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Development of a Dashboard-Based Information System to Improve Prospective Customer Engagement at PLN UP3 Bima

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ABSTRACT

PT PLN (Persero) UP3 Bima faces challenges in effectively managing and analyzing prospective customer data, resulting in delays in decision-making and suboptimal utilization of potential connected power. This study aims to develop an interactive dashboard system using Looker Studio and Google Sheets to improve operational efficiency and support digital transformation within PLN. The methodology includes user needs analysis, real-time data integration from Google Sheets, and the design of data visualizations in Looker Studio based on key parameters such as customer growth trends, sector classification, and potential connected power. The implementation results show that the system effectively delivers accurate and timely information, assisting management in identifying opportunities to increase new customer connections. The impact of this system includes enhanced effectiveness in managing prospective customer data, faster decision-making processes, and stronger support for data-driven strategies to increase customer acquisition in a measurable way.

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1. Introduction

Digital transformation has become a key driver in the modernization of various sectors, including the electricity industry. Energy companies such as PT PLN (Persero) are increasingly required to adopt advancements in information technology to enhance operational efficiency, service quality, and customer engagement. According to [1] , the digitalization of electricity infrastructure plays a crucial role in supporting the decentralization and decarbonization of power systems, while also improving the effectiveness of customer data management, In the operational context of PLN UP3 Bima, the process of recording and monitoring prospective customers still encounters several challenges[2], [3], [4]. These include limited access to real-time data, fragmented information across different units, and the absence of interactive visualization tools to support strategic decision-making. As [2] points out, without an integrated and centralized information system, available data becomes less effective in supporting the planning of electricity network expansion and in meeting customer power demands, With the rapid

development of digital technologies, the integration of tools such as Google Sheets and Looker Studio offers a promising solution for real-time and visual management of prospective customer data .

The main problem identified in this study is the ineffectiveness of the current data management system for prospective customers at PLN UP3 Bima. The existing system still relies heavily on manual data entry and spreadsheet-based processes that are not integrated across departments. As a result, data related to prospective customers such as submitted applications, potential power capacity, customer classification, and follow-up status is often scattered, inconsistently updated, and difficult to access in a centralized and timely manner. Moreover, the absence of a structured and interactive data visualization platform limits the ability of management and field officers to monitor customer development trends, detect bottlenecks in service delivery, and identify areas with high potential for connection expansion. This lack of integration and visualization leads to several critical operational consequences. Decision-making becomes delayed and reactive rather than proactive, as decision-makers do not have access to up-to-date and comprehensive insights. Customer service responsiveness is reduced due to incomplete information about the status and needs of prospective clients. Furthermore, it becomes challenging to align marketing and technical resources efficiently, which in turn affects the company's ability to optimize energy distribution planning and increase electrification rates in a targeted manner. Addressing this core issue is crucial not only for improving internal operational processes but also for strengthening the institution's strategic capacity in supporting national electrification programs and customer acquisition targets. Therefore, there is a strong need to develop a centralized, real-time, and visual data management system that can provide stakeholders with accurate insights, improve coordination among units, and facilitate smarter decision-making.

This integration enables the transformation of raw datasets into structured, insightful, and easy-to-analyze information. Previous studies, such as [3] , have demonstrated the effectiveness of Big Data Analytics in optimizing customer data derived from Advanced Metering Infrastructure (AMI), highlighting its relevance in improving utility operations. Furthermore, [4] in the implementation of the renewable energy generation integration dashboard showed that the presentation of visual-based information can improve operational efficiency and accelerate decision making. Likewise, [5] stated that the use of data analytics can provide a significant impact on operational optimization in the energy sector. Studies by [6] [7] show that smart grid and smart meter integration play a major role in improving customer service response through detailed consumer data analysis. On the other hand, [8] highlights how the incorporation of geospatial data into dashboards can provide deeper insights into usage patterns and demographics. In the context of internal efficiency, [9] emphasizes the importance of advanced measurement infrastructure for the analysis of electricity consumption patterns, while [10] shows that web-based platforms are able to improve data access and cross-team collaboration in the energy sector. In addition, [11] highlights that digitalization also drives a more customer-centric service model, which strengthens consumer engagement through a more personalized approach. Customer Relationship Management (CRM) systems, as stated by [12] , also play a significant role in driving more effective customer interaction strategies.

The objective of this study is to develop an interactive dashboard system integrating Google Sheets and Looker Studio to enhance the effectiveness of prospective customer data management at PT PLN (Persero) UP3 Bima. Specifically, this research aims to analyze the need for an information system capable of centrally and in real-time monitoring and managing prospective customer data, design and implement a dashboard that presents key information such as potential connected power, customer growth trends, and sector classification in an informative visual format, and improve the efficiency of decision-making processes by providing accurate and easily interpretable data. In addition, this study seeks to evaluate the impact of the implemented system on the quality of data management and the responsiveness of operational units in following up on new connection requests.

