



Integrating Academic Information System Based on Enterprise Architecture using ETL: A Case Study of SIUNU Using the TOGAF ADM Framework

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Abstract:

Nahdlatul Ulama University, which manages multiple institutions, requires an integrated information system to coordinate academic and administrative processes efficiently. However, developing such a system faces challenges related to business process complexity and the need for diverse user role distribution. This study aims to design an integrated academic information system (SIUNU) by combining BPMN business process modeling and RACI matrix analysis to produce a modular, scalable, and accountable system architecture in a multi-campus environment. The research employs a qualitative-descriptive methodology with a case study approach. Business process modeling was conducted using Business Process Model and Notation (BPMN) 2.0 to visually represent workflows. The research produced business process models for five main modules: Authentication (login, forgot password, logout), Academic Dashboard (student data, lecturer data, GPA summaries, tracer studies), Evaluation and Reporting (teaching evaluation), Letter Management (drafting, verification, disposition, archiving), and the MBKM Module (program registration, credit conversion). RACI analysis generated structured role mapping, showing the Super Admin as the primary accountable party for system configuration, PTNU Admin as the operational implementer, Lecturers as academic consultants, and Students as active users of personal data. The integration of BPMN and RACI proved effective in producing an academic information system design framework that is not only technically robust but also organizationally accountable. This research contributes to the development of academic information system literature through an integrative approach and provides a ready-to-implement design for Nahdlatul Ulama University.

Keywords: Integrated Information System; SIUNU; BPMN; RACI Matrix; Role-Based Governance

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INTRODUCTION

Universities today require cohesive digital infrastructures that can manage academic and administrative activities efficiently (Gapasin, 2026; Hindarto, 2023; Omodan, 2024). For Nahdlatul Ulama University, which operates across multiple institutions, an integrated system becomes essential (Adawiyah, 2026; Baihaqi & Miskiyah, 2025; Qorib, 2025). This study proposes a design framework for SIUNU that leverages standardized process modeling and structured role analysis to ensure effective system implementation (Kolluri, 2025; Singgalen, 2024). The BPMN methodology provides a transparent visual representation of system interactions, while RACI is employed to distribute authority and accountability (Ahmad, 2024).

The SIUNU system comprises various modules, including Authentication and Academic, designed to enhance access control, academic data management, and operational

efficiency across university stakeholders (Yoheswari, 2025). The Authentication module enables secure login, password reset, and user activation functionalities (Manulis et al., 2016; Wang et al., 2018). Meanwhile, the Academic module supports data visualization, tracer studies, academic calendars, and lecture evaluations (Asamoah, 2022). These components are aligned with the university's goals of improving data security, scalability, and usability (Dhillon et al., 2016).

Technically, SIUNU is built on a modern stack: a Laravel backend, Next.js frontend, PostgreSQL database, and Apache HTTP server. It supports both web and mobile platforms, ensuring accessibility for diverse user classes, including students, faculty, and administrative staff. Functional and non-functional requirements detailed in the SRS emphasize performance (e.g., supporting 1,000 concurrent users), security (e.g., validated credentials and access control), and usability (e.g., intuitive interfaces and responsive design). By adhering to these specifications, SIUNU aims to deliver a robust and sustainable digital infrastructure to support Nahdlatul Ulama University's academic ecosystem (Siregar et al., 2025).

Several previous studies have examined the development of integrated academic information systems with various approaches (Adams et al., 2016; Szymkowiak et al., 2021; Tarafdar & Davison, 2018). Zampognaro (2017) developed a use-case-based approach in needs engineering that can identify user needs collaboratively with domain experts. Sunardi and Suharjito (2019) compared the Laravel and Slim frameworks, showing that Laravel offers better scalability through the MVC principle for complex systems. Putra et al. (2025) examined the trends of API-based web development using Laravel and React/Next.js for dynamic interfaces. Ahmad (2024) applies the RACI model to improve governance consistency through structured role distribution. Choina and Skublewska-Paszkowska (2022) analyzed database performance, showing PostgreSQL excels in performance and transactional support. Lopes (2023) examined BPMN for business process modeling, while Emma (2024) introduced the RBAC model as the basis for role mapping.

