

Facility Reservation System with Priority-Based Internal-External Conflict Resolution

Alfina Choerunnisa¹, Fandy Setyo Utomo^{2*}

¹ Sistem Informasi, Fakultas Ilmu Komputer, Universitas Amikom Purwokerto

^{2*} Magister Ilmu Komputer, Fakultas Ilmu Komputer, Universitas Amikom Purwokerto

23SA21A015@students.amikompurwokerto.ac.id¹, fandy_setyo_utomo@amikompurwokerto.ac.id^{2*}

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ABSTRACT

The Education Office of Banyumas Regency manages six facility locations whose reservation process is still recorded manually using physical whiteboards, leading to unequal access to schedule information, double-booking risks, and the absence of an audit trail. This study aims to develop SIMPUL (Sistem Informasi Manajemen Peminjaman Unit Lokasi), a facility reservation system that implements a priority-based scheduling conflict resolution mechanism to automatically handle conflicts between internal and external users, along with reminder and digital calendar features. The system was developed using the Prototyping method (Aldisa) with Laravel 12, PHP 8.2, and MySQL, supported by data collected through observation, interviews, and a literature review. Testing was conducted using Black Box Testing, the System Usability Scale (SUS), and User Acceptance Testing (UAT). All Black Box Testing scenarios produced outputs that matched expectations. SUS evaluation involving nine respondents yielded an average score of 80.0, which falls in the acceptable category, while UAT results showed acceptance rates of 90.0% among internal users and 72.2% among external users. Based on these results, SIMPUL is capable of supporting facility reservation management by providing equal access to schedule information for internal and external users and automatically detecting and resolving scheduling conflicts, and has been declared feasible for implementation at the Education Office of Banyumas Regency.



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I. INTRODUCTION

The increasing use of information and communication technology supports the implementation of digital-based systems in government to improve the quality of public services [1], [2]. The application of information systems as a medium for information provision in educational institutions is demonstrated through the development of a web-based information system for the Information Systems and Technology Education Study Program at UPI Purwakarta Campus by Amhar et al. [3]. The system was developed with the aim of improving service quality and providing information needed by students and the public, and was declared to have passed functional testing using Black Box Testing. The application of information systems in central

government agencies operating at the district level is also demonstrated through the development of a Laravel-based information system at BPS Buleleng, a non-ministerial government institution, by Supriatmaja et al. [4]. The Education Office of Banyumas Regency is a regional government body that administers government affairs in the field of education within the Banyumas Regency area [5]. This institution has a number of internal work units that routinely require the use of rooms for various activities such as meetings, training, and other events. Based on observation results, the Education Office of Banyumas Regency manages six facility locations, namely Ki Hajar Dewantara Hall, Tutwuri Building, Ing Ngarso Sung Tulodho Building, Gurinda Sarwa Mandala Building, Sinergi Room, and Planning Lobby.

The six facility locations have different capacities and facilities as shown on the system interface. These capacity differences form the basis for validation when users select a location so that the number of activity participants matches the capacity of each building and reservation errors do not occur. For small-scale activities, Sinergi Room and Planning Lobby are available, with maximum capacities of 24 people and 19 people respectively. Sinergi Room is equipped with air conditioning, tables, and chairs, while Planning Lobby provides chairs, tables, a smart TV, and air conditioning. For medium-scale meeting activities, Tutwuri Building and Ing Ngarso Sung Tulodho Building both have air conditioning, a projector, a sound system, tables, and chairs, with a difference in maximum capacity, namely 30 people and 60 people. Different from these two buildings, Ki Hajar Dewantara Hall functions as an executive meeting room for divisional meetings or meetings with regional coordinators and is equipped with a meeting table, air conditioning, a microphone, and a smart TV with a maximum capacity of 40 people. When activities involve a large number of participants, Gurinda Sarwa Mandala Building is used as the main hall, which can accommodate up to 200 people and is equipped with a main stage, a sound system, air conditioning, stackable chairs, and a transit or dressing room to support events such as seminars, competitions, or receptions. Specifically for the use of Gurinda Sarwa Mandala Building by external parties, a retribution fee is charged in accordance with the Banyumas Regency Regional Regulation on Regional Taxes and Retributions, namely Rp105,000.00 per day for government institutions and Rp200,000.00 per day for private institutions, while the fees for the other five locations have not been regulated in that regulation.

The results of observation and interviews show that the management of facility location reservations at the Education Office of Banyumas Regency is still carried out manually using two whiteboards in the area behind Gurinda Sarwa Mandala Building as well as activity information sheets posted in front of room doors. Employees who wish to know room availability can view the schedule through the whiteboard or the available activity information sheets. If they are unable to come in person, employees can contact colleagues or parties who are aware of the schedule condition to check both sources, then convey room availability information to the applicant. For parties outside the institution, the reservation process is carried out by contacting the liaison responsible for facility reservations. What makes this process prone to error is that the writing of the schedule on the whiteboard is not done by one specific person, but can be done by employees, interns, or whichever party is currently responsible for the use of the room.

This condition is consistent with the findings of García-Granja et al. [6], which show that several existing reservation systems, particularly commercial systems, did not provide online reservation options, while availability status monitoring remained inaccurate, particularly in Wi-Fi-based

systems, resulting in information that did not always correspond to the actual availability of the space. More broadly, research on Indonesia's Electronic-Based Government System (SPBE) highlights its role in improving public service quality, efficiency, transparency, and accessibility [7]. However, at the Education Office of Banyumas Regency, schedule information is only available in physical form, which results in employees who are not near the location being unable to know room availability directly without visiting the location or contacting another party. The absence of an automatic validation mechanism causes reservation schedule clashes. For example, at Ki Hajar Dewantara Hall there were two activity information sheets from the General Affairs and Personnel Sub-Division and the Junior High School Division recorded for the same schedule, namely Thursday, June 11, 2026, at 10:00 until finished. In addition, writing on the whiteboard can be erased and paper posted on the door can be removed at any time, so that no history or audit trail is available to determine which party made a schedule change.

