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Financial Data Warehousing at Village Credit Institution xyz Using a Star Schema

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ABSTRACT

The role of information technology is the main focus in financial management, especially in supporting the data analysis process for effective decision making. Village Credit Institution xyz, as a financial institution owned by Pekraman Villages in Bali, faces obstacles in presenting financial data that is still in the form of tables. The presentation is not effective in providing a clear and adequate picture to support management decision-making. Makes it difficult to identify customers with bad or current credit. This research aims to build a financial data visualization system at Village Credit Institution xyz using Looker Studio, with a data warehouse design implemented using Kimball's Nine Steps method. The ETL process is carried out using Pentaho Data Integration (PDI) to compile data from various sources. The final result of this research is data visualization in the form of 9 main menus. This system allows the presentation of data in the form of interactive graphs, thus facilitating data analysis, accelerating the decision-making process, and increasing the efficiency of financial data management in Village Credit Institution. System testing was conducted using the User Acceptance Testing (UAT) method with a result of 92.48% or strongly agree, indicating that the developed system has met the needs of users.

1. Introduction

The role of information technology is increasingly becoming the main focus in various aspects of life, including in financial management. With the advancement of information technology, it can assist companies in conducting more effective data analysis in making management decisions. One effective solution is the use of dashboards that provide a visual interface that combines and presents important information to achieve certain goals at a glance (Wahyudi & Syazili, 2021). financial institutions owned by Pekraman Villages in traditional areas of Bali. One effective solution is the use of dashboards that provide a visual interface that combines and presents important information to achieve certain goals at a glance (Wahyudi & Syazili, 2021).Lembaga Perkreditan Desa (Village Credit Institution) is a financial institution owned by the Pekraman Village in the traditional area of Bali. Decision-making needs to be done by the Village Credit Institution to support the sustainability of this financial institution. it was found that there were significant obstacles in presenting financial data to the Village Credit Institution, especially leaders who are responsible for managing and controlling operations. Currently, Village Credit Institution xyz uses several information systems to manage financial data, such as Core Banking System (CBS) for savings and loan business activities (savings, deposits, loans) and FastPay information system to serve bill payments (PLN, PDAM, landline, data packages, etc.). However, the presentation of data is still in the form of tables or lists of numbers that are difficult to understand. This form of presentation is not effective to support proper

decision-making and requires considerable time for reprocessing. This difficulty impacts the efficiency of decision-making, as analysis of the raw data must be done manually, which is time- and labor-consuming. In addition, identifying customers with bad and current loans was a challenge as the data was only available in tabular form, making the identification process difficult. Another significant problem with the current information system is that it only provides data input and output functions without a data visualization dashboard. This deficiency makes it difficult for users to understand and analyze financial data quickly and accurately, which in turn impacts accurate and timely reporting to interested parties. This is a crucial aspect of financial risk management. Therefore, the implementation of data visualization in Village Credit Institution xyz will present more interesting and interactive data, speed up the analysis process, support better decision making, and overcome existing problems in financial data management. According to (Alfeno et al., 2020) a good dashboard will be able to help in identifying trends, patterns and anomalies in the data so that in the end it can help in making effective decisions. Likewise, the importance of making financial reports in a visual form, of course this will greatly assist management in making decisions for the company (Aristi Saputri et al., 2021). The advantage of visualizing existing data with a variety of data visualization tools will make it easier for us to analyze and visualize the desired data (Husna & Prasetyo Utomo, 2023) and using the Nine Step Methodology data warehouse results in a better data warehouse design using star schema modeling and using star schema will speed up queries for information deliver (Akbar & Rahmanto, 2020).

