



DEVELOPMENT OF A DATA VISUALIZATION DASHBOARD AT PT KAI REGIONAL DIVISION III PALEMBANG

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Abstract :

PT Kereta Api Indonesia (Persero) Regional Division III Palembang still processes and presents operational data manually in Microsoft Excel. This practice is time-consuming and prone to error, particularly when large datasets are handled. This study aims to implement a previously designed data visualization dashboard as a web-based application and to test its main functions. The system was developed by combining the Prototype method for analysis and design with Rapid Application Development (RAD) for implementation, applying an object-oriented programming paradigm based on use case, activity, class, and entity relationship diagrams. Data were collected through direct observation during the internship. Functional testing used black-box testing with the equivalence partitioning technique. The result is a web-based dashboard comprising ten modules, namely authentication, analytical dashboard, data explorer, data visualization, data calculator, workbook management, account management, audit log, data storage, and settings. It reads Excel and CSV files and automatically converts them into six chart types. Black-box testing on five features showed that all valid and invalid test classes produced the expected results, so the system satisfies the specified functional requirements. The dashboard is therefore functionally feasible as an alternative to manual data processing in Excel.

Keywords : data visualization, dashboard, web-based application, Rapid Application Development, black-box testing

INTRODUCTION

Advances in information technology have changed the way organizations manage and present their data. Technology no longer serves only as a medium for storing data; it also supports the processing and presentation of information so that decisions can be made faster and more accurately (Noviyana & Nasution, 2024). This is particularly relevant for large service organizations such as PT Kereta Api Indonesia (Persero) (hereafter PT KAI), a state-owned enterprise in rail transportation that supports public mobility and the distribution of goods across regions and contributes substantially to the national economy (PT Kereta Api Indonesia [Persero], 2024). PT KAI changed from a public corporation (Perumka) into a limited liability company in 1999 under Government Regulation Number 19 of 1998, and it has since developed into a modern company that uses information technology to support public service and operational efficiency (Muttaqin, 2025). In recent years the company has carried out digital transformation through integrated information systems covering



passenger data, online ticketing, logistics management, and the monitoring of schedules and track infrastructure, which has been reported to increase productivity, speed up internal bureaucracy, and strengthen accountability to the public (Muttaqin, 2025).

In South Sumatra, these operations are managed by Regional Division III Palembang (Divre III Palembang), which is responsible for railway operations on the Palembang–Lubuk Linggau line and the South Sumatra Light Rail Transit (LRT). The wide and complex coverage of this work area requires a reliable information system that can manage and integrate data from various stations and operational units. However, observations during the internship showed that Divre III Palembang still uses Microsoft Excel as the main medium for storing, processing, and presenting operational data, such as monthly volume and revenue data of each work unit. The data are stored in separate Excel files according to the needs of each section. Whenever a report or monitoring result is needed, users must open the relevant file, select the data, process it manually, and create charts with the built-in features of Excel. This process has to be repeated for every new analysis, so it takes considerable time and is prone to error, especially when the amount of data is large. In addition, there is no central repository that keeps the history of uploaded Excel files and their processing results, and there is no mechanism to record user activity, which makes it difficult to trace changes when errors occur.

A data visualization dashboard is one way to address these problems, because it presents data in graphical form that makes patterns, trends, and comparisons easier to grasp. Several previous studies have examined dashboards as a medium for presenting organizational data. Febrianty et al. (2023) analyzed and designed an employee data dashboard at PT Solen System Indonesia in Yogyakarta and succeeded in building a dashboard that supports employee data monitoring. Hidayat (2023) designed a dashboard for visualizing Transjakarta passenger data and presented the information in a more interactive form to support decision-making. Taken together, these studies indicate that the success of a dashboard depends not only on the quality of its design but also on the implementation stage, that is, the extent to which the design is realized as a running system that users can actually operate in the field. Among the studies reviewed in this article, the emphasis lies on the analysis and design of dashboards for employee and passenger data. Less attention has been given to documenting the implementation of a dashboard that reads spreadsheet files directly and combines analytical visualization with role-based access control and user activity auditing in the operational setting of a railway company.

To address this gap, a web-based data visualization dashboard for PT KAI Divre III Palembang was designed and then developed. The analysis and design stages were carried out jointly within the internship team, and this article focuses on the development stage: building the interface of each page, applying the authentication flow and user access rights, implementing the mechanism for reading and processing Excel data, and presenting the processed data as an interactive analytical dashboard. Through this stage, the feasibility of the design

can be tested in practice, to determine whether the system is able to solve the data processing problems faced by Divre III Palembang and whether each feature works according to the specified requirements.

Based on the background above, the research problem of this article is how a web-based data visualization dashboard is developed at PT KAI Divre III Palembang in accordance with the predetermined design. The objectives are, first, to implement the dashboard design as a web-based application that can be used by users at PT KAI Divre III Palembang, and second, to test the main functions of the implemented system to ensure that it runs according to the specified requirements. The contribution of this article is a documented implementation of a dashboard that converts Excel and CSV files into several chart types automatically, restricts features by user role, records user activity in an audit log, and has been tested with black-box testing.

RESEARCH METHOD

This study employed the Rapid Application Development (RAD) method, which allows the system to be built quickly through active user involvement and an iterative process (Kendall & Kendall, 2010). The requirements and the design used as its input came from the analysis and design stage that the internship team carried out with the Prototype method (Rahmawati & Fikari, 2026). This research was conducted at PT Kereta Api Indonesia (Persero) Regional Division III Palembang, in the Information Systems section, over a period of one month, from July to August 2025. The author took part directly in observing the existing process, analyzing needs, developing, and evaluating the system. The analysis and design stages were carried out jointly by the team, whereas the development stage was the author's assigned responsibility.

Data were collected through direct observation of the data management process in the Information Systems section and through documentation of the existing Excel-based operational data. The observation covered how monthly volume and revenue data of each work unit were recorded in separate Excel files, how users selected and processed the data manually, how charts were created with the built-in features of Excel, and what problems arose in the process. The object of this study is the operational data management process in the Information Systems section and the system built to support it, so no population and sample of respondents were used. The data used to test the system were operational data of PT KAI Divre III Palembang that had been adjusted for the purposes of the internship, in .xlsx, .xls, and .csv formats.

The RAD method used in this study consists of three stages, shown in Figure 1:

1. Requirements Planning. The output of the analysis and design stage, namely the use case diagram, activity diagrams, class diagram, entity relationship diagram (ERD), and the interface design, was reviewed to confirm the system requirements to be built. Because the requirements had already been identified from observation of the existing process, this stage refined them into the functional and nonfunctional requirements

- that served as the basis of development, rather than identifying them again from the beginning.
2. RAD Design Workshop. The interface design and process flow were refined intensively and repeatedly, with users in the Information Systems section giving feedback on each proposed design. The refinement covered the layout of each page, the process flow of the main features (authentication, account approval, Excel upload, data analysis, and data storage), and the access rights of the Administrator, Manager, and User roles, so that the agreed design could be built directly.
 3. Implementation. The agreed design was built as a web-based application page by page, covering authentication, the analytical dashboard, data explorer, data visualization, data calculator, Excel workbook management, account management, audit log, data storage, and settings. The system was then tested and made ready for use by users at PT KAI Divre III Palembang.