Similar problems in the manual management of room reservations have encouraged a number of researchers to develop web-based information systems. A room management information system was developed by Prasetyo and Chernovita [8] at the Education Office of Salatiga City to facilitate checking room availability and the online reservation of building schedules, thereby reducing dependence on manual processes. Saputra et al. [9] developed the Room Reservation Information System (SINORA) at the General Affairs Section of the Regional Secretariat of Kudus Regency to support the recording and management of borrowing data, including adding, viewing, updating, and deleting reservation records, which improved the efficiency of room management. The HOME application developed by Irfiani et al. [10] provides a real-time dashboard for viewing room availability and reservation information. In the research of Aulia and Tambotoh [11], a web-based room reservation system was designed using the Prototype method and produced a recommendation to add automatic reminder and digital calendar features. Pangestu et al. [12] developed the Room Reservation Information System (SISERU), which provides several features, including room searches based on date and time, online reservation, reservation cancellation, and notifications. These features support the reservation process, with the system evaluated through black-box testing, performance testing, and User Acceptance Testing (UAT).

A review of this research indicates that web-based room reservation information systems are capable of overcoming the limitations of manual systems and improving schedule management efficiency [8], [9], [10]. However, previous studies have generally differentiated users based on their roles or administrative authority, such as administrators and regular users, rather than on the institutional affiliation of the applicant. Consequently, explicit differentiation between internal and external applicants in terms of submission

procedures and access rights remains limited in these reservation systems [8], [9], [10], [11], [12]. A reminder feature and digital calendar integration were also identified as recommended future development rather than implemented features in the study by Aulia and Tambotoh [11]. This study develops SIMPUL using the Laravel framework on local government institution infrastructure, with the Prototyping development method, which allows requirements to be validated directly together with users [13]. Different from these studies, SIMPUL distinguishes internal and external users through separate submission procedures, applies an automatic priority mechanism for handling schedule conflicts, allows the operational buffer value to be configured independently for each facility location, and provides a reminder feature together with digital calendar integration as part of the implemented system rather than as a suggestion for future work. An automatic recommendation mechanism is also available that suggests another building at the same time or an alternative time slot at the same building when a schedule clash occurs. In terms of evaluation, this study combines Black Box Testing, System Usability Scale, and User Acceptance Testing to measure functionality, usability, and user acceptance, while several previous studies emphasize system functionality. This is in line with the findings of Ismanto et al. [14], who show that evaluation focusing on only one aspect risks failing to capture the difference between users' perceptions of the system and their actual experience while using it.

Based on the problems and gaps that have been identified, this study aims to develop SIMPUL (Sistem Informasi Manajemen Peminjaman Unit Lokasi) at the Education Office of Banyumas Regency. SIMPUL distinguishes internal and external users through separate submission procedures, automatically detects and resolves schedule conflicts through a priority-based mechanism, and allows the operational buffer for each facility location to be configured independently. The system is also equipped with supporting features such as activity reminders and a digital calendar download in ICS format including a Google Calendar Web Intent link so that users can save their approved schedules directly to their Google Calendar accounts. These supporting features together with the core conflict resolution mechanism are expected to improve the efficiency of facility reservation management and ensure transparency of schedule information for all users.

II. METHOD

A. Data Collection

Data were collected through three techniques, namely observation, interviews, and a literature review. Observation was carried out to map the condition of the ongoing schedule recording and the facility reservation flow, in order to identify inequality of access to information and the potential for scheduling conflicts. Interviews were conducted with the

parties handling facility reservations within the institution to explore the operational specifications of the system, including the external submission deadline provisions, the operational buffer between activities that can be changed by the admin, and the priority rules between internal and external users. The literature review was conducted to develop a theoretical foundation through a review of literature on software engineering, system development methods, and government facility management.

B. Database Design

The SIMPUL database was designed using MySQL based on the results of system requirements identification. This design consists of five interrelated tables. The *pengguna* table stores data for all system users, including name, email address, encrypted password, user role (admin, internal, or external), and account status. The *gedung* table stores information for each available facility location, including building name, capacity, configurable operational buffer duration, and availability status. The *peminjaman* table is the main table that records the entire reservation submission process, including user data, facility location, date and time of execution, submission status, admin notes, and supporting documents uploaded by the user. The *audit_log* table is used to record every important activity in the system, including user identity, data changes made, and IP address as part of the system activity logging requirement. Meanwhile, the *notifications* table is used to store reminder data that will be sent to users according to the specified schedule. These five tables are interrelated so as to support an integrated data management process. A similar approach to interconnected facility management was also presented by Matarnah et al. [15] through the integration of various data sources into facility management systems.

C. System Development Method

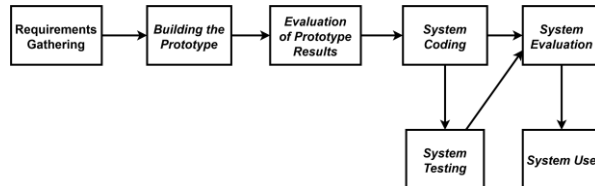
This study uses the Prototyping method based on the Aldisa concept [13]. In this study, the term Prototyping refers to the system development method used, while prototype refers to the system design produced during the development process. The Prototyping method adopts an iterative approach in which the initial prototype is improved based on user feedback until the system meets user requirements [13]. This iterative characteristic is suited to conditions in government institutions that have dynamic work procedures and require system adjustments based on user input. In contrast, the Waterfall approach described by Rumonang et al. [16] follows a sequential development process in which each stage is completed before the next stage begins.

Compared to Agile approaches such as Scrum, which use roles such as Product Owner and Scrum Master and sprint-based development [17], the Prototyping method is more suitable for this study because system development does not require the division of such roles. Users only need to play a role in conveying system requirements, providing input

during the development process, and conducting evaluations. The method also lets the design be validated with users before coding begins, reducing the risk of mismatches during implementation [18]. The seven stages of system development are shown in Figure 1.

Figure 1. Stages of the Adopted Prototyping Method

- 1) *Requirements Gathering*: At this stage, system requirements are identified based on the results of the



observation and interviews that have been conducted. The information obtained is used to understand business processes, identify problems that occur, and determine system requirements as a basis for developing the prototype design.