2. Methodology

This study uses an applied approach in developing an interactive dashboard system to visualize PT PLN (Persero) UP3 Bima's prospective customer This research method is designed to develop and implement an interactive dashboard system to visualize prospective customer data at PT PLN (Persero) UP3 Bima in a real-time and integrated manner. The approach used is applied research, utilizing the integration of Google Sheets as the primary data source and Looker Studio as the main platform for data visualization. The complete process flow of the dashboard system development is illustrated in Figure 1. The diagram outlines the main stages, beginning with the data loading process from Google Sheets. This step is followed by data cleansing and validation to ensure data quality, consistency, and accuracy by eliminating duplicate entries, correcting input errors, and addressing missing values.data in real-time. This method was chosen to answer practical needs in the field, by combining data integration and visualization techniques using web-based technology.

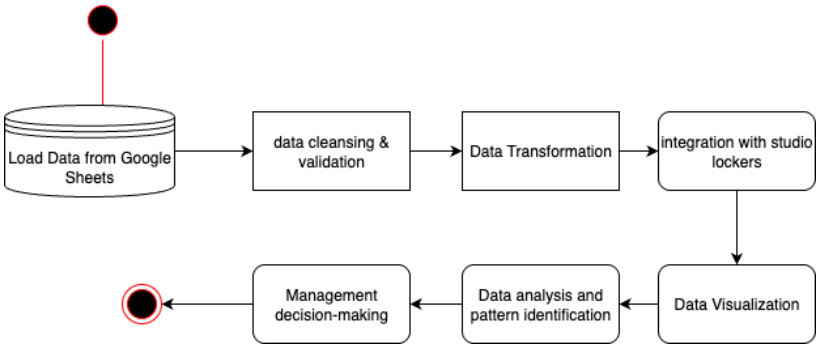

Figure 1. Research methodology

Based on figure 1, the data undergoes a transformation process to structure it into a format suitable for analysis and visualization. The transformed data is then integrated with Looker Studio using the Studio Lockers feature, enabling real-time display of data through interactive charts and visual dashboards. The next stage involves data analysis and pattern identification, aiming to uncover trends in customer growth, sector classifications, and potential connected power estimates. The results of this analysis and visualization serve as the foundation for management decision-making, supporting the company's strategic efforts in electricity network expansion and customer acquisition in a more data-driven and measurable way.

2.1 Data Sources and Processing

Primary data was obtained directly from PLN UP3 Bima through the collection of prospective customer information recorded digitally in Google Sheets. This data includes information such as customer name, address, tariff type, business sector, and service progress status. The data format is structured to facilitate the processing and integration process with visualization tools. This process refers to the real-time data management approach as described by Ahmed and Mueller, who suggest the use of spreadsheet-based dashboards for efficiency and ease of synchronization.

2.2 Visualization System Integration

The visualization system was developed using Looker Studio as the main platform to build interactive dashboards. Google Sheets is directly connected to Looker Studio to allow automatic data updates and dynamic visualizations without the need for manual input. This process follows the dashboard development model carried out by Gultom et al., which emphasizes the importance of direct integration between platforms for real-time and informative data presentation. In addition, to support spatial visualization, an interactive map based on Leaflet.js is used that is connected to customer data via API or export in JSON format. This visualization is used to show the distribution of potential customers based on location coordinates, sectors, and related ULPs. This process adopts the method described by Rohan Wickramasuriya et al. in the combination of Geographic Information System (GIS) and business intelligence.

2.3 System Testing and Validation

After the dashboard system was developed, a testing process was carried out using the PLN UP3 Bima operational scenario, such as data addition simulation, changing service status, and monitoring the distribution of potential customers. Validation was carried out by comparing the dashboard display to actual data to ensure accuracy and consistency. This validation process refers to the Guerrero-Prado et al. approach, which emphasizes the importance of functional and systemic validation in developing big data analytics-based solutions [16].

2.4 Limitations

The development of this system has limitations, namely the limited connection of the official PLN API, so the data used is a manually updated copy of internal data. In addition, testing was carried out on a UP3 Bima scale and did not include cross-regional integration or national PLN data centers. However, this system

can still be replicated in other units with similar data formats, in accordance with the principle of scientific reproducibility.

3. Results and Analysis

3.1. Digital Map of Potential Customer Distribution

The visualization of potential customer distribution through a digital map dashboard plays a crucial role in supporting data-based decision-making within electricity service operations. By displaying customer location patterns across different regions, particularly within the operational scope of PT PLN (Persero) UP3 Bima, this interactive tool provides a comprehensive overview of service coverage, demand concentration, and opportunities for grid expansion. The map is not only useful for identifying geographical clusters of potential customers but also for facilitating targeted planning and more efficient resource allocation in the field.

