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DESIGN AND ANALYSIS OF A DATA VISUALIZATION DASHBOARD FOR PT KERETA API INDONESIA (PERSERO) REGIONAL DIVISION III PALEMBANG USING THE PROTOTYPE METHOD

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Abstract :

Abstract:

The management of operational data at PT Kereta Api Indonesia (Persero) Regional Division III Palembang still relies on Microsoft Excel as the primary medium for storing, processing, and presenting data. All data analysis is carried out manually, and information is still displayed in tabular form, making it difficult for users to quickly and comprehensively understand large volumes of data, identify patterns, or observe trends. This condition results in an inefficient and time-consuming monitoring and decision-making process, as the company has not yet had an automated dashboard capable of transforming Excel data into visual information. This study aims to analyze user requirements and design a web-based data visualization dashboard using the Prototype method, which consists of five stages: Communication, Quick Plan, Modeling Quick Design, Construction of Prototype, and Deployment, Delivery and Feedback. Data were collected through observation, interviews, and discussions with the Information Systems Division. System modeling was carried out using Business Process Model and Notation (BPMN) and Unified Modeling Language (UML), including Use Case Diagrams, Activity Diagrams, and Class Diagrams, while the user interface prototype was designed using Figma. The results show that the proposed dashboard is able to accommodate the functional and non-functional requirements identified, including Excel/CSV file upload, automatic data processing, data visualization in the form of bar charts, line charts, and pie charts, as well as statistical analysis (minimum, maximum, average, and sum). The resulting dashboard prototype is expected to serve as a reference for further system development, enabling faster, clearer, and more effective data monitoring and decision-making at PT Kereta Api Indonesia (Persero) Regional Division III Palembang.

Keywords : *data visualization, dashboard, Prototype method, Microsoft Excel, decision support*

INTRODUCTION

The rapid advancement of information technology has significantly influenced how organizations manage and present data. In today's digital era, technology no longer functions merely to store data but also supports faster and more accurate data analysis and decision-making (Noviyana & Nasution, 2024).

Previous studies have examined the development of data visualization dashboards in various contexts. Febrianty et al. (2023) successfully developed an employee data dashboard at PT Solen System Indonesia in Yogyakarta to support

employee data monitoring. Similarly, Hidayat (2023) designed a dashboard for visualizing Transjakarta passenger data, resulting in a more interactive presentation of information to support decision-making. Although numerous studies have discussed dashboard development, most focus on presenting information through graphs within a specific domain, while research on dashboards that utilize Excel files as the primary data source to support operational data analysis remains relatively limited. This gap motivates the present study, which focuses on designing a data visualization dashboard tailored to user needs at PT Kereta Api Indonesia (Persero) Regional Division III Palembang.

Currently, the data management system at PT Kereta Api Indonesia (Persero) Regional Division III Palembang still relies on Microsoft Excel as the primary medium for storing, processing, and presenting operational, monitoring, and reporting data. Users process data stored in Excel files and present it in tabular form according to their information needs. The entire data analysis process is still carried out manually by observing and processing data available in Excel worksheets, which causes several problems: data presented in tabular form makes it difficult for users to quickly and comprehensively understand information, especially when the volume of data is large; identifying patterns, trends, or comparisons requires manual chart creation, making the analysis process time-consuming and inefficient; and information cannot yet be presented visually, making it difficult for users to obtain a fast, clear, and detailed overview of the data.

In addition to these presentation challenges, PT Kereta Api Indonesia (Persero) Regional Division III Palembang does not yet have a dashboard system capable of automatically converting Excel data into data visualizations. All data remains stored in Excel files and has not been integrated into a visualization medium that could help users understand information more easily. As a result, the monitoring and data analysis process still depends on manual processing, making information delivery suboptimal.

Based on the conditions described above, there is a clear gap between the company's information needs and the system currently in use. The company requires a fast, clear, and easily understandable presentation of information to support monitoring activities and decision-making, yet the available data is still presented in Excel tables, making the analysis and information delivery process less than optimal.

