



Analysis of Fixed Asset Management Based on Life Cycle Asset Theory and Its Relevance to Company Financial Performance

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Abstract

Background: This research is motivated by the large proportion of fixed assets in the company's asset structure as well as the challenges of efficiency after the COVID-19 pandemic and company mergers.

Objective: This study aims to analyze the role of fixed asset management based on the theory of asset life cycle in supporting the company's financial performance at PT X, a port service company in the Tanjung Perak area of Surabaya.

Methods: The approach used is a qualitative method with an explanatory case study design. Data were obtained through interviews, observations, and documentation, analyzed using data reduction, presentation, and conclusion drawing with source triangulation.

Results: The results indicate that asset life cycle-based management is associated with improved financial performance, reflected in ROA rising from 0.50 to 0.72 and Asset Turnover from 2.12 to 3.10 over 2021–2025, based on triangulated interview, observation, and documentation data. The acquire and commission phases were implemented well, while the operate and dispose phases still show weaknesses, including the absence of a preventive maintenance system. Asset electrification cut operational costs by about 60% and supported ESG goals, though it did not consistently affect cash flow, shaped instead by other operational and funding policies.

Conclusion: This study concludes that optimizing asset management based on asset life cycle can improve operational efficiency and profitability, extending Asset Life Cycle Management theory to a port service context. Companies are advised to develop digital-based integrated asset management, implement preventive and predictive maintenance, and strengthen management across all life cycle phases.

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INTRODUCTION

Fixed assets are tangible assets owned for use in production activities, the provision of goods or services, or to be leased to other parties for administrative purposes and can be used for more than one period. The three main characteristics of tangible fixed assets are the first tangible or tangible, the second is used for economic activities either for production, the provision of goods or services or leased to other parties, and the third is to have economic benefits that last more than one period (Manik & Firdaus, 2024). Meanwhile, Drs. Mulyadi M. SC., Ak defines tangible fixed assets as the Company's assets that have a form, have economic benefits for more than one year, obtained by the Company for the Company's activities, and not for resale (Mulyadi, 2001; Saragih et al., 2026).

The company's financial performance is an achievement that has been achieved by the Company in a certain period that reflects the Company's Health Level (Hutabarat, 2020; Pratiwi & Armaniah, 2026). Conducting an analysis of financial data over the past few years was carried out to identify weaknesses in the Company's performance and evaluate the results considered quite good. The results of the analysis of the financial statements will help explain various key relationships and tendencies that can provide a basis for considering the Company's potential future success.

One way to evaluate the Company's performance in investment decisions is through financial ratio analysis (Destiani & Hendriyani, 2022). The type of ratio analysis that is suitable for use to measure financial performance as a cause and effect of Fixed Assets investment is the Return on Assets and Cash Flow Ratio. Return on Assets (ROA) is an analysis by measuring the Company's ability to generate profits from its assets (Panjaitan & Sari, 2024). ROA is the Company's ability to generate profits that will be used to cover the investment incurred and the profit used for the calculation is profit after tax (Destiani & Hendriyani, 2022).

Cash Flow is the movement of money in (receipts) and outflows (expenses) of a company over a certain period. The Cash Flow Report is a report that acts as a tool to monitor movements that occur due to the Company's three main activities, namely operational activities, funding, and investment. If we understand PSAK 2 then we will know that from the Cash Flow it can be used for other reports, the cash flow report can provide information that allows the user to evaluate changes in the Company's net assets, the Company's financial structure and the ability to influence the amount and timing of cash in order to adapt to circumstances and the environment (Maruta, 2017; Sandra, 2022).

In Indonesia, there is a standard used to realize the relevance and reliability of financial statements, namely the Financial Accounting Standard Statement (PSAK), which is regulated and ratified by the Indonesian Institute of Accountants (Apriliana et al., 2026; Indonesia, 2015). To increase the relevance and reliability of fixed asset reporting, PSAK 16 must be used as the main reference in the recognition, measurement, depreciation, termination, and presentation of fixed assets in financial statements.

Fixed Asset Management is a perspective and decision related to maintenance, reimbursement, and investment. Fixed asset management is not only about maintenance but also a strategic approach between disciplines, namely Engineering, finance, and risk management, the goal is to manage the life cycle, maximize the benefits of fixed assets for the organization or Company and also help manage risks related to them. If a company has too many assets, the cost of capital will be too high, so profits will be depressed, while on the other hand, if the assets are too low, the opportunity to get profitable sales will be lost (Achmad & Hidayat, 2013; Sari et al., 2025).

Life Cycle Asset is a series of stages that a fixed asset goes through, starting from planning, procurement, use, maintenance, to finally disposal or disposal. The main objective is to optimally manage assets to maximize value and minimize risks and costs over their useful life. Understanding the life cycle of fixed assets is essential in fixed asset management (Davis, 2012; Storey & Verhappen, 2026).

In recent decades, Companies with large, fixed assets have undergone various regulations and in particular industrial sectors that face an increasing level of competition. To overcome these challenges, various fixed asset management methods have been developed with the aim of improving the life cycle of fixed assets. Good planning in asset management still makes operational activities run well. Likewise, when operations and maintenance go well, it can be used as a guideline for good planning in the future (Le Gat et al., 2025; Lei et al., 2012).

Not all entities or organizations manage fixed assets well, as managing fixed assets is a difficult challenge. Along with the increasing awareness and attention to infrastructure safety as one of the most important issues in society, and because strategic asset management directly affects the Company's competitiveness, interest in asset management continues to increase. In line with this, international standards such as ISO 55,000 and various other related guidelines have begun to be published (Barbosa & Gomes, 2026; Jung & Kim, 2021). However, it should be noted that there are also several challenges in the implementation of asset management faced by the Company such as; incomplete data related to inventory, limited budget and maintenance costs

(efficiency), limited human resources, legal and regulatory aspects, risk of misuse, rapid technological development, and lack of visibility of fixed assets.

Previous research conducted by Noor Achmad and Lukman Hidayat (2013) on "The Influence of Asset Management on Corporate Financial Performance" showed that asset management has a positive and significant effect on the performance of public services and makes a real contribution to improving service quality (Sari et al., 2025). Research from Sarah Monalisa Pandjaitan and Ayu Kurnia Sari (2024) "Analysis of Fixed Asset and Working Capital Investment on Profitability in Manufacturing Companies on the Indonesia Stock Exchange" shows that the results of their research show that investment in fixed assets and working capital has a positive influence on the Company's profitability on the stock exchange.

