

A GALAXY SCHEMA APPROACH FOR INTEGRATING HETEROGENEOUS MACROECONOMIC DATA INTO AN ANALYTICAL DASHBOARD

Aurora Grace Valensia Pohan Simanjuntak ¹, Benny Pinontoan ², Christian A. J. Soewoeh ³

^{1,2,3}Study Program of Information Systems, Department of Mathematics,

Faculty of Mathematics and Natural Sciences

Sam Ratulangi University

Email: auroragracevalencia@gmail.com

Abstract

Local economic data in Jayawijaya Regency, such as Gross Regional Domestic Product (GRDP), poverty rates, Human Development Index (HDI), and unemployment statistics, is often scattered across different spreadsheets and standard documents. This scattering considerably hinders deep, multi-aspect assessment for regional leaders. This study aims to build and deploy a dynamic analytical dashboard that aggregates economic figures for the period 2020-2024. The design of this system employs a Data Warehouse with a multidimensional Galaxy Schema to merge indicators with distinct measurement types into a single central place. The Extract, Transform, Load (ETL) process was automated using Pentaho Data Integration, achieving 100% data matching accuracy with no data loss. Using Tableau Public as the visual display section, the dashboard functions through three subject-based views: Executive Summary, Economic Growth, and Social Welfare.

Keywords: Analytical Dashboard, Data Warehouse, Galaxy Schema, Macroeconomic, Visualization

INTRODUCTION

The rapid move toward including data in government calls for careful planning to guide regional development [6]. The Central Bureau of Statistics provides vital economic data for Jayawijaya Regency, including Gross Regional Domestic Product, poverty levels, the Human Development Index, and the unemployment rate. These indicators are crucial tools for local leaders to gauge community well-being and pinpoint where economic programs are needed [3].

However, utilizing these indicators effectively remains difficult due to highly fragmented data management. Historical macroeconomic data are stored in disparate formats—such as Excel spreadsheets, CSV files, and static PDFs—without a centralized repository. This fragmentation complicates cross-sectoral collaboration,

induces time inefficiencies [20], and limits the authorities' capacity to monitor regional progress [4] proactively. To overcome this separation, Data Warehouse (DW) and Business Intelligence (BI) tools provide a key approach for consolidating disparate inputs into a single, organized location [5]. This strategy has also been effectively applied to manage complex national meteorological records [2].

Within this BI framework, implementing automated data connection tools effectively speeds up the Extract, Transform, Load (ETL) process, ensuring data accuracy [8]. Furthermore, intuitive visualization systems dynamically enhance transparency and evidence-based governance in the public sector [12], [17], [19], demonstrating immense value in tracking critical public issues such as health

pandemics [1]. While these BI applications are widely researched and have even been adapted to map national internet infrastructures [16], previous studies have predominantly relied on traditional dimensional models, such as the Star Schema, which are structurally inadequate for managing complex, heterogeneous macroeconomic datasets that possess entirely different measurement scales and units [18].

Using simple models tends to limit the ability to correlate data across sectors and can often lead to redundant information or failed integration attempts. To tackle this design issue, this paper presents a Data Warehouse that employs a multidimensional Galaxy Schema alongside an interactive analytical dashboard. The Galaxy Schema handles complex financial and social data by linking multiple independent fact tables via shared, standardized dimensions, helping maintain consistency across diverse measurements.

This study examines the shortcomings of traditional models. It seeks to address them by bringing together various macroeconomic indicators within a single analytical framework based on the Galaxy Schema. What is interesting here is how this work contributes to the Business Intelligence field by demonstrating that multidimensional modeling can enhance data integration and support evidence-based decision-making, especially in the public sector. More precisely, it proposes a multidimensional Galaxy Schema model and demonstrates how it can be implemented through a regional decision-support dashboard.