Given these problems and needs, a web-based data visualization dashboard is required that can automatically process Excel files into various visual forms, such as bar charts, line charts, pie charts, and other visualizations. This system is also equipped with data analysis features to help users understand information more quickly and accurately. With such a dashboard, information that was previously presented in tabular form can be displayed more interactively, making it easier to understand and supporting monitoring and decision-making activities within the company.

This research applies the Prototype method in the system development process. This method was selected because it allows researchers and users to interact directly throughout the development process, enabling user requirements to be identified, evaluated, and refined gradually. The Prototype method consists of five stages: Communication, Quick Plan, Modeling Quick Design, Construction of Prototype, and Deployment, Delivery and Feedback. During the Modeling Quick Design stage, the user interface design process is carried out using Figma to produce an interactive and easily understandable system design prior to implementation. Through these stages, the system can be developed more effectively, obtain user feedback from the early stages of development, and produce a system that aligns with user needs.

Based on the problems and needs described above, this study is entitled "Design and Analysis of a Data Visualization Dashboard for PT Kereta Api Indonesia (Persero) Regional Division III Palembang Using the Prototype Method."

RESEARCH METHOD

This study employed the Prototype method, which allows direct interaction between researchers and users throughout the system design process so that user requirements can be identified, evaluated, and refined progressively before further development. This research was conducted at PT Kereta Api Indonesia (Persero) Regional Division III Palembang, specifically within the Information Systems Division, over a period of one month, from July to August 2025.

Data were collected through observation, interviews, and discussions with staff of the Information Systems Division to identify the current data processing workflow and its problems, as well as through documentation of existing Excel-based operational data. The population of this study was the operational data management process within the Information Systems Division, with the Division itself serving as the primary informant regarding user needs and system requirements.

The Prototype method used in this study consists of five stages:

1. Communication. Researchers conducted observations, interviews, and discussions with the Information Systems Division to identify problems in the operational data processing workflow. The results indicated that data is still managed using Microsoft Excel, so that data analysis and information presentation are still performed manually. These findings formed the basis for identifying the system's functional and non-functional requirements.
2. Quick Plan. Based on the requirements identified in the Communication stage, researchers determined the system scope, required software, and the main features to be designed, including login, Excel file upload, data visualization in the form of charts, and presentation of analysis results (minimum, maximum, average, and total values).
3. Modeling Quick Design. This stage involved designing the initial system

model. Business processes and system interactions were modeled using Business Process Model and Notation (BPMN), while the system structure was modeled using Unified Modeling Language (UML), including Use Case Diagrams, Activity Diagrams, and Class Diagrams. The user interface was designed using Figma. The resulting design was discussed with users to obtain feedback for prototype refinement.

4. Construction of Prototype. Based on the design produced in the previous stage, a prototype was developed focusing on the interface design and system workflow, enabling users to gain an overview of the dashboard's functions. The prototype was then evaluated together with users to determine whether the design met the company's operational needs.
5. Deployment, Delivery and Feedback. The prototype results were presented to users to obtain feedback. Users reviewed the dashboard design and provided suggestions regarding the display, usability, and feature suitability. This feedback was used as the basis for refining the analysis and design, resulting in a data visualization dashboard prototype that aligns with the needs of PT Kereta Api Indonesia (Persero) Regional Division III Palembang.