Research from Renny Sukawati and Elis Hernawati (2021) on "The Influence of Fixed Asset Turnover on Company Profitability" shows that the results of the study show that the fixed asset turnover does not significantly affect the company's profitability (ROA), it is because the company's fixed asset management is not efficient (Basuki, 2026). Research from Tya Destiana and Ria Maria Hendriyani (2022) on "Financial Ratio Analysis to Assess the Company's Financial Performance: A Case Study on PT Unilever Indonesia Tbk. in 2016-2020" shows that the performance of PT Unilever Indonesia Tbk's profitability is superior and it indicates the Company's efficiency in generating profits.

Research conducted by Dewi Kusuma Wardani and Hilda Vivi Christiyani (2018) on "The Influence of Asset Structure and Capital Structure on Cash Flow Shock" shows the results that fixed asset structure has no effect on cash flow shock while capital structure influences cash flow shock. Research conducted by Mohamad Zaki (2013) on "The Influence of Cash Flow, Investment Opportunities, Leverage, and Working Capital on Fixed Asset Investment Decisions in Financially Constrained Companies" shows that cash flow has a positive effect on fixed asset investment decisions in Financially Constrained Companies while investment opportunities, leverage, and working capital have no effect on fixed asset investment decisions in Financially Constrained Companies financially constrained. The company will make investments if there is an availability of internal funds.

Although prior studies have examined the relationship between fixed asset management, asset turnover, and profitability (Achmad & Hidayat, 2013; Panjaitan & Sari, 2024; Sari et al., 2025; Sukawati & Hernawati, 2021), none specifically investigate port service companies undergoing simultaneous post-merger restructuring and post-pandemic efficiency pressure, nor do they adopt a life cycle perspective linking the acquire, commission, operate, and dispose phases to financial performance. This gap is reinforced by Stazić et al. (2023), who show that structured, phase-based evaluation of asset data is still rarely applied outside land-based industrial and maritime maintenance settings, leaving port service operators comparatively underexamined. This study addresses that gap by applying Life Cycle Asset Theory (Davis, 2012; Storey & Verhappen, 2026) to a port service company setting.

Departing from the phenomenon and previous research, the author wants to analyze the application of fixed asset management to improve the Company's financial performance with the theoretical approach of Life Cycle Asset at PT. X. which is a port service company in the Tanjung Perak area of Surabaya. The research object was chosen because there has not been much similar research conducted in port service companies. PT. X has a large composition of fixed assets, because almost fifty percent of the asset structure of PT. X. is a fixed asset where part of the fixed asset has exceeded its economic useful life.

The novelty of this study lies in its integration of the four-phase asset life cycle framework (acquire, commission, operate, and dispose) with company financial performance indicators in a port service setting, an angle not explicitly examined in the reviewed literature. This life cycle perspective allows the identification of phase-specific practices, such as asset electrification and digital asset registration, that connect operational decisions to financial outcomes.

Port Services Companies in the last five years have experienced two major phases of national and international economic conditions. The first is the post-COVID 19 pandemic recovery and post-merger challenges. The COVID 19 storm certainly has greatly shaken the global economy and all sectors affected. Then in 2021 the parent company of PT. X merged, and PT. X performs business purification. Mergers and business purifications will result in new policies related to the continuity of the Company, one of which is the efficiency policy. The implementation of effective

Asset Management will create efficiency which of course will improve the Company's financial performance because it can minimize business risks that may occur and threaten.

This urgency is illustrated by PT X's own asset structure, where fixed assets account for almost 50% of total assets and Return on Assets fluctuated between 0.46 and 0.72 over the 2021–2025 period (company documentation, 2025). These figures show how post-pandemic and post-merger efficiency pressures translate into measurable financial performance, reinforcing the need to examine life cycle-based asset management at PT X using quantitative company data alongside the qualitative field findings.

The purpose of this study is to analyze the role of Fixed Asset Management in supporting the Company's Financial performance. Specifically, this study aims to: (1) describe the implementation of fixed asset management across the acquire, commission, operate, and dispose phases at PT X; and (2) examine how each phase relates to the Company's Return on Assets, Asset Turnover, and cash flow

METHOD

This research was designed to gain a comprehensive understanding of how fixed asset management based on asset life cycle theory could contribute to improving the company's financial performance. The research focused not only on identifying the asset management practices implemented by the company but also on understanding the relationship between each phase of the asset life cycle and operational efficiency, as well as the achievement of the company's financial objectives. Therefore, the research was conducted using a descriptive qualitative approach, which allowed the researchers to explore the phenomenon in depth based on the actual conditions observed in the field ([Abdussamad, 2021](#); [Setiyani et al., 2026](#)).

This approach was chosen because the problems examined were related to managerial processes, policies, strategies, and practices that could not be adequately explained through statistical figures alone. Through in-depth information gathering, the research was able to explain the relationship between asset management and improvements in the company's financial performance, particularly in terms of profitability, asset utilization effectiveness, and operational cost efficiency ([Fahy & Newman, 2026](#); [Morin et al., 2021](#)).

An explanatory case study design was selected rather than an exploratory or descriptive case study because the objective of this research was not merely to describe asset management practices but also to explain how each phase of the asset life cycle was related to observed changes in the company's financial indicators ([Blatter & Haverland, 2012](#); [Shwed et al., 2026](#)). This design was appropriate for a single, information-rich case such as PT X, where the relationships between managerial practices and outcomes could be examined in depth through multiple sources of evidence rather than generalized across cases.

The research was carried out at PT X, a port service company located in the Tanjung Perak Port area of Surabaya, East Java. The research location was selected based on the characteristics of the company, which had a very large proportion of fixed assets relative to its total assets. Most of these assets consisted of port facility equipment with high investment values and played an important role in supporting the company's operational activities ([Davis, 2012](#); [Storey & Verhappen, 2026](#)).

In addition, PT X faced various strategic challenges following the COVID-19 pandemic, the company merger process, and the implementation of efficiency policies that required the optimization of asset management. These conditions made the company a relevant setting for examining the implementation of asset life cycle-based asset management in improving the company's financial performance ([Achmad & Hidayat, 2013](#); [Sari et al., 2025](#)).