- 2) *Building the Prototype*: The prototype is designed based on the results of the system requirements identification obtained in the previous stage. The system design is prepared using UML diagrams, comprising a use case diagram to depict functional requirements, an activity diagram to model the process flow, and a class diagram to depict the structure and relationships between classes in the system.
- 3) *Evaluation of Prototype Results*: The prototype design that has been prepared in the previous stage is discussed and validated together with the employees who handle facility reservations at the Education Office of Banyumas Regency.
- 4) *System Coding*: The prototype design that has been declared suitable is then implemented into program code using the Laravel 12 framework with the PHP 8.2 programming language and a MySQL database. At this stage, each system feature is developed according to the requirements and design that have been agreed upon, including the implementation of the database structure using migration and Eloquent ORM so that all data can be managed consistently. The result of this stage is a system that can be run and is ready to enter the trial stage.
- 5) *System Testing*: After the system has finished being developed, users conduct trials to ensure the system matches the established requirements. The input obtained is used as a basis for refinement before the system is tested again. This process is repeated until the system meets user requirements.
- 6) *System Evaluation*: The next stage is system evaluation using Black Box Testing, System Usability Scale (SUS), and User Acceptance Testing (UAT). The evaluation

results are used to assess system quality based on aspects of functionality, usability, and user acceptance.

- 7) *System Use*: After going through the stages of development, testing, and evaluation, SIMPUL is declared ready to be implemented as a digital alternative to support the management of facility reservations at the Education Office of Banyumas Regency.

D. System Evaluation

System evaluation was carried out using three complementary methods to comprehensively measure functionality, usability, and the level of user acceptance. For both usability and acceptance assessments, data were collected through questionnaires administered to respondents after they had used the system.

- 1) *Black Box Testing*: Functional testing used the Black Box Testing method, which evaluates whether system output matches input without examining the internal code structure [19]. Each test scenario includes a scenario description, category, expected result, test result, and status.
- 2) *System Usability Scale*: Ease of use was evaluated using the System Usability Scale, a standard instrument of ten alternating positive and negative statements rated on a five-point Likert scale [20]. The SUS score is calculated using Equation (1).
- 3) *User Acceptance Testing*: User Acceptance Testing measures how well end users accept and use the system for its intended purpose [21]. The instrument differs between internal users (eight statements, n=7) and external users (nine statements, n=2) to reflect their different usage patterns, with the acceptance percentage calculated using Equation (2).

$$\sum[(x_{odd} - 1) + (5 - x_{even})] \times 2.5 \quad (1)$$

where x_i is the response value on the i -th item on the standard scale. A SUS score above 68 is considered above average and is used as a benchmark for evaluating system usability [20].

$$\text{Acceptance Percentage} = \left(\frac{\text{Actual Score}}{\text{Ideal Score}} \right) \times 100\% \quad (2)$$

The results are interpreted into five categories, namely Strongly Disagree (0–20%), Disagree (21–40%), Neutral (41–60%), Agree (61–80%), and Strongly Agree (81–100%) [21].

III. RESULTS AND DISCUSSION

A. Requirements Gathering

Observation and interviews yielded twelve functional requirements for SIMPUL, summarized in Table I. Several nonfunctional requirements were also identified and are described below.

TABLE I
SIMPUL FUNCTIONAL REQUIREMENTS

No	Functional Requirement
1	The system displays the list of facility locations and the public schedule without requiring a login process.
2	The system provides a user authentication mechanism supporting more than one login method, accompanied by login attempt restrictions for account security.
3	Users can submit a reservation for a single date or a range of several dates according to activity needs.
4	The system differentiates the submission procedure between user groups with different authority levels, accompanied by the upload of supporting documents and identity cards according to verification needs.
5	The system validates schedule availability by taking into account a configurable operational buffer between activities, and rejects submissions that violate this provision.
6	The system provides a schedule conflict handling mechanism when there is more than one submission for the same slot, based on priority rules between user groups.
7	The system provides recommendations for another building or an alternative time slot when a submission is rejected due to a schedule conflict.
8	The admin can verify, approve, and reject submissions requiring a verification process, move the building or schedule of a submission through the change submission feature, and manage building, user, and schedule data.
9	The system automatically changes the submission status according to the time of execution (approved → in progress → completed).
10	The system provides an activity reminder mechanism for users as well as support for integration with digital calendars.
11	The system records all important activities into an audit log along with data before and after the change, the identity of the actor, and the IP address.
12	The admin can generate a building usage report based on a specific period and download it in a format that can be used for administrative purposes.

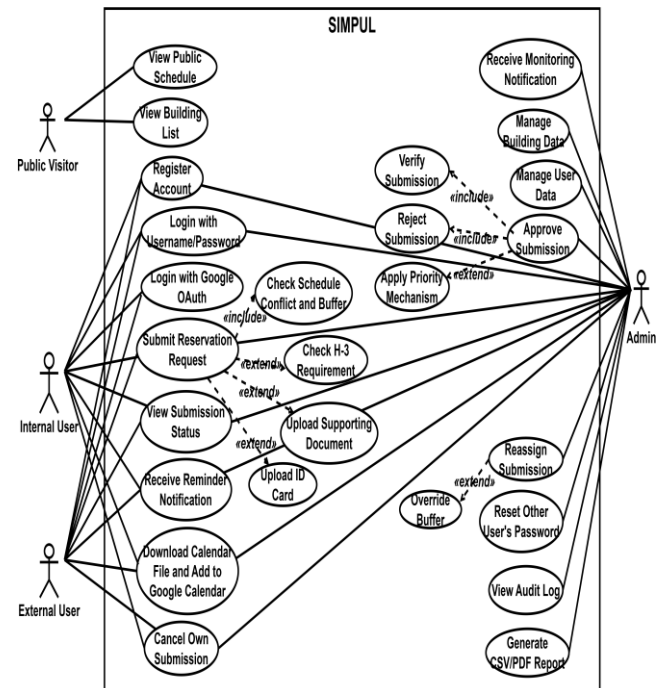
On the nonfunctional aspect, the system can be accessed through a browser without additional installation. Security is handled through Role-Based Access Control, input data validation including restrictions on the type and size of uploaded files, protection of forms against request forgery, restriction of authentication attempts, and storage of credentials outside the source code. The system also requires a mechanism for automatically and periodically updating submission status and sending reminders without requiring manual action from the admin.