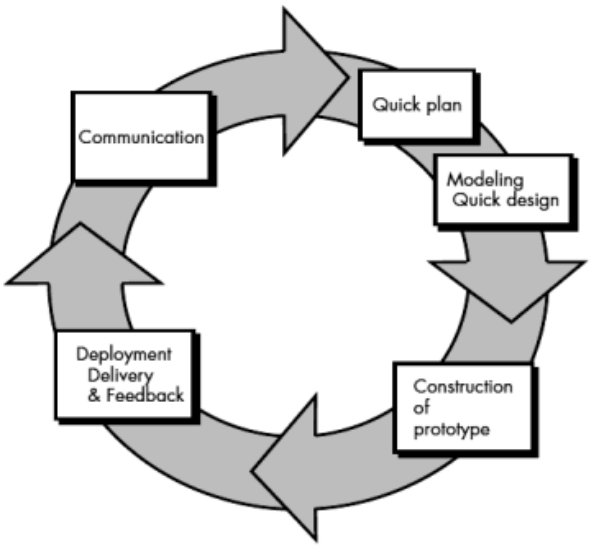

Figure 1: Prototype Method

Data analysis techniques used in this study included requirements analysis (functional and non-functional), business process analysis using BPMN, and system design analysis using UML diagrams, all of which served as the basis for the interface design developed in Figma. 12

FINDINGS AND DISCUSSION

Requirements Identification

Based on observations, interviews, and discussions with the Information Systems Division of PT Kereta Api Indonesia (Persero) Regional Division III Palembang, several system requirements were identified as the basis for designing the data visualization dashboard. These requirements consist of

functional requirements, namely: (1) a login feature based on user access rights (admin, manager, and user); (2) the ability to upload, view, and delete Microsoft Excel files (.xlsx and .csv) as data sources; (3) automatic data processing to generate minimum, maximum, average, and sum values; (4) data visualization in the form of Bar Chart, Line Chart, and Pie Chart; (5) the ability to read and manage more than one sheet within a single Excel file; (6) a dashboard preset feature to save visualization configurations; and (7) an export feature to output analysis results in Excel format. Non-functional requirements include fast and stable processing of relatively large Excel files, a simple and interactive interface, data security through authentication, cross-browser accessibility, and system scalability for future feature additions. A summary of these requirements is presented in Table 1.

Table 1 : System Requirements Identification

Need	Description
Login	The system provides user authentication based on access rights.
Upload File Excel	The system is capable of uploading Excel files (.xlsx/.csv).
Data processing	The system processes data automatically.
Data Visualization	The system displays bar charts, line charts, and pie charts.
Data analysis	The system calculates the minimum, maximum, and average values, as well as the total number of data points.
Multi Sheet	The system is capable of reading more than one sheet from an Excel file.
Export Data	The system provides a feature to export analysis results to Excel format.

Current Business Process Analysis

The current business process at PT Kereta Api Indonesia (Persero) Regional Division III Palembang begins when the user obtains operational data in the form of a Microsoft Excel file. The user then processes the data manually, including compiling tables and calculating minimum, maximum, average, and sum values. When data visualization is required, the user must create charts manually using the features available in Microsoft Excel. The process involves two main actors, the Supervisor and the Manager. The process begins when the Supervisor compiles raw data and inputs it into a spreadsheet, then sends the file to the Manager for review. If the data is found invalid, the Manager returns it with correction notes, requiring the Supervisor to re-input the data; this cycle repeats until the data is verified as valid, after which the Manager approves the

report. This manual process is time-consuming and prone to errors and rework whenever data inconsistencies are found.