Research Question

How to establish and configure a central data warehouse utilizing the multidimensional galaxy schema to integrate various macroeconomic indicators, and how to design an interactive dashboard that transforms this aggregated data into a valuable resource for local policymakers to make well-informed choices?

Research Objectives

This research focuses on the development and establishment of a primary data warehouse framework. It uses the Galaxy Schema method to combine multiple economic indicators into a single database efficiently. This study also seeks to create an interactive review dashboard using this combined dataset. Its goal is to convert complex statistical data into a straightforward, trustworthy visual tool that helps local authorities in Jayawijaya Regency make better-informed decisions.

Research Significance

The general benefit of this research is to develop an integrated Data Warehouse architecture and an interactive analytical dashboard to improve the efficiency of macroeconomic data monitoring in Jayawijaya Regency. The specific benefits are divided into two main areas:

1. Theoretical Significance

This study adds to the fields of Business Intelligence and Data Warehousing by demonstrating Galaxy Schema's ability to merge diverse macroeconomic data. It acts as an important resource for upcoming research on intricate multidimensional data modeling and visualization within the public sector.

2. Practical Significance

This study offers local authorities a single data source that does away with the necessity of mixing data manually. It shows how social and economic well-being indicators are linked, which helps people make smart choices for the ongoing development and growth of Jayawijaya Regency.

Previous Studies

Earlier research has effectively used data visualisation tools and Business Intelligence to show government statistics. Recent worldwide studies highlight the need for conceptual data integration for thorough analysis [18] as well as the use of advanced data warehouse designs to handle complicated, different data types [11]. Furthermore, the incorporation of data-driven business analytics has shown to be absolutely essential for precise forecasting and strategic decision-making [9], [14].

However, a careful review of earlier research on public sector data shows a major knowledge vacuum. Previous research has mostly depended on conventional Star Schema architecture. Although several software techniques have automated data merging [7], [10], traditional models have significant limitations in combining datasets with greatly different measurement scales and units [5], [13]. They need sophisticated multidimensional modeling to bring together different macroeconomic indicators at once without repeating data, but they don't have it. Due to these constraints, this study suggests a centralized Data Warehouse design employing a multidimensional Galaxy Schema to combine four different macroeconomic indicators that have common spatial and

temporal dimensions, therefore enhancing regional monitoring in Jayawijaya Regency.

LITERATURE REVIEW

Macroeconomic Indicators

Indicators such as Gross Regional Domestic Product (GRDP), poverty rates, and the Human Development Index (HDI) are essential for evaluating regional development. Because the basic measurement units for these markers differ, a properly structured data combination approach is vital for analyzing their relationships across diverse industries [15], [17].

Data Warehouse and ETL Process

Analyzing historical data requires a centralized store called a Data Warehouse. Using programs like Pentaho Data Integration, the Extract, Transform, and Load (ETL) process automatically retrieves and cleans data from several sources to preserve the structure and guarantee data quality [8], [10]. Establishing a strong foundation for Business Intelligence requires all of this approach [5].

Galaxy Schema

Standard dimensional designs, such as the Star Schema, are highly optimized and efficient for single-subject analysis due to their simple, denormalized structure [18]. However, a major disadvantage of the Star Schema is its inability to natively support complex environments that involve multiple fact tables sharing conformed dimensions. This limitation often leads to data duplication and integration failures when merging diverse datasets.

The Galaxy Schema, also known as the Fact Constellation Schema, solves this problem by allowing multiple independent

fact tables to share the same consistent dimensions. The primary advantage of this architecture is its structural flexibility and scalability; it effectively prevents data duplication when integrating separate metrics into a single cohesive model [20].

Previous research has mostly used star schema-based data warehouses for business intelligence applications. Although they are useful for single-subject analysis, these models have restrictions when dealing with varied macroeconomic indicators with various measurement units. This constraint emphasizes the necessity of a more adaptable multidimensional approach, like the Galaxy Schema, to offer regional legislators a thorough and trustworthy decision-support instrument.