This study contributes to the development of a comprehensive data warehouse system for Village Credit Institution XYZ, addressing key operational challenges related to fragmented and underutilized financial data, including savings, deposits, loans, income, and expenditure. By employing Kimball's Nine-Step methodology for data warehouse design, the research provides a structured framework tailored to the institution's needs. Furthermore, the integration of the Pentaho Data Integration (PDI) platform in the ETL process enhances the reliability and consistency of data transformation, enabling the consolidation of financial records into a unified, analyzable format. Data Warehouse development in the study was carried out by means of Kimball's Nine Steps method, then for the Extract, Transform, and Load (ETL) process using the Pentaho Data Integration (PDI) or Kettle application, so that data information owned by Village Credit Institution is easier to understand and manage a business becomes easier. Data visualization that will be made at Village Credit Institution xyz using Looker Studio. Looker Studio relies on a combination of charts and types of graphs commonly found in tools, there are additions such as providing features, including the ability to integrate multiple sources into one report and allow dynamic report updates, so you don't have to modify the original data (Perdana et al., 2024). Therefore, a data warehouse is needed that can store and present data more easily (Monalisa H et al., 2023). n addition, testing will also involve User Acceptance Testing (UAT). Testing is carried out by end users to ensure that the system meets their needs and expectations (Suprapto, 2021). By conducting this test, researchers can ensure that the data warehouse and visualization system built not only provides better data and is easy to understand, but also reliable, secure, and effective in supporting the needs of analysis and decision making at Village Credit Institution xyz.

2. Literatur Review

Various studies have been conducted to develop data visualization to improve the efficiency of analysis and decision making in various sectors. (Mulyani & Kartini, 2023) designed a ticketing dashboard at PT Brantas Abipraya to facilitate monitoring of IT services, overcome repeated incident reports, and improve documentation and evaluation of technical problems so that management can take preventive action.With this dashboard, all incoming complaints and IT service requests can be organized more systematically, allowing the IT team to respond to problems more quickly and effectively. (Anugerah, 2024) developed a Tableau dashboard that presents commodity price data from five markets in Balikpapan, enabling the public, traders, and stakeholders to access food price information more quickly and easily, and supporting regional inflation control policies.With this visualization, food price fluctuations can be monitored in real-time, helping in decision-making

related to the distribution of goods and market intervention to maintain price stability. (Bina, 2024) used Google Data Studio to visualize credit data at Jejamo Jaya Abadi Cooperative, helping financial analysis, increasing selectivity in determining credit customers, and making it easier to monitor smooth payments. With this dashboard, cooperatives can more easily identify payment trends, detect potential non-performing loans, and take strategic steps to reduce the risk of bad debts. (Anderson, 2023) designed a Google Analytics integration with an automated dashboard for PT Kawan Lama Sejahtera, accelerating the process of analyzing website traffic that was previously done manually, so that companies can more efficiently evaluate their digital performance. With more interactive and dynamic visualizations, companies can easily track visit trends, identify user behavior patterns, and develop more effective digital marketing strategies. Meanwhile, (Sabrina, 2024) utilized Power BI to present data on the causes of death in Indonesia over the period 2000-2022, providing a clearer picture of population health trends and factors contributing to mortality rates. By processing data from various sources, this research produces visualizations that can be used by the government and health institutions in designing more targeted policies to reduce mortality and improve public welfare.

3. Research Method

The financial data visualization system developed in this research uses Kimball's Nine Steps as the main method in building a data warehouse.This method was chosen because it provides a systematic structure in data management and ensures more accurate and efficient information to analyze.Another advantage of the Kimball method is that it can be developed at a low cost in the development process.This is the main consideration for companies in building data warehouses and business intelligence (Anshari & Retno, 2023). The stages carried out in the system design and development process include:

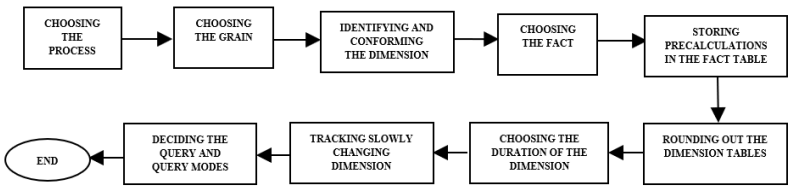

Fig.1. Data Warehouse Processes

1. Choosing the Process - Identify the main business processes in Village Credit Institution financial management that will be developed in the visualization system.
2. Choosing the Grain - Determine the level of detail of the data to be presented, such as per transaction, per customer, or per specific period.
3. Identifying and Conforming the Dimensions - Grouping related data elements to ensure cohesiveness and accuracy in presentation.
4. Choosing the Fact - Determining the key metrics that are indicators in the financial analysis, such as the amount of savings, loans, or operating expenses.
5. Storing Pre-Calculations in Fact Table- Perform data optimization to speed up the analysis process, such as processing total savings and loan trends.
6. Rounding-out the Dimension Tables - Enhance the information in the dimension tables to cover all aspects required in the analysis.
7. Choosing the Duration of the Dimension - Determining the time span for data tracking to get a more accurate long-term analysis.
8. Tracking Slowly Changing Dimension - Manage data changes that are not instantaneous, such as changes in customer information or financial policies.

9. Deciding the Query Priorities and Modes - Optimizing search and retrieval strategies so that the system can present information quickly and efficiently.

Data Processing Method

The data processing process in the financial Data Warehouse at Village Credit Institution XYZ applies the Extract, Transform, Load (ETL) method using Pentaho Data Integration (PDI) as the main tool. According to (Steven et al., 2021). ETL is a collection of processes to prepare data from operational sources for data data. This process consists of Extraction, Transformation, Loading, and several processes that are carried out before being published into the data warehouse. The following are the main stages in the ETL process based on the image shown:

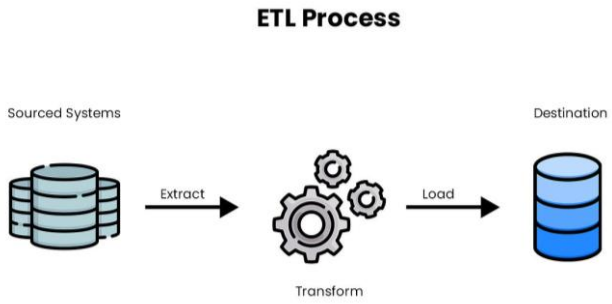

Fig.2. ETL Process

1. **Extract (Data Extraction)**: At this step, financial data is extracted from various source systems, including the Core Banking System, historical financial statements, and other data sources used by Village Credit Institution XYZ. The extracted data includes a variety of different formats and structures, such as customer savings, loan and deposit transaction data from 2019 to 2024. In order for the data to be integrated in the Data Warehouse system, a conversion process is carried out to equalize the data format so that it can be processed further.

2. **Transform (Data Transformation)**: After the data has been successfully extracted, the next stage is transformation, which aims to improve the quality of the data before it is incorporated into the Data Warehouse. This transformation process includes several important steps:

    - Data Cleaning: Removing invalid data, eliminating duplicates, as well as ensuring that all data conforms to predefined standards.
    - Normalization and Grouping: Data is grouped based on Star Schema, where fact tables such as fact_savings, fact_loans, and fact_deposits are linked to dimension tables such as dim_nasabah and dim_time.
    - Aggregate Value Calculation: Perform calculations such as total savings, total loans, and total operating costs that will be used in business analysis.
    - Mapping Data to Data Warehouse Schema: Data that has been cleaned and grouped is then organized to fit the Star Schema model, ensuring that each transaction can be associated with its corresponding dimension for further analysis.

3. **Load (Loading Data to the System)**: Data that has undergone transformation is then loaded into the data warehouse system database. This process is done on a scheduled basis so that the data is always updated and ready to be visualized in Looker Studio. Utilizing a data warehouse with a star schema approach allows for faster and more efficient data retrieval.

Star Schema

Fig.3. *Star Schema*

Star schema is a dimensional model that is easy to understand and simple in structural design. (Andreas Alessandro F.P , Deo Anggora, 2023). The most common modeling paradigm is the star schema, where the data warehouse contains: a central table (fact table) that contains most of the data without redundancy, and dimension tables, one for each dimension. The schema graph resembles a starburst, with dimension tables displayed in a radial pattern around the central fact table. There are two dimension tables, namely dim_customer, which stores customer information such as ID, data version, and login and logout status, and dim_time, which records time information such as month and year. Meanwhile, the fact tables consist of fact_savings, fact_loans, and fact_deposits, which store the total savings, loans, and deposits of customers in a certain period, respectively, as well as fact_operational_cost_revenue, which records operational costs and related revenues. Each fact table has a surrogate key that links it to the dimension table, allowing for faster and more efficient data analysis..

