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Analysis and Design of the Nusa Graha Module for Village Asset Management and Facility Booking on the NUSAEKA Multi-Tenant SaaS Platform

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Abstract

In most regions of Indonesia, village asset management and the process of booking village facilities are still carried out manually, which can lead to disorganized record-keeping, data loss, and a lack of access for village residents. This study was conducted to analyze and evaluate the Nusa Graha module as a component of the Nusaeka multi-tenant SaaS platform, focusing on village inventory management, automatic asset depreciation, and web-based village booking services. This research was conductes through a literature review and system analysis obtained through consultation with supervising lecturer as well as document analysis. The analysis results include business flowcharts, Data Flow Diagrams (DFDs) at levels 0 and 1, and Entity-Relationship Diagrams (ERDs), which consist of several main tables. The result of this study have led to the design of the Nusa Graha modular system, which is expected to assist and facilitate vilages in managing their assets and streamlining the facility booking process, thereby creating a structured and integrated systam. Additionally, the Nusa Graha module facilitates integration with the Nusa Artha financial module if the village subscribes to it.

Keywords: *Asset Management; Booking System; SaaS; Multi-Tenant; Village Information System*

1. Introduction

In this industry 4.0 era, advancements in information technology have been developing at an increasingly rapid pace in step with the times, including in areas such as asset management and public services at the village level, which have also undergone significant changes. To this day, many villages still manage their assets, equipment, and facilities manually or using simple tools [3]. However the continued manual management of village assets can lead to disorganizes record-keeping, data loss, recording errors, and difficulties in determining the real-time condition of assets-issues that frequently arise. Village assets themselves can become a significant source Pendapatan Asli Desa (PADes) if effectively managed through a leasing scheme to the community.

Similar problems are also found in asset rental systems that are still conductes manually, leading to inefficient and disorganized rental processes. According to research conducted at the PKTJ Tegal Public Service Agency, a non-integrated asset leading system can lead to disorganized booking processes, flow feedback from tenants, and a higher likehood of administrative errors [2]. Another study was also conducted at the Meteseh Village Multipurpose Building, which showed that village facilities are managed manually, requiring residents to come directly to the village hall just to check asset availability. This clearly demonstrates inefficiency and hinders the accessibility of public services.

One solution to this problem is to develop a web-based information system that can digitally integrate the entire asset management process. Additionally, the use of a web-based system can expedite the booking process, speed up response times, and simplify the monitoring and management of rental data. Therefore, this study focuses on the analysis and design of the Nusa Graha Module, which is part of the Nusaeka platform, to help address these challenges. The Nusa Graha module is built on a multi-tenant Software as a Service SaaS model. This multi-tenant architecture allows a single platform to be used by multiple villages while keeping data separate for each village. The module is designed to support the management of village assets, including asset inventory, asset status tracking, and the booking or rental of facilities by residents and non-residents.

Multi-tenant feature in the Nusa Graha module allows villages that subscribe to the financial module to record rental payments within the system. However, integration with the financial module is optional. The results of the analysis and system design is this study include Data Flow Diagrams (DSDs) Entity Relationship Diagrams (ERDs), and business process flowchart for the Nusa Graha module. This study is expected to serve as a foundation for developing a more structured system and improving the efficiency of village services in managing digital assets and facility rentals.

2. Literature Review

2.1. Information Systems

A system is a collection of components that work together to archive specific objectives, while information is data that has been collected and possesses values or meaningful insights for the recipient. Information can also provide new insights to enhance knowledge about a subject or situation. According to [9] an information system consist of a collection of hardware, software, brainware, procedures, and regulations that have been integrated to transform data into useful information for problem-solving and decision-making. An information system is a set of related components that collect, process, analyze, and disseminate information to support decision-making and business development. Therefore, overall, an information system is a process that runs regularly and operates in a cyclical manner.

2.2. Data Asset Management

Based on [3], an asset is a resource owned by an entity-whether tangible or intangible-that hold economic or exchange value for individuals, institutions, or organizations. Ministry of Home Affairs Regulation No. 1 of 2016 defines village assets as property owned by the village that is acquired through the Village Budget (APBDes) or derived from the village's original wealth [4]. Asset management is the process of ensuring assets are properly recorded and utilized. Design, procurement, user, utilization, security, maintenance, disposal, and control are all aspects of asset management itself, which must be carried out based on the principles of functionality, transparency, efficiency, and accountability.