B. Building the Prototype

Based on the requirements in Table I, the system was designed using four UML diagrams that depict the interactions, process flow, and data structure of SIMPUL.

The use case diagram in Figure 2 models four actors, namely public visitors, internal users, external users, and admins. Public visitors can view public information and schedules without logging in. Internal users submit reservations that are approved automatically, while external users submit requests that require admin verification. The admin manages all data, verification decisions, and building usage reports.

Figure 2. SIMPUL Use Case Diagram



Two submissions for the same facility location are declared to clash if the two time ranges intersect after taking into account the operational buffer relative to the existing schedule. This condition is formulated in Equation (3).

$$\text{Clash} = (T_{\text{new_start}} < T_{\text{old_end}} + \text{buffer}) \text{ AND } (T_{\text{new_end}} > T_{\text{old_start}} - \text{buffer}) \quad (3)$$

The buffer in this equation is the operational gap between activities in units of minutes. This value is configured individually for each facility location. For external submissions, H-3 denotes a requirement to submit at least three days before the execution date. If a clash is detected, the system returns a recommended alternative slot or building. If there is no clash, the system determines the initial status of the submission according to the user's role.

The first activity diagram in Figure 3 depicts the overall reservation submission flow and schedule validation mechanism based on Equation (3). The flow begins with the applicant selecting the building and time, followed by validation of schedule availability. If there is a violation of the operational buffer or the slot is already filled, the system rejects the submission and displays an alternative recommendation.

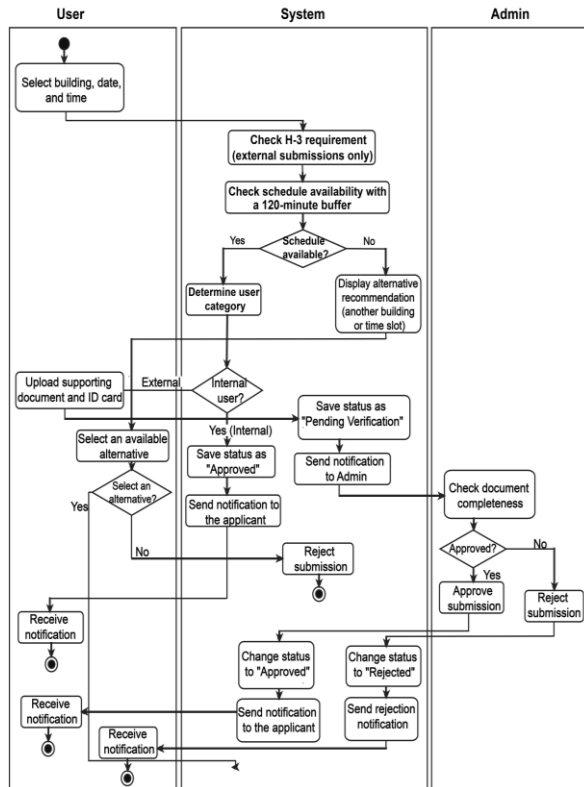


Figure 3. Submission and Schedule Validation Flow

The second activity diagram in Figure 4 depicts the priority-based conflict handling mechanism between internal and external submissions. The priority rule applies unidirectionally and only applies under certain conditions, namely when an internal submission is saved and clashes with an external submission that is still pending verification for the same slot. Under this condition, the system automatically rejects the external submission and records a note that the slot is prioritized for the internal agenda in the admin notes. If the slot in the external submission has already been previously approved, a new internal submission that clashes with that slot will be validated through the general clash detection mechanism in Equation (3) and rejected like other submissions, so that the user category priority rule does not override a slot that has already been confirmed. For clash conditions between submissions within the same user category, whether internal with internal or external with external, the system does not apply a special priority rule, and conflict resolution follows the mutual exclusion principle in Equation (3), namely the submission that first obtains status retains the held slot, while the subsequent submission for the same slot will be rejected and directed to an alternative recommendation as summarized in Algorithm 1.

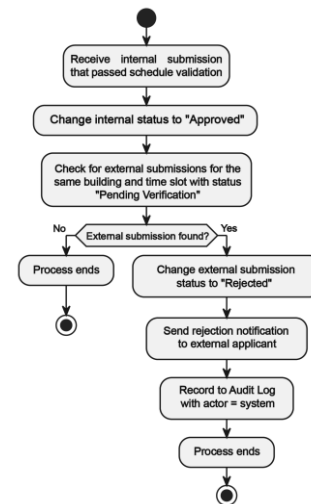


Figure 4. Priority-Based Conflict Handling Mechanism

Algorithm 1. Handling of Submissions and Priority Conflict Resolution

Input: new_submission (building, date, start_time, end_time, applicant_type)
Output: status of new_submission, list of recommendations (if rejected)

```

1. START
2. IF applicant_type = internal OR
   applicant_type = admin THEN
3.   initial_status ← APPROVED
4.   FOR EACH p ∈ FindClashes(building,
   date, start_time, end_time) DO
5.     IF p.status = SUBMITTED AND
       p.applicant_type ∈ {external}
       THEN
6.       p.status ← REJECTED
7.       p.note ← Slot prioritized for
       internal agenda
8.   ELSE
9.     initial_status ← SUBMITTED
10.    IF ClashExists(building, date,
    start_time, end_time) THEN
11.      REJECT new_submission
12.    RETURN
       AlternativeRecommendation(building
       , date, start_time, end_time)
13.  ELSE
14.    SAVE new_submission WITH
       initial_status
15.  END

```

The order of steps in Algorithm 1 deliberately places the general clash check after the determination of the initial status and the release of external slots that are still pending verification. This arrangement makes the internal priority right apply only to external submissions that have not been

approved by the admin. Any submission that clashes with an already approved slot is still checked through the same general clash mechanism as other new submissions. In this way, this final check still applies to all categories of applicants.

The class diagram in Figure 5 maps the relationships between five main data entities, namely Pengguna, Gedung, Peminjaman, AuditLog, and Notifikasi, as well as three service classes, namely ValidasiJadwalService, EmailSimpulService, and LaporanService. The relationships between tables in this diagram depict the data structure design that becomes the reference for system development.

