of interface ports with types and numbers as shown in Table 2 and Fig. 5. The network model described in the previous section was then used as a building block in this project to create a high-speed data transmission network, making the Silawan – Batu Gade – Liquica – Dili FOCS Network possible. functions as a backbone network. The following sections describe the overall system configuration required.

Table 2. Port Interface Type

No	Port Type	Quantity	Information
1	10G	8	Actual Capacity requested in Timor Leste
2	STM1	4	Capacity equivalent to 155 Mbps
3	STM4	4	Capacity equivalent to 620 Mbps
4	STM16	2	Capacity equivalent to 25 Gbps
5	1G Ethernet	4	1Gbps Ethernet

Source: developed by the authors.

With the number of interface ports available according to Figure 4, the total capacity per link is 200 G. The configuration of transmission equipment based on 100 G technology for the FOCS network from Silawan – Batu Gade – Liquica – Dili is shown in Figure 5. Each cable segment provides an end-to-end capacity of 100 Gbps, which is divided into several interface ports (tributaries) as explained in the previous section.

3.9. Types of Optical Cables

The FOCS Silawan – Batu Gade – Liquica – Dili Network Cable uses two types of fibre optic cores: G.652D fibre optic core is generally only used for landline cables. On the SKSO network Silawan – Batu Gade – Liquica – Dili, G.652D is also used for integration with landline cables that use the same type of fibre optic core. The characteristics of the G.652D optical fibre core are shown in Table 3.

Table 3. G.652 D Fibre Optic Core Characteristics

No	Attribute	Details	Mark
1	Mode field diameter	Wavelength	1310nm
		Face value range	8.6-9.5 microns
		Tolerance	±0.6 microns
2	Cladding diameter	Nominal	125.0 microns
		Tolerance	±1 micron
3	Non-circular cladding	Maximum	1.0
	Cable termination wavelength	Maximum	1260nm
4	Disadvantages of macro bends	Radius	30mm
		Number of rounds	100
		Maximum at 1625 nm	0.1dB
5	Prove stress	Minimum	0.69 GPA
6	Chromatic dispersion coefficient	λ0 min	1300nm
		λ0max	1324nm
		S0max	0.092 ps /nm2×km
7	Attenuation coefficient	Maximum at 1550 nm	0.4dB/km
		Maximum at 1383 nm ±3nm	0.4dB/km
		Maximum at 1550 nm	0.3dB/km
8	PMD coefficient	m	20 Cables
		Q	0.01
		Maximum PMDQ	0.20 ps /√km

Source: developed by the authors.

This research was analysed using quantitative calculations using the cost-benefit method. LCN's investment feasibility assessment uses capital budgeting techniques to determine whether a proposed investment is feasible or not. In the capital budgeting method, NPV is used

to measure feasibility and Payback Period for calculations in calculating how long the return on capital invested in a particular company will be. Below is presented the CAPEX assumption data for LCN (Lafaek Cable Network) Infrastructure development. In this research, capital budgeting calculations were carried out using the Payback Period and NPV in Timor Leste Azmi, et al. [30], [31].

The Optical Cable Segment is as follows:
Phase 1: Inland Underground & Inland Aerial: Silawan-Batu Gade-Liquica-Dili

In determining CAPEX, it is divided into several categories:
  • OSP FO is an investment in network infrastructure development and SITAC (Node/POP) is a budget for allocating network access points for easy backbone distribution to providers.
  • Equipment is a budget for purchasing equipment by the capacity design implemented.

The table below shows the assumption of Capex Dry Cable OSP Inland Underground and Inland Aerial, which is shown in Table 4.

Table 4. Assumption Capex Dry Cable OSP Inland Underground & Inland Aerial

No	Description	Price in USD
1	Inland Underground Cost – 105000 Meters	1.632.515,02
2	Inland Aerial Cost = 105000 Meters	404.297,52
3	NOC DILI DWDM Cost	716,838.97
4	Supporting Facilities	246,348.49
5	Tools & Work Equipment	
6	Pre Opex	
	Grand Total Investment Cost	**3,000,000**

Source: developed by the authors.