Analytical Dashboards

Business Intelligence platforms take data gathered and turn it into easy-to-understand visual stories. Analytical dashboards help public-sector policymakers make better decisions by presenting key performance data and highlighting emerging trends [6], [12].

Data Visualization

Data visualization helps folks observe and understand trends in large datasets. By using applications such as Tableau Public, complex figures can be rendered into readily comprehensible visual charts. Thoughtfully designed visuals enable involved parties to follow links between financial expansion and public well-being metrics without specialized technical skills [17], [19].

RESEARCH METHODOLOGY

Data Collection

The main resource for this study involves existing numerical facts gathered

from formal documents issued by the BPS-Statistics of Jayawijaya Regency [3]. This collection contains four particular economic and societal well-being measures:

1. Gross Regional Domestic Product (GRDP): Quantified using currency amounts (Rupiah) to represent total economic creation.
2. Poverty Rate: Presented as both percentage values and total human counts.
3. The Human Development Index (HDI) is a composite metric that indicates a country's success across health, education, and living standards.
4. Open Unemployment Rate: Displayed using percentages.

The information spans the years 2020 through 2024 and was obtained in different layouts, mostly Excel documents and CSV files. This raw material needed a structured combination method to address differences and prepare it for complex structural analysis.

System Development Methods

Design and execution of the analytical dashboard using the Research and Development (R&D) method forms the basis of this investigation. The R&D approach was preferred over other approaches, including conventional Software Development Life Cycle (SDLC), Agile, or Design Science Research (DSR), because it stresses the ongoing cycle of creating a data-driven product, rigorously checking its data validity, and improving it for practical application. The research and development approach are ideal for Business Intelligence and Data Warehouse development, unlike Agile, which concentrates on quick software feature iteration, or general SDLC, which is

normally optimized for transactional applications. Its organized stages offer a strong framework for validating, integrating, and modeling complicated, varied datasets into a trustworthy analytical tool. The Research and Development (R&D) approach utilized in this study includes several phases, specifically:

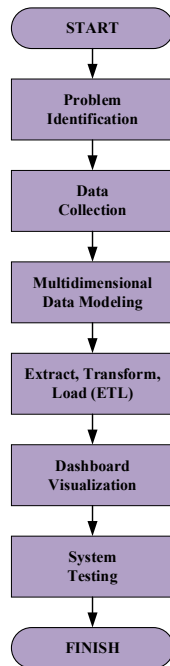


Figure 1. R&D Diagram

The Research and Development (R&D) approach utilized in this study includes several phases, specifically:

1. Problem Identification

This initial phase involves observing the macroeconomic data management at BPS-Statistics Jayawijaya to identify challenges, such as fragmented historical records scattered across various spreadsheet formats.

2. Data Collection

Secondary macroeconomic datasets, including GRDP, HDI, poverty, and unemployment rates for the 2020-2024 period, are gathered from formal documents issued by the Central Bureau of Statistics of Jayawijaya Regency.

3. Multidimensional Data Modeling

This stage focuses on designing the Data Warehouse architecture using the Galaxy Schema approach, mapping four distinct fact tables that share conformed temporal and spatial dimensions.

4. Extract, Transform, Load (ETL)

The technical integration is implemented using Pentaho Data Integration to extract raw files, perform data cleansing, and automatically load the structured data into a centralized MySQL database.

5. Dashboard Visualization

The integrated MySQL repository is connected to Tableau Public to design an interactive analytical dashboard that transforms consolidated data into intuitive visual insights for regional monitoring.

6. System Testing

The final phase validates the system's reliability by testing the accuracy of the ETL transformation flows in Pentaho and the functionality of the interactive filters in the Tableau dashboard.