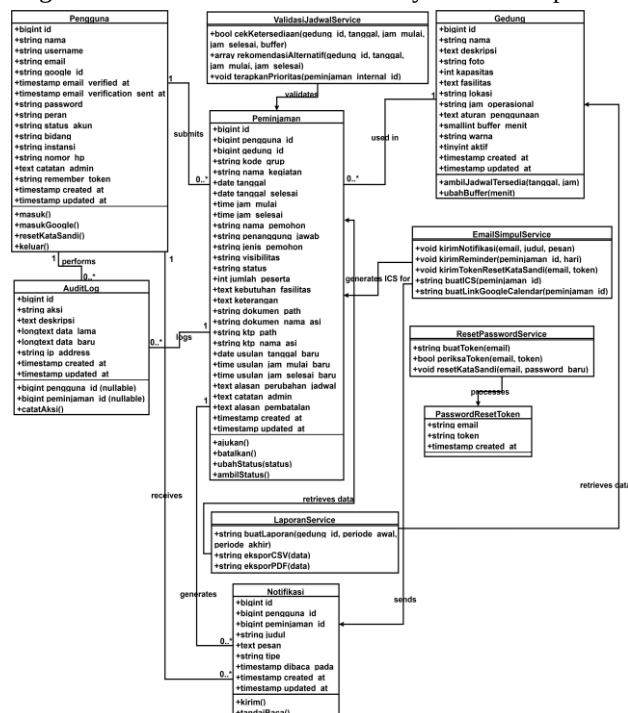


Figure 5. SIMPUL Class Diagram

C. Evaluation of Prototype Results

The prototype design was discussed and validated together with the employees who understand the facility reservation process at the Education Office of Banyumas Regency to ensure its suitability with user requirements and the ongoing business process. The results of this discussion form the basis for refining the design before it is implemented into the system.

The evaluation results produced three main adjustments to the initial design. The user category was set into two groups, namely internal and external, with different submission procedures according to operational needs. External submissions were set to be at the earliest three days (H-3) before the date of execution to provide time for administrative verification, while the facility usage rules were adjusted so that reservations could be made on both working days and weekends. Based on these adjustments, the

prototype design was declared to be in accordance with user requirements and the business process, so that it could proceed to the system coding stage.

D. System Coding

The system was coded using Laravel 12 with PHP 8.2 and a MySQL database based on the prototype design that had been agreed upon in the previous stage. Implementation was carried out with reference to the results of the system and database design so that all functions that had been designed could be integrated into the application. The results of this implementation produced various features ready for use according to user needs.

User authentication was implemented through conventional accounts as well as Google accounts (Google OAuth), accompanied by a restriction on the number of login attempts to prevent unauthorized access attempts. The operational buffer value between activities was implemented with a default value of 120 minutes, which can be reconfigured by the admin according to the needs of each facility location. The activity reminder mechanism was implemented through notifications and emails sent at H-3, one day before (H-1), and the day of activity execution, equipped with a digital calendar file in ICS format as well as a Google Calendar Web Intent link that makes it easy for users to save the schedule directly to their respective Google Calendar accounts. The process of updating submission status and sending reminders is run automatically through a task scheduler, namely every five minutes to update submission status, once a day at 07:00 to send reminders, and every six hours to monitor submissions that have not yet been verified.

In addition to this mechanism, the system provides management of changes to submissions that have already been approved. Applicants can cancel a submission through the cancel action, which will change the status to canceled with the reason for cancellation filled in by the applicant. If a schedule adjustment is needed, the admin can move the submission to another building or time through the change submission feature, and every change will be recorded in the submission history so that it can be traced by both the admin and the applicant. For external applicants, a change to important attributes of an already approved submission, namely building, date, start time, end time, or number of participants, will change the submission status back to submitted, requiring re-validation by the admin before the change is applied. This rule ensures that significant changes to a slot that has already been confirmed still go through the same verification and clash-checking process as a new submission in Equation (3), so that schedule consistency is maintained. However, the system does not yet provide a special pathway for emergency conditions requiring a sudden priority change outside the internal and external priority mechanism described in Section III.B. Therefore, conflicts between submissions within the same internal category under such conditions are still resolved through manual

communication between the applicant and the admin, followed up by moving the building or adjusting the schedule of the other party through the change submission feature. In addition to submission management, the system also displays facility usage cost information. For Gurinda Sarwa Mandala Building, the submission form shows a reference retribution fee table to external applicants based on their institution type, and the fee amount can be configured by the admin for any facility location. Payment is arranged directly with the admin outside the system after the submission is approved. The results of implementing these mechanisms are shown through five main interfaces representing the SIMPUL features, from the submission process to verification and reporting.

Figure 6 shows the reservation submission form. This form adjusts its fields according to the user's role. External users are required to upload supporting documents and can optionally include an identity card. Before the submission is saved, the system validates schedule availability as well as the operational buffer to prevent facility usage clashes.

Figure 6. Reservation Submission Form

After the submission is sent, the applicant can monitor its progress independently through the history page in Figure 7. This page displays the submission details along with its status change history. Applicants can monitor the progress of their submission independently without having to contact the admin.

Figure 7. Submission History Page

Facility location availability is displayed through the calendar page in Figure 8. The calendar presents the usage schedule for each facility location visually so that users can know which times are still available before submitting a reservation. This display helps users reduce the possibility of submitting a request for an already filled schedule.

Figure 8. Building Availability Calendar

On the admin side, the verification page in Figure 9 becomes the decision-making center for external submissions. The admin can review submission data, examine supporting documents, and then make a decision in the form of approval, rejection, or schedule reassignment.

Figure 9. Submission Verification Page

The report page in Figure 10 allows the admin to compile a building usage recap based on a specific period. This recap can be exported to CSV or PDF format for documentation and administrative purposes.

Figure 10. Report and Data Export Page

E. System Testing

After the system had finished being developed, trials were conducted by users to ensure its suitability with the established requirements. During this process, users provided input regarding the submission flow, interface appearance, and the suitability of features with the ongoing business process. This input was used for system refinement, and re-testing was then conducted until the system was declared to be in accordance with user requirements. The next stage continued with the final evaluation using the established testing instruments.