2.3. Booking System

A booking system, also known as a reservation system, is a system commonly used to manage the booking or inventory process so that users can check availability and make reservations in an organized manner. A web-based booking system is a digital solution that allows users to submit requests to use facilities or services online without having to go through a lengthy confirmation process. This booking system involves two main roles: users, who can view asset availability, submit requests, and monitor approval status; and administrators, who are responsible for managing data, confirming or rejecting requests and monitoring all transactions through an integrated dashboard.

2.4. Software as a Service (SaaS) & Multi-Tenant

Software as a Service (SaaS) is the provision of web-based applications that allow users to access system without the need for local installation and often utilize cloud-based systems. In practice, SaaS often employs a multi-tenant architecture, meaning a single application can be used by multiple organizations (tenant) simultaneously on shared infrastructure, while logically managing data across tenants [8]. Research on multi-tenant SaaS on AWS explains that the main challenges of multi-tenancy are maintaining tenant data isolation, system security, and scalability as the number of tenants increases [8]. Additionally, multi-tenant systems require access control mechanisms such as role-based access control (RBAC) and data-level security measures like row-level security to prevent tenant data breaches.

3. Research Methodology

This study was conducted using systems analysis techniques to integrate the Nusa Graha module into the Nusaeka multi-tenant SaaS platform. The objective of this study is to develop a village asset management system and a process for booking village assets and facilities without implementing a full-scale application.

3.1. Data Collection

Data collection in this study was conducted using two methods. First, relevant scientific journals were reviewed on the topics of asset management, booking systems, facility rentals, and the concept of multi-tenant SaaS architecture. To determine the functional and non-functional aspects of the Nusa Graha module, system requirements were obtained through discussions and consultations with the supervising lecturer as well as by analyzing documents.

3.2. Business Process Design

The system design phase involves modeling business processes using flowcharts to illustrate the system's workflow, which includes asset procurement, facility verification, employee identity verification, and payment confirmation. Flowcharts are created from two prespectives: one for village administrations and another for users (resident tenants).

3.3. Data Flow Analysis

Data Flow Diagrams (DFDs) are used in data analysis to depict the flow of data between system entities and processes. DFDs are used to determine how data flows from user input to the output required by various parties within the Nusa Graha module.

3.4. Database Design

The Entity-Relationship (ERD) in this study is used in the data structure to identify entities, attributes, and relationship between tabels within the Nusa Graha module. The ERD in this study covers seven main entities: asset, asset_categories, asset_booking, asset_payment, asset_depreciations, asset_maintenance, and renters.

4. Results and Discussion

4.1. Overview of the Nusa Graha Module

One of the modules in the Nusaeka platform, Nusa Graha, is designed to support the management of village-owned assets and facilities. The Nusa Graha module is designed to help villages more easily record and catalog assets such as village halls, activity equipment, and other facilities in a structured manner. Additionally, Nusa Graha provides a booking service for village facilities that can be used by both village residents and visitors from outside the village. In the Nusa Graha module, village administrators can review asset data, asset categories, and asset maintenance records, as well as verify bookings made by users. Users can also reserve facilities based on availabel schedules; the system then determines the booking status and payment details. This module uses a multi-tenant SaaS concept which allows for the separation of data between villages via tenant_id and facilitates operational integration with other modules on the Nusaeka platform.

4.2. System Requirements Analysis

A system requirements analysis was conducted to identify and determine the features required for the Nusa Graha module. This module is designed to streamline the booking process and provide digital access to village facilities. Based on the results of the requirements analysis, this system has several key roles: superdamin, village admin, village residents, and non-resident renters. In the module, this superadmin is responsible for managing renters and modules on the Nusaeka platform, while the village admin is responsible for managing assets, verifying bookings, and processing payments. Meanwhile, village residents and non-resident renters are considered users who book village facilities.