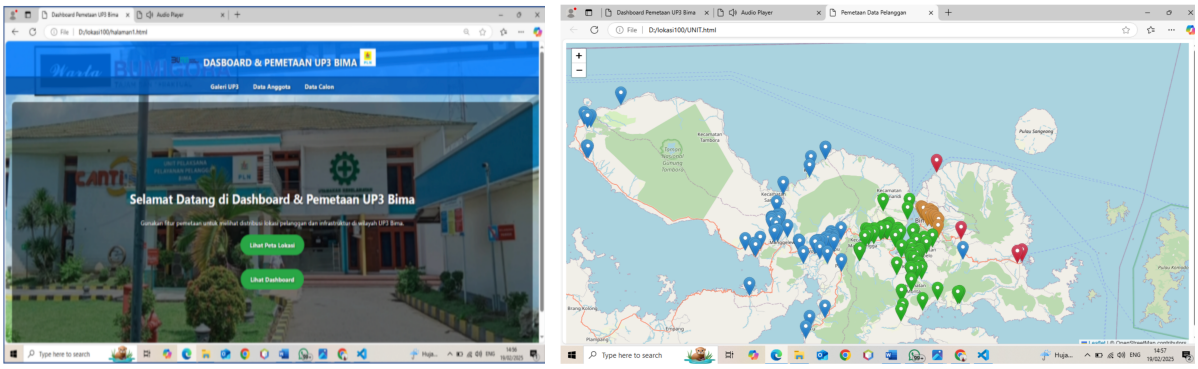

Figure 2. Customer Data Mapping per UNIT

Figure 2, displays a map visualization of potential customer distribution within the working area of PT PLN (Persero) UP3 Bima, presented through an interactive digital dashboard. Each marker in different colors represents various categories or locations of potential customers based on Customer Service Unit (ULP) areas or business sectors. The green markers indicate a concentration of potential customers in the central part of Sumbawa Island, particularly in areas with high electricity demand. The blue markers are mostly found in the western region, likely representing ULP Bima or Dompu, which have strong potential in the agricultural or trade sectors. The red and orange markers indicate potential customers in the eastern and northern areas, possibly representing industrial or large-scale business sectors. This map assists PLN in geographically identifying customer locations for power grid planning, prioritizing electricity connection services, and facilitating spatial analysis of underserved market potential. The implementation of this dashboard supports a data-driven and location-based approach in operational and strategic decision-making within PLN UP3 Bima.

3.2 Customer Data Trends and Statistics Analysis

The dashboard also presents a graph of service demand trends over a period of time. The analysis results show a spike in the number of potential customers at the beginning and end of the year, mainly due to the stimulus program and village electricity expansion. This data is visualized in the form of bar and line graphs, allowing PLN to monitor peak demand times and manage resource allocation efficiently.

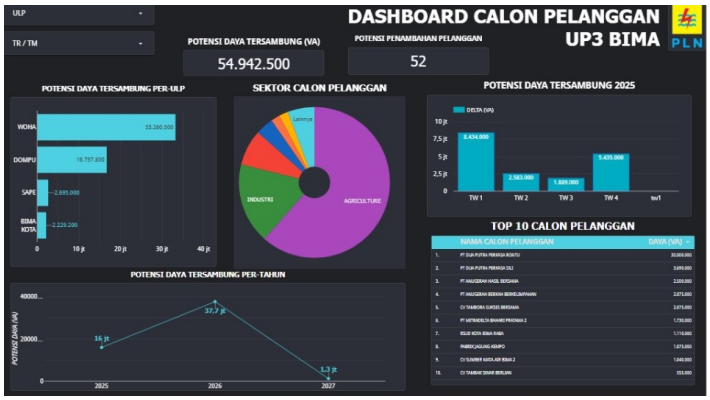

Figure 3 . UP3 Bima Prospective Customer Dashboard

Figure 3 illustrates the interactive dashboard of potential customers at PT PLN (Persero) UP3 Bima, developed using the integration of Google Sheets and Looker Studio. This dashboard presents real-time, structured, and visual data to support strategic decision-making regarding electricity connection planning. It features dropdown filters for selecting ULP and TR/TM categories, enabling customized data views. The dashboard highlights a total connected power potential of 54,942,500 VA with 52 prospective customers. ULP Woha has the highest potential, followed by Dompu and Sape. The pie chart shows that the agriculture sector dominates, followed by trade/services, others, and industry. A bar chart projects potential power connections for 2025, while a line chart shows an increasing trend peaking in 2026 and a decrease in 2027. Additionally, a table lists the top 10 potential customers by connected power. Overall, the dashboard provides valuable insights into customer profiles, sectoral distribution, and annual projections, aiding PLN UP3 Bima in identifying priority areas, monitoring sector growth, and planning efficient power network expansion.