ETL Process

In this study there are several ETL processes, namely ETL of savings facts, ETL of loan facts, ETL of deposit facts, ETL of operating costs facts to income. In this ETL process using Village Credit Institution Desa Adat beng operational data that has been stored in Microsoft Excel. The tools used to carry out this ETL process are using the Pentaho Data Integration Kettle application, then it will be stored in the data warehouse using SQL Workbench.

Fact_Loan

This ETL process starts by retrieving loan data from INPUT_FILE_LOAN, with the system ensuring there is no duplication or conflict through wait_clear_loan and Clear Loan. The retrieved data is filtered to remove empty values (select_account, filter_null), then processed by time (slice_time, Sort Time) before being verified with the time reference in the database (Lookup Time, Filter Null Time, Insert Time). Next, customer data is processed in a similar way: selected, sorted, validated against the customer database, and inserted into the system (Select Customer, Sort Customer, Lookup Customer, Insert Customer). Once the customer and time data is validated, the clean loan data is inserted into the main database via Insert Loan. This process ensures that the data loaded is accurate, duplication-free, and ready to be used for analysis and reporting.

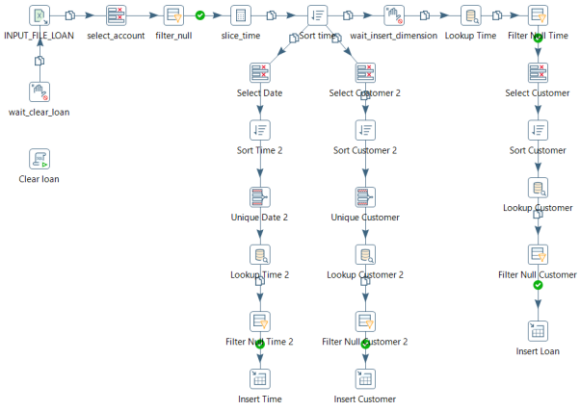

Fig.4. ETL Loan Facts

Savings Facts

This ETL process starts by retrieving savings data from INPUT_FILE_SAVINGS, ensuring there is no duplication through wait_clear_savings and Clear Savings. The retrieved data is filtered so that only valid data is processed (select_account, filter_null), then separated by time (slice_time, Sort Time) and verified with the time reference in the database (Lookup Time, Filter Null Time, Insert Time). Next, customer data is processed in a similar way: selected, sorted, validated, and inserted into the system (Select Customer, Sort Customer, Lookup Customer, Insert Customer). After checking for duplicates (Lookup Duplicate, Filter Duplicate), the clean and validated savings data is loaded into the main database via Insert Savings. This process ensures that the data entered is accurate, duplication-free, and ready for further analysis and reporting.

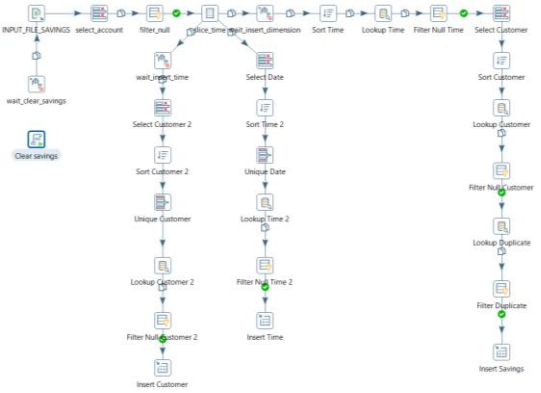

Fig.5. ETL Savings Facts

Deposits Facts

This ETL process starts by retrieving data from INPUT_FILE_DEPOSIT, ensuring there is no old data interfering through wait_clear_deposit and Clear Deposit. The data is then filtered so that only valid data is processed (select_account, filter_null), then separated by time (slice_time, Sort Time) and verified against the time reference in the database (Lookup Time, Filter Null Time, Insert Time). Customer data is processed similarly: selected, sorted, validated, and inserted into the system (Select Customer, Sort Customer, Lookup Customer, Insert Customer). After duplicate detection and filtering (Lookup Duplicate, Filter Duplicate), clean and validated deposit data is loaded into the database via Insert Deposit. This process ensures only valid and unique data is used, supporting more accurate analysis and reporting.