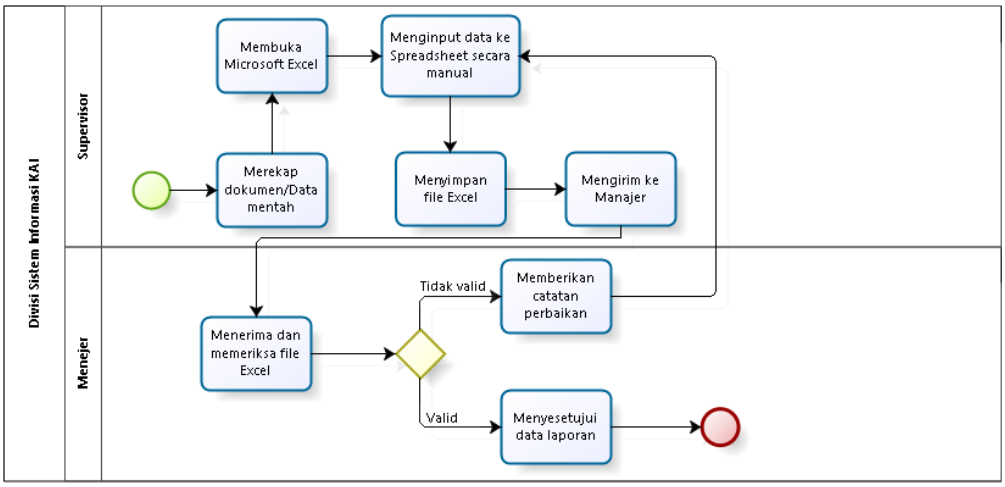

Figure 2 : Current Business Process (As-Is)

System Modeling Using UML

Based on the requirements identified above, the proposed system was modeled using Unified Modeling Language (UML), consisting of a Use Case Diagram, an Activity Diagram, and a Class Diagram, to describe the interactions between actors and the system as well as the overall system structure. The Use Case Diagram identifies three actors involved in the system, namely Staff/User, Manager, and Administrator, each with different access rights. Staff/User can perform six main functions: Login and Register, View Dashboard, Explore Data/Table, Visualize Charts, Use the Statistical Calculator, and Access Storage Guidance. Manager holds all Staff/User privileges plus two additional functions, Upload Excel Workbook and Delete Workbook. Administrator holds the highest access level, encompassing all functions available to Staff/User and Manager, plus three specific functions: Account Management, View Audit Log, and Delete All Data, as shown in Figure 3.

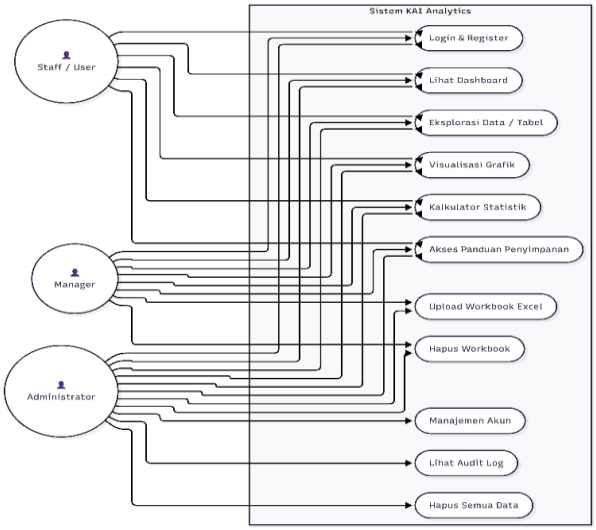

Figure 3 : Use Case Diagram of the Proposed System

The system workflow is further described through the Activity Diagram. As a representative example, the Login and Registration Activity Diagram illustrates the process across two swimlanes, User and System. The process begins when the user opens the login page; if the user does not yet have an account, they are directed to the registration page and submit a registration request that remains in a pending status until approved by the Administrator. If the user already has an account, they enter their username and password, which the system validates; invalid credentials return the user to the input stage, while valid credentials grant access to the system's main page, as shown in Figure 4. Similar activity diagrams were also developed for account confirmation, Excel file upload, data visualization and analysis, and storage management, each describing the corresponding interaction between actors and the system in detail.