Although these studies make important contributions, there is still a significant research gap: the absence of studies that integratively combine business process modeling with BPMN and structured role analysis with RACI in a single academic information system design framework for a multi-campus environment. Previous research has tended to address technical aspects (such as the selection of frameworks or databases) or governance aspects separately, without integrating the two in a holistic approach that simultaneously includes the dimensions of processes, roles, and technologies (Janssen et al., 2020). In addition, the context of Nahdlatul Ulama University, with its multiple institutions and diverse stakeholders, has never been studied in depth in the academic information system literature (Nuruzzaman et al., 2025).

The novelty of this research lies in the integration of BPMN and RACI methodologies into a holistic and contextual academic information system design framework for a multi-campus environment. This research offers a new approach that simultaneously models the flow of business processes while defining the distribution of responsibilities and accountability of each actor in the system. This integration allows for the creation of a system design that is not only technically robust but also organizationally accountable and aligned

with the institutional governance structure. Another novelty is the application of this framework in the context of Nahdlatul Ulama University, which has unique characteristics as a network of universities with various units and levels of authority, requiring an adaptive and scalable system design approach.

RESEARCH METHODS

This research employs a qualitative-descriptive methodology, focusing on analyzing institutional processes and designing an information system that aligns with both operational workflows and user roles. The aim is to construct a reliable system architecture using visual process modeling and structured role assignments. The research method integrates Business Process Model and Notation (BPMN) for representing workflows, and the RACI (Responsible, Accountable, Consulted, Informed) matrix for defining user responsibilities. This dual approach enhances system transparency, user accountability, and process efficiency, as suggested by White and supported by Ahmad (2024).

System Design Framework

The SIUNU system is constructed using a design framework that merges process modeling and role-based analysis. This framework enables the depiction of institutional logic through BPMN diagrams and assigns responsibilities through RACI matrices. It is tailored to suit the operational ecosystem of Nahdlatul Ulama University, where multiple roles and hierarchical levels require coordinated interaction.

This approach ensures not only functional clarity but also facilitates collaboration between technical developers and administrative personnel by making workflows visible and understandable. As advocated by Dumas, such a structured approach ensures alignment between process expectations and system capabilities.

The framework is iterative in nature, beginning with stakeholder interviews, followed by process identification, model creation, validation, and refinement. The integration of BPMN and RACI not only defines “what happens” but also “who is responsible,” thus covering both procedural and accountability dimensions.

Business Process Modeling (BPMN)

BPMN 2.0 is used to visually represent the sequential flow of activities across various functional areas of the SIUNU system. Each BPMN diagram describes the interaction between users and system components based on real operational processes. In the authentication module, the BPMN diagram captures login, logout, password reset, and role-based redirection workflows. The academic dashboard module visualizes processes for GPA reports, graduation metrics, and academic calendar access. The evaluation module details lecturer self-assessment, admin verification, and reporting. Meanwhile, the letter management module outlines workflows for drafting, validating, approving, archiving, and tracking incoming or outgoing correspondence. The MBKM module includes program registration, validation of study credits, and data management related to institutional collaboration. These diagrams are not only designed for technical implementation but also reviewed with end users to ensure clarity and relevance. As noted by White, process

visualization through BPMN serves as an effective communication bridge between developers and non-technical stakeholders.

Role Definition via RACI Matrix

To ensure accountability in system operations, a RACI matrix is employed to map out stakeholder responsibilities across more than thirty system functionalities. The matrix assigns each actor a level of involvement as Responsible, Accountable, Consulted, or Informed. Key stakeholders include Super Admin, PTNU/LPTNU Admins, Management, Lecturers, Educational Staff, and Students. For instance, in the process of user activation, the Super Admin holds both A and R roles, while Admins are responsible for the operational implementation and students are informed parties. In the teaching evaluation process, Admins are marked as responsible, while lecturers and students act as consulted stakeholders. The RACI model draws from the Role-Based Access Control (RBAC) concept developed by Sandhu ', providing a clear access control mechanism that is particularly useful in managing information systems in education. This approach is further contextualized for academic institutions following the framework proposed by Ahmad (2024), who emphasizes the importance of role distribution in maintaining governance consistency.