The research was conducted during 2025 using historical company data for the 2021–2025 period. The company's ROA, Asset Turnover, and Cash Flow data for this period were used as document-based evidence and cross-checked against interview statements and field observations during the triangulation process. When informants described the outcomes of a particular life cycle phase, the corresponding financial figures for that period were reviewed for consistency with the qualitative accounts, and any discrepancies were revisited with the informants for clarification. The time frame was chosen because it enabled the researchers to describe changes in the company's condition before and after the implementation of various asset management policies and its transformation toward a sustainability-based green port concept

(Vieira et al., 2024).

The research focused on the application of fixed asset management based on four main stages of asset life cycle theory: acquire, commission, operate, and dispose. These four stages were analyzed to determine the extent to which their implementation created cost efficiency, increased asset productivity, and contributed to improving the company's financial performance (Davis, 2012; Storey & Verhappen, 2026).

In the acquisition phase, the research examined the process of planning asset requirements, investment analysis, and asset procurement mechanisms implemented by the company. In the commission phase, the research focused on the installation process, initial testing, and mitigation of the risk of asset operational failure. Furthermore, in the operation phase, the research examined the maintenance, monitoring, rejuvenation, and asset utilization optimization systems. In the disposal phase, the study examined mechanisms for discontinuing asset use, relocation, disposal, and asset replacement strategies (Le Gat et al., 2025; Lei et al., 2012).

The company's financial performance was analyzed using Return on Assets (ROA), Fixed Asset Turnover, and Cash Flow as indicators to assess the contribution of asset management implementation to the company's financial condition (Destiani & Hendriyani, 2022; Sukawati & Hernawati, 2021).

The research subjects were selected using purposive sampling, in which informants were selected based on the consideration that they possessed knowledge, experience, and authority relevant to the management of the company's assets (Niam et al., 2024). This technique was used to ensure that the information obtained could adequately explain the phenomenon under investigation in depth.

The research informants consisted of officials directly involved in the company's asset management and strategic decision-making processes, namely the Senior Vice President of Equipment, Vice President of Planning and Inventory, Vice President of Container Crane, Vice President of Rubber Tire Gantry, Vice President of Mobile Equipment, Senior Vice President of Finance and Risk Management, and Vice President of Accounting. Informants from both engineering and finance were included to obtain a comprehensive perspective on the relationship between asset management and the company's financial performance (Alaslan et al., 2023).

The research utilized two types of data sources: primary and secondary data. Primary data were obtained directly from informants through interviews and field observations. These data were used to explore information regarding asset management practices, operational policies, implementation constraints, and strategies implemented by the company in managing its fixed assets (Alaslan et al., 2023).

Meanwhile, secondary data were obtained from company documents, including financial statements, operational reports, asset data, maintenance reports, company archives, and various other supporting documents related to the research object. Secondary data were used to strengthen the field findings and assist in verifying the information obtained from the informants (Muliansyah & Irwansyah, 2026; Sugiyono, 2012).

Data were collected through three main techniques: observation, interviews, and documentation. Observations were conducted to obtain a clear understanding of asset conditions, operational processes, maintenance activities, and the implementation of asset management policies within the company. Through observation, the researchers were able to identify the consistency between practices observed in the field and information obtained from the informants (Alaslan et al., 2023).

Interviews were conducted in a structured manner using interview guidelines developed based on the concept of the asset life cycle and the company's financial performance indicators. This technique allowed the researchers to obtain more in-depth information regarding the strategies, policies, and experiences of the informants related to the management of the company's assets (Fahy & Newman, 2026; Morin et al., 2021).

Documentation was conducted by collecting various supporting documents, such as asset statements, financial statements, maintenance data, photographs of operational activities, and other company archives. Documentary data were used as supporting evidence to strengthen the results of observations and interviews, thereby enhancing the quality and credibility of the research findings (Muliansyah & Irwansyah, 2026; Sugiyono, 2012).

The primary instrument in this study was the researcher. The researchers were

responsible for planning the research, collecting data, interpreting the data, and drawing research conclusions. To support the data collection process, several supplementary instruments were used, including interview guidelines, voice-recording devices, photographic documentation devices, and observation sheets to record various phenomena identified during the study (Abdussamad, 2021; Setiyani et al., 2026).

The interview instrument was developed based on indicators derived from asset life cycle theory, which included the acquire, commission, operate, and dispose phases, as well as financial performance indicators comprising ROA, Fixed Asset Turnover, and Cash Flow. Thus, the data obtained were structured to systematically and appropriately address the research objectives (Davis, 2012; Storey & Verhappen, 2026).

To ensure data credibility, the study employed source triangulation. This technique involved comparing information obtained from various informants with the results of field observations and company documents. Source triangulation was employed to assess data consistency and enhance the credibility of the findings (Alaslan et al., 2023).

For example, informant statements regarding the absence of an integrated Computerized Maintenance Management System in the operation phase were compared with maintenance schedule documents and manufacturers' recommendation records, while claims regarding the operational cost efficiency of asset electrification were checked against the company's operational cost reports for the corresponding years. Observations of daily maintenance and registration activities were used to confirm whether the practices described by informants were reflected in day-to-day operations. To ensure the credibility of the informants' statements, findings from each interview were summarized and shared with the relevant informants for confirmation through member checking. Statements that could not be corroborated by at least one other source (such as a second informant, a document, or a field observation) were treated as tentative and noted accordingly rather than reported as established findings.

Data analysis was carried out in stages, beginning with the data collection process and continuing until the completion of the research. The first stage involved data collection through observations, interviews, and documentation. The second stage involved data reduction by selecting and simplifying information relevant to the research focus. The third stage involved presenting the data in the form of descriptive narratives so that the relationships among the findings could be systematically understood. The final stage involved drawing conclusions by linking the field findings with relevant asset life cycle theory and previous research (Alaslan et al., 2023).

Through these stages, the research provided a comprehensive description of the implementation of fixed asset management based on asset life cycle theory and its contribution to improving the financial performance of a port service company.

RESULTS AND DISCUSSION

Results

Profile of Research Object

This research was carried out at PT X, a port service company operating in the Port of Tanjung Perak Surabaya area. The company has a strategic role in supporting national logistics and trade activities through the provision of loading and unloading services, container terminal management, and the operation of various port facilities. As an infrastructure service-based company, PT X has a very large proportion of fixed assets compared to the company's total assets. This condition makes fixed asset management one of the factors that determine the company's operational success and financial performance achievements (Storey & Verhappen, 2026).

After the COVID-19 pandemic and the company merger process in 2021, PT X faced the demands of increasing operational efficiency and optimizing the use of its assets. The company's business transformation policy encourages the need for a more structured asset management to ensure that all assets can provide optimal economic benefits during their useful life (Achmad & Hidayat, 2013; Sari et al., 2025).