The functional requirements of this system include data and category analysis, and facility booking based on dates and times selected by users. Additionally, the system provides features for booking verification by the village administrator and payment processing, which are implemented within the Nusa Graha module. For renters from outside the village, the system provides registration and the ability to upload identity documents, such as an ID card, as supporting evidence for asset rental. From a non-functional prespective, the Nusa Graha module implements a multi-tenant SaaS concept using a tenant_id to ensure data separation between villages and role-based access control to guarantee system security.

4.3. Business Process Design (Flowchart)

The flowchart in the Nusa Graha module uses flowcharts to illustrate the asset management system and the process for reserving village assets. The flowchart is divided into two sections: the village administrator flowchart and the user or renter flowchart. The objective of this study is to explain the system's activities based on the actions of the various parties in the Nusa Graha module.

4.3.1. Village Administrator Flowchart

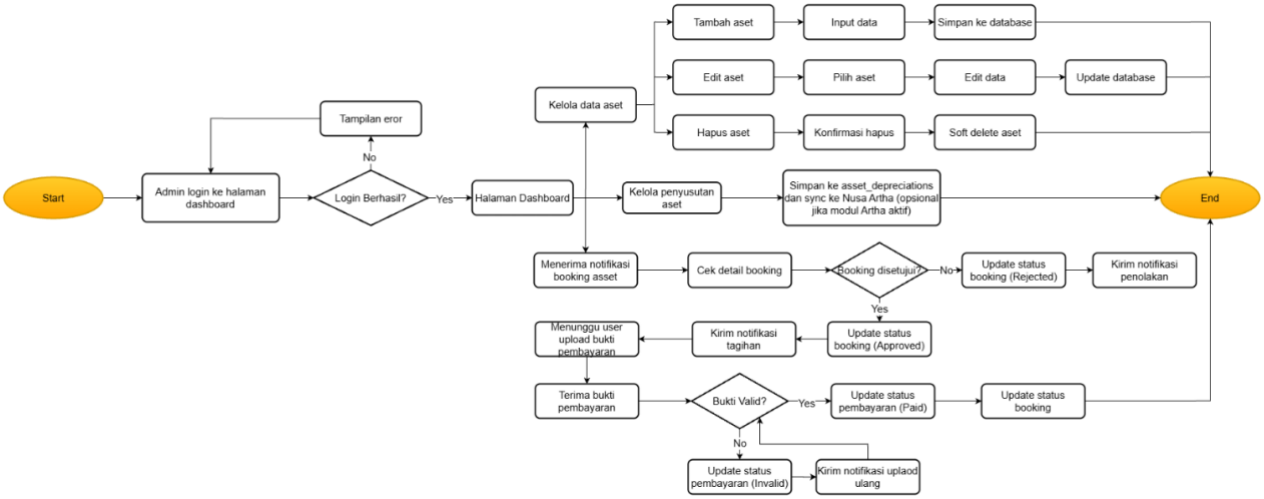

Fig. 1: Village Administrator Flowchart

Based on the village administrator flowchart above, the process begins with the administrator logging in to the dashboard page to view data and receive booking requests. In this module, the administrator can review the booking details and decide whether to accept or reject the order. Once the administrator has confirmed the booking, the user will receive a notification that the booking has been accepted. Next, the administrator can receive proof of payment from the user and verify the payment. If the payment is valid, the system will confirm the payment status, indicating that the booking process was successful. Additionally, the administrator can view depreciable assets and enter depreciation data into the system.