Use Case Analysis

Use case analysis is employed to capture the expected interactions between users and the system, ensuring that features are developed in response to actual institutional needs. Core use cases include user authentication, academic dashboard access by role, teaching evaluation input and validation, letter workflow processing, and MBKM program participation. Use cases help define system boundaries and clarify the roles of actors, scenarios, and outcomes. Odeh highlight the effectiveness of use-case modeling in identifying requirements collaboratively with domain experts, while Somé emphasizes the value of formalizing use cases to guide system conceptualization in early development phases.

Database Design and Structure

The system database is built using PostgreSQL, selected for its support of relational integrity, role-based access control, and high performance in handling academic data. Key entities include user accounts, student and lecturer records, evaluation reports, correspondence, and MBKM-related data. The design adheres to database normalization principles to ensure data consistency and avoid redundancy. According to Choina & Skublewska-Paszkowska (2022) , PostgreSQL provides superior performance and transactional support when integrated with backend frameworks, while Ports & Grittner demonstrate how Serializable Snapshot Isolation ensures reliable data operations with minimal performance overhead.

Technology Stack and System Architecture

The SIUNU platform utilizes a full-stack architecture consisting of Next.js for frontend development, Laravel (PHP) for backend processing, and PostgreSQL for data management. The system is hosted on an Apache server, with continuous integration and deployment (CI/CD) pipelines configured via GitLab. Performance testing is conducted using k6 to simulate multi-user access and monitor response times under load. As discussed by Sunardi

& Suharjito (2019), Laravel offers scalability and standardization through MVC principles, while (Putra et al., 2025) emphasize that combining Laravel with frontend frameworks like React or Next.js enables dynamic UI and efficient API-based communication.

RESULTS AND DISCUSSION

Related Work

The design and implementation of academic information systems such as SIUNU are strongly grounded in prior research on process modeling, access control, and modular system architecture. One of the fundamental methodologies used in modeling system behavior is the Business Process Model and Notation (BPMN). White introduced BPMN as a standard graphical notation that enables both technical and non-technical users to visualize the sequence of business activities and decisions in a coherent, standardized format. BPMN allows developers to model real-world processes with symbols that are intuitive and universally understood, thereby reducing ambiguity in system specifications.

Building upon White's foundation, Dumas offered a more structured and comprehensive explanation of BPMN 2.0, particularly in complex organizational settings such as universities. Their work emphasizes the role of process modeling in aligning stakeholder expectations, optimizing workflows, and facilitating system automation. Through BPMN, not only can functional flows be diagrammed, but exceptions, parallelism, and coordination among multiple actors can also be accurately represented.

In line with process modeling, requirements engineering is another critical area that supports successful system development. Sommerville states that the success of any information system depends heavily on how well the system requirements are captured, validated, and translated into software design. Use case modeling, as part of this process, provides a structured mechanism for defining user interactions with the system, ensuring that the system behavior reflects actual needs and expectations. This is particularly relevant in educational institutions, where system users range from administrators and faculty to students and external partners.

To support secure and structured interactions within such systems, role-based access control (RBAC) becomes essential. Sandhu pioneered the RBAC model, which assigns permissions based on user roles rather than individual identities. This model significantly enhances maintainability, policy enforcement, and scalability of access management in large-scale systems. In the context of SIUNU, RBAC principles are mapped and operationalized using a RACI matrix to delineate who is Responsible, Accountable, Consulted, and Informed for every system function. This role clarity minimizes authorization conflicts and supports traceable decision-making processes.

System architecture also plays a crucial role in ensuring that process logic and access control are technically sustainable. Pressman argues that a modular architecture—where functionality is separated into manageable and reusable components—improves system extensibility, fault isolation, and testing capabilities. Such an architecture supports the implementation of distributed responsibilities, allowing SIUNU to scale across different departments while maintaining centralized oversight.

Further advancing these ideas, Ahmad (2024) contextualizes the use of BPMN and RBAC models within higher education governance. His study illustrates how structured role definitions, when combined with process transparency and modular workflows, improve compliance with institutional policies and enhance administrative accountability. This is particularly critical in multi-campus systems like SIUNU, where decision rights and data access must be clearly managed across different organizational layers.

In summary, the current research draws upon foundational and contemporary work on system modeling, access control, and architecture. By synthesizing the contributions of White, Dumas, Sommerville, Sandhu, Pressman, and Ahmad, this study positions SIUNU as a modern, scalable academic information system grounded in well-established best practices.