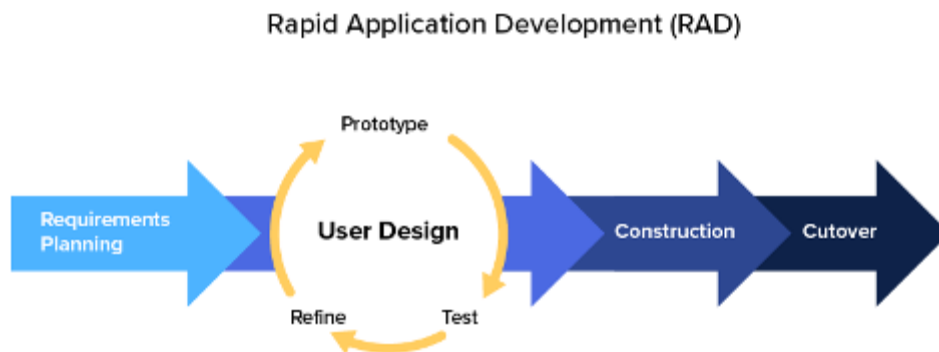


Figure 1 : Rapid Application Development (RAD) Method Applied in This Study

The system was built with the object-oriented programming (OOP) paradigm. OOP models a system as a collection of interacting objects, each an instance of a class with attributes that represent data and methods that represent behavior (Rosa & Shalahuddin, 2018). It rests on four principles: encapsulation, which bundles data and methods in one object and protects the data from improper access; inheritance, which passes attributes and methods from a class to its subclasses; polymorphism, which allows one method to behave differently in different classes; and abstraction, which simplifies a complex system by showing only the parts relevant to the user (Rosa & Shalahuddin, 2018). OOP was chosen because it matches the class diagram produced in the design stage, so the classes, attributes, and relations could be translated directly into the program structure.

The implemented system was tested with black-box testing, which focuses on the output of the system for a given input without examining the internal code structure (Pressman & Maxim, 2015). The technique used was equivalence partitioning, which divides input data into valid and invalid equivalence classes

and selects one or more representative data from each class for testing (Pressman & Maxim, 2015). Testing was applied to five features: login, registration, Excel upload, data calculator, and account management.

Data analysis techniques in this study included requirements analysis (functional and nonfunctional), design analysis using UML diagrams and the ERD prepared in the analysis and design stage, and descriptive analysis of the test results. In the last of these, the actual output of the system was compared with the expected result for each test class. A class was marked "Conforming" when the two matched, and "Not conforming" otherwise. The feasibility of the system was concluded from the conformity of all test classes with the specified functional requirements.

FINDINGS AND DISCUSSION

This section presents the results in the order of the development process. Because the analysis and design stages were reported in a previous study of the same project (Rahmawati & Fikari, 2026), they are summarized here only to the extent needed to explain the implementation. The implementation of each page and the testing results follow, together with a discussion of the findings.

Analysis of the Existing System and Problems

Data management at PT KAI Divre III Palembang is carried out with Microsoft Excel as the main medium for storage and processing. Operational data, such as the monthly volume and revenue of each work unit, are recorded in separate Excel files according to the needs of each section. When the data are needed for reporting or monitoring, the user opens the relevant file, selects the data, and processes it manually, either through simple calculations or by creating charts with the built-in features of Excel. The process must be repeated whenever a new report or analysis is required.

Observation of this process identified four problems. First, manual processing in Excel takes a relatively long time, especially when the data are large. Second, presenting data only in tables makes it difficult for users to understand patterns, trends, and comparisons quickly. Third, there is no central medium that stores the history of uploaded Excel files and their processing results, so data are easily scattered across separate files. Fourth, there is no mechanism for recording user activity on uploaded or changed data, so the history of changes is hard to trace when errors occur. In the design, the first problem is addressed by automatic reading of Excel and CSV files and by the analytical dashboard and data calculator. The second is addressed by chart visualization. The third is addressed by workbook storage with a switchable active workbook, and the fourth by an audit log of user activities.

Requirements Identification

The requirements identified in the analysis stage (Rahmawati & Fikari, 2026) were refined in the Requirements Planning stage into ten functional and four nonfunctional requirements, as summarized in Table 1. The functional requirements describe what the system must be able to do, while the nonfunctional requirements describe the qualities it must have. Requirement

NF3 was set so that operational data are not sent to an external server and their confidentiality is maintained.

Table : 1 Functional and Nonfunctional Requirements of the System

Code	Requirement
F1	The system authenticates users through a login page and a registration page for new accounts.
F2	The system reads and uploads Excel and CSV files, including files with more than one sheet.
F3	The system automatically displays a data summary on an analytical dashboard based on the uploaded file.
F4	The system displays, filters, and exports detailed data through the Data Explorer page.
F5	The system generates data visualizations in bar, line, area, pie, scatter, and radar charts.
F6	The system performs statistical calculations on data columns selected by the user through the Data Calculator.
F7	The system stores several Excel files as workbooks and allows users to switch between active workbooks.
F8	The system manages user accounts, including approval of new registrations and assignment of user roles.
F9	The system records user activities in an audit log.
F10	The system provides backup and restore mechanisms for data.
NF1	The interface is user-friendly for users with a non-technical background.
NF2	Access rights are restricted by user role (Administrator, Manager, and User).
NF3	The system can be accessed locally (localhost) without sending data to an external server.
NF4	The system responds quickly during data processing and chart generation.

System Design

The system design produced in the analysis and design stage consists of a use case diagram, activity diagrams, a class diagram, and an entity relationship diagram (ERD) (Rahmawati & Fikari, 2026). The use case diagram identifies three actors with different access rights, namely User, Manager, and Administrator. The User can log in and register, view the dashboard, explore data, visualize charts, and use the statistical calculator. The Manager holds all User privileges and can additionally upload and delete workbooks. The Administrator holds the highest access level, with all functions of the User and Manager plus account management, viewing the audit log, and deleting all data, as shown in Figure 2.