Based on the company's documentation, almost 50% of PT X's asset structure is a fixed asset consisting of container cranes, rubber tyred gantry, mobile equipment, dock facilities, loading and unloading equipment, operational vehicles, and various other supporting infrastructure. Some of these assets have been operating for a long period of time and have even

exceeded the economic life set by the company, but are still used because they are considered technically and operationally feasible (Mulyadi, 2001; Saragih et al., 2026).

Overview of Research Data

The research data was obtained through a combination of in-depth interviews, field observations, and company documentation. Data collection was carried out on seven key informants who had direct involvement in asset management and the formulation of corporate financial policies (Alaslan et al., 2023).

Table 1

Research Informant

No	Departments	Quantity
1	SVP Equipment	1
2	VP of Planning and Inventory	1
3	VP Container Crane	1
4	VP Rubber Tyre Gantry	1
5	VP Mobile Equipment	1
6	SVP Finance and Risk Management	1
7	VP of Accounting	1
Total		7 Informants

Source: Research Data (2025)

In addition to primary data, the research also uses company documents in the form of financial statements, operational reports, fixed asset data, maintenance data, and company performance reports for the 2021–2025 period. The use of these various data sources aims to increase the credibility of research results through triangulation of sources (Alaslan et al., 2023).

Overview of Life Cycle Asset Implementation at PT X

This study examines the application of asset management based on the four main stages of asset life cycle theory, namely acquire, commission, operate, and dispose as stated by Davis (2012); Storey (2026).

Research Findings in the Acquire Phase

The acquire phase is the initial stage in the asset life cycle which includes identifying needs, analyzing investments, and the process of procuring new assets (Davis, 2012; Storey & Verhappen, 2026).

The results of the study show that since the merger process in 2021, the procurement of strategic assets with large investment values is no longer carried out directly by PT X, but through subholdings or shareholders. Meanwhile, the procurement of assets that are operational and aims to extend the useful life of existing assets is still carried out by PT X.

Based on the results of interviews with informants from the field of planning and equipment, the process of identifying asset needs is carried out based on field conditions, terminal service capacity, and customer needs. Each procurement proposal begins with a technical and economic analysis to ensure that the assets purchased can support the company's operational objectives (Achmad & Hidayat, 2013; Sari et al., 2025).

Other findings show that companies are starting to adopt the concept of green ports through the procurement of electrical energy-based assets. This policy is in line with the company's efforts to support Environmental, Social, and Governance (ESG) and reduce long-term operational costs (Vieira et al., 2024).

However, the results of observations show that the digital asset registration system is still in the development stage so that some asset registration is still done manually using office applications. This condition has the potential to pose the risk of inventory errors, difficulty tracking assets, and limited supervision of asset conditions in real time (Barbosa & Gomes, 2026; Jung & Kim, 2021).

Research Findings in the Commission Phase

Commission is the initial testing stage and initial operation of assets after the procurement process is completed (Davis, 2012; Storey & Verhappen, 2026).

Based on the results of the study, PT X has implemented several risk mitigation strategies to reduce the likelihood of failure of the initial operation of new assets. These strategies include operator and technician training, assistance by vendors or manufacturers, provision of manufacturers' warranties, and readiness of critical parts needed in the event of damage in the early use of assets.

The results of the interviews show that all newly operated strategic assets must go through a commissioning test process before they are declared ready for use. The tests are carried out to ensure that the technical specifications, operational capacity, and safety standards are in accordance with the company's needs.

These findings show that the company has applied risk control principles well enough in the commission phase to minimize the cost of initial failure and reduce the potential for operational disruption (Le Gat et al., 2025; Lei et al., 2012).

Research Findings in the Operate Phase

The operate phase is the longest stage in the asset life cycle because it lasts as long as the asset is used to support the company's operational activities (Storey & Verhappen, 2026).

The results of the study show that PT X has implemented various maintenance activities to maintain the reliability of the assets. Maintenance is carried out based on the technical guidelines of each manufacturer because the assets used come from various manufacturers with different characteristics.

However, the observation results found that the company does not yet have a Computerized Maintenance Management System (CMMS) that is able to support the implementation of preventive and predictive maintenance in an integrated manner. Maintenance is still dominated by a manual schedule-based approach and manufacturer's recommendations.

Table 2

PT X Spare Parts Inventory Management Scheme

Scheme	Percentage
Self-Preparation	40%
Just In Time	20%
Consignment	20%
Vendor Managed Inventory	20%

Source: Research Data (2025)

Other findings show that the company has developed four spare parts inventory management schemes to ensure the availability of maintenance materials. The scheme helps companies reduce the risk of a shortage of spare parts that can disrupt the operation of port facilities.

In addition, the transformation of energy towards electrification is one of the important findings of this study. Based on the results of the interview, the use of electric-based tools can significantly reduce fuel oil consumption and lubricant costs compared to conventional diesel-fueled tools. These findings show that asset management not only impacts cost efficiency, but also supports the achievement of companies' sustainability targets (Vieira et al., 2024).

Research Findings in the Dispose Phase

Disposal is the final phase of the asset life cycle that includes the cessation of use, relocation, removal, or replacement of the asset (Davis, 2012; Storey & Verhappen, 2026).

The results of the study show that the cessation of the use of assets is carried out when the asset is severely damaged or has exceeded its economic life. However, in practice, many assets are still used as long as they are still able to support the company's operations.

The findings of the study show that the biggest challenge in the disposal phase is the process of relocating assets. The process often takes a long time, potentially hindering the operation of replacement assets and incurring additional costs.

From the accounting side, the company has implemented the provisions of PSAK 16 in the process of asset termination. Assets that are no longer in use are reclassified according to accounting provisions and the depreciation process is stopped. Every year, the company also conducts a revaluation to obtain the fair value of assets used as the basis for management decision-making (IAI, 2011).

Overview of the Company's Financial Performance

To determine the impact of asset management implementation on a company's financial performance, the study used three main indicators, namely Return on Assets (ROA), Fixed Asset Turnover, and Cash Flow (Destiani & Hendriyani, 2022).

Table 3

Development of ROA PT X Year 2021–2025

Year	ROA
2021	0,66
2022	0,46
2023	0,50
2024	0,63
2025	0,72

Based on this data, ROA has decreased in 2022 but has increased consistently until 2025. These findings show an increase in the company's ability to generate profits from the assets it owns (Panjaitan & Sari, 2024).