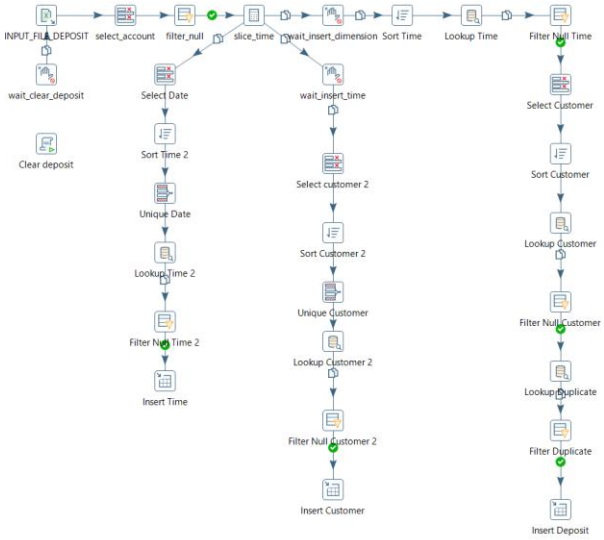

Fig.5. ETL Deposits Facts

Fact Operating Expenses to Operating Income

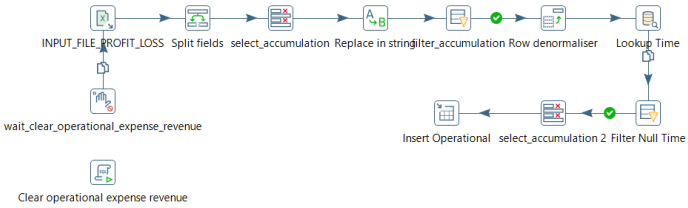

Fig.6. ETL Facts Operating Expenses to Operating Income

This ETL process in Pentaho starts with INPUT_FILE_PROFIT_LOSS, which reads a source file containing profit and loss data. The data is then processed through Split fields to separate the required columns, followed by select_accumulation to select the relevant accumulation data. Next, Replace in string is used to replace certain values in the string, followed by filter_accumulation which filters the accumulation data so that only valid data is passed on. After that, Row denormaliser is used to normalize the data from pivot format to individual rows. The data is then matched with the time dimension using Lookup Time, and the results are checked through the Null Time Filter so that only data with valid time values are processed further. The filtered data then goes through select_accumulation 2 before being inserted into the database using Insert Operational. On the other hand, there is a cleanup process performed before the main execution through wait_clear_operational_expense_revenue, which waits for the previous process to finish, as well as Clear operational expense revenue which ensures that the old data has been cleared before the new data is inserted.

4. Result and Discussions

Data Visualization

This research produces a financial data visualization system at VILLAGE CREDIT INSTITUTION xyz using Looker Studio. The system successfully transforms financial data that was previously only available in tabular format into interactive visualizations that are easier for management to understand. The system consists of 9 main pages that display information about savings, deposits, loans, operating costs, and income in a structured manner.