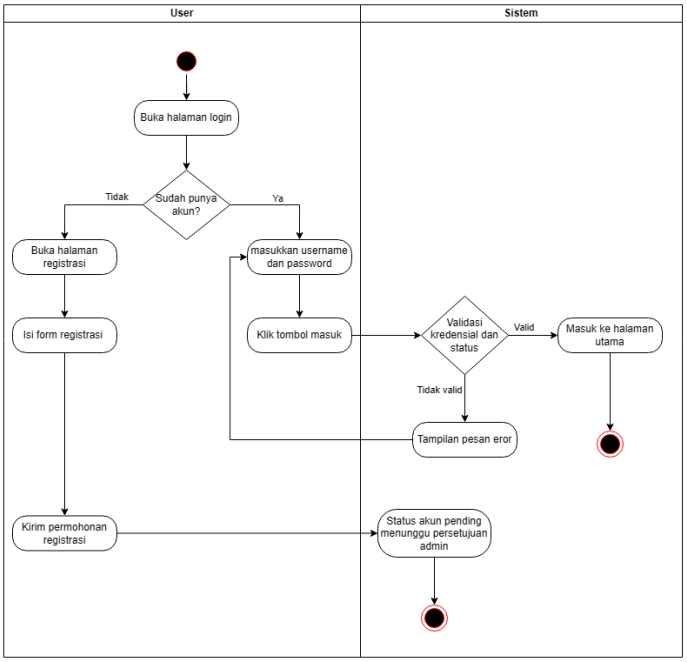

Figure 4 : Activity Diagram of Login and Registration

The system's data structure is represented through the Class Diagram, which consists of four main classes: User, Workbook, AuditLog, and SheetData. The User class contains attributes such as id, username, full_name, email, password, role, status, nip, jabatan, division, unit_kerja, created_at, and last_login, along with the login() and register() methods for authentication and registration. The User class is related to the Workbook class through an "Uploads" relationship with a one-to-many cardinality, to the AuditLog class through a "Triggers" relationship, and the Workbook class is related to the SheetData class through a "Contains" relationship, representing the fact that one workbook can contain multiple data sheets, as shown in Figure 5.

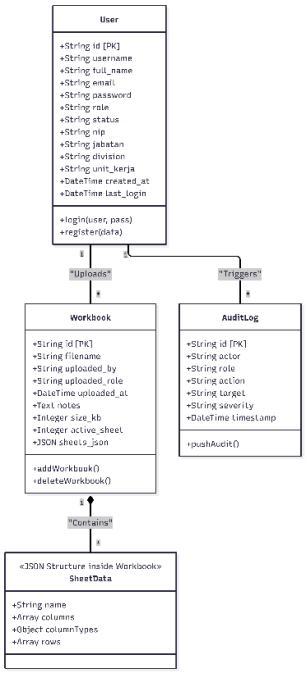

Figure 5 : Class Diagram of the Proposed System

Database Design Using Entity Relationship Diagram (ERD)

The system's database structure was designed using an Entity Relationship Diagram (ERD), developed in two stages: a logical ERD, representing the conceptual data structure independent of technical data types, and a physical ERD, representing the detailed implementation structure including data types and field lengths. The logical design identifies four main entities, users, workbooks, audit, and audit_log, connected through one-to-many relationships, in which a single user can generate multiple audit records and upload multiple workbooks. In the physical design, the users entity is implemented with id as the primary key (VARCHAR2(255)), username and email as unique keys, and additional attributes such as fullName, password, nip, division, jabatan, and unitKerja. The workbooks entity includes uploaded_by as a foreign key referencing the users entity, along with attributes such as filename, notes, size_kb, active_sheet, sheets_json, and uploaded_at, as shown in Figure 6.