SYSTEM ANALYSIS

The current way of handling macroeconomic data in Jayawijaya Regency relies heavily on separate, file-based systems that are not connected. Key statistical indicators, such as GRDP, poverty, unemployment, and HDI, can be found in various publications and are available in formats such as Excel spreadsheets, PDFs, and CSV files. This method is hampered by combined units of measurement and laborious hand labor, therefore impeding policymakers' capacity to compare data throughout several industries.

The proposed approach uses a Data Warehouse with several dimensions structured under the Galaxy Schema to appropriately handle this issue. Data integration is mostly accomplished by converting many measurement units—percentages, index scores, and monetary values, among others—into separate, specialized fact tables. Shared dimensions such as Time (Year/Quarter) and Geography (District) then link these distinct fact tables. This method lets complicated inquiries regarding several economic indicators to be answered while also avoiding duplicate data. Compared to the Star Schema, which is optimized for single-subject analysis, the Galaxy Schema offers greater flexibility for integrating multiple related datasets, making it better suited to macroeconomic data analysis. To ensure the proposed system successfully addresses the operational bottlenecks, the following system requirements were established:

1. Functional Requirements

The system must automatically extract, cleanse, and transform raw data from diverse formats (Excel, CSV) using Pentaho Data Integration, securely load the integrated multidimensional data into a centralized MySQL database, and provide interactive Tableau dashboards that allow users to filter metrics by specific years and geographical districts.

2. Non-Functional Requirements

The system needs to ensure the visual charts update smoothly, with no lag or pauses visible. It should have a simple, easy-to-use design so that regional policymakers, who may not have much technical knowledge, can use it without any trouble. The data

warehouse structure needs to be scalable so it can easily add new macroeconomic datasets in the future without changing the current data layout.

The logical structure of this multidimensional modeling is illustrated in Figure 2.

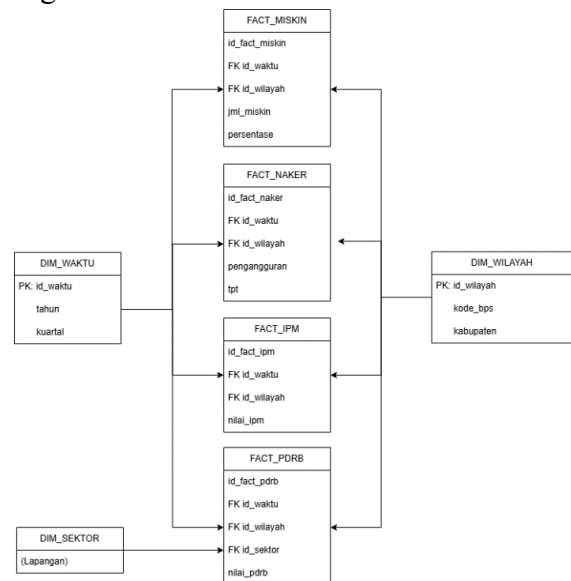


Figure 2. Galaxy Schema Modeling

SYSTEM DESIGN / DEVELOPMENT

The system architecture employs a four-tier framework to ensure an organized, automated transfer of macroeconomic data from disparate raw sources into a centralized database, ultimately converting it into engaging visual insights. The conceptual structure of this system, which incorporates ETL procedures and multidimensional modeling, is depicted in Figure 3.

The data process starts at the Data Source Tier, where fragmented macroeconomic records in Excel or CSV formats are pulled from BPS-Statistics Jayawijaya. The data then flows into the Data Staging Tier via Pentaho Data Integration, where it undergoes cleaning and transformation to resolve differing

measurement units. After that, the processed data is placed in the Data Storage Tier. This data warehouse is built on MySQL and uses the Galaxy Schema to efficiently store several fact tables that share common dimensions.