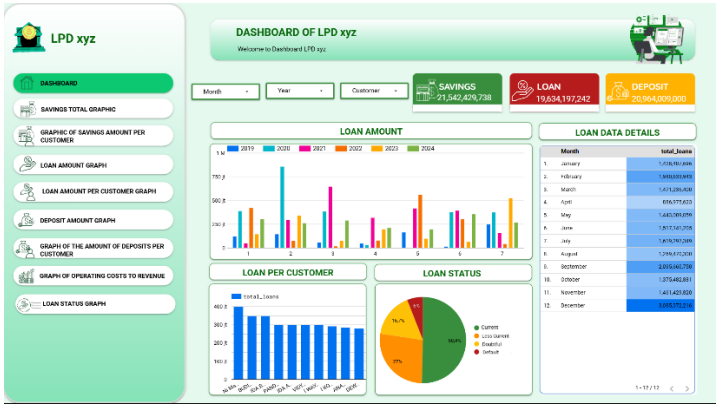

Fig.7. Village Credit Institution xyz Dashboard Page

The Total Savings page displays customer savings data in line graphs, pie charts, and tables that can be filtered by month or year. Line graphs show savings trends by month, pie charts illustrate each month's contribution to the annual total, and tables support detailed analysis. Total savings, loans, and deposits information is also presented as a financial summary, assisting Village Credit Institutions in monitoring performance and making strategic decisions.

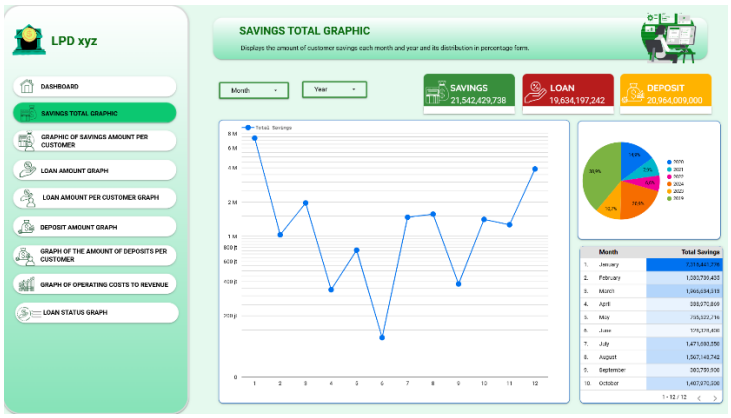

Fig.8. Savings Amount Page

This page visualizes the financial data of Village Credit Institution Desa Adat Beng through graphs and tables. The bar graph shows the number of customer loans per month and year, as well as the loan amount per month. The pie chart displays the percentage of loans based on their status (current, substandard, doubtful, bad). Data table presents loan details

Fig.9. Loan Amount Page

This page presents loan amounts in bar graphs, pie charts, and data tables with month and year filters. The bar graph shows the pattern of loans each year, helping to identify trends of increasing or decreasing loans. The pie chart illustrates the contribution of monthly loans to the annual total. The data table provides a detailed quantitative analysis of loans per customer.

Fig.10. Page Total Comparison of Operating Expenses to Revenue

This page displays operating expenses and revenue data in bar charts and tables that can be filtered by month and year. The bar graph shows a comparison between annual operating expenses and revenue, making it easy to monitor financial balance. The data table provides a breakdown of costs and revenue by year to support strategic decision-making, such as cost optimization or revenue enhancement.

5. Conclusion

This research has successfully created a financial data visualization system for Village Credit Institution xyz using Looker Studio. With this system, financial data that was previously only available in tabular form can be displayed more interestingly and easily understood in the form of interactive graphics. This makes it easier for management to analyze financial information and make faster and more informed decisions. Data processing using the Extract, Transform, Load (ETL) method with Pentaho Data Integration (PDI) ensures that data taken from various sources is processed accurately and efficiently. User Acceptance Testing (UAT) results show a user satisfaction level of 92.48%, which indicates that this system is easy to use, functions well, is efficient, and reliable. In addition, the system has also successfully accelerated the financial analysis process from several days to just minutes, providing great benefits to Village Credit Institutions in financial planning.