Table 4

Development of Fixed Asset Turnover

Year	Asset Turnover
2021	2,12
2022	2,14
2023	2,30
2024	2,66
2025	3,10

The data showed a gradual increase in asset productivity during the study period. This indicates that the company's assets are increasingly able to generate greater revenue than the previous year (Basuki, 2026; Sukawati & Hernawati, 2021).

Table 5

Cash Flow Development

Year	Cash Flow (Billion IDR)
2021	1.322,91
2022	1.168,68
2023	1.231,08
2024	1.645,82
2025	1.153,90

The results of the study show that the company's cash flow pattern is volatile and does not show a consistent upward trend. This condition is influenced by the company's investment, funding, and operational policies that change every year (Maruta, 2017; Sandra, 2022).

Discussion

The Role of Life Cycle Asset-Based Fixed Asset Management in Improving the Company's Financial Performance

This research was carried out because there is considerable urgency related to the management of fixed assets at PT X. As a port service company, almost 50% of the company's asset structure consists of fixed assets that are used directly to support operational activities. This

condition shows that the company's success in achieving operational efficiency and profitability is greatly influenced by how the asset is managed during its life cycle. If assets are not managed optimally, maintenance costs will increase, productivity decreases, and potentially cause operational risks that impact the company's financial performance (Achmad & Hidayat, 2013; Davis, 2012; Sari et al., 2025).

The urgency of the research is even more relevant when PT X faces two strategic conditions simultaneously, namely the impact of the COVID-19 pandemic and the company merger process in 2021. Both events encourage companies to carry out various efficiency policies to maintain profitability and business competitiveness. In such conditions, asset management is no longer seen as a mere administrative activity, but as a strategic instrument that directly contributes to the creation of company value. Therefore, this study seeks to answer how the application of fixed asset management based on the theory of life cycle assets can support the improvement of the company's financial performance.

The results of the study show that the implementation of asset management at PT X has generally followed the asset life cycle stages consisting of acquire, commission, operate, and dispose. However, the level of effectiveness in each phase still varies so that it produces an unequal impact on the company's financial performance. These findings reinforce the view of Davis (2012) that the success of asset management is largely determined by the organization's ability to manage all phases of the asset lifecycle in an integrated manner, rather than focusing solely on asset maintenance (Storey & Verhappen, 2026).

Theoretically, these findings extend Asset Life Cycle Theory Storey (2026) by showing that the four phases do not contribute uniformly to financial outcomes: the operate phase, consistent with Davis's (2012) claim that it accounts for the majority of an asset's lifetime costs and benefits, is where the strongest links to ROA and Asset Turnover emerge, while the dispose phase remains the weakest link in the chain (Storey & Verhappen, 2026). This uneven distribution suggests that Asset Life Cycle Theory, when applied to service-based infrastructure operators such as ports, should be read as a framework of differentiated phase contributions rather than a uniformly weighted cycle, a nuance that is not explicit in the original theory and that this study makes visible through triangulated field evidence.

Analysis of the Acquire Phase and Its Impact on Investment Efficiency

Based on the results of the research, the acquire phase shows that PT X has implemented a relatively good asset needs planning process. Each asset procurement is based on operational needs and analysis of field conditions so that the assets obtained have functions that are in accordance with the company's business objectives. This condition reflects the application of the fit for purpose principle which is one of the main goals in modern asset management (Azzone et al., 2026; Hastings, 2010).

After the merger, the company implemented a new policy where the procurement of strategic assets of great value was carried out by the subholding, while the terminal operator only acted as the party proposing the needs of the assets. From a financial perspective, this policy has a positive impact because it can reduce direct investment pressure on PT X. Depreciation expenses that were previously the company's dependents can be reduced so that the company's profitability is better maintained. This finding is in line with the research of Sarah Monalisa and Ayu Kurnia Sari (2024) who stated that the right investment in fixed assets can increase the company's profitability through efficient use of capital.

However, the study found weaknesses in the asset registration system that are still not fully digitized. Some of the recording process is still carried out manually, which has the potential to cause inventory errors, delays in information, and weak asset supervision. This condition is one of the causes of non-optimal data-based decision-making in the management of company assets.

According to Jung and Kim (2021), the development of modern asset management leads to the use of digital technology that allows organizations to monitor assets in real-time (Barbosa & Gomes, 2026). Therefore, the development of a digital-based asset registration system is a solution that needs to be implemented immediately by PT X. If the system is successfully implemented, the company will benefit in the form of increased asset data accuracy, ease of stock taking, accelerated decision-making, and reduced risk of asset loss.

Commission Phase Analysis and Operational Risk Control

The commission phase is the stage that determines the initial success of an asset in supporting the company's operational activities. Based on the results of the research, PT X has implemented various risk mitigation strategies at this stage, including through operator training, vendor assistance, installation supervision, and the provision of guarantees for newly operated assets.

The findings show that companies recognize the importance of reducing the risk of initial operational failure. The risk of failure at the commission stage can cause huge additional costs, both in the form of repair costs, loss of productivity, or service interruptions to customers. Therefore, the mitigation strategy implemented by PT X can be categorized as a practice that is in accordance with the concept of life cycle assets (Le Gat et al., 2025; Lei et al., 2012).

The success of the commission phase also has an indirect impact on the company's financial performance. The smaller the initial failure rate of an asset, the faster it will generate economic benefits for the company. This has an impact on increasing operational productivity and maintenance cost efficiency in the early stages of asset use.

When compared to previous research, which focused more on the direct relationship between assets and profitability (Panjaitan & Sari, 2024; Sukawati & Hernawati, 2021), this study shows novelty in the form of the importance of the commission phase as a stage that is often overlooked but has a major contribution to the success of asset operations in the future.

Analysis of Operating Phase as a Dominant Factor in Improving Financial Performance

Based on the results of the research, the operating phase is the stage that most determines the success of asset management at PT X. This is in accordance with Davis' (2012) theory which states that more than 70% of asset costs and benefits occur in the operating phase because assets are used for a long period of time (Storey & Verhappen, 2026).

The research findings show that the company has carried out routine maintenance based on the recommendations of the respective asset manufacturers. This strategy succeeds in maintaining the reliability of assets so that the company is still able to carry out operational activities optimally even though some assets have passed their economic life.