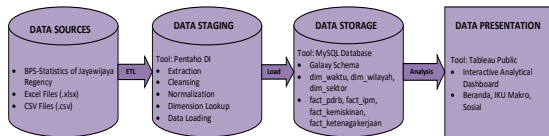


Figure 3. System Architecture

The specific functions of each tier are described as follows:

1. Data Source Tier

This tier includes secondary macroeconomic data from BPS-Statistics Jayawijaya for the years 2020 through 2024. The data is stored in different formats, such as Excel spreadsheets and CSV files, which serve as the system's basic input.

2. Data Staging Tier

This tier uses Pentaho Data Integration to improve data flow. It retrieves information from the starting location, performs cleaning and standardization to accommodate various measurement units, and modifies the information to conform to the dimensional structure.

3. Data Storage Tier

The data is stored in a single central MySQL database. This level serves as the main place to store data, organized according to the Galaxy Schema, which efficiently stores different fact tables while keeping shared time and region details.

4. Data Presentation Tier

This final tier utilizes Tableau Public as the Business Intelligence platform. It connects directly to the Data Warehouse to generate an interactive analytical dashboard, providing

polycymakers with visual narratives and correlational insights

IMPLEMENTATION AND DISCUSSION

The analytical dashboard was developed utilizing Tableau Public as the front-end business intelligence platform. For data extraction, cleansing, and transformation, Pentaho Data Integration serves as the primary ETL tool. A centralized MySQL database serves as the data warehouse to store integrated macroeconomic records, based on the Galaxy Schema multidimensional architecture.

ETL and Data Warehouse Implementation

The deployment stage started by setting up the data connection system with Pentaho Data Integration. To encourage self-operations and improve how well the system worked, every distinct modification step was compiled into a single comprehensive task document (.kjb). This automated approach carefully managed the various big-picture economic figures from BPS Jayawijaya and loaded them directly into the main MySQL database.

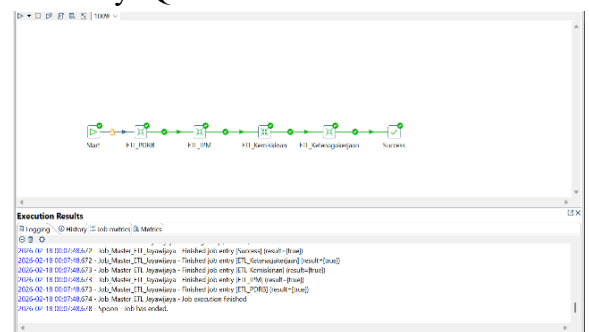


Figure 4. Automated ETL Workflow in Pentaho

The execution of this ETL pipeline successfully mapped the disparate measurement units of GRDP, poverty, HDI,

and unemployment into the previously designed Galaxy Schema. The process achieved accurate data reconciliation, ensuring that the Data Warehouse was structurally prepared for the presentation layer without data redundancy.

Dashboard Visualization

The presentation layer was developed utilizing Tableau Public, which connects directly to the structured MySQL Data Warehouse. Based on the implemented Galaxy Schema architecture, the multidimensional data with varying measurement units is visualized into three main thematic interfaces to facilitate interactive analysis.

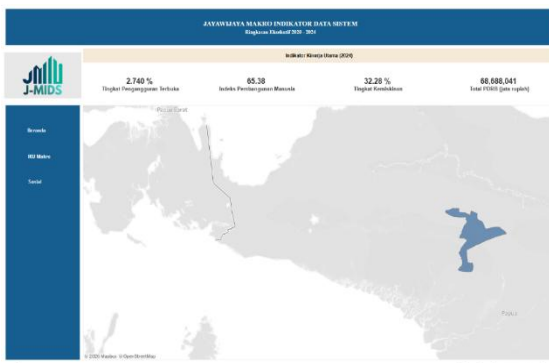


Figure 5. Executive Summary Dashboard

The Executive Summary dashboard presents a high-level overview of Jayawijaya Regency's macroeconomic performance. This page consolidates the four primary indicators from 2020 to 2024. This provides a comprehensive snapshot of overall regional development in a single, unified view.