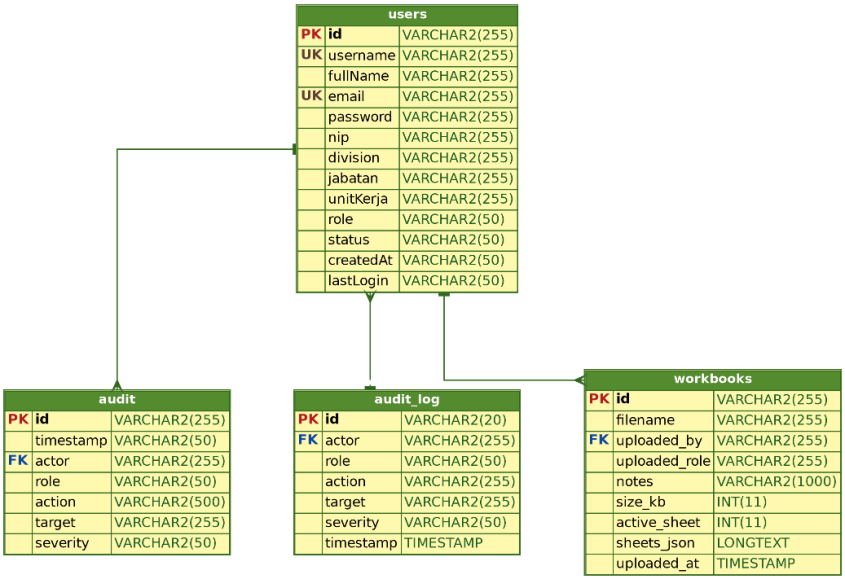

Figure 6 : Entity Relationship Diagram (Physical)

Based on this analysis, several core problems in the existing process were identified: (1) operational data is still stored and processed manually using Microsoft Excel; (2) information is presented only in tabular form, making it difficult for users to quickly interpret large datasets; (3) chart creation is time-consuming because it must be done manually; (4) no automated dashboard exists to convert Excel data into visual form; (5) monitoring and analysis processes are not optimal due to the multiple manual steps required; and (6) information delivery to management is less effective because it is not presented visually. The UML and ERD models described above directly address these problems by providing a clear structural and behavioral blueprint for a system capable of automatically transforming Excel data into visual information to support faster, more effective, and more efficient monitoring, analysis, and decision-making.

User Interface Prototype

The Construction of Prototype stage translated the models above into a set of interface designs developed using Figma, focusing on usability, visual consistency, and ease of access to information. The Login page provides an authentication form (username and password) along with a registration tab, corresponding to the requirement for role-based authentication, as shown in Figure 7.

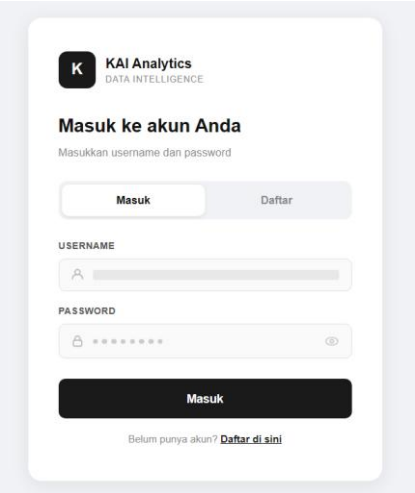

Figure 7 : Login Page Interface

The main Dashboard page displays a sidebar containing menus such as Dashboard, Data Explorer, Visualization, Calculator, Upload Excel, Workbook, Account Management, Audit Log, Storage, and Settings, with menu visibility adjusted according to user roles. The central panel allows users to interactively configure the visualization by selecting the data column, grouping method, calculation type (Total, Average, Minimum, Maximum, Count, Median), chart type (Bar, Line, Area, Pie), and the number of top records to display. This design directly fulfills the identified requirement for automatic data visualization and statistical analysis, as shown in Figure 8.