Process Modeling with BPMN

The modeling of business processes within the SIUNU system adopts the Business Process Model and Notation (BPMN) 2.0 standard, a visual modeling language that supports the design, execution, and management of structured workflows. BPMN was chosen for its capacity to communicate process logic in a standardized way that is understandable to both technical and non-technical stakeholders, in line with the recommendations by Dumas and White.

Each module in the SIUNU system is modeled using BPMN diagrams that illustrate the flow of tasks, decision gateways, data interactions, and participant swimlanes. These diagrams enable validation of workflows, identification of bottlenecks, and consistent process documentation, which are vital in the academic context, where multiple roles interact across numerous services.

1. Authentication Module

The authentication process is divided into three distinct workflows: login, forgot password, and logout, each modeled in separate BPMN diagrams. In BPMN Authentication (Login), the process starts with user input of credentials and continues with system validation. If successful, users are redirected based on their role; if not, error notifications or account lockouts are triggered. The BPMN Authentication (Lupa Password) diagram details the flow for password recovery through email/token validation and confirmation. Meanwhile, BPMN Authentication (Logout) models secure session termination, ensuring clean state disposal and redirection to the landing page. These processes include error boundary events and decision gateways to handle exceptions and user role conditions effectively.

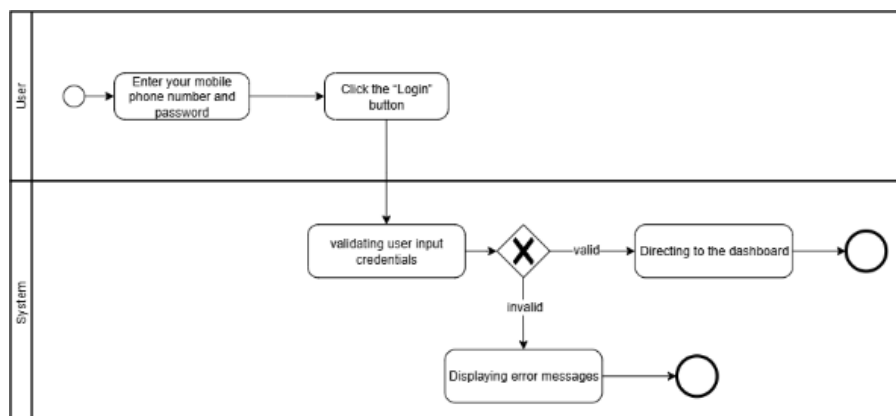


Figure 1. Authentication Login

Source: Results of analysis and modeling by researchers using BPMN (2025)

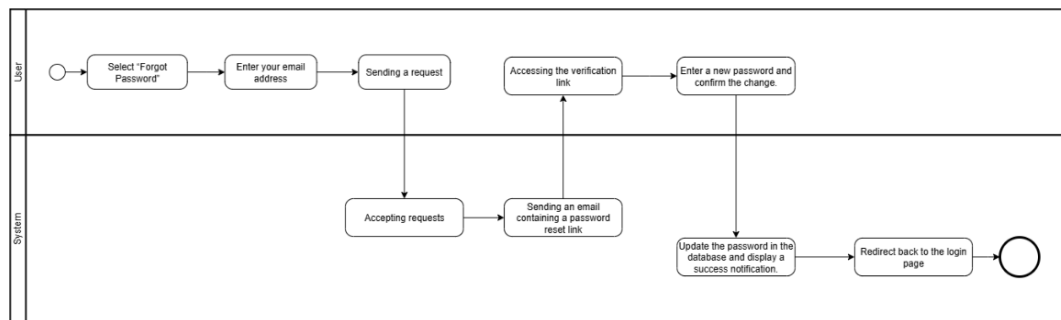


Figure 2. Authentication Forgot Password

Source: Results of analysis and modeling by researchers using BPMN (2025)