Figure 6. Economic Growth Dashboard

The Economic Growth interface focuses specifically on the distribution of the Gross Regional Domestic Product (GRDP) across various districts. The visualizations in this section highlight economic output trends and include interactive parameter filters (such as Year and District). This feature allows users to easily track growth trajectories and identify regional income disparities with greater precision.

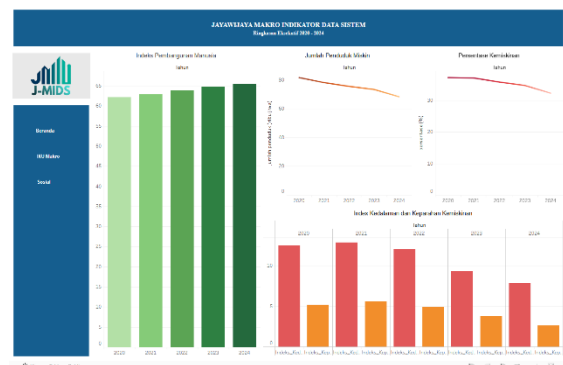


Figure 7. Social Welfare Dashboard

The Social Welfare dashboard aims to show the relationships among different social well-being measures, such as poverty levels, the Human Development Index (HDI), and unemployment rates. Using the interactive graphs on this page, policymakers can readily examine patterns in social welfare allocation across all districts and observe how these crucial measures connect from one year to the next.

System Testing and Evaluation

By testing the system directly in the Tableau Public interface, they assessed its usability and performance after conducting server-side data validation. The interactive dashboard reacts swiftly when users change variables like 'Year' and 'District,' updating the display with minimal latency to provide easy access to real-time data. This demonstrated the ease of use of our UI. The test scenarios (Table 2) showed that all clickable items, navigation tabs, and graphic tooltips operated without any problems. This guarantees that regional politicians, even those lacking sophisticated technical expertise, can easily run the system to carry out cross-sectoral analysis.

Table 1. Data Quantity Reconciliation

Macroeconomic Indicator	Source data count	MySQL record count	Error	Validation Status
GRDP	340 rows (20 quartal x 17 sector)	340 rows	0	Valid
Poverty	5 rows (Year 2020-2024)	5 rows	0	Valid
Employment	5 rows (Year 2020-2024)	5 rows	0	Valid
HDI	5 rows (Year 2020-2024)	5 rows	0	Valid

Once the server-side checks were complete, the next step was to run real-world tests and observe how users interacted with the interface built in Tableau Public. This assessment was conducted to confirm the functionality of all interactive elements, ensuring they operate as intended, with a focus on the 'Year' and 'District' selections and the visual feedback during interactions with the figures. Based on the results shown

in Table 2, each part of the dashboard worked as expected. The visual charts updated seamlessly without any logical errors during user interaction, accurately reflecting the underlying multidimensional data and effectively supporting cross-sectoral analysis.

Table 2. Customer Test Case Design

Test Scenario	Action Performed	Expected Result	Status
Year Filter	Select the year "2023" in the filter panel on the Home page.	All KPI metrics automatically adjust and only display data for the year 2023	Passed
Tab Navigation	Click on the navigation tab to move to the dashboard.	The system switches to the dashboard page smoothly without display errors	Passed
Tooltip Interaction	Hover the cursor over one of the bars in the IKU Macro Dashboard chart.	An information box (tooltip) appears displaying detailed figures, year, and sector name specifically	Passed
Visual Synchronization	Change the filter parameter on the Social Dashboard.	The poverty and HDI charts move synchronously reflecting parameter changes in real-time	Passed

Scientific Discussion and Interpretation of Results

The results show that the Galaxy Schema performs well at combining diverse macroeconomic data, making it easier to analyze multiple indicators from different angles. Unlike older methods that handle one subject at a time, this new system offers greater flexibility and easier expansion when dealing with multiple fact tables and

shared dimensions, without introducing duplicate data. The analysis of the visual outcomes highlights significant multidimensional relationships between economic growth and social welfare indicators.