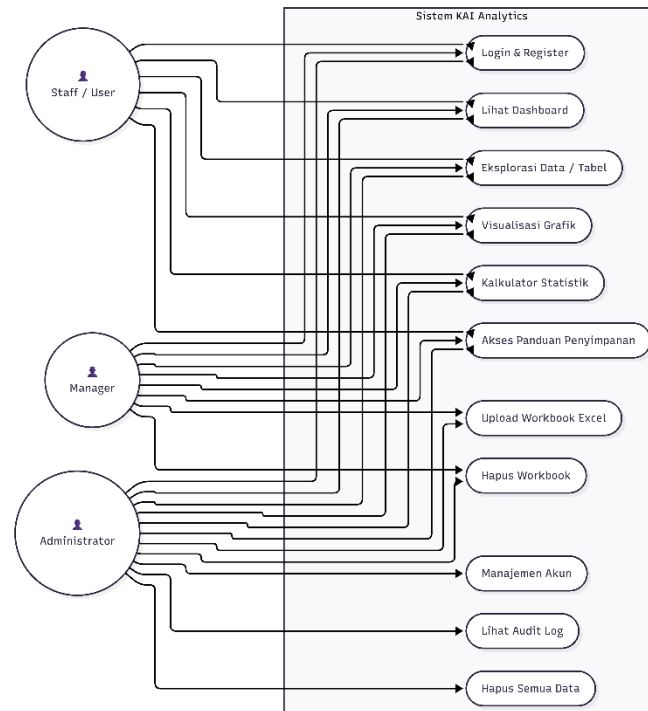


Figure 2 : Use Case Diagram of the Proposed System

The workflow of each process is described by activity diagrams, of which the data visualization and analysis diagram is presented as a representative example because it covers the core features of the system (Figure 3). The process begins when the user selects the active workbook from the sidebar and then chooses one of three analysis features. In the Data Explorer, the system displays a table of rows and columns that can be filtered, searched, and sorted. In the Statistical Calculator, the user selects a numeric column and a function (SUM, MIN, MAX, or AVERAGE), and the system displays the result as a descriptive statistics summary. In chart visualization, the user selects the columns for the X and Y axes and the chart type, and the system processes them into a diagram. These three paths correspond to requirements F4, F6, and F5 in Table 1.

Four other activity diagrams were prepared in the same way. Login and registration holds a new account as "Pending" until it is approved by the Administrator, and valid credentials and account status grant access to the main page. Account confirmation lets the Administrator approve a pending request and assign a role, or reject it. Excel upload reads a file, shows the list of sheets with a data preview, and stores the workbook and the audit record after the user saves. Data storage management covers export backup in JSON format, import backup, and reset data.

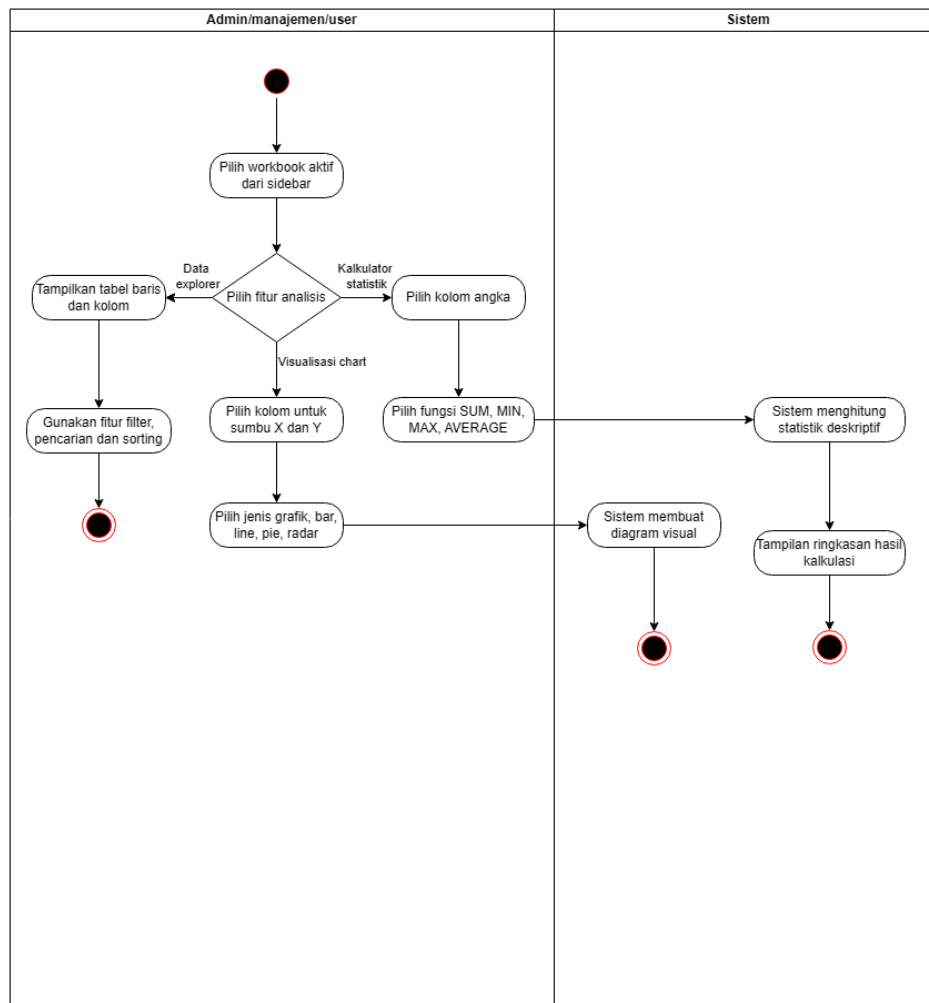


Figure 3 : Activity Diagram of Data Visualization and Analysis

The class diagram represents the data structure used by the system, including the user, workbook, sheet, and audit log classes. One user can upload many workbooks and trigger many audit records, and one workbook can contain multiple sheets (Rahmawati & Fikari, 2026). Because the system was built with the object-oriented paradigm, the classes, attributes, and relations in this diagram could be translated directly into the program structure (Rosa & Shalahuddin, 2018), as shown in Figure 4.

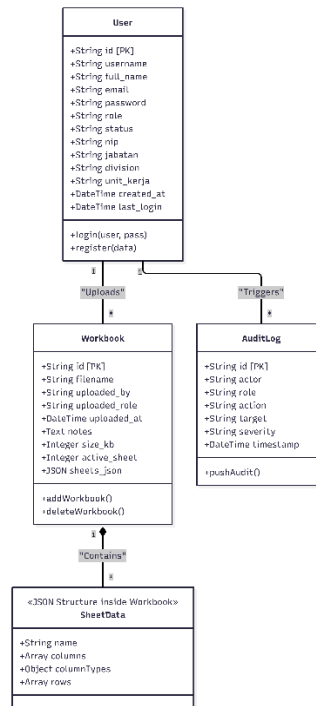


Figure 4 : Class Diagram of the Proposed System

The database structure was designed with an ERD in a logical and a physical form. The logical design has four main entities, namely users, workbooks, audit, and audit_log. The users entity holds the identity attributes of a user (username, fullName, email, password, nip, division, jabatan, unitKerja, role, status, createdAt, and lastLogin), and one user can be related to many records in the other three entities. The physical design (Figure 5) adds data types, lengths, and key markers. Each entity has an id as its primary key, username and email in users are unique keys that prevent duplicate accounts, and actor in audit and audit_log and uploaded_by in workbooks are foreign keys referring to users. The workbooks entity also stores size_kb (INT) and sheets_json (LONGTEXT) to hold the data of uploaded sheets. Although the ERD is expressed in relational form, the current implementation stores data in the browser's LocalStorage, as explained in the results of the storage page, and moving to a server database is proposed as future development.