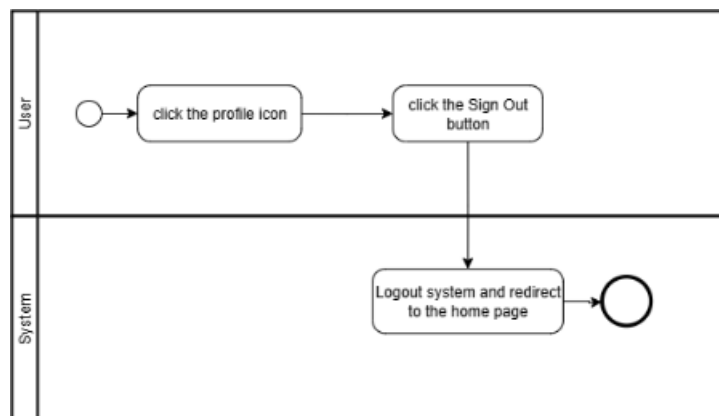


Figure 3. Authentication Logout

Source: Results of analysis and modeling by researchers using BPMN (2025)

2. Academic Dashboard Module

The Academic Dashboard module in SIUNU includes multiple workflows designed to present aggregated institutional data tailored to each user role. The BPMN diagram for this module begins with an authenticated user initiating a dashboard request. Depending on their role, such as Super Admin, Admin PTNU, or Management, the system filters data access using the PTNU identifier and specific role-based privileges. The process continues with data retrieval from various sources, including student profiles, lecturer data, GPA (IP/IPK) distributions, graduation statistics, tracer study results, and academic calendars.

Exclusive gateways are used to validate access rights before allowing the display of sensitive information. For instance, Admin PTNU can access rekapitulasi IPK and graduation summaries, while students are limited to their personal academic records. In the event of unauthorized access or failed data queries, the system triggers exception-handling events that inform users through appropriate alerts.

Once validated, the data is rendered into visual summaries in the form of charts, tables, and downloadable reports. The structure of this module, which consistently follows a request–filter–retrieve–render pattern, ensures clarity and security across dashboard

interactions. This supports institutional decision-making by providing filtered insights tailored to administrative, academic, and student stakeholders.

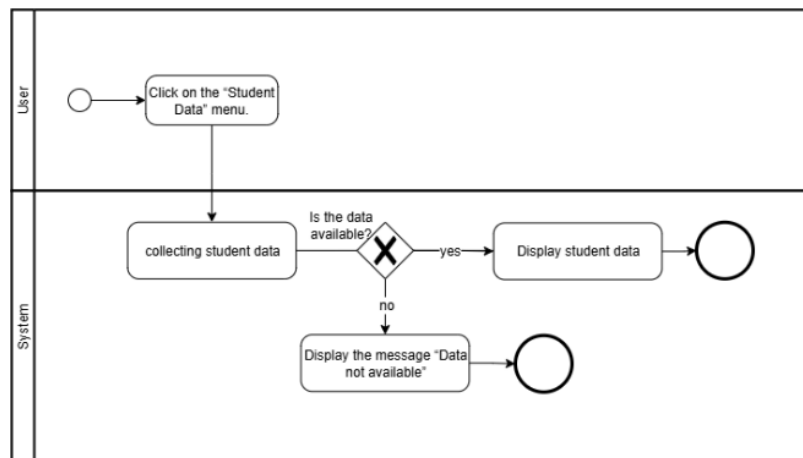


Figure 4. Academic Dashboard – Student Data

Source: Results of analysis and modeling by researchers using BPMN (2025)

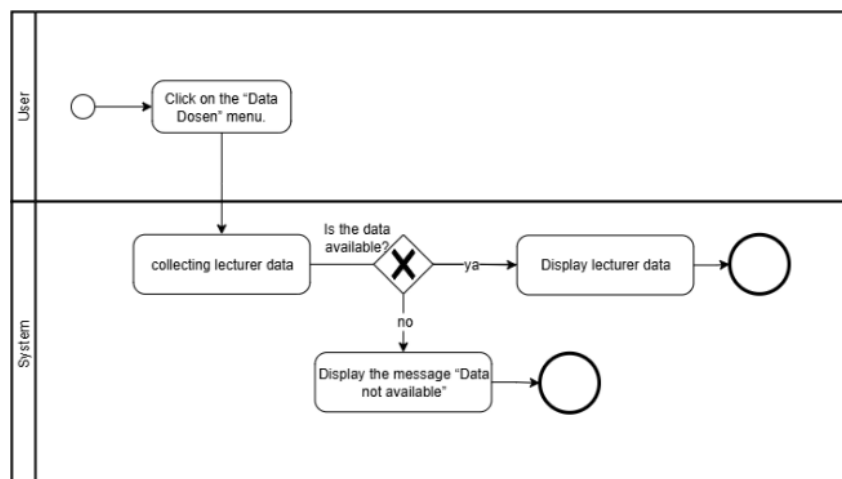


Figure 5. Academic Dashboard – Lecturer Data

Source: Results of analysis and modeling by researchers using BPMN (2025)