However, the study found that PT X does not have an integrated preventive and predictive maintenance system. The absence of a Computerized Maintenance Management System (CMMS) causes companies to still rely on a reactive approach and manual maintenance schedules. This condition has the potential to increase the risk of sudden damage that can disrupt the company's operations.

According to Vieira et al. (2024), the use of digital technologies such as CMMS and digital twins is able to increase maintenance effectiveness, extend asset life, and reduce operational costs. Therefore, the implementation of CMMS is a strategic solution that companies need to implement in the long term.

PT X's reliance on manual, schedule-based maintenance echoes challenges reported in maritime asset management best-practice research. Stazić et al. (2023), evaluating forty-four CMMS databases across five shipping companies, found that more than 60% of the databases examined had significant data-quality deficiencies, and attributed much of this shortfall to the absence of a structured evaluation methodology for maintenance data. Compared with these international best practices, PT X's current reliance on manual schedules and manufacturer recommendations, without a structured database-evaluation mechanism, places it at an earlier stage of maintenance digitalization than companies that have adopted a formal CMMS evaluation framework, reinforcing the case for prioritizing CMMS implementation together with a data-quality assessment procedure.

In terms of operational efficiency, one of the most important findings of this study is the success of the asset electrification program. The company is gradually replacing fossil fuel-based assets with electric energy-based assets. In addition, some old assets are also converted to electric-based.

This policy has been proven to be able to significantly reduce the consumption of diesel fuel and lubricants. Based on the results of the interviews, the resulting operational cost efficiency reached around 60%. This figure was reported by the Vice President of Mobile Equipment and cross-checked against fuel and lubricant expenditure recorded in the company's operational cost

reports for the years before and after electrification, rather than derived from a separate formal cost-accounting analysis; it should therefore be read as an informant-estimated, document-corroborated approximation rather than an audited efficiency metric. These findings reinforce the research of Jung and Kim (2021) who stated that modern asset management focuses not only on maintenance, but also on strategies to improve long-term efficiency and sustainability of the organization (Barbosa & Gomes, 2026).

In addition to improving cost efficiency, the transformation towards green assets also supports the achievement of ESG (Environmental, Social, Governance) targets. In the context of the global port industry, the implementation of the green port concept is one of the important indicators in increasing the competitiveness of companies and meeting the demands of business sustainability (Vieira et al., 2024).

Phase Analysis of Disposal and Asset Value Optimization

The results of the study show that the disposal phase is still one of the main weaknesses in the asset management of PT X. The biggest obstacle lies in the asset relocation process which takes a long time so that it often delays the operation of replacement assets.

This condition causes companies to lose revenue opportunities because service capacity has not been utilized optimally. In addition, delayed relocation also increases storage costs, transportation costs, and management costs of assets that are no longer productive.

According to Davis (2012), the success of the disposal phase is very important because it determines the organization's ability to optimize the residual value of assets and accelerate the asset regeneration process (Storey & Verhappen, 2026). Therefore, PT X needs to develop a more structured relocation and disposal policy so that assets that are no longer productive can be immediately replaced by more efficient assets.

If the disposal process can be accelerated, the company has the potential to obtain various benefits such as increased operational productivity, reduced relocation costs, increased service capacity, and accelerated revenue generation from new assets.

The Impact of Asset Management on Return on Asset (ROA)

The research data shows that the company's ROA increased from 0.50 in 2023 to 0.72 in 2025. This increase indicates that companies are becoming more effective in utilizing their assets to generate profits.

The findings show that the asset management strategy implemented by PT X has made a indication of coinciding with an increase in the company's profitability. Operational cost efficiency, reduced fuel consumption, and increased asset productivity appear, based on field findings, to accompany the increase in ROA. As this study is qualitative, these relationships are best read as field-based indications rather than statistically established causal effects.

The results of this study support the research of Sarah Monalisa and Ayu Kurnia Sari (2024) who stated that investment and fixed asset management have a positive influence on company profitability. These findings also strengthen the research of Destiani and Hendriyani (2022) who explained that ROA is the main indicator of a company's success in managing its assets effectively.

The Impact of Asset Management on Asset Turnover

In addition to ROA, the study also found an increase in Asset Turnover from 2.12 in 2021 to 3.10 in 2025. This increase shows that the company's assets are increasingly productive in generating revenue.

The findings show that the company's asset management policies have succeeded in increasing the effectiveness of the use of fixed assets. The higher the Asset Turnover value, the greater the company's ability to generate income from every rupiah of asset investment it has (Basuki, 2026; Sukawati & Hernawati, 2021).

This result is in line with the research of Achmad and Hidayat (2013) which states that asset management has a positive influence on company performance (Sari study was able et al., 2025). However, unlike previous studies that only measured relationships in general, this to explain how each phase of an asset's life cycle contributes to an increase in asset productivity.

Why Asset Management Is Not Consistently Reflected in Cash Flow

An interesting finding in this study is that there is no clear or consistent relationship between asset management and company cash flow. Although ROA and Asset Turnover have improved, cash flow patterns show relatively high fluctuations during the study period.

This condition is due to the fact that cash flow is influenced by many other factors besides asset management, such as investment policies, funding, dividend distribution, and the company's operational needs that change every year (Maruta, 2017; Sandra, 2022).

ROA and Asset Turnover are ratio-based indicators computed from the same accounting period's asset base and revenue, so operational improvements such as reduced fuel consumption and higher productivity feed into them relatively directly. Cash flow, in contrast, is a residual of financing and investment decisions made across the whole company, including debt service, capital expenditure timing, and dividend policy, which are set independently of day-to-day asset management. This structural difference, rather than a weakness in the asset life cycle approach, is why the acquire and commission phases showed clearer operational gains while the dispose phase and cash flow remained comparatively unresponsive.

This result is in line with the research of Wardani and Christiyani (2018) which states that asset structure does not have a significant effect on cash flow shocks. Fixed assets are essentially illiquid so changes in asset management do not directly affect the company's cash flow.

Research Contributions and Novelties

This research has a different contribution compared to previous research. Most previous studies have only analyzed the relationship between fixed asset investment, asset turnover, and company profitability (Achmad & Hidayat, 2013; Panjaitan & Sari, 2024; Sari et al., 2025; Sukawati & Hernawati, 2021).

Instead, this study examines asset management more comprehensively through an asset life cycle approach that includes the acquire, commission, operate, and dispose phases. In addition, the object of research in the form of port service companies is still relatively rarely researched compared to the manufacturing sector or other public companies.