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References

Akbar, M., & Rahmanto, Y. (2020). Desain Data Warehouse Penjualan Menggunakan Nine Step Methodology Untuk Business Intelegency Pada Pt Bangun Mitra Makmur. *Jurnal Informatika Dan Rekayasa Perangkat Lunak*, *1*(2), 137–146. https://doi.org/10.33365/jatika.v1i2.331

Alfeno, S., Sutrisno, S., & Soleman, M. D. (2020). Implementasi Dashboard Informasi Sistem Sebagai Model Alat Ukur Tingkat Penjualan PT. Sumber Sekar Sejahtera. *Jurnal Sisfotek Global*, *10*(1), 8. https://doi.org/10.38101/sisfotek.v10i1.273

Anderson, K. (2023). Perancangan Website Dashboard Visualisasi Data Terintegrasi Google Analytics Untuk Pt. Kawan Lama Sejahtera. *Jurnal Informasi Dan Komputer*, *11*(1), 2023.

Andreas Alessandro F.P , Deo Anggora, A. W. (2023). *Jurnal Tefsin*. *1*(1), 13–18.

Anshari, S. F., & Retno, S. (2023). Penerapan Metode Nine-Step Kimball Dalam Pengolahan Data History Menggunakan Data Warehouse dan Business Intelligence. *Jurnal Ilmu Komputer*, *16*(1), 69. https://doi.org/10.24843/jik.2023.v16.i01.p07

Anugerah, S. (2024). *Perancangan Dashboard Visualisasi Data Komoditas Pasar Balikpapan*

dengan Tableau. *12*(1).

Aristi Saputri, T., Muharni, S., & Perdana, A. (2021). Pemanfaatan Google Data Studio Untuk Visualisasi Data Bagi Kepala Gudang UD Salim Abadi. *Ilmu Komputer Untuk Masyarakat*, *2*(2), 67–72.

Bina, D. (2024). *Visualisasi Data Pemetaan Nasabah Kredit Pada Koperasi Simpan Pinjam Jejamo Jaya Abadi Tulang Bawang Barat*. *4*(1), 76–84.

Husna, L., & Prasetyo Utomo, P. E. (2023). Analisis Dan Visualisasi Data Body Performance Menggunakan Tiga Tools Visualisasi. *Jurnal Ilmiah Intech : Information Technology Journal of UMUS*, *5*(1), 32–40. https://doi.org/10.46772/intech.v5i1.1167

Monalisa H, Runtulalo, S. D. E. P., Alwin M, & Sambul. (2023). Interface Design Of The Monitoring System For The Achievement Of Major Performance Indicators In Collage. *Jurnal Teknik Informatika*, *18*(02), 59–66. https://ejournal.unsrat.ac.id/index.php/informatika

Mulyani, A., & Kartini, K. (2023). Visualisasi Data Ticketing Servicedesk Dengan Dashboard Pada Pt Brantas Abipraya Ticketing Servicedesk Data Visualization With Dashboard At Pt Brantas Abipraya (Persero). *Journal of Information System, Applied, Management, Accounting and Research.*, *7*(2), 289–300. https://doi.org/10.52362/jisamar.v7i2.1074

Perdana, C., Usep Abdul Rosid, & Bian Austin Okto. (2024). Visualisasi Data Aset Tidak Bergerak Menggunakan Looker Studio Pada PT XYZ. *Jurnal Informatika*, *3*(1), 37–44. https://doi.org/10.57094/ji.v3i1.1607

Sabrina, S. S. (2024). Visualisasi Data Penyebab Kematian Di Indonesia Rentang Tahun 2000-2022 Dengan Power Bi. *Jurnal Informatika Dan Teknik Elektro Terapan*, *12*(2). https://doi.org/10.23960/jitet.v12i2.4071

Steven, K., Hariyanto, S., Arijanto, R., & Wijaya, A. H. (2021). Penerapan Business Intelligence Untuk Menganalisis Data Pada Pt. Suryaplas Intitama Menggunakan Microsoft Power Bi. *Algor*, *2*(2), 41–50. https://doi.org/10.31253/algor.v2i2.550

Wahyudi, I., & Syazili, A. (2021). Dashboard Monitoring Website Dosen Studi Kasus Universitas Bina Darma. *Jurnal Pengembangan Sistem Informasi Dan Informatika*, *2*(3), 188–197. https://doi.org/10.47747/jpsii.v2i3.555