F. System Evaluation

The final evaluation was carried out using three complementary instruments. The three are Black Box

Testing, System Usability Scale (SUS), and User Acceptance Testing (UAT). These three instruments were used to evaluate the aspects of functionality, usability, and level of user acceptance of the developed system.

- 1) *Black Box Testing Results*: Functional testing was carried out using the Black Box Testing method, which evaluates the suitability of system output to input without examining the internal structure of the code. Test scenarios were prepared based on the twelve functional requirements that had been identified in Table I. The test results are presented in Table II.

TABLE II
SIMPUL BLACK BOX TESTING

No	Requirement ID	Test Scenario	Category	Expected Result	Test Result	Status
1	FR-1	Accessing the public schedule without logging in	Valid	The system displays the list of facility locations and the public schedule	The system successfully displays the list of facility locations and the public schedule without requiring a login process	Match
2	FR-2	Logging in with a conventional account, correct credentials	Valid	The user successfully logs in to the dashboard according to their role	The system authenticates the user and directs them to the dashboard according to their role (admin/internal/external)	Match
3	FR-2	Logging in with a conventional account, incorrect password	Invalid	The system rejects and displays an error message	The system rejects the login process and displays a credential error message	Match
4	FR-2	Repeated login attempts exceeding the limit	Invalid	The system temporarily restricts further login attempts	The system temporarily blocks login attempts after the attempt limit is exceeded	Match
5	FR-2	Logging in using a Google account	Valid	The user successfully logs in through Google authentication	The system successfully authenticates the user through Google OAuth and directs them to the dashboard	Match
6	FR-3	Submission by an internal user	Valid	The submission is automatically approved without a verification queue	The system saves the internal submission with a status automatically approved without an admin verification process	Match
7	FR-4	External submission, H-3 met and documents complete	Valid	The submission is saved with a pending verification status	The system saves the external submission with a pending verification status	Match
8	FR-4	External submission less than H-3	Invalid	The system rejects and displays a deadline notice	The system rejects the submission and displays a notice of the H-3 deadline violation	Match
9	FR-4	External submission without supporting documents	Invalid	The system rejects and requests document completion	The system rejects the submission and displays a request for completion of supporting documents	Match
10	FR-5, FR-7	Submission for a slot violating the 120-minute	Invalid	The system rejects the submissions at 11:00 and	The system rejects the submissions at 11:00 and	Match

		operational buffer (activity at 08:00-11:00 at a location, followed by a new submission at 11:00 or 12:00 at the same location)		12:00 because they fall within the operational buffer range and displays a recommendation for an alternative building/slot, while a submission for the same location starting at 13:00 can be accepted	12:00 according to the configured operational buffer, displays a recommendation for an alternative building/slot, and accepts the submission at 13:00 for the same location	
11	FR-6	Conflict between an internal and external submission for the same slot, with the external submission status still submitted (not yet approved by the admin)	Valid	The internal submission is directly approved, the external submission status automatically changes to rejected accompanied by an admin note	The system approves the internal submission and changes the external submission status to rejected with an admin note that the slot is prioritized for the internal agenda	Match
12	FR-6	Conflict between an internal and external submission for the same slot, with the external submission status already approved by the admin	Valid	The internal submission cannot take precedence, the system displays a recommendation for an alternative building/slot for the internal submission, the external status does not change	The system rejects the internal submission that clashes with the already approved external submission and displays a recommendation for an alternative building/slot for the internal submission	Match
13	FR-6	Conflict between two internal submissions for the same slot and location, submitted at different times	Valid	The submission sent first is accepted, the subsequent submission is rejected and the system displays an alternative slot/location recommendation that can be selected directly	The system accepts the first submission, rejects the second submission, and displays a recommendation that can be selected directly	Match
14	FR-6	Conflict between two external submissions for the same slot and location, submitted at different times	Valid	The submission sent first is accepted, the subsequent submission is rejected with an alternative recommendation, following the same rule as a clash between internal submissions	The system accepts the first submission, rejects the second submission, and displays an alternative recommendation	Match
15	FR-5, FR-6	Two submissions at the same time, 08:00-11:00, at different locations, as well as two submissions at different times, 08:00-11:00 and 15:00-17:00, at the same location	Valid	Both submissions are accepted because there is no simultaneous time and location clash	The system accepts both submissions without displaying a clash warning	Match
16	FR-5, FR-6	Two submissions at the same time, 08:00-11:00, at the same location	Invalid	The system detects a clash, one submission is rejected and an alternative building/slot recommendation is displayed	The system rejects one submission and displays an alternative recommendation	Match
17	FR-8	Admin approves/rejects an external submission	Valid	The status changes according to the admin's decision, a notification is sent to the applicant	The submission status changes according to the admin's decision and a notification is sent to the applicant	Match

18	FR-8	Admin manages building and user data (add/edit/delete)	Valid	Data is saved and updated according to the input	Building and user data are saved and updated according to the admin's input	Match
19	FR-9	Automatic status change by the task scheduler	Valid	Status automatically changes from approved → in progress → completed	The task scheduler automatically changes the submission status according to the time of execution	Match
20	FR-10	Sending reminders and downloading the ICS file	Valid	Notification/email sent at H-3, H-1, the day of, ICS file can be downloaded	Notifications and emails are sent according to schedule (H-3, H-1, the day of), the ICS file is successfully downloaded	Match
21	FR-10	Testing the reliability of email notification delivery for 12 test submissions (6 internal, 6 external) for the H-3, H-1, and day-of reminders, with external submissions adjusted to the minimum H-3 requirement	Valid	All notifications are sent according to the reminder schedule at each time point	12 of 12 notifications (100%) were sent and received according to the reminder schedule for both user categories	Match
22	FR-10	Testing the suitability of data in the ICS file against submission details (title, date, time, and location) after being imported into a third-party calendar application	Valid	The data stored in the ICS file displays the title, date, time, and location according to the submission	The data in all tested ICS files matches the submission	Match
23	FR-11	Recording of audit logs (data before/after, actor, IP)	Valid	The system automatically records an audit log every time a data change occurs	The system automatically records an audit log covering data before/after, the actor, and the IP address	Match
24	FR-12	Admin exports the building usage report	Valid	The report file is downloaded according to the selected format (CSV/PDF)	The report file is successfully downloaded according to the selected format (CSV/PDF)	Match

All 24 test scenarios produced outputs that matched expectations, including six special scenarios (No. 11–16 in Table II) that tested the priority-based conflict resolution mechanism, as well as two additional scenarios (No. 21–22 in Table II) that tested the reliability of email notification delivery and the validity of the digital calendar data. These results show that the schedule validation logic, the conflict priority mechanism, and the submission status change flow in SIMPUL operate correctly according to the established functional requirements.