3. Evaluation and Reporting Module

The Evaluation and Reporting module manages the teaching performance review process. It starts when lecturers submit self-evaluation forms through the system. These forms are received by Admin PTNU for validation. If the submissions are incomplete or incorrect, the process is redirected back to the lecturer for revision. This feedback loop is modeled using looping tasks that ensure completeness and correctness before further processing.

Upon successful validation, the data is compiled into institutional performance reports and archived in a secure repository. Scheduled triggers are also embedded within the BPMN diagram to open or close evaluation windows based on the academic calendar. Gateways ensure that only eligible lecturers can submit evaluations, and boundary events are applied to

capture submission errors or invalid periods. This structured modeling supports timely and accountable teaching assessments, aligning with institutional quality assurance mechanisms.

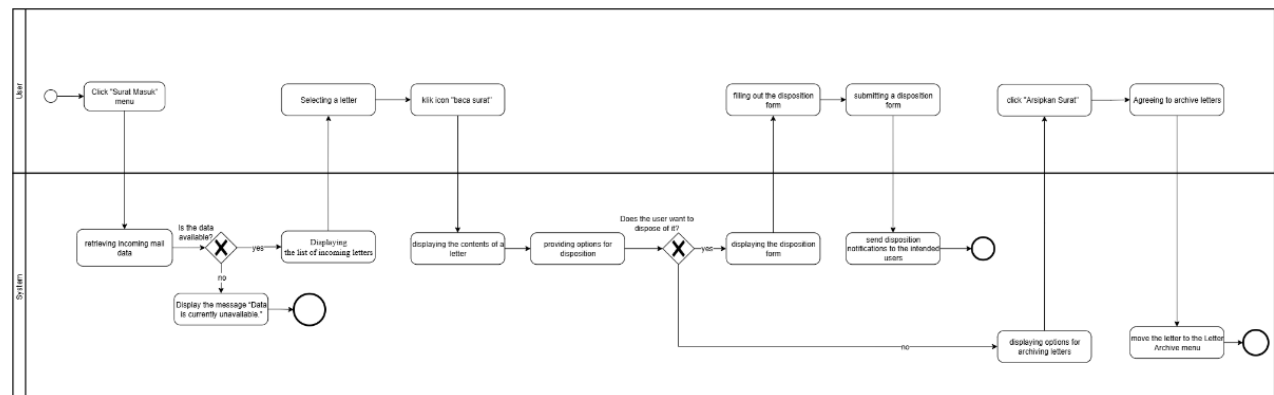


Figure 6. Letter Management Module

Source: Results of analysis and modeling by researchers using BPMN (2025)

4. Letter Management Module

This module handles the drafting, review, verification, disposition, and archiving of institutional letters, both incoming and outgoing. The BPMN workflow begins with staff members initiating a letter draft and continues through routing logic that depends on document type and target recipients. The system forwards the draft to relevant department heads or units for review.

Verification tasks include checking metadata completeness, document classification, and digital signing by authorized personnel. Once validated, the document is archived and, if required, assigned to a disposition process to direct it to the appropriate destination. The BPMN structure includes distinct lanes to assign responsibilities to specific users such as admins, educational staff, and management, thereby minimizing delays and improving document traceability.

5. Master Data and MBKM Module

The Master Data and MBKM module ensures the consistent management of institutional data and the implementation of the Merdeka Belajar Kampus Merdeka (MBKM) program. Workflows in this module begin with creating and updating core data elements such as academic calendars, campus profiles, faculties, and user roles. For MBKM integration, the system includes workflows for registering student participants, validating academic credit transfers, and recording collaborations with partner institutions.

Each activity in this module includes validation steps to ensure role-specific permissions and compliance with academic policies. For example, faculty or administrative staff may input program data, while verification is completed by Admin PTNU. Credit conversions are only processed once internal and external validations are completed, and all actions are logged in the system for audit purposes.