In addition to CAPEX costs, there are Operational Expenditure (OPEX) costs, which cover all costs incurred throughout the year for items such as EDTL and maintenance. Investments also take into account depreciation, COGS, interest, and taxes. Table 5 explains the investment factors in the analysis [32, 33].

Table 5. Investment Factors

Depreciation	Investment 10 %.
Cogs	Income 2 %.
OPEX	Income 30 %.
Interest	9% Loan (CAPEX)
Tax	7 %
Loans	7 %

Source: developed by the authors.

Sources are important in investment appraisal because they provide a practical approach to determining whether profitable or not. The table below shows the total revenue of Metrolink, LDA with the price assumptions shown in Table 6.

Table 6. Revenue Metrolink, Lda

Year	Income in USD
2022	629,848
2023	1,515,707
2024	1,618,156
2025	2,232,849
2026	2,574,345

Source: developed by the authors.

4. Results and Discussions

Referring to previous research [10, 15] by analysing the feasibility of investing in the West Palapa Ring mega project in Indonesia which will be implemented in 2022 for the deployment of Undersea Optical Cables & Land Cables. Next are the Middle Palapa Ring and East Palapa Ring projects. This infrastructure development aims to create a backbone network that can connect the entire Timor-Leste region down to the district level. Therefore, the land cable network and fibre optic air cables will be connected to a network that will be expanded to reach all districts and cities in the relevant area. Finally, users can use this telecommunications network through network access. From the previous story and context, it can be concluded that Metrolink, LDA named the Lafaek Cable Network which consists of 6 segments:

1. Fibre Optic Inland Underground from Silawan – Batu Gade – Liquica – Dili
2. Fibre Optic Inland Aerial from Silawan – Batu Gade – Liquica – Dili
3. Microwave Alor 3 – Husbuk - Dili
4. Microwave Alor 3 – Dare – Dili
5. Microwave Silawan – Batu Gade – Dili
6. Microwave Alor 1 – Wetar – Baucau – Dili

Metrolink, Lda as a company providing internet and telecommunications services in Timor Leste, will invest in optimizing existing infrastructure to develop the company and meet increasing customer needs. while making a profit. This analysis aims to determine the feasibility of the investment plan proposed by Metrolink, Lda. The Metrolink (MTL) investments listed below have been implemented, are being implemented, or will be implemented:

1. Alor 3 Microwave Investment – Husbuk - Dili USD 430,000.00 – 2019.
2. Microwave Investment Alor 3 – Dare – Dili USD 550,000.00 – 2020.
3. Silawan Microwave Investment – Batu Gade – Dili.
4. Investment in Fiber Optic Cables via Land Cables and Aerial Cables in the area Silawan – Batu Gade – Liquica – Dili.
5. NOC and Office MTL investment USD 106,000.00.

The research was conducted using the Point Planning Analysis method, Extension Network Technical Analysis to calculate the point location and the required bandwidth capacity as well as cost and benefit analysis to estimate the potential economic value of this project. Figure 6 shows the Investment Network Topology Phase I Investment Plan topology.
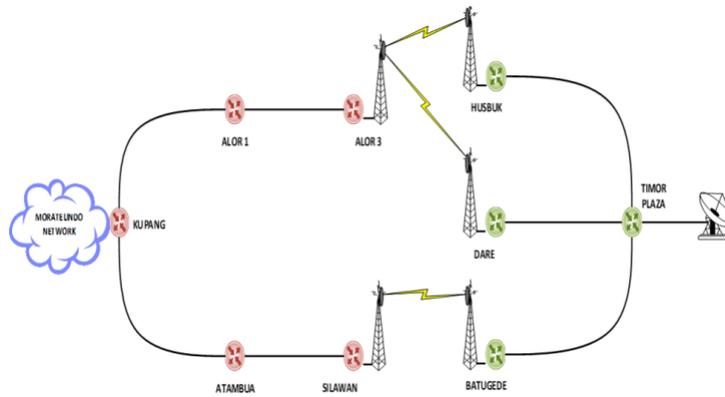
Figure 6. Investment Network Topology Phase I Investment Plan
Source: developed by the authors.