- 2) *System Usability Scale (SUS) Results:* The SUS evaluation was carried out on nine respondents consisting of seven internal users, including one admin, and two external users. Scores were calculated using Equation (1) and the results are presented in Table III.

TABLE III
SYSTEM USABILITY SCALE SCORE PER RESPONDENT

Respondent	User Type	Total Score	SUS Score
Respondent 1	Internal	31	77.5
Respondent 2	Internal	40	100.0
Respondent 3	Internal	37	92.5
Respondent 4	Internal	32	80.0
Respondent 5	Internal (Admin)	32	80.0
Respondent 6	External	29	72.5
Respondent 7	External	30	75.0
Respondent 8	Internal	30	75.0
Respondent 9	Internal	27	67.5
Overall Average			80.0

The average SUS score of 80.0 exceeds the benchmark of 68, indicating that the system's usability is above average [20]. Eight of the nine respondents obtained a score above that threshold. The highest score was achieved by Respondent 2 with a value of 100.0. The lowest score was recorded by Respondent 9 with a value of 67.5. Respondent 9 was the only one below the threshold, but the difference was only 0.5 points. The proportion of respondents below this benchmark is small and the difference is slight, indicating that SIMPUL achieved an above-average usability score in this evaluation.

- 3) *User Acceptance Testing (UAT) Results:* UAT was conducted to measure the extent to which end users can accept and use the system according to its purpose [21]. The instrument was differentiated between internal and external users because the two have different usage patterns. The internal group used eight statements with seven respondents, while the external group used nine statements with two respondents. The internal user UAT results are presented in Table IV and the external user UAT results are presented in Table V, with scores calculated using Equation (2).

TABLE IV
INTERNAL USER UAT RESULTS (N=7)

Statement	Actual/Ideal	Percent	Category
Makes it easier to know room/building availability	33/35	94.3%	Strongly Agree
Clash validation helps prevent double-booking	32/35	91.4%	Strongly Agree
The availability calendar helps activity planning	32/35	91.4%	Strongly Agree
The Add to Digital Calendar feature makes reminder storage easier	33/35	94.3%	Strongly Agree
The automatically approved internal booking flow already meets requirements	34/35	97.1%	Strongly Agree
The automatic preparation buffer (120-minute buffer) is appropriate	27/35	77.1%	Agree
The display and information are easy to understand	30/35	85.7%	Strongly Agree
Overall, SIMPUL meets requirements and is	31/35	88.6%	Strongly Agree

feasible implementation for			
Overall	252/280	90.0%	Strongly Agree

TABLE V
EXTERNAL USER UAT RESULTS (N=2)

Statement	Actual/Ideal	Percent	Category
Makes it easier to independently check room/building availability	9/10	90.0%	Strongly Agree
Clash validation helps avoid submitting for a full time slot	7/10	70.0%	Agree
The Public Calendar display is informative and clear	8/10	80.0%	Agree
The Add to Digital Calendar feature makes reminder storage easier	6/10	60.0%	Neutral
The process of filling out the submission form is easy to do	8/10	80.0%	Agree
The submission deadline rule (H-3) is reasonable and appropriate	7/10	70.0%	Agree
The process of uploading supporting documents is easy and the instructions are clear	6/10	60.0%	Neutral
The status flow (submitted → pending verification → approved/rejected) is already appropriate	6/10	60.0%	Neutral
Overall, SIMPUL makes things easier for the public and is feasible for implementation	8/10	80.0%	Agree
Overall	65/90	72.2%	Agree

As an additional note, the admin (Respondent 5) also tested the administrative functions covered in the test scenarios in Table II, namely submission verification, building data management, audit log recording, and report preparation. All these functions were assessed as operating according to procedure without significant issues.

G. System Use

Based on the testing and evaluation results that have been carried out, SIMPUL is declared to meet all functional requirements, have an acceptable level of usability, and receive positive acceptance from users. The system was then handed over to the Education Office of Banyumas Regency for use as a digital alternative to the existing manual recording system.

H. Discussion

The SIMPUL results successfully addressed the problems found in the facility reservation process at the Education Office of Banyumas Regency, particularly regarding schedule recording that was still done manually, the potential for reservation clashes, and the previous absence of well-documented activity recording. All Black Box Testing scenarios ran according to the expected results, so that schedule validation based on Equation (3), the priority mechanism between internal and external users, and the submission status change all functioned according to the design. These results were supported by the application of system rules established at the Prototype Results Evaluation stage, such as the establishment of the H-3 submission deadline for external users and the priority mechanism when a schedule conflict occurs. In addition, activity recording through the audit log provides a history of data changes so that the reservation management process becomes more documented compared to the previous manual recording.

The System Usability Scale (SUS) score of 80.0 shows that the SIMPUL interface could be used well by both user groups during the testing process, although this evaluation involved nine respondents, so the results should be interpreted as an initial indication of the system's level of usability and do not yet represent all prospective SIMPUL users. The Black Box Testing results provided functional evidence that all main system functions ran according to user requirements. The User Acceptance Testing (UAT) acceptance rate for the internal group of 90.0%, in the strongly agree category, was mainly supported by the simpler submission process, automatic schedule clash validation, and ease of obtaining facility availability information compared to the previous mechanism, which was still carried out manually.