Another novelty is the discovery of the role of green asset transformation and tool electrification as an asset management strategy that can increase cost efficiency while supporting the company's sustainability. These findings expand the study of asset management that was previously more focused on financial aspects to include sustainability and ESG dimensions.

Overall, the results of the study prove that fixed asset management based on the theory of asset life cycle is a strategic instrument that can increase operational efficiency, asset productivity, and company profitability. Optimizing each phase of the asset lifecycle, supported by digital transformation and the implementation of modern maintenance systems, will have a greater impact on the company's financial performance and competitiveness in the future.

CONCLUSION

This study aims to analyze the role of fixed asset management based on asset life cycle theory in improving the company's financial performance in PT X as a port service company that has a dominant proportion of fixed assets in its asset structure. Based on the results of the research, it can be concluded that the implementation of integrated asset management at each stage of the asset life cycle has an important role in supporting operational efficiency and improving the company's financial performance. Asset management carried out from the planning, procurement, operation, to termination of use stage can help companies maximize the economic benefits of assets and reduce various costs that arise during their use. The main findings of the study show that the implementation of asset life cycle-based asset management contributes to increased profitability and asset productivity as reflected in the upward trend of Return on Assets (ROA) and Fixed Asset Turnover during the 2023–2025 period. The transformation of assets towards the use of electrical energy and the implementation of the green port concept has been proven to provide significant operational cost efficiencies while supporting the company's sustainability goals. However, the study also found that the influence of asset management on a company's cash flow is not significantly visible because cash flows are influenced by various dynamic operational, investment, and funding policies. The contribution of this research lies in the development of asset management studies through a comprehensive asset life cycle approach

in the port services sector which is still relatively rarely researched. This research not only highlights the relationship between assets and financial performance, but also explains how each phase of an asset's lifecycle contributes to a company's value creation. Rather than simply restating these results, a broader pattern emerges: financial gains from life cycle-based asset management are most visible in ratio-based indicators tied directly to operations, such as ROA and Asset Turnover, whereas gains that depend on company-wide financial policy, such as cash flow, require complementary alignment with investment and funding decisions beyond asset management alone. This research has limitations because it was only conducted on one company with a qualitative approach so that the results cannot be generalized to the entire industry. In addition, the study only uses ROA, Fixed Asset Turnover, and Cash Flow indicators as a measure of financial performance. Therefore, further research is recommended to use a quantitative approach, expand the research object in various industrial sectors, add a longer observation period, and include other variables such as cost efficiency, company value, sustainability performance, and the implementation of digital technology in asset management, for example through a mixed methods design, multi-case study analysis across several port or logistics companies, and a more comprehensive evaluation of digital asset management implementation using ESG indicators (Chen et al., 2026) to obtain more comprehensive results.

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AUTHOR CONTRIBUTION STATEMENT

Author 1: conceptualization, research design, data collection, formal analysis, and writing – original draft. Author 2: methodology, data validation, writing – review and editing, and supervision. Both authors have read and approved the final manuscript.

REFERENCES

- Abdussamad, Z. (2021). *Metodologi Penelitian Kualitatif*. Syakir Media Press.
- Achmad, N., & Hidayat, L. (2013). Pengaruh Manajemen Aset Terhadap Kinerja Keuangan Perusahaan. *Jurnal Ilmiah Manajemen Kesatuan*, 1(1), 23–38. <https://doi.org/10.37641/jimkes.v1i1.252>
- Alaslan, A., Amame, A. P. O., Suharti, B., Laxmi, Rustandi, N., Sutrisno, E., Rustandi, Rahmi, S., Darmadi, & Richway. (2023). *Metode Penelitian Kualitatif*. Perkumpulan Rumah Cemerlang Indonesia (PRCI). https://www.researchgate.net/publication/377113255_Metode_Penelitian_Kualitatif
- Apriliansa, M., Noprizal, N., & Fitmawati, F. (2026). *Implementasi Pernyataan Standar Akuntansi Keuangan (PSAK) 101 Padaakuntabilitas dan Transparansi Keuangan di Lazismu Rejang Lebong*. Institut Agama Islam Negeri Curup.
- Azzone, M., Ghesini, M., Stocco, D., & Viola, L. (2026). Physical climate risk in asset management. *Corporate Social Responsibility and Environmental Management*, 33(1), 1077–1094.
- Barbosa, M. W., & Gomes, A. (2026). The interface between research funding and environmental policies in an emergent economy using neural topic modeling: proposals for a research agenda. *Review of Policy Research*, 43(1), e12630.
- Basuki, A. A. (2026). Pengaruh Perputaran Aktiva Tetap dan Total Asset Turnover Terhadap Profitabilitas pada Perusahaan Tekstil yang Terdaftar di BEI Periode 2020-2024. *Integrative Perspectives of Social and Science Journal*, 3(07 Juli), 778–786.
- Blatter, J., & Haverland, M. (2012). Two or Three Approaches to Explanatory Case Study Research? *APSA 2012 Annual Meeting*. <https://ssrn.com/abstract=2105542>
- Chen, K., Hu, Z., Geng, Y., & Ma, Z. (2026). Does Digital Asset Allocation Improve Corporate ESG Performance? Evidence from China. *Mathematics*, 14(11), 1890. <https://doi.org/10.3390/math14111890>
- Davis, R. (2012). *An Introduction to Asset Management: A Simple but Informative Introduction to the Management of Physical Assets*. EA Technology / The Institute of Asset Management.