By clearly showing these connections, the dashboard helps policymakers better identify economic differences between districts. The primary benefit of this system is its ability to transform fragmented statistical records into a cohesive, centralized repository, thereby empowering local authorities in Jayawijaya Regency to make precise, evidence-based policy decisions.

CONCLUSION

This study developed and implemented an analytical dashboard to display macroeconomic data for Jayawijaya Regency. By automating the ETL process and creating a single place to store all data, the system eliminates the need for people to manually gather and combine data, making it easier to bring together indicators measured in different ways.

This study also contributes to the field of Business Intelligence by demonstrating the effectiveness of the Galaxy Schema in integrating various macroeconomic indicators into a unified analytical framework. The findings show that multidimensional data modeling is important for making macroeconomic analysis more flexible and scalable, providing regional policymakers with a reliable, interactive basis for decision-making.

However, some limitations were noted, especially the reliance on fixed historical information sets (Excel and CSV files), which require manually running the ETL

job document whenever BPS publishes fresh yearly figures. Moreover, the current system is limited to four primary macroeconomic metrics; thus, additional work and investigation are needed to incorporate a wider range of local datasets or to establish automatic, live data linking via an API to broaden the system's analytical reach.

REFERENCES

- [1] Afikah, P., Avorizano, A., Afandi, I. R., & Hasan, F. N. 2022. *Implementasi Business Intelligence untuk Menganalisis Data Kasus Virus Corona di Indonesia Menggunakan Platform Tableau*. Jurnal Pseudocode, Vol. 9.
- [2] Andriyati, M., Ardiansyah, S., & Putra, M. G. L. 2021. *Penerapan Business Intelligence pada Data Cuaca Badan Meteorologi, Klimatologi, dan Geofisika (BMKG)*. SPECTA Journal of Technology, Vol. 5 No. 2, doi: 10.35718/specta.v5i2.260.
- [3] BPS-Statistics of Jayawijaya Regency. 2024. *Jayawijaya Regency in Figures 2024*. Jayawijaya: BPS-Statistics.
- [4] Chen, J. 2024. *Construction and Application of an Economic Intelligent Decision-Making Platform Based on Artificial Intelligence Technology*. Informatica, Vol. 48 No. 9, 89-106, doi: 10.31449/inf.v48i9.5705.
- [5] Fauziah, M. N., Hartono, R., & Supriatman, A. 2024. *Pengembangan Data Warehouse Pada Apotek X Untuk Kebutuhan Business Intelligence*. JATI (Jurnal Mahasiswa Teknik Informatika), Vol. 8 No. 4, doi: 10.36040/jati.v8i4.10646.