3.3 Data Processing and Access Efficiency

Before the system was developed, customer data processing was done manually through Excel and physical reports, which were at high risk of input errors and duplication. After implementing a Looker Studio-based dashboard system connected to Google Sheets, data access became more efficient and could be accessed directly across units. A comparison of efficiency can be seen in Table 1

Table 1. Comparison of manual and dashboard-based data processing systems

No	Criteria	Running System (Manual)	Proposal System (Dashboard)
1	Data processing method	Manual (Excel)	Automatic (Looker Studio)
2	Data visualization	No interactive charts available	Dashboards with various types of charts are available
3	Data access speed	Slow and requires manual searching	Fast, real-time, and accessible from multiple devices
4	Prediction and analysis	Difficult to do, requires manual analysis	Possible with interactive charts, dynamic filters, and analytical features
5	Data integration	Disparate and not centralized	Centralized in one dashboard connected to the data source
6	Data security	Prone to input errors and data loss	Cloud-based security and storage features
7	Accessibility	Limited to certain devices	Accessible in real-time from multiple devices and locations

Based on table 1, compares the current running system (manual) with the proposed system (interactive dashboard using Looker Studio) based on seven key criteria. In terms of data processing methods, the manual system relies on Excel, which requires manual input and processing, while the proposed dashboard system enables automatic data processing, improving efficiency. Regarding data visualization, the manual system lacks interactive charts, whereas the dashboard offers various types of dynamic and interactive visualizations for better data interpretation. In terms of data access speed, the manual system is slow and requires manual searching, while the dashboard allows fast, real-time access across multiple devices. For prediction and analysis, the manual system makes it difficult and time-consuming, as it depends on manual analysis. In contrast, the dashboard supports easier and more dynamic analysis through interactive charts, filters, and analytical tools. Regarding data integration, the manual system is fragmented and lacks centralization, while

the dashboard centralizes all data in one interface connected directly to the source. In the aspect of data security, the manual system is prone to input errors and potential data loss, whereas the dashboard offers cloud-based storage and security features that ensure data safety. Lastly, for accessibility, the manual system is limited to certain devices, while the dashboard can be accessed in real time from various devices and locations, enhancing mobility and collaboration.

4. Analysis

This section presents a comparative analysis between the existing manual system and the proposed dashboard-based system to demonstrate the improvements in efficiency, accessibility, and data-driven decision-making. The analysis begins with an evaluation of the current workflow, which predominantly relies on manual data entry and processing using spreadsheet software such as Microsoft Excel. This method often results in redundant work, inconsistent data formatting, and increased human error. Furthermore, the absence of real-time visualization tools hinders management's ability to promptly monitor customer trends or detect anomalies in registration or service requests. In contrast, the proposed dashboard system leverages Google Sheets for centralized data storage and Looker Studio for interactive visualizations. Through this integration, data is automatically updated, visualized in real-time, and can be accessed remotely through multiple devices. This transition significantly enhances decision-making speed and accuracy, especially for monitoring prospective customer metrics. Key improvements observed from the implementation of the dashboard include faster data access time, the ability to perform predictive analysis through dynamic filtering and drill-down capabilities, and improved data security through cloud-based management. Moreover, with centralized integration, stakeholders no longer need to reconcile multiple data sources, leading to more cohesive reporting and analysis. The overall outcome of this analysis confirms that the dashboard system is not only more efficient but also aligns with digital transformation initiatives, providing a scalable solution for future operational needs.

5. Conclusion

This study confirms that the implementation of an interactive dashboard system utilizing Leaflet.js for spatial visualization and the Google Sheets API for seamless data integration has significantly improved the efficiency and accuracy of managing prospective customer data within the PLN UP3 Bima operational scope. The system successfully replaces conventional manual processes that were prone to data entry errors, update delays, and limited accessibility. The dashboard enables faster and more insightful data visualization and analysis, empowering management to develop responsive, data-driven service strategies. The practical significance of this study lies in its demonstration of how digital transformation through the application of data science and geospatial technologies can be effectively implemented even in resource-constrained environments. It proves that digitalization is not merely a theoretical concept but can manifest through simple, scalable, and impactful solutions when supported by a clear strategy and technical direction.

The study acknowledges several limitations. First, the current system lacks advanced predictive analytics capabilities and has not undergone full-scale integration testing with PLN's existing enterprise systems. Additionally, while cloud-based storage is utilized, further attention must be given to data security, privacy regulations, and user authentication particularly if the system is to be deployed on a larger scale or connected to sensitive operational datasets.

Future research is encouraged to enhance the system by integrating machine learning models to predict customer demand trends and forecast electricity consumption needs. Incorporating automated alerts, access role management, and real-time analytics will further strengthen the platform's utility and resilience.

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