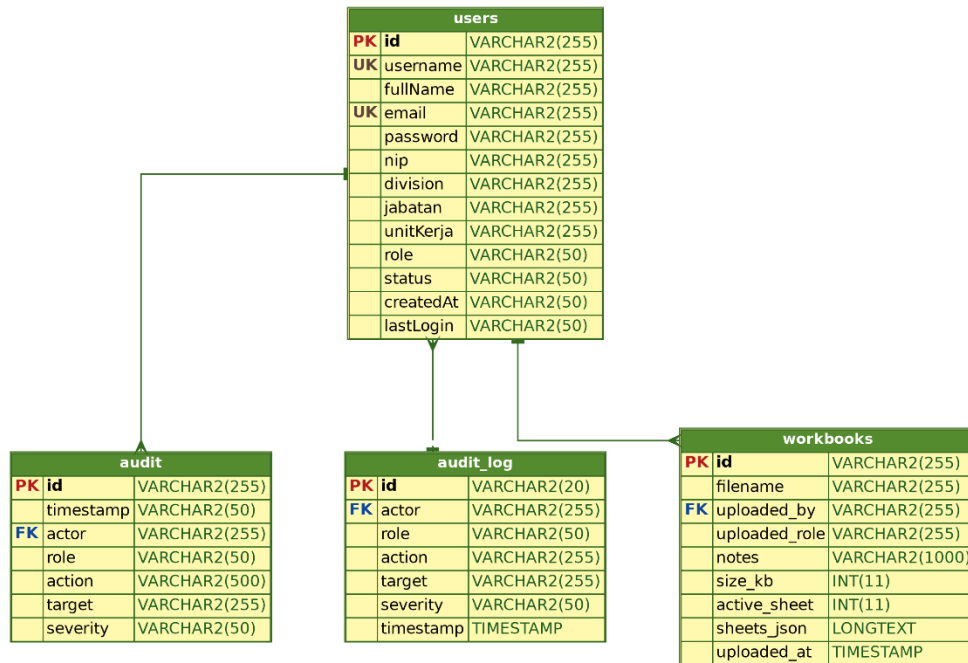


Figure 5 : Entity Relationship Diagram (Physical)

Discussion of the Analysis and Design Results

Each problem found in the existing process corresponds to a feature in the design, and each feature is stated as a requirement in Table 1. The design outputs also form a connected set. The use case diagram defines who may do what, the activity diagrams define the order of each process, the ERD defines how data and user activity are related, and the class diagram defines the structure that is translated into code. This is consistent with the way the two methods were combined. The design produced in the Prototype stage became the input for Requirements Planning and the RAD Design Workshop, so the Implementation stage could proceed without identifying the requirements again (Kendall & Kendall, 2010; Pressman & Maxim, 2015).

Two design decisions respond to the organizational problems rather than the technical ones. The registration flow holds a new account as "Pending" until the Administrator assigns a role, which ties system access to authorization. The audit log and the user-linked foreign keys in the ERD allow every upload and change to be traced to a user, which addresses the absence of an activity record in the existing Excel-based process.

Implementation Results

After the design was refined in the RAD Design Workshop, it was implemented as a web-based application. The results are presented page by page and grouped by function, and each page is related to the requirements in Table 1.

Authentication Pages

The Login page is the main gateway before users can access the system. Users must enter a registered username and password. The system checks the credentials and, if they match, directs the user to the Dashboard page according

to the role of the account (F1, NF2). A link to the registration page is provided at the bottom of the form for users without an account, and a button to show or hide the password makes input easier without reducing security (Figure 6).

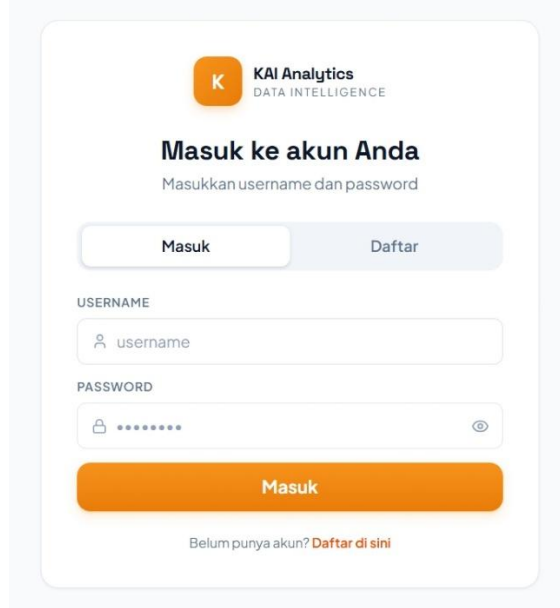
The image shows a login page for 'KAI Analytics DATA INTELLIGENCE'. At the top is an orange square logo with a white 'K'. Below the logo, the text 'Masuk ke akun Anda' is displayed in bold, followed by 'Masukkan username dan password' in a smaller font. There are two buttons: 'Masuk' (orange) and 'Daftar' (light blue). Below these buttons are two input fields. The first is labeled 'USERNAME' and contains the placeholder text 'username'. The second is labeled 'PASSWORD' and contains a series of dots, with a small eye icon to its right for toggling visibility. At the bottom of the form is a large orange button labeled 'Masuk'. Below this button is a link that says 'Belum punya akun? [Daftar di sini](#)'.

Figure 6 : Login Page

The Register page is used by new users to request an account. The registration form asks for full name, email address, username, and password, with position and division as optional fields that complete the user profile. After the form is submitted, the account is stored with the status "Pending" and cannot be used to log in until it is approved by the Administrator. This mechanism ensures that only authorized users can access the operational data of the company (F1, F8, NF2), as shown in Figure 7.

KAI Analytics
DATA INTELLIGENCE

Buat akun baru

Isi data Anda untuk mendaftar

Masuk Daftar

NAMA LENGKAP *

Budi Santoso

EMAIL *

nama@kai.id

USERNAME * PASSWORD *

budi.s *****

JABATAN DIVISI

Staf Operasional

Daftar

Sudah punya akun? [Masuk](#)

Figure 7 : Register Page

Analysis and Visualization Pages

The Dashboard page is the core of the system. It automatically displays an analytical summary of the uploaded Excel data in visual form (F3). At the top of the page, users select the workbook and the sheet to be analyzed. The "Customize Display" feature lets users choose the data column to be calculated, the grouping category, the calculation type (total, average, minimum, maximum, count, or median), and the chart type (bar, line, area, or pie) without any manual setup in the Excel file. Below it, the system displays summary cards with the main calculation result, the number of rows and columns, a bar chart and a pie chart of the data distribution, a ranking of the top categories, and a summary table of all numeric columns in the active sheet. All components are updated immediately whenever the user changes a setting (Figure 8).