Figure 7 shows the investment network topology Phase II Investment plan topology. Figure 8 shows the development plan topologies (3) Silwan–Batu Gade–Liquica–Dili.
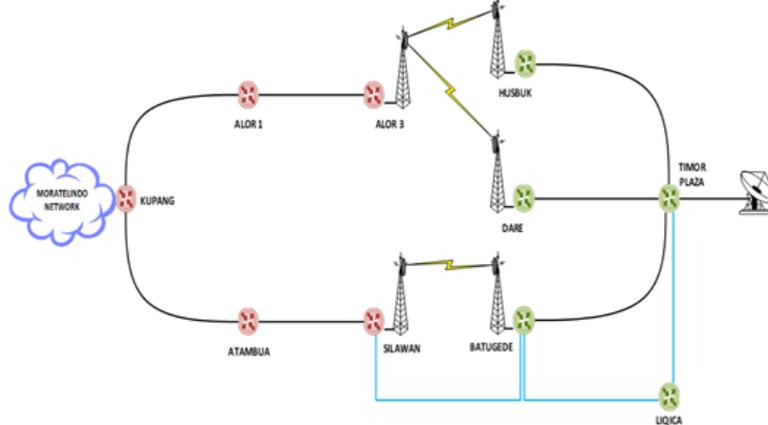

Figure 7. Investment Network Topology Phase II Investment Plan
*Source:* developed by the authors.
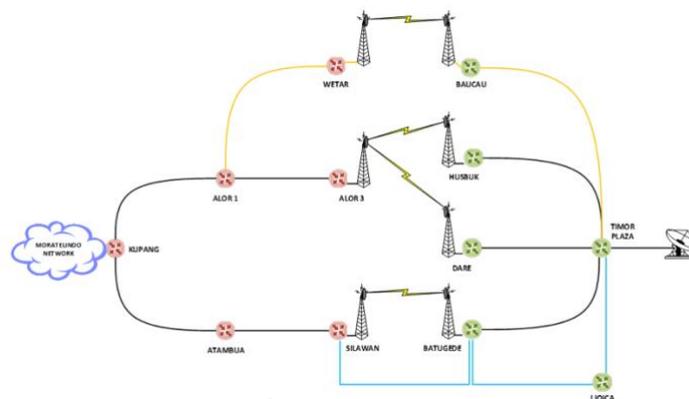
Figure 8. Development Plan (3) Silawan–Batu Gade–Liquica–Dili
Source: developed by the authors.

Figure 9 presents the plan map of the Inland Underground & Inland Aerial Cable Map Project. (Silawan–Batu Gade–Liquica– Dili)
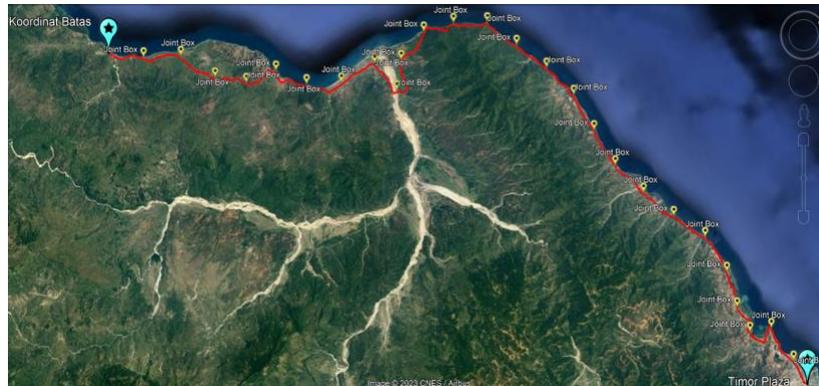
Figure 9. Inland Underground & Inland Aerial Cable Map (Silawan–Batu Gade–Liquica– Dili)
Source: developed by the authors.