4.3.2. User Flowchart

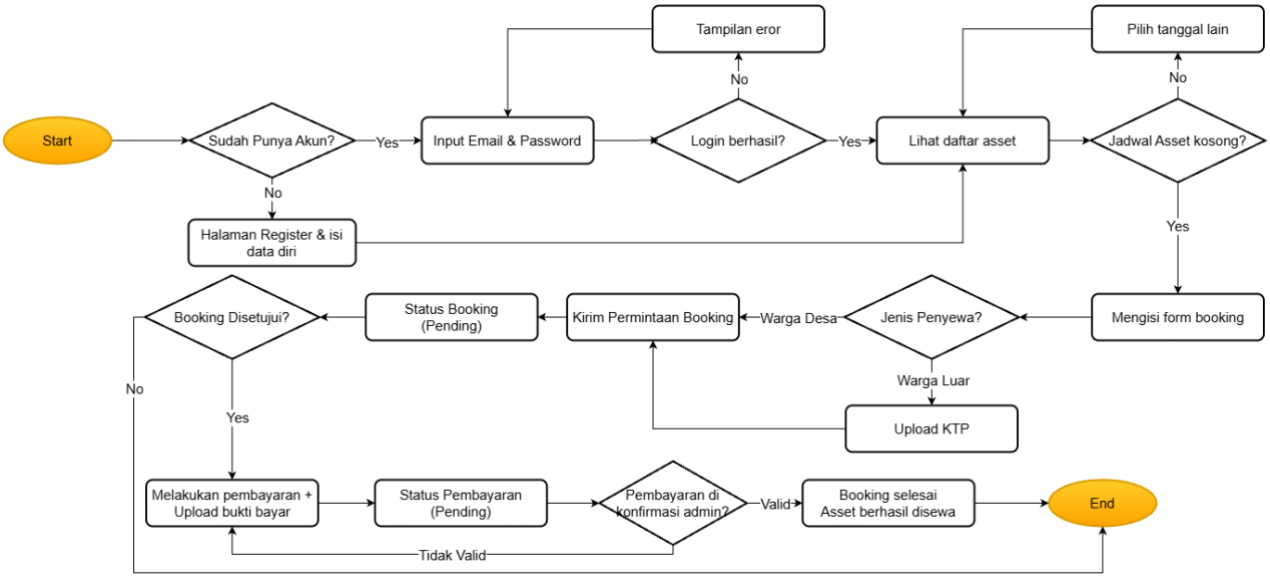

Fig. 2: User Flowchart

Based on the user flowchart above, the user process begins with logging in or registering for users who do not yet have an account. After logging in, users will be able to view a list of available assets and select a rental schedule. After checking schedule availability, users can fill out the booking form; if the user is not a resident of the village ora is an outsider, they are required to attach identification documents such as an ID card when masking a reservation. The booking request will be marked as pending to await confirmation from the village administrator. Once the booking has been confirmed by the admin, the user can proceed to the payment process using the payment receipt. When the booking is confirmed, the system will notify the user.

4.4. Designing Data Flow Diagrams (DFDs)

The Data Flow Diagrams (DFDs) in this module consist of two levels: Level 0 DFDs (Context Diagrams) and Level 1 DFDs, which are used to illustrate data flows within the Nusa Graha module.

4.4.1. Level 0 DFD

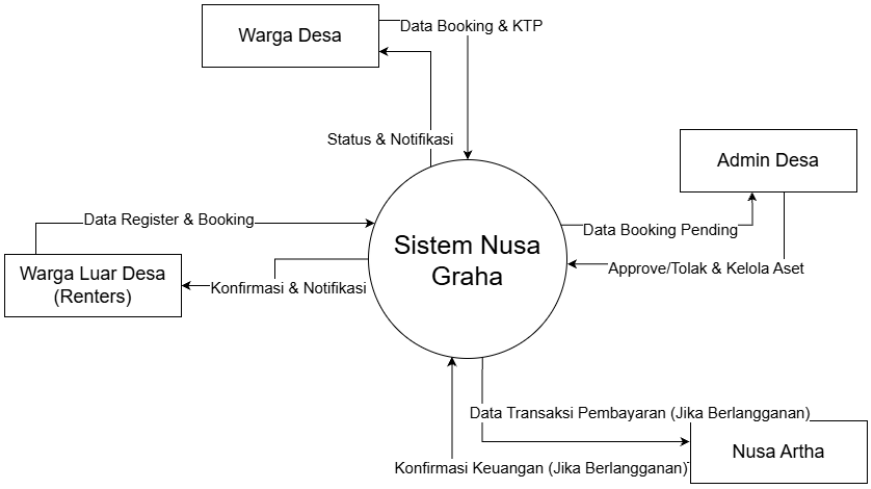

Fig. 3: Level 0 DFD

The level 0 DFD above depicts the Nusa Graha system as a whole as a single process that interacts with eight external entities. Village residents can enter booking data and ID card information into the system, then receive status updates and notifications in response. Non-residents or tenants receive confirmations and notifications from the system after submitting registration and booking data. the village administrator receives pending booking data from the system and can send approval or rejection request as well as asset data to the system. Nusa Artha then receives payment transaction data from the system as part of the money exchange between modules on the Nusaeka platform.