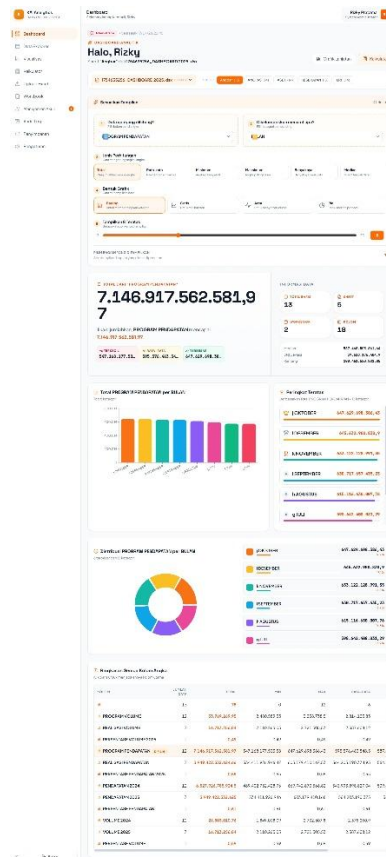


Figure 8 : Dashboard Page

The Data Explorer page gives direct access to all rows and columns of the active sheet in tabular form (F4). Users can search across all columns and add filters according to their needs. The bottom of the table shows a total row (Σ) that automatically sums every numeric column, and a "Column Statistics" panel presents a complete statistical summary of the selected column, including average, median, mode, standard deviation, variance, and percentile values. The data can also be exported back to Excel format with the "Export Excel" button (Figure 9).

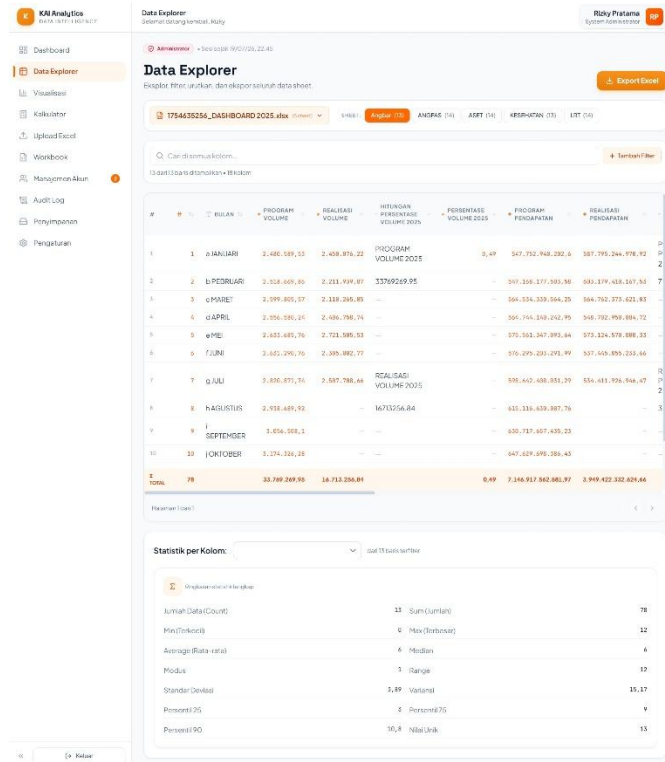


Figure 9 : Data Explorer Page

The Data Visualization page provides chart creation that is more flexible than the summary charts on the Dashboard (F5). Users select the chart type (bar, line, area, pie, scatter, or radar), the category on the X axis, the numeric value on the Y axis, the calculation type, the sorting order, and the number of top categories (Top N) to be shown. Each combination of settings immediately produces a chart with a short narrative description above it, together with a detail table of the chart data that includes the percentage contribution of each category to the total (Figure 10).

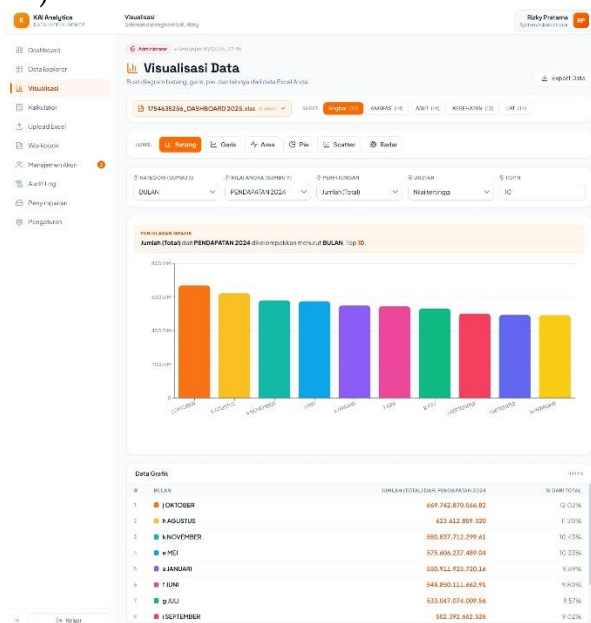
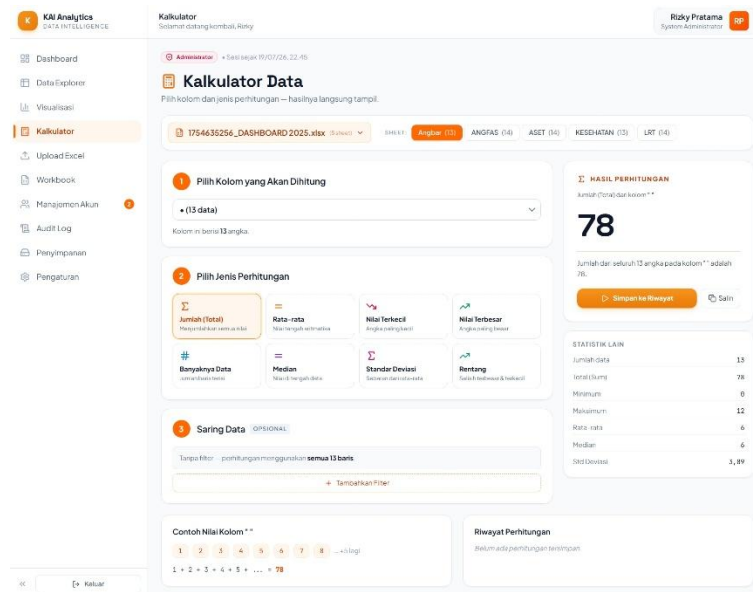


Figure 10 : Data Visualization Page

The Data Calculator page was implemented to perform statistical calculations on a single data column without opening the whole table (F6). Users select the column and the type of calculation, such as sum, average, minimum, maximum, count, median, standard deviation, or range. The result is shown directly on the right-hand panel together with other supporting statistics. The system also provides a "Filter Data" feature for calculating only part of the rows, and a saved calculation history so that users can review earlier results (Figure 11).