One of the objectives of this infrastructure construction is to build a backbone network that can connect the entire territory of Timor-Leste to the district level. Therefore, it is further connected with an extension network to reach every district and city in the region concerned. Users can eventually enjoy these telecommunications networks through those access networks. A simple concept of the extension network can be seen in Figure 10.
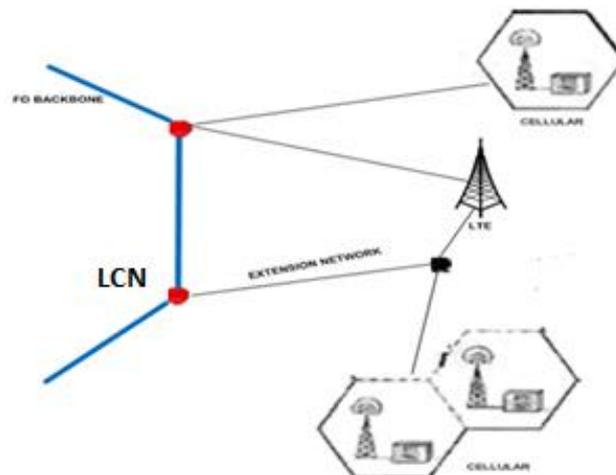

Figure 10. LTE Broadband Network Infrastructure
Source: developed by the authors.

This method is used to determine how long the return rate of the investment is; if the time required is shorter or equal to the required time, then the project is acceptable. This is because the sooner the return time, the lower the risk; otherwise if it takes longer than required, the project will be rejected or unqualified. To calculate the payback period, divide the total cost of the investment by the net cash flow. To calculate the payback period, divide the total cost of the investment by the net cash flow. With these calculations, it can be seen that this method is very simple and more preferential to investments that generate cash flows, as shown in Table 7.

Table 7. Payback Period

No		Description	Price in USD
1	2023	629,848	(2,370,152)
2	2024	1,515,707	(854,445)
3	2025	1,618,156	763,712
4	2026	2,232,849	2,996,561
5	2027	2,574,345	5,570,906

Source: developed by the authors.

Metrolink, Ltd. has planned an investment in 2023 to continue a project that has already been undertaken with an investment value of $3,000,000 and a discount rate of 9%. The timeframe for planning the investment is 5 years to come. The NPV analysis is done by calculating the present value of the entire cash flow operation. If the result is positive then financially the investment project is considered profitable and vice versa if the outcome is negative then unprofitable. Table 8 shows the Net Present Value (NPV) Calculation Results on this project.

Table 8. Net Present Value (NPV) Calculation

Year	Net Income in USD	DF (9%)
0	(3,000,000)	1
1	629,848	0.9174
2	1,515,707	0.8417
3	1,618,156	0.7722
4	2,232,849	0.7084
5	2,574,345	0.6499

Source: developed by the authors.

Table 9 shows Investment Feasibility Calculations Results where the Payback Period result is 2 Years 7 Months in 5 years targeted by Metrolink, Lda, and NPV is positive above 0 which is USD 3.358.050 of USD 3.000.000

Table 9. Investment Feasibility Calculation Results

No	Methodology	Silawan–Batu Gade–Liquica–Dili	Results
1	Payback Period	5 years	2 Years 7 Months
2	Net Present value	Positive above 0	3,358,050 USD

Source: developed by the authors.