- [6]Frempong, D., et al. 2022. *Real-Time Analytics Dashboards for Decision-Making Using Tableau in Public Sector and Business Intelligence Applications*. Journal of Frontiers in Multidisciplinary Research, Vol. 3 No. 2, doi: 10.54660/ijfmr.2022.3.2.65-80.
- [7]Hasan, F. N., & Sudaryana, I. K. 2022. *Penerapan Business Intelligence & Online Analytical Processing untuk Data-Data Penelitian dan Luarannya pada Perguruan Tinggi Menggunakan Pentaho*. Infotech: Journal of Technology Information, Vol. 8 No. 2, doi: 10.37365/jti.v8i2.143.
- [8]Lokaadinugroho, I., Girsang, A. S., & Burhanudin. 2021. *Tableau Business Intelligence Using the 9 Steps of Kimball's Data Warehouse & Extract Transform Loading of the Pentaho Data Integration Process Approach in Higher Education*. JURNAL EMACS (Engineering, Mathematics and Computer Science), Vol. 3 No. 1, doi:10.21512/emacsjournal.v3i1.6816
- [9]Machireddy, J. R., Rachakatla, S. K., & Ravichandran, P. 2021. *AI-Driven Business Analytics for Financial Forecasting: Integrating Data Warehousing with Predictive Models*. Journal of Machine Learning in Pharmaceutical Research, Vol. 1 No. 2, 1-15.
- [10]Murtiwiayati, M., Agathon, H., & Safitri, L. 2024. *Implementasi Data Warehouse dan Business Intelligence Menggunakan Pentaho dan Metabase untuk Membuat Dashboard Visualisasi Kinerja Penjualan E-Commerce Wish*. Jurnal Penelitian Teknologi Informasi dan Sains, Vol. 2 No. 4, doi: 10.54066/jptis.v2i4.2783.
- [11]Özcan, M., & Peker, S. 2021. *Designing a Data Warehouse for Earthquake Risk Assessment of Buildings: A Case Study for Healthcare Facilities*. Sakarya University Journal of Computer and Information Sciences, Vol. 4 No. 1, doi: 10.35377/saucis.04.01.872729.
- [12]Pandensolang, F., Manoppo, F., & Sumendap, A. 2022. *Implementasi Business Intelligence Untuk Analisa dan Visualisasi Perbandingan Perencanaan dan Realisasi Anggaran pada BNNP Sulawesi Utara*. Jurnal Teknik Informatika, Vol. 17 No. 3.
- [13]Purwanto, J., & Renny. 2021. *Perancangan Data Warehouse Rumah Sakit Berbasis Online Analytical Processing (OLAP)*. Jurnal Teknologi Informasi dan Ilmu Komputer (JTIK), doi: 10.25126/jtiik.202184842.
- [14]Putri, F. I., Suryamen, H., & Wahyuni, U. M. 2024. *Penerapan Business Intelligence Dashboard dan Forecasting pada Jumlah Pasien Puskesmas XYZ*. Innovation and Technology Jurnal Ilmu Komputer, Sistem Informasi dan Teknologi Informasi (Innotech), Vol. 1 No. 2.
- [15]Rivanza, A., Yudhanto, D. P., Rifky, M., & Ashari, M. I. 2026. *Implementasi Business Intelligence dalam Menganalisis Disparitas Pendidikan: Studi Kasus Harapan dan Realisasi Lama Sekolah*. Jurnal Akuntansi dan Sistem Informasi, Vol. 1 No. 2.
- [16]Rusydi, A., & Hasan, F. N. 2023. *Implementasi business intelligence untuk visualisasi kekuatan sinyal*

internet di Indonesia menggunakan platform tableau. TEKNOSAINS: Jurnal Sains, Teknologi dan Informatika, Vol. 10 No. 1, doi: 10.37373/tekno.v10i1.378.

- [17]Senduk, F. K., Waluyo, R., & Isnaini, K. N. 2025. *Analisis Data dengan Business Intelligence dan Tableau untuk Visualisasi Garis Kemiskinan Indonesia*. Sistemasi: Jurnal Sistem Informasi, Vol. 14 No. 3.
- [18]Turcan, G., & Peker, S. 2022. *A multidimensional data warehouse design to combat the health pandemics*. Journal of Data, Information and Management, Vol. 4 No. 4, 371-386.
- [19]Wahyudi, T., Nopianto, M., Rani, J., Kurniawan, D. R., & Nugraha, D. 2023. *Implementasi Dashboard Monitoring Laju Pertumbuhan Penduduk di Rukun Warga 011 Pondok Kelapa Menggunakan Tableau Public*. Jurnal Pengabdian Nasional (JPN) Indonesia, Vol. 4 No. 2, doi: 10.35870/jpni.v4i2.203.
- [20]Zafary, F. 2020. *Implementation of business intelligence considering the role of information systems integration and enterprise resource planning*. Journal of Intelligence Studies in Business, Vol. 10 No. 1, doi: 10.37380/JISIB.VIII.563.