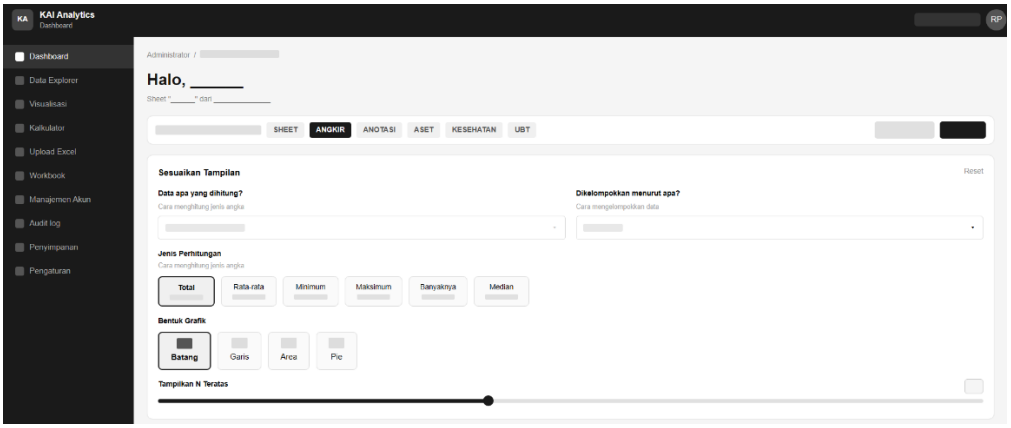

Figure 8 : Dashboard Main Page Interface

The Data Explorer page presents uploaded data in tabular form, complete with search and filter functions, an "Export Excel" button, and a "Column Statistics" panel displaying descriptive statistics such as sum, average, minimum, maximum, median, mode, standard deviation, percentile, and unique values, addressing the requirement for descriptive statistical analysis, as shown in Figure 9.

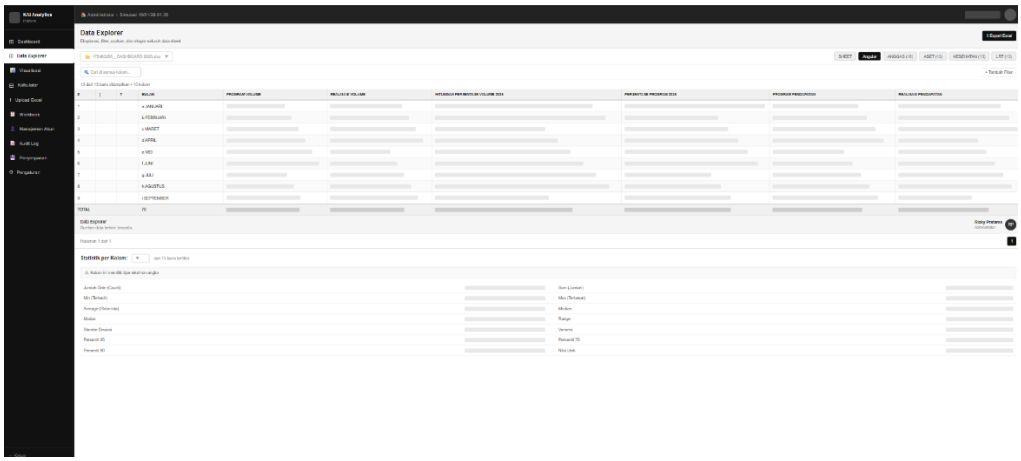

Figure 9 : Data Explorer Page Interface

The Visualization page enables users to generate charts (Bar, Line, Area, Pie, Scatter, and Radar) by configuring the category axis, value axis, calculation method, sorting order, and Top-N data limit. The system automatically generates a chart description based on the selected parameters, followed by the chart itself and a data table summarizing values and percentages. This page directly corresponds to the requirement for Bar Chart, Line Chart, and Pie Chart visualization identified earlier, as shown in Figure 10.