4.4.2. Level 1 DFD

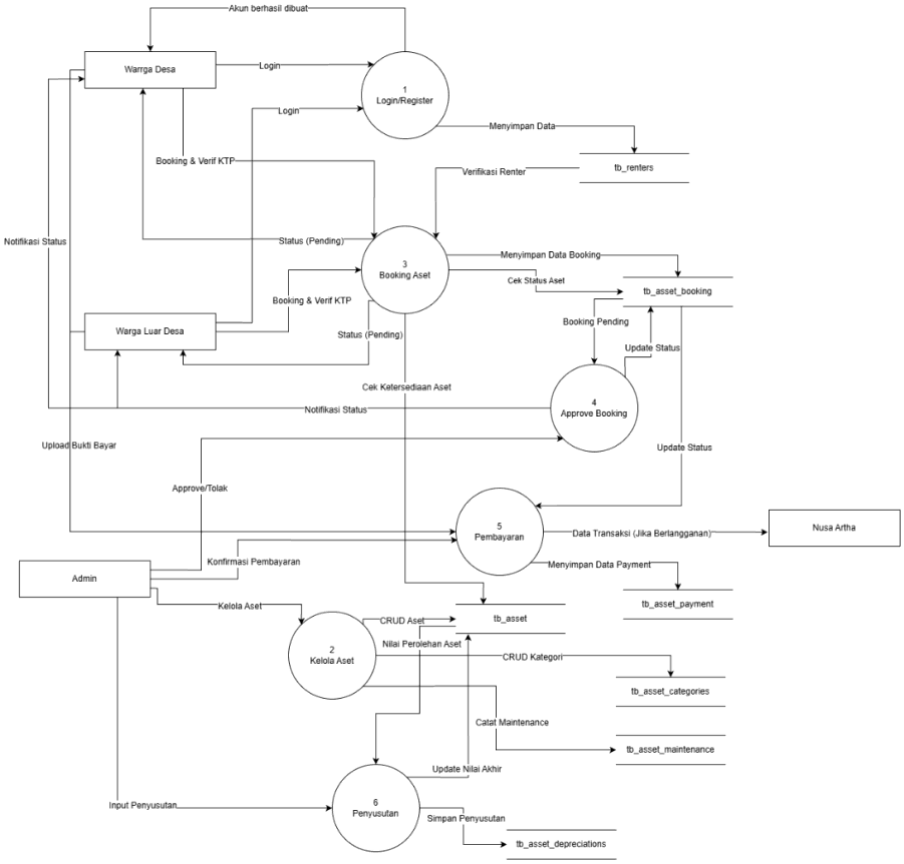

Fig. 4: Level 1 DFD

This level 1 DFD breaks down the system into its main processes. Procedure 1 (Login/Register) will require user authentication, and the data will be stored in the `tb_renters` table. Procedure 2 (Manage Assets) in this process allows the administrator to perform CRUD operations on the `tb_asset` table, CURD operations on the `tb_asset_categories` table, and maintenance operations on the `tb_asset_maintenance` table. Proceduer 3 (Asset Booking) will receive data input village residents or non-residents along with ID verification bofore processing the booking data into the `tb_asset_booking` table with a pending status. Procedure 4 (Approve Booking) completes the administrative process and changes the booking status in the `tb_asset_booking` table. Procedure 5 (Payments) includes data transfer to Nusa Artha, admin confirmation, storage in `tb_asset_payment`, and uploading of payment proof from the renter. Proceduer 6 (Depreciation) will receive asset quality depreciation input from the admin and store the results in `tb_asset_depreciations`.