5. Conclusion

According to the discussion above, the determination of cash flow, investment, and share investment is determined by the importance of capital budgeting. The development of the Timor Leste LCN (Lafaek Network Cable) Backbone Network has quite potential in terms of investment and is feasible to implement by looking at the NPV analysis and payback period profitability within 5 years. Development via Inland Underground Cables & Aerial Land Cables is obtained at a discount rate of 9% where the Payback Period is 2 Years and 7 Months. NPV in 5 years is around 3,358,050.494 USD. Determining line rental profitable assumptions greatly influences the NPV value and payback Period. DWDM technology is a solution that meets the network capacity of the Lafaek Cable Network area Silawan – Batu Gade – Liquica – Dili. Because of its large size, it can reach its total usage capacity at a competitive price. This also applies to Metrolink internet customers. Route Silawan – Batu Gade – Liquica – Dili. when

used with DWDM technology it will have a capacity of up to 200 Gbps.
The LCN (Lafaek Cable Network) project in the Silawan – Batu Gade – Liquica – Dili area will also be connected to PT's backbone network. Mora Telematikas Indonesia (Moratelindo), is the largest Tier 1 ISP company in Indonesia. This confirms that the project is very feasible from the point of view of the business approach.

Service Pricing for each service. While calculating Revenue the results have huge effects on the NPV Value and Payback Period. Return of capital and achievement of profits by the target market for service sales. Metrolink, Lda has been operating and serving the Timor-Leste market as one of the largest ISP providers since 2019, serving the country's largest Telco-O operators, government agencies, and private businesses. The project also includes upgrading services from existing microwave infrastructure to submarine mode infrastructure while optimizing it At the moment shows both quantitatively and qualitatively. With Metrolink, Lda has a majority stake as a national investment, or, the Timor-Leste government will undoubtedly protect and promote this investment in the long term. Customers require fast connections with low latency (Dili-Singapore +/- 50 ms) compared to other providers; This performance must be maintained so that Metrolink, Lda remains the leading service provider in Timor-Leste. Metrolink, Lda's collaboration partner with Moratelindo, has more than 20 years of experience in the telecommunications sector and the Indonesian government has entrusted the construction of the West and East Palapa Ring to these two companies. Indonesia is making progress with a total length of undersea cables of more than 20,000 km.

Implications for further study are to explore the front-end design engineering and design engineering details model for the implementation of optical cabling, whether it can be applied in industry or is needed for further research. As well as the licensing and environmental impact of the release to be carried out. Results of the eligibility analysis using financial aspects of capital budget indicators such as net present value (NPV) and payback period (PBP). The result of the analysis of investment proposals using capital budgeting in Metrolink, Lda. i.e., cash flow is the income generated by business operations in a certain period, which is obtained by adding net income with depreciation and interest after taxation, proceeds net cash flow gained by increasing the profits of Metrolinks with the number of decisions by taking into account their taxes and the capital costs that must be borne by the initial investment or investment so that such information can be gained from the income report. The revenue generated by Metrolink, Lda. is pretty good for a telecommunications company. With a little capital, you can make a big profit. The above explanation proves that a bank interest rate of 7% will result in a net value with lower risk. Metrolink, Lda. can recover the initial cost of the investment in 2 years and 7 months and has a greater cash flow than the investment cost. Having outlined some of the above conclusions, it is necessary to make some reservations related to fixed asset investments that can be considered in future decision-making. As for the suggestion that can be made, it is to add employees because, with investment increasing services and production in the future, a business will be much more and, of course, the existing human resources will be stressed.

6. Limitation of the Study

First, there are many Techno-Economy methods, in this paper the investment aspects discussed are the economic aspects of NPV and the Payback Period. Second, this study has compared the

two NPV and payback period models. This study will also consider the forecast growth of demand and capacity. Further research is aimed at analysing the economic aspects of the application of technology. The technology used is DWDM on the Backbone Network Fiber Optic Cable Silwan-Batu Gade-Liquica-Dili. In addition, it made licensing agreements with the Indonesian and Timor-Leste governments in carrying out interconnection and distribution of optical cables, and environmental impact. Besides, it made a network implementation design with DWDM equipment and routers.

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