For the external group, the acceptance rate of 72.2% falls into the agree category. Three statements received a Neutral score of 60.0%, namely the Add to Digital Calendar feature, the supporting document upload process, and the submission status flow. These three aspects are directly related to the reservation process by external users, who must go through document upload and verification stages before the submission is approved. The cause of the neutral ratings on these three statements cannot be ascertained because respondents did not provide open comments on the questionnaire. In addition, the still-limited number of external respondents means this evaluation result cannot yet

represent all external users, so future research could involve a larger number of respondents. Based on the three aspects that received a Neutral rating in the external group (Table V), simplifying the supporting document upload flow and adding more explicit submission status instructions could be a direction for improvement in further SIMPUL development.

The gap between the internal acceptance rate of 90.0% and the external rate of 72.2% is also worth examining beyond the three individual statements. Internal users interact with a simplified process in which submissions are approved automatically, so their experience mainly involves confirming that an already convenient workflow performs as expected. External users, in contrast, must complete document upload, wait for admin verification, and meet the H-3 submission deadline before a request is confirmed. This three-step process may have contributed to the lower acceptance score. The gap does not by itself provide evidence of a flaw in the priority mechanism, as both groups gave positive responses to the clash-validation statements (91.4% for internal users and 70.0% for external users). It may instead suggest that the verification process is one potential source of friction for external users, which could be considered in future interface improvements.

Beyond the acceptance rate gap, other feedback from respondents pointed to smaller usability concerns. Input from internal respondents showed that the default operational buffer value of 120 minutes was still felt to be less flexible under certain conditions. Nevertheless, this value can be adjusted by the admin according to the usage needs of each facility location. Other input obtained after the final evaluation, in the form of a proposal to add a dark mode, was not included as part of the development in this study because the system had already been declared complete. Therefore, this proposal is recorded as a recommendation for further development.

The priority mechanism also raises a fairness question that deserves direct discussion. Internal submissions take precedence over an external submission only while that external submission is still pending verification, which reflects the operational reality of a government facility, where internal institutional activities are generally treated as a higher priority than requests from outside parties. Once an external submission has already been approved, the same mechanism protects it even against a later internal request for the same slot, so the advantage given to internal users is conditional rather than absolute. A rejected external submission is also not left without an option, since the system automatically offers an alternative building or time slot through the recommendation mechanism described earlier. The system therefore provides equal visibility into facility availability for both user groups rather than an equal claim to a contested slot.

SIMPUL differs from several previous studies through an automatic priority mechanism between internal and external users, a configurable operational buffer setting for each

facility location, and the use of a combination of Black Box Testing, System Usability Scale (SUS), and User Acceptance Testing (UAT) to evaluate functionality, usability, and user acceptance. Compared to classic scheduling algorithms such as First Come First Served (FCFS), Shortest Job First (SJF), and Round Robin, which are commonly examined in CPU scheduling systems [22], the SIMPUL mechanism conceptually only resembles the FCFS principle within each user category, rather than formally applying it. Priority is determined based on the user category, namely internal users take precedence over external users. If there are several submissions within the same category, schedule determination follows the order of submission. This approach also differs from the hybrid Priority Scheduling–First In First Out mechanism in a similar room reservation system [23], which uses a priority score as the basis for scheduling, whereas SIMPUL only differentiates priority between internal and external users without applying a priority score. In addition, the notification feature and digital calendar integration help users obtain activity schedule information more easily without having to view the schedule directly at the location. Thus, SIMPUL not only serves as a digital alternative to the manual recording process but also provides more structured reservation information management, making it easier for users to obtain information on facility usage schedules. At the same time, a comparable web-based reservation system has evaluated functional behavior and conflict-decision logic [23]. However, this study has not yet evaluated performance aspects such as response time and the ability to handle concurrent requests. These limitations are discussed in the following section.

IV. CONCLUSION

This study produced the web-based SIMPUL (Sistem Informasi Manajemen Peminjaman Unit Lokasi). This system was developed using the Aldisa Prototyping method with Laravel 12 and MySQL as an answer to three main problems, namely manual schedule recording, the absence of automatic conflict validation, and the absence of an audit trail in the management of facility reservations at the Education Office of Banyumas Regency. All 24 Black Box Testing scenarios produced outputs matching expectations. These results demonstrate that the schedule validation logic, the conflict priority mechanism, and the submission status change flow operate correctly. The SUS evaluation of nine respondents produced an average score of 80.0, exceeding the SUS benchmark of 68. UAT showed an acceptance rate of 90.0% for the internal group, in the strongly agree category, and 72.2% for the external group, in the agree category. Based on all these results, SIMPUL is considered feasible as a digital alternative to the manual recording system at the Education Office of Banyumas Regency.

This study has several limitations. The number of respondents for user acceptance testing among external users was very limited, with only two respondents, so the resulting

acceptance percentage should be interpreted as an early indication rather than a statistically representative result. SIMPUL was also only tested at one institution, namely the Education Office of Banyumas Regency, so the evaluation results may not necessarily apply to other government institutions with different operational characteristics. The testing conducted has focused on functional aspects, usability, and user acceptance within a short period after implementation and has not yet evaluated the system over a longer period of actual use. Performance aspects such as response time and the ability to handle concurrent requests have not been tested due to limitations in load testing tools. The quantitative impact of the implementation on the number of real scheduling conflicts compared to the previous manual system has also not been measured because the evaluation only covered a single time period. The calendar integration feature in SIMPUL uses an ICS file downloaded once at the time the submission is created so changes to submission data made after the file has been added to the user's calendar are not automatically updated and the appearance of reminder notifications in third party calendar applications also depends on the user's device settings such as automatic synchronization status and battery optimization which are beyond the system's control.

Based on these limitations, several development directions can be pursued in future research. SIMPUL can be trialed at other local government institutions with similar user structures, namely internal and external, with adjustments to each institution's policies and operational procedures. Evaluation should be conducted over a longer period of use to measure the consistency of the priority mechanism and its quantitative impact on the number of scheduling conflicts compared to the previous manual system. Performance testing also needs to be carried out to measure the scalability of SIMPUL before it is implemented at a larger user scale, covering response time and the system's ability to handle concurrent requests. The number of external user respondents in usability and user acceptance testing also needs to be increased so that the evaluation results are more representative. In terms of features, further development could include two-way calendar synchronization and the addition of a dark mode to the interface.

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