4.5. Database Design (ERD)

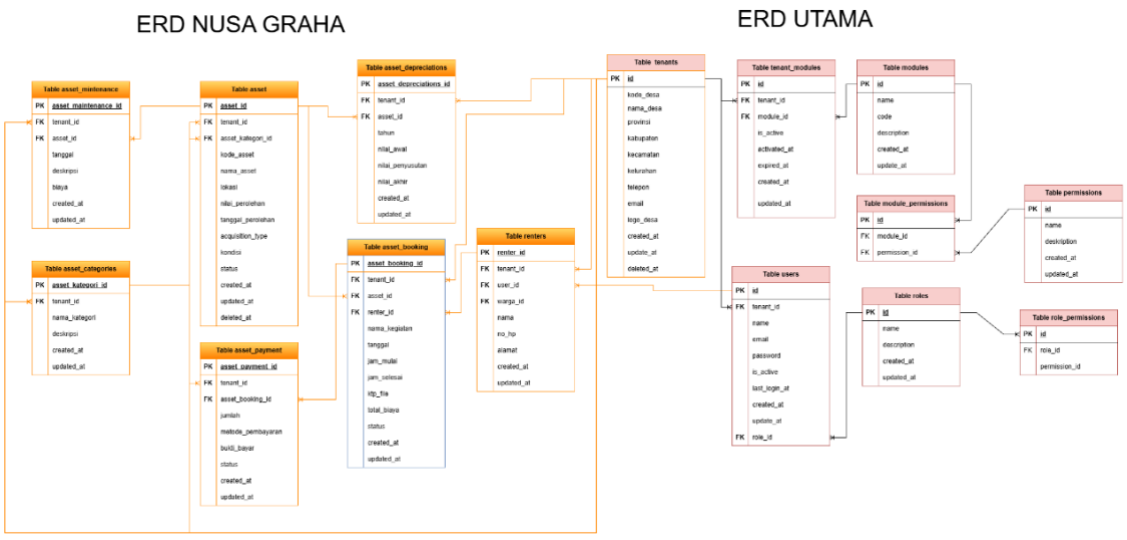

Fig. 5: Entity Relationship Diagram

The main table in the Nusa Graha module is tb_asset, which contains information about village assets such as asset name, location, condition, acquisition value, and status. The tb_asset_categories table is used to group assets according to specific categories. Additionally, there is the tb_asset_maintenance table used to track asset maintenance activiteis, and table naed tb_asset_depreciations used to calculate asset depreciation based on the current period. To improve the quality of village facility rentals, the system provides a table named tb_asset_booking, which contains booking data such as the assets used, usage history, activity name, booking status, and identity verification documents like uploaded ID cards for non-residents. Asset renter data is stored in the tb_renters table, while payment processes are stored in the tb_asset_payment table, which is linked to the booking data. in this module, all tables are linked to the tenant_id table to ensure that each village is stored separately and aligns with the multi-tenant concept on the Nusaeka platform.

4.6. Discussion of Multi-Tenant and Modular Subscription

The Nusa Graha module was developed using the multi-tenant SaaS concept, whereby a single application can be used by multiple villages simultaneously as tenants. On this platform, data separation between tenants is achieved by using by multiple villages simultaneously as tenants. On this platform data separation between tenants is achieved by using a tenant_id in each module-specific table, ensuring that asset, booking, payment, and depreciation data remain tied to the respective village. This concept makes the system more scalable because many villages can use it without having to create separate applications for each village. Additionally, the Nusaeka platform employs a modular subscription concept, allowing each village to select the modules it needs. For asset management and village facility rentals, the Nusa Graha module can operate independently. When integrated with other modules, such as Nusa Artha, all payment transaction data will also be entered into that module and can be utilized according to the village's financial needs.

5. Conclusion

Based on the analysis conducted, the Nusa Graha module on the Nusaeka multi-tenant SaaS platform successfully facilitates structured management of village assets as well as the booking or rental processes for village facilities. The system design has produced business process models in the form of flowcharts, data flow models using DFDs, and a basic data design using ERDs, covering tables for assets, asset categories, reservations, rentals, payments, maintenance, and asset depreciation. Additionally, the Nusa Graha module has implemented a multi-tenant concept using a tenant ID to ensure the separation of data between villages and supports modular subscriptions, allowing villages to customize module usage according to their needs. This module also supports booking verification and payment processing, asl well as operational integration with the Nusa Artha module for financial processing if subscribed.

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