**Figure 11 : Data Calculator Page**

Data Management Pages

The Upload Excel page is the main input mechanism of the system (F2). It accepts .xlsx, .xls, and .csv files through an upload area that supports both drag-and-drop and manual file selection. The system reads the first row as the column header, detects the data type of each column automatically (number, text, date, or boolean), and reads all sheets of an Excel file at once. Usage instructions are displayed on the right side of the page to help users understand the supported file formats (Figure 12).

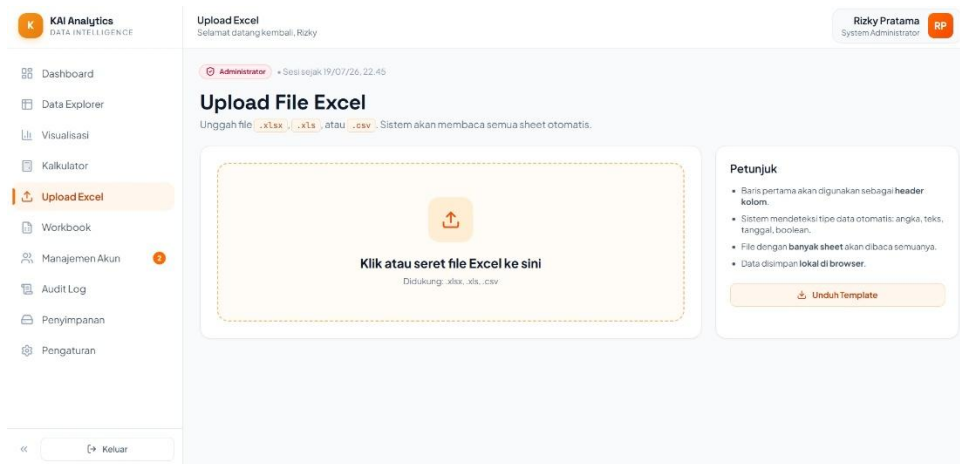


Figure 12 : Upload Excel Page

The Workbook page is the center for managing all Excel files that have been uploaded (F7). Each workbook is displayed as a card containing the number of sheets, the number of rows, the file size, the upload time, and the user who uploaded it. Users can set a workbook as the active workbook, download the uploaded file again, or delete a workbook that is no longer needed. The active workbook becomes the data source for the Dashboard, Data Explorer, Data Visualization, and Data Calculator pages (Figure 13).

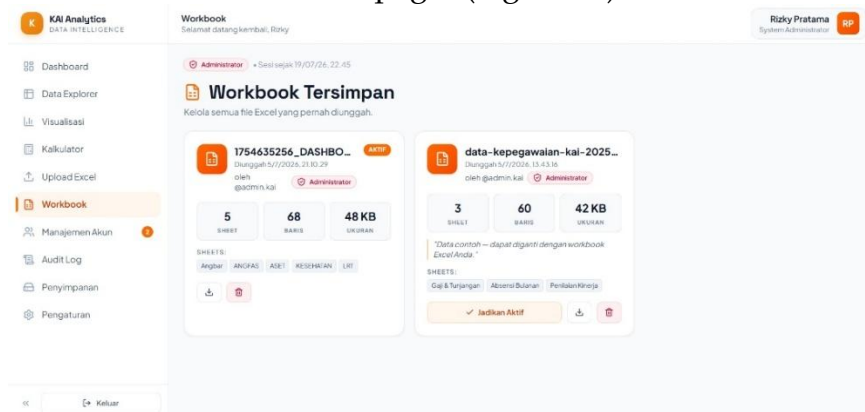


Figure 13 : Workbook Page

Administration and System Pages

The Account Management page is available only to the Administrator for managing all user accounts (F8, NF2). It lists accounts by status, namely Requests (waiting for approval), Active, Inactive, and all registered accounts. For each pending account, the Administrator can approve, reject, or delete the request. The identity of the user, including employee number (NIP), position, division, and work unit, is displayed to help the Administrator decide on the eligibility and the role of the account (Figure 14).

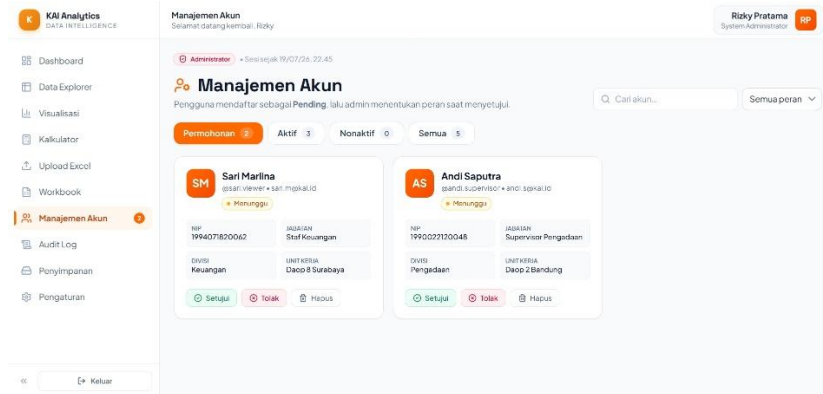


Figure 14 : Account Management Page

The Audit Log page records important activities in the system (F9), such as login, logout, workbook upload, approval of new accounts, and automatic data backup. Each record shows the username, role, time of the event, a description of the activity, and a severity level of SUCCESS or INFO. Search and filtering by severity help the Administrator trace a particular activity history, and all records can be exported with the "Export" button (Figure 15).