Role Analysis with RACI

To ensure operational clarity, a comprehensive RACI matrix Smith was developed encompassing over 30 system functions across major modules, including Authentication,

Dashboard, Academic Records, MBKM, Facility Reporting, and Letter Management. Roles defined include Super Admin, Admin PTNU/LPTNU, Management, Lecturer, Educational Staff, and Students. The matrix assigns each role one or more levels of responsibility per function: Responsible (R), Accountable (A), Consulted (C), or Informed (I).

This approach not only enhances accountability but also optimizes communication and reduces process overlap, aligning with the principles of Role-Based Access Control (RBAC) as introduced by Sandhu⁷ and validated in educational environments by (Ahmad, 2024).

1. Role Distribution Patterns

The analysis of the RACI matrix reveals the distribution of responsibilities and oversight throughout the system's ecosystem. Each role performs a unique function in supporting process execution, compliance, and user engagement. Below is a detailed interpretation:

- a) Super Admin: Serves as both Accountable and Responsible (A/R) for strategic and system-wide tasks such as configuring user access, overseeing activity logs, and managing access rights. Their central role reflects high-level authority and full control over critical security and configuration settings.
- b) Admin PTNU/LPTNU: Holds the most operational responsibility (R) in the system. This role is actively involved in executing academic processes, managing user accounts, updating dashboards, validating evaluations, and handling institutional letters. Admins act as the functional backbone of SIUNU, ensuring that daily operations align with institutional policies.
- c) Lecturers: Frequently marked as Consulted (C), especially in tasks involving academic reporting, tracer studies, and teaching evaluations. However, they also take on the Responsible (R) role in the MBKM module, particularly in academic mentoring, program approvals, and study result validation. This duality highlights their importance in academic and policy implementation.
- d) Educational Staff: Primarily Responsible (R) for logistical and administrative support activities such as managing facilities, inventory, performance reports, and correspondence. Their consistent involvement in back-office tasks ensures the system runs smoothly in support of front-end functions.
- e) Students: Take Responsibility (R) for interactions that involve personal data or user-generated input, including login, password management, MBKM participation, and teaching feedback. In other institutional processes, students are typically marked as Informed (I), reflecting their position as recipients of academic and administrative outcomes.
- f) Management: Plays a strategic and advisory role. They are usually marked as Consulted (C) or Informed (I), especially in high-level data reviews such as dashboards, academic summaries, and performance analytics. Their input is crucial in aligning system outputs with institutional goals and compliance standards.

2. Expanded Function Mapping

Table 1. Mapping Functions and Roles in the SIUNU System Using the RACI Matrix

Functions	Role					
	Super Admin	Admin LPTNU/PTNU	Management	Lecturer	Educational Staff	Students
User Activation	A/R	R	I	I	I	R
Login	I	I	I	I	I	R
Change Password	I	I	I	I	I	R
Access Rights Management	A/R	R	I	I	I	I
User Activity Audit Log	A/R	C	I	I	I	I
Academic Dashboard	A/R	R	C	I	I	I
Student Data Summary	A/R	R	C	I	I	I
Lecturer Data Summary	A/R	R	C	I	I	I
Graduation Summary	A/R	R	C	I	I	I
IP/IPK Summary	A/R	R	C	I	I	I
Tracer Study Summary	A/R	R	C	I	I	I
Academic Calendar	A/R	R	C	I	I	I
Classroom Reports	A	R	C	C	I	I
Teaching Evaluation	A	R	C	C	I	C
Facility Reports	A/R	R	C	I	R	I
Inventory of Facilities and Equipment	A/R	R	C	I	R	I
Teaching Staff Performance Reports	A/R	R	C	I	R	I
P2M Dashboard	A/R	R	C	C	I	I
Research Data Summary	A/R	R	C	R	I	I
Rekap Data Pengabdian	A/R	R	C	R	I	I
Recap of Grants & HKI	A/R	R	C	R	I	I
Manage News	A/R	R	C	C	C	I
Manage Gallery/Images	A/R	R	C	C	C	I
PTNU Profile, Scholarships, etc.	A/R	R	C	I	I	I
MBKM Program Management	A/R	R	C	R	C	I
MBKM Study Results Recognition	A	R	C	R	C	I
Participant and Partner Data Collection	A/R	R	C	C	I	I
Manage Incoming Letters	A/R	R	C	I	R	I
Manage Outgoing Letters	A/R	R	C	C	R	I
Create Letters	A/R	R	C	C	R	I
Letter & Document Archive	A/R	R	C	I	R	I
Letter Disposition	A	R	C	C	R	I

Source: Results of the researcher's analysis based on interviews and observations of business processes within Nahdlatul Ulama University (2025)

3. Visualized RACI Summaries by Module

The To improve understanding across stakeholders, the role responsibilities are grouped and presented per system module. This structured representation aligns with the matrix in 5.2 and further clarifies how institutional workflows are supported through the RACI model.