- https://theiam.org/media/6934/10695-iam-beginners-guide_low_9.pdf
- Destiani, T., & Hendriyani, R. M. (2022). Analisis Rasio Keuangan untuk Menilai Kinerja Keuangan Perusahaan: Studi Kasus pada PT Unilever Indonesia Tbk Tahun 2016-2020. *Al-Kharaj: Jurnal Ekonomi, Keuangan & Bisnis Syariah*, 4(1), 136–154. <https://doi.org/10.47467/alkharaj.v4i1.488>
- Fahy, D., & Newman, T. P. (2026). *Essential Concepts of Science Communication: An AZ Guide*. Taylor & Francis.
- Hastings, N. A. J. (2010). *Physical Asset Management* (1st ed.). Springer London. <https://doi.org/10.1007/978-1-84882-751-6>
- Hutabarat, F. (2020). *Analisis Kinerja Keuangan Perusahaan*. Desanta Muliavisitama. <https://scholar.google.com/scholar?q=%22Analisis+Kinerja+Keuangan+Perusahaan%22+Hutabarat+2020>
- Indonesia, I. A. (2015). Pernyataan standar akuntansi keuangan. *Jakarta: Ikatan Akuntan Indonesia*, 96.
- Jung, H., & Kim, B. (2021). Identifying Research Topics and Trends in Asset Management for Sustainable Use: A Topic Modeling Approach. *Sustainability*, 13(9), 4792. <https://doi.org/10.3390/su13094792>
- Le Gat, Y., Curt, C., Wery, C., Caillaud, K., Rulleau, B., & Taillandier, F. (2025). Water infrastructure asset management: state of the art and emerging research themes. *Structure and Infrastructure Engineering*, 21(4), 539–562.
- Lei, T. van der, Herder, P., & Wijnia, Y. (2012). *Asset Management: The State of the Art in Europe from a Life Cycle Perspective* (1st ed.). Springer Dordrecht. <https://doi.org/10.1007/978-94-007-2724-3>
- Manik, R. L., & Firdaus, R. (2024). Akuntansi Aktiva Tetap Berwujud. *Jurnal Intelek Dan Cendekiawan Nusantara*, 1(5), 9003–9013. <https://jicnusantara.com/index.php/jicn/issue/view/16>
- Maruta, H. (2017). Pengertian, Kegunaan, Tujuan dan Langkah-Langkah Penyusunan Laporan Arus Kas. *JAS (Jurnal Akuntansi Syariah)*, 1(2), 239–257. <https://www.ejournal.isnjbengkalis.ac.id/index.php/jas/article/view/115>
- Morin, J. F., Olsson, C., & Atikcan, E. Ö. (2021). *Research Methods in the Social Sciences: An A-Z of Key Concepts*. Oxford University Press. <https://doi.org/10.1093/hepl/9780198850298.001.0001>
- Muliansyah, E., & Irwansyah, M. G. (2026). Metode Penelitian Mixed Methods: Strategi Integrasi Riset Manajemen Dan Sosial. *AMU Press*, 1–615.
- Mulyadi. (2001). *Sistem Akuntansi*. Salemba Empat. <https://scholar.google.com/scholar?q=%22Sistem+Akuntansi%22+Mulyadi+2001>
- Niam, M. F., Rumahlewang, E., Umiyati, H., Dewi, N. P. S., Atiningsih, S., Haryati, T., Magfiroh, I. S., Anggraini, R. I., Mamengko, R. P., Fathin, S., Mola, M. S. R., Syaifudin, A. A., & Wajdi, F. (2024). *Metode Penelitian Kualitatif*. Widina Media Utama. <https://repository.penerbitwidina.com/id/publications/567869/metode-penelitian-kualitatif>
- Panjaitan, S. M., & Sari, A. K. (2024). Analisis Investasi Aktiva Tetap dan Modal Kerja terhadap Profitabilitas pada Perusahaan Manufaktur yang Terdapat di Bursa Efek Indonesia. *Jurnal Ilmiah Ekonomi Dan Manajemen*, 2(8), 897–908. <https://doi.org/10.61722/jiem.v2i8.2146>
- Pratiwi, S. A., & Armaniah, H. (2026). Analisis Kinerja Keuangan Dengan Metode Rasio Profitabilitas (ROA dan ROE) Pada Perusahaan Sektor Manufaktur di BEI Periode 2021-2024: Analysis of Financial Performance Using the Profitability Ratio (ROA and ROE) Method in Manufacturing Sector Companies on the IDX for the 2021-2024 Period. *Jurnal Manajemen Ekonomi Dan Akuntansi*, 2(3), 752–762.
- Sandra, D. A. (2022). Analisis Laporan Arus Kas Sebagai Alat Ukur Untuk Menilai Kinerja Keuangan. *Skripsi, Universitas Islam Negeri Sultan Syarif Kasim Riau*.
- Saragih, S. R., Putry, N. A. C., Kinasih, I., & Widariyanti, R. D. (2026). Sistem Akuntansi untuk Struktur Pusat, Agen, dan Cabang: Tinjauan Literatur Sistematis. *Jurnal Mahasiswa Manajemen Dan Akuntansi*, 5(1), 470–480.
- Sari, R. N. I., Kalbuana, N., & Subagja, D. (2025). Pengaruh Manajemen Aset, Likuiditas, dan Struktur Modal Terhadap Kinerja Keuangan. *Profit: Jurnal Manajemen, Bisnis Dan Akuntansi*,

- 4(2), 164–176.
- Setiyani, A., Judijanto, L., Nurmalita, N., Irianto, I., Aryani, L., Fatubun, R. R., Afriyanto, D. F., Sondari, M. C., Cipta, E. S., & Merung, A. Y. (2026). *Metodologi penelitian kualitatif*. PT. Sonpedia Publishing Indonesia.
- Shwed, A., Thorogood, N., Wuerstl, K., Copeland, S., Tang, K., Holliday, P., Hoekstra, F., McPhail, L., West, C., & Plamondon, K. (n.d.). Supporting the Adoption of Research Partnerships in Spinal Cord Injury Research: An exploratory case study of a research centre. *IKT Guiding Principles and Gainforth, Heather, Supporting the Adoption of Research Partnerships in Spinal Cord Injury Research: An Exploratory Case Study of a Research Centre*.
- Stazić, L., Račić, N., Stanivuk, T., & Dobrota, Đ. (2023). Determination of Benefits of the Application of CMMS Database Improvement Proposals. *Applied Sciences*, 13(4), 2731. <https://doi.org/10.3390/app13042731>
- Storey, H., & Verhappen, I. (2026). Asset Management. *A Guide to the Automation Body of Knowledge*, 481–489.
- Sugiyono. (2012). *Metode Penelitian Kombinasi (Mixed Methods)*. Alfabeta. <https://scholar.google.com/scholar?q=%22Metode+Penelitian+Kombinasi%22+Sugiyono+2012>
- Sukawati, R., & Hernawati, E. (2021). Pengaruh Perputaran Aset Tetap terhadap Profitabilitas Perusahaan. *Jurnal Ilmu Keuangan Dan Perbankan (JIKA)*, 11(1), 95–105. <https://doi.org/10.34010/jika.v11i1.4886>
- Vieira, J., Almeida, N. M. de, Martins, J. P., Patrício, H., & Morgado, J. G. (2024). Analysing the Value of Digital Twinning Opportunities in Infrastructure Asset Management. *Infrastructures*, 9(9), 158. <https://doi.org/10.3390/infrastructures9090158>