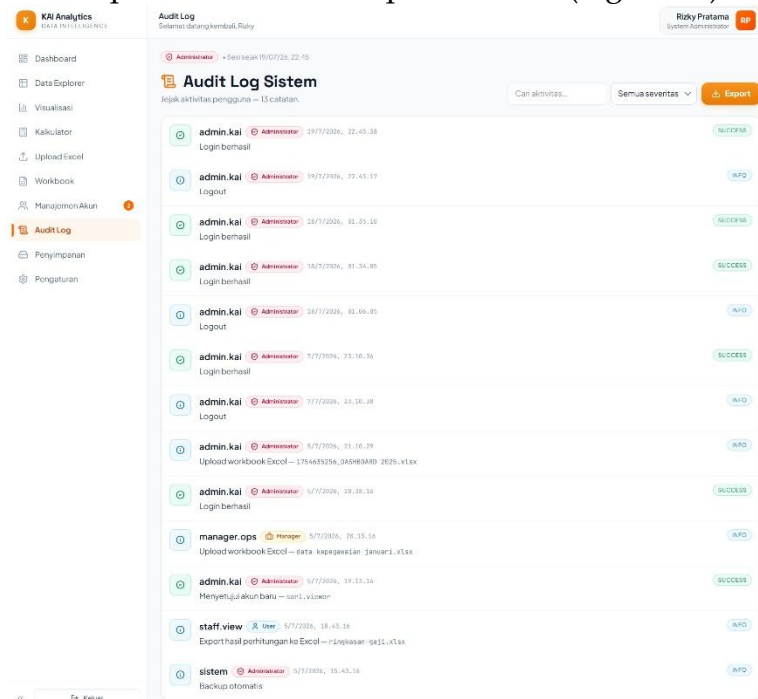


Figure 15 : Audit Log Page

The Data Storage page gives users transparency about where and how the data of the system are stored. In the current implementation the system uses the browser's LocalStorage. The page explains that all data are stored on the user's device and are not sent to an internet server (NF3), but may be lost if the browser cache is cleared. To reduce this risk, the page provides a "Download Backup" feature that exports all data into one JSON file and a "Restore from Backup"

feature that returns data from a previously downloaded backup (F10). A "Storage Details" table shows the storage size of each data category (Figure 16).

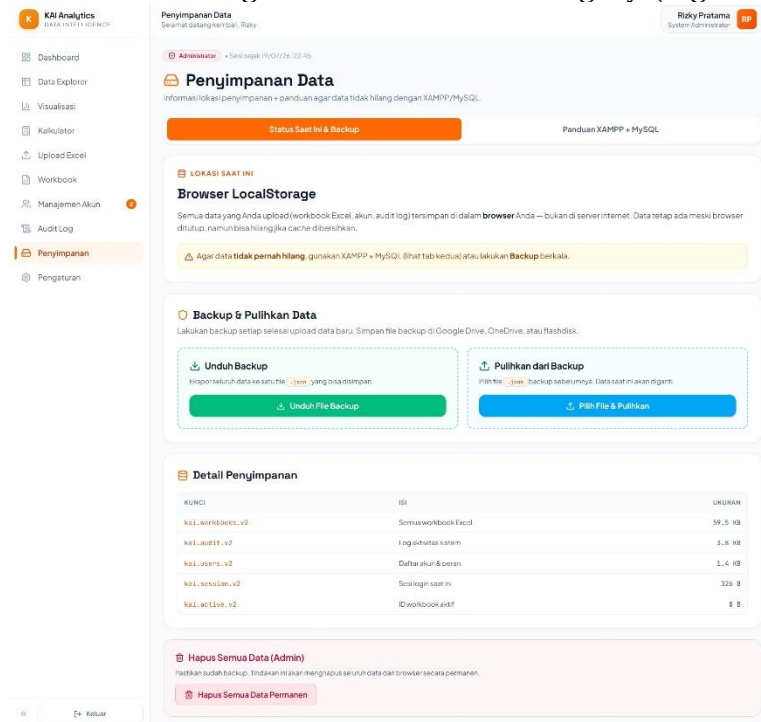


Figure 16 : Data Storage Page

The Settings page shows the profile of the logged-in user and brief system statistics, namely the number of workbooks, total sheets, total data rows, registered accounts, and audit entries, along with general application information such as the storage mode and the build version. Its Role Access Matrix explicitly shows what each role (Admin, Manager, and User) can do in each feature of the system (NF2). For the Administrator, the page also provides advanced system actions, namely Reload System and Reset Entire System (Figure 17).

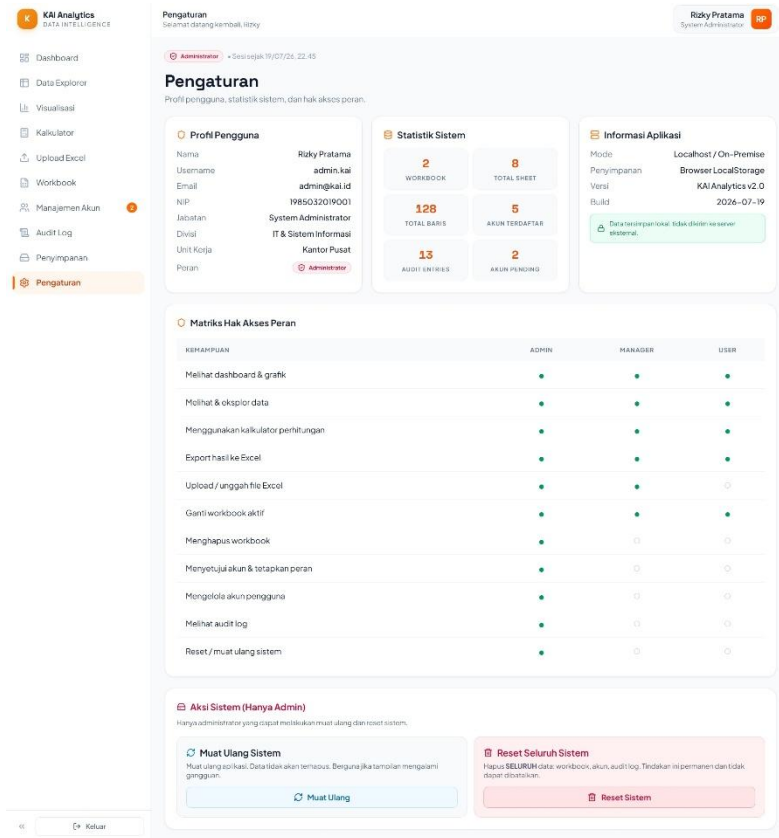


Figure 17 : Settings Page

Overall, the twelve pages cover all ten functional requirements (F1-F10) and the requirements on role-based access (NF2) and local data storage (NF3). The requirements on a user-friendly interface (NF1) and fast response (NF4) were addressed in the interface design but were not evaluated formally in this study, so they are noted as limitations and are followed up in the suggestions for further research.

System Testing Results

The implemented system was tested with black-box testing using the equivalence partitioning technique on five features: login, registration, Excel upload, data calculator, and account management. For each feature, valid and invalid equivalence classes were defined and a representative input was tested for each class. In total, 22 test classes were tested. The results for each feature are presented in Tables 2 to 6.