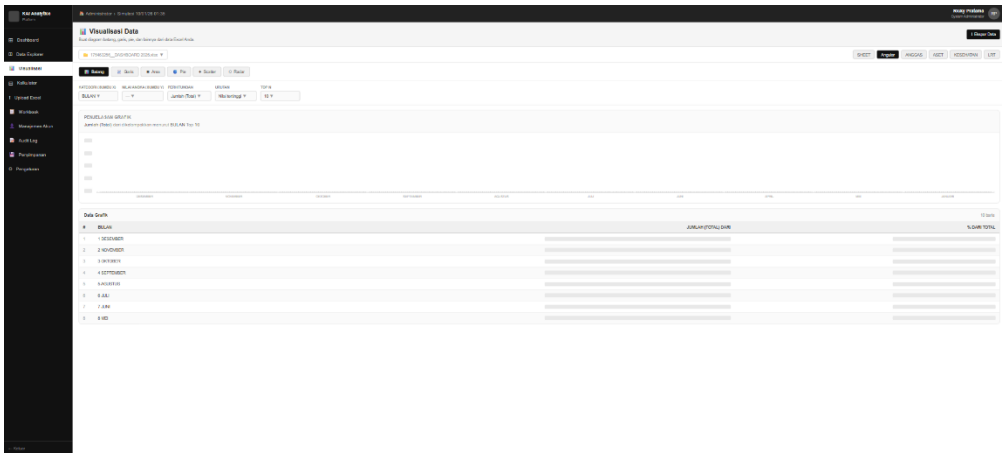

Figure 10 : Data Visualization Page Interface

In addition to these core pages, the system also provides supporting features, including a statistical Calculator page for performing custom calculations on selected data columns; an Upload Excel page supporting .xlsx, .xls, and .csv formats with automatic data-type detection; a Workbook management page for storing and activating multiple uploaded files; an Account Management page for administrators to verify and approve user registrations; an Audit Log page for tracking user activity; a Storage page explaining local browser-based data storage with backup and restore functionality; and a Settings page displaying user profile information and system

statistics. These supporting features strengthen the system's overall usability, security, and manageability, complementing the core visualization functions. Overall, the resulting prototype demonstrates that all functional and non-functional requirements identified in the Communication and Quick Plan stages have been accommodated in both the system models (Use Case, Activity, Class, and ERD) and the interface design. The dashboard transforms data that was previously presented only in static Excel tables into an interactive, automatically generated visual format, thereby addressing the core problem identified at the outset of this study, namely the absence of an automated visualization system to support faster and more effective monitoring and decision-making at PT Kereta Api Indonesia (Persero) Regional Division III Palembang.

CONCLUSION

This study shows that data processing and presentation at PT Kereta Api Indonesia (Persero) Regional Division III Palembang still rely on Microsoft Excel, with data analysis, processing, and visualization performed entirely manually. This condition causes information to be presented only in tabular form, making it difficult for users to quickly interpret large volumes of data, identify patterns, or produce visualizations without a time-consuming manual process.

Based on the functional and non-functional requirements identified through observation, interviews, and discussions with the Information Systems Division, a web-based data visualization dashboard was designed using the Prototype method, encompassing the Communication, Quick Plan, Modeling Quick Design, Construction of Prototype, and Deployment, Delivery and Feedback stages. The Modeling Quick Design stage produced a Business Process Model and Notation (BPMN) of the proposed workflow, a Use Case Diagram identifying the roles and access rights of Staff/User, Manager, and Administrator, an Activity Diagram describing the system's operational logic, a Class Diagram representing the relationships among the User, Workbook, AuditLog, and SheetData entities, and an Entity Relationship Diagram (ERD) defining the underlying database structure.

These models formed the foundation for the Construction of Prototype stage, which produced a user interface developed in Figma, consisting of the Login, Dashboard, Data Explorer, and Visualization pages as the core features, supported by additional features for statistical calculation, file management, account administration, audit logging, storage, and settings. The resulting dashboard prototype is expected to serve as a reference for further system development, enabling operational information to be presented in a more informative, effective, and easily understandable manner, thereby supporting more efficient monitoring and decision-making processes at PT Kereta Api Indonesia (Persero) Regional Division III Palembang.

Future research is recommended to proceed to the system implementation and coding stage based on the models presented in this study, incorporate more interactive features such as real-time filtering and reporting, expand data source integration beyond Microsoft Excel, and conduct system testing along with user

satisfaction evaluation of the developed dashboard.

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