1) Authentication Module

- a. Super Admin: Accountable and Responsible (A/R) for access rights and account activation.
- b. Admin PTNU: Responsible (R) for implementing user registration and credential support.
- c. Students: Responsible (R) for login and password management.

2) Dashboard & Academic Data

- a. Super Admin: A/R for the data aggregation logic.
- b. Admin PTNU: R for dashboard setup and real-time monitoring.
- c. Management: Consulted (C) for high-level interpretation.
- d. Students: Informed (I) via accessible summaries and academic metrics.

3) Teaching Evaluation & Academic Reporting

- a. Admin PTNU: R for evaluation execution.
- b. Lecturers: C for evaluation input and research updates.
- c. Students: C for feedback collection during teaching assessments.

4) Letter Management

- a. Admin PTNU: R for document workflow operations.
- b. Educational Staff: R for physical and digital archiving.
- c. Super Admin: A/R for system configurations and log visibility.
- d. Management: C for oversight and decision disposition.

5) MBKM Module

- a. Admin PTNU: R for MBKM registration, validation, and transcript entry.
- b. Lecturers: R/C for academic mentoring and recognition.
- c. Students: R for participation data input and confirmation.
- d. Super Admin: A/R for verifying institutional MBKM compliance.

4. Benefits and Strategic Implications

The implementation of the RACI model in SIUNU provides multiple strategic advantages. Firstly, it reduces potential conflicts in task execution by clearly delineating roles, especially between those who are accountable (A) and those responsible (R), thus avoiding duplication of efforts and minimizing ambiguity. Secondly, it enhances transparency by ensuring that every process is traceable—this supports academic audits, performance evaluations, and administrative compliance. In addition, the model directly informs the design of the system's access control, reinforcing RBAC mechanisms so that permissions align precisely with assigned responsibilities. Finally, the RACI matrix is inherently adaptable; as institutional policies evolve or modules are updated, realignment can be done with minimal disruption to workflows.

CONCLUSION

This study presents the analysis and design of the SIUNU (Sistem Informasi Universitas Nahdlatul Ulama) platform by integrating Business Process Model and Notation (BPMN) with role-based responsibility mapping through a RACI matrix. The combination of these two methodologies offers a structured, transparent, and adaptable foundation for system development in higher education environments. BPMN diagrams enable the visualization of institutional workflows in a standardized format, improving communication between technical teams and stakeholders. Simultaneously, the RACI matrix helps clarify role distribution across system functions, ensuring accountability, efficiency, and policy alignment.

The modular approach used in the design of SIUNU facilitates both scalability and maintainability, particularly important for dynamic academic ecosystems where governance structures and administrative procedures frequently evolve. By modeling processes such as authentication, dashboard access, evaluation, correspondence, and MBKM, the system captures core academic and administrative functions in a cohesive architecture. This modeling approach supports alignment with institutional goals, improves data governance, and reduces ambiguity in system behavior.

For future work, the system will proceed into the development and implementation phase. This includes building working prototypes of each module using the identified technology stack (Next.js, Laravel, PostgreSQL), followed by functional and usability testing with real users from NU-affiliated institutions. Feedback gathered during this phase will inform iterative refinements to workflows and interface design. Furthermore, SIUNU is envisioned to serve as a foundation for an integrated academic service ecosystem across NU universities, which may involve interoperability with existing systems such as learning management platforms, alumni networks, and national education data repositories.

Finally, ongoing research will explore the application of continuous process improvement strategies, such as agile BPM or adaptive case management, to maintain relevance and responsiveness to institutional changes. Long-term sustainability will also consider governance models, user training, and the formulation of data standards for use across the NU academic network.

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