Table : 2 Equivalence Partitioning Test of the Login Page

No	Input Data	Test Class	Expected Result	Test Result
1	Registered username and password that match	Valid	The user logs in successfully and is directed to the Dashboard page	Conforming

2	Registered username, wrong password	Invalid	The system denies access and displays an error message	Conforming
3	Unregistered username	Invalid	The system denies access and displays an error message	Conforming
4	Username or password left empty	Invalid	The system displays a validation message that the field is required	Conforming
5	Registered account with the status "Pending" (not yet approved by the Administrator)	Invalid	The system denies access until the account is approved	Conforming

Table : 3 Equivalence Partitioning Test of the Register Page

No	Input Data	Test Class	Expected Result	Test Result
1	All required data (name, email, username, password) filled in correctly and the email format is valid	Valid	The account is registered successfully with the status "Pending"	Conforming
2	Invalid email format (without "@" or domain)	Invalid	The system displays a validation message that the email format is invalid	Conforming
3	Username already used by another account	Invalid	The system rejects the registration and displays a message that the username is already in use	Conforming
4	One of the required fields (name, email, username, or password) left empty	Invalid	The system displays a validation message that the field is required	Conforming
5	Position and division fields left empty (optional fields)	Valid	The registration is still processed	Conforming

Table : 4 Equivalence Partitioning Test of the Upload Excel Page

No	Input Data	Test Class	Expected Result	Test Result
1	File in .xlsx, .xls, or .csv format with a	Valid	The file is uploaded successfully and all sheets are read by the system	Conforming

	header in the first row			
2	File in a format other than .xlsx, .xls, or .csv (for example .pdf or .docx)	Invalid	The system rejects the upload and displays a message that the format is not supported	Conforming
3	Excel file with more than one sheet	Valid	All sheets are read and can be selected in the sheet navigation	Conforming
4	Empty file (no data rows)	Invalid	The system displays a message that no data were found	Conforming
5	No file selected when the upload button is pressed	Invalid	The system does not process the upload and stays on the Upload Excel page	Conforming

Table : 5 Equivalence Partitioning Test of the Data Calculator Page

No	Input Data	Test Class	Expected Result	Test Result
1	Column with numeric data selected with a valid calculation type (total, average, etc.)	Valid	The calculation result and supporting statistics are displayed according to the selected column	Conforming
2	Column with text data (not numeric) selected for calculation	Invalid	The system displays a message that the column cannot be calculated statistically	Conforming
3	No column selected yet	Invalid	The system displays an empty result or a request to select a column first	Conforming
4	"Filter Data" applied to part of the data rows	Valid	The calculation result covers only the rows that match the filter	Conforming

Table : 6 Equivalence Partitioning Test of the Account Management Page

No	Input Data	Test Class	Expected Result	Test Result
1	Administrator approves an account with the status "Pending" and assigns a role	Valid	The account status changes to "Active" according to the assigned role	Conforming
2	Administrator rejects an account with the status "Pending"	Valid	The account status changes to rejected or inactive	Conforming

3	A user with the User role tries to access the Account Management page	Invalid	The system denies access because it is outside the access rights of the User role	Conforming
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Table 7 summarizes the results of all five features. All 22 test classes, consisting of 9 valid and 13 invalid classes, produced results that conform to the expected results.

Table : 7 Summary of Black-Box Testing Results

Feature	Related Requirement	Valid Classes	Invalid Classes	Total	Conforming
Login	F1, NF2	1	4	5	5
Register	F1, F8	2	3	5	5
Upload Excel	F2	2	3	5	5
Data Calculator	F6	2	2	4	4
Account Management	F8, NF2	2	1	3	3
Total		9	13	22	22

Discussion

The test results show that the system handles both valid and invalid inputs on the five tested features. Invalid credentials, accounts that have not been approved, unsupported file formats, empty files, non-numeric columns, and access by an unauthorized role were all rejected with an appropriate response, while valid inputs were processed as expected. On this basis, the tested features satisfy the functional requirements F1, F2, F6, and F8 and the access-rights requirement NF2 in Table 1.

The results on access control deserve particular attention because they answer a need that the Excel-based process could not meet. In the existing process, any user who has a file can open and change it. In the implemented system, a new account cannot be used until the Administrator approves it (Tables 2 and 3), and a user with the User role cannot open the Account Management page (Table 6). Together, these two mechanisms limit access to operational data according to role and authorization.

The other problems found in the existing process are addressed by features of the implemented system. Automatic reading of Excel and CSV files and the analytical dashboard address manual processing and tabular-only presentation, workbook storage addresses the lack of a central repository, and the audit log addresses the lack of an activity record. Compared with the previous studies reviewed in the Introduction, which concentrated on the analysis and design of dashboards (Febrianty et al., 2023; Hidayat, 2023), this study shows that a dashboard design can be realized as a working web-based application and that its main functions can be tested. It also extends the design of the same project (Rahmawati & Fikari, 2026) by turning it into a system that runs.

Several limitations should be taken into account when interpreting these results. First, the black-box test covered five features only, so the Dashboard, Data Explorer, Data Visualization, Workbook, Audit Log, Data Storage, and Settings pages were not part of the test scope. Second, equivalence partitioning uses representative data for each class, so it does not test every possible input. Third, the test data were operational data that had been adjusted for the internship, and this study did not carry out user acceptance testing or performance testing. The time saved compared with manual processing in Excel was therefore not measured. Fourth, the system currently stores data in the browser's LocalStorage, which means that data stay on one device, may be lost when the browser cache is cleared, and cannot be accessed by many users at the same time. Moving the storage to a server database such as MySQL, testing with larger Excel files, and evaluating user satisfaction are therefore proposed as further development.

CONCLUSION

This study developed a web-based data visualization dashboard for PT Kereta Api Indonesia (Persero) Regional Division III Palembang, where operational data are still stored, processed, and presented manually in Microsoft Excel. The system was built with the Rapid Application Development method on the basis of the design previously produced with the Prototype method, and it applies the object-oriented programming paradigm.

The implementation resulted in an application with ten modules, namely authentication, analytical dashboard, data explorer, data visualization, data calculator, Excel workbook management, account management, audit log, data storage, and settings. The system reads Excel (.xlsx and .xls) and CSV files, including files with more than one sheet, and converts them automatically into six chart types (bar, line, area, pie, scatter, and radar) together with statistical summaries. Access to features is restricted by three user roles, namely Administrator, Manager, and User, and a new account must be approved by the Administrator before it can be used. User activities are recorded in an audit log, and data can be backed up and restored.

Black-box testing with the equivalence partitioning technique on the login, registration, Excel upload, data calculator, and account management features covered 22 test classes, consisting of 9 valid and 13 invalid classes, and all of them produced results that conform to the expected results. This indicates that the tested features run in accordance with the specified functional requirements, including input validation and role-based access restriction, so the dashboard is functionally feasible as an alternative to manual data processing in Excel at PT Kereta Api Indonesia (Persero) Regional Division III Palembang. However, user-friendliness and response speed were not evaluated formally, and the pages outside the five tested features were not part of the test scope.

Further research is recommended to move data storage from the browser's LocalStorage to a server database such as MySQL, so that data are safer, do not depend on the browser cache, and can be accessed by many users at the same

time. It is also recommended to add notifications for the Administrator when new account requests or other important activities occur, to test the performance of the system with Excel files of much larger volume than the test data used in this study, to add report export in PDF format in addition to Excel, and to evaluate user satisfaction with the developed dashboard.

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