Equivalent: Jurnal Ilmiah Sosial Teknik
Volume 8, Issue 2, 520-530
e_ISSN: 2775-0833
https://jurnalequivalent.id/index.php/jequi/index
DOI: doi.org/10.59261/jequi.v8i2.287

Enterprise Architecture Design for Class Approval and Scheduling Governance (Permission Planning) at Universitas Terbuka

Muhammad Rif'an[1*]
Universitas Terbuka, Indonesia

Iwan Susanto[2]
Universitas Terbuka, Indonesia

Iswaya Maalik[3]
Universitas Terbuka, Indonesia

Zakirman[4]
Universitas Terbuka, Indonesia

Erika Pradana[5]
Universitas Terbuka, Indonesia

***Corresponding author:**
Muhammad Rif'an, Universitas Terbuka, Indonesia.
✉ m.rifan@ecampus.ut.ac.id

Article Info:

Article history:
Received: March 10, 2026
Revised: May 11, 2026
Accepted: May 15, 2026

Keywords:
Academic management system;
Class permission planning;
Enterprise architecture;
Open and distance learning.

Abstract

Background: Large open and distance universities must plan classes under high enrolment volatility, limited teaching capacity, and strict accountability. At Universitas Terbuka (UT), class permission planning is still carried out through fragmented tools such as spreadsheets and email-based coordination. The process becomes slow during peak periods, decisions are difficult to trace, and policy rules are applied inconsistently across units.

Objective: This paper outlines a context-specific academic management solution capable of near-real-time automated checks and explainability through rule-based decision rationales in the permission-to-class-request process at scale for a mega-university.

Methods: This study employed a Design Science Research (DSR) approach using the *TOGAF Architecture Development Method (ADM)* as the artifact-construction framework. The outcome delivered *as-is* and *to-be* business workflows, a common information model, a componentized application architecture, and a technology architecture. Data were collected through observations, document analysis, and semi-structured interviews with stakeholders from academic administration, academic units, and IT services.

Results: These requirements were subsequently translated successfully into an early prototype (*SIMPATIK*), which was then tested through formative usability walkthroughs involving a sample of 40 respondents, demonstrating acceptable usability evidence while falling short of complete process-performance validation. Usability ratings (mean = 4.25–4.55 on a five-point scale) suggested high perceived clarity and usability.

Conclusion: These artifacts form a reusable blueprint for institutions operating under similar scale and governance constraints during implementation.

To cite this article: Rif'an, M., Susanto, I., Maalik, I., Zakirman, & Pradana, E. (2026). Enterprise Architecture Design for Class Approval and Scheduling Governance (Permission Planning) at Universitas Terbuka. *Equivalent: Jurnal Ilmiah Sosial Teknik*, 8(2), 520-530. https://doi.org/10.59261/jequi.v8i2.287

INTRODUCTION

The model of open and distance higher education has matured into one that subjects academic planning to scrutiny every semester. With increasing student numbers, however, decisions about opening and merging classes and assigning staff are no longer part of routine administration. Instead, they are treated as a shared institutional responsibility. Timeliness is

expected. Consistency is demanded. One requirement is the explainability of decisions, since both learners and auditors need to understand the reasons behind them, particularly under increasingly scrutinized open and distance learning (ODL) programs with respect to governance and quality assurance (Ferdousi et al., 2022; Zuhairi et al., 2020).

In this setup, digital transformation is not merely about the digitization of forms. Workflow redesign is required. Decision rules must be made explicit. Data and governance structures must be prepared for scalable decision-making. This shift has been widely discussed in systematic reviews of digital transformation in higher education and broader industry contexts, including the roles of strategy, governance, and institutional capability building (Bisri et al., 2023; Castro et al., 2020; Mohamed et al., 2022; Zhu et al., 2021). It has also been associated with the Education 4.0 agenda, in which educational institutions are increasingly expected to function as responsive and data-driven service providers (Mukul & Büyüközkan, 2023).

The national open and distance university of Indonesia, Universitas Terbuka (UT), is not exempt from these pressures. The demands arising from numerous study programs and regional learning centers must be aligned with available teaching capacities. At the same time, Open and Distance Flexible Learning (ODFL) principles, public accountability, and institutional commitments to value must be maintained (Ferdousi et al., 2022; Zuhairi et al., 2020). Under conditions of uncertainty, these pressures often push organizations toward increasingly ad hoc coordination practices and fragmented operational patchworks, as observed in higher education transformations in extreme conditions (Antonopoulou et al., 2023).

One workflow in which the impact is immediate is class permission planning. Additional classes may be opened, sections may be merged, and offerings may be closed. These decisions consider enrollment patterns, lecturer availability, and policy-imposed constraints. For students, such outcomes may determine either the postponement or progression of their studies. Lecturer workload distribution and program service standards are also affected. However, this workflow is often supported by a patchwork of spreadsheets, email coordination, and manual reconciliation across systems. During peak enrollment periods, repeated data entry and rework are frequently triggered. Furthermore, policy directives imposed from higher administrative levels can reduce traceability and weaken transparency. As a result, maintaining equitable service delivery becomes more difficult (Antonopoulou et al., 2023).

As higher education administration increasingly adopts platform-like service models, interoperability, shared data assets across multiple use cases (Dong et al., 2020; Polin et al., 2023), and consistent service quality across institutional supply chains (Alrehaili et al., 2021; Polin et al., 2024) become central concerns. Consequently, the challenge is no longer merely one of separate software applications or workplace automation, but rather of designing an integrated ecosystem, consistent with the principles of smart campus thinking. In such ecosystems, transparency becomes paramount. The extent to which reasons are communicated, outcomes are perceived as fair, and accountability is established has been shown to influence trust and acceptance of intelligent or autonomous decisions (Matheus et al., 2023; Wanner et al., 2022).

Enterprise Architecture (EA) is frequently associated with higher education institutions in relation to aligning institutional strategy with initiatives that drive the digital transformation of educational organizations. EA provides institutions with a systematic capability to develop IT investments aligned with strategic goals, integrate cross-unit processes, and enforce governance standards at scale capabilities that are critically important in large and distributed higher education environments (Lamey et al., 2023). As a structured framework spanning business, data, application, and technology layers, EA enables educational organizations to move beyond uncoordinated digitization toward coherent institutional transformation. These principles are anchored in real-time data cohesion and policy-consistent decision-making, functioning as critical enablers for coordinating multi-stakeholder processes in higher education (Dang & Pekkola, 2020). Enterprise Architecture also connects institutional strategy with processes, data, applications, and technology. Previous studies have reported benefits such as reduced duplication, stronger governance, and shared roadmaps across organizational units (Alghamdi, 2024; Dang & Pekkola, 2020; Kotusev et al., 2023). Moreover, practical EA guidance in higher education has emphasized the importance of integrated and intelligent solutions capable of

operating within real institutional constraints (Lamey et al., 2023). However, mapping studies in the education domain continue to highlight recurring gaps, including fragmented requirements, weak semantic data alignment, and limited workflow-level evidence that can be translated into operational reference designs (Bourmpoulias & Tarabanis, 2020). In higher education, TOGAF-based planning has been used to structure transformation programs and optimize academic business processes, yet detailed workflow-level cases with user-facing validation remain limited (Anam et al., 2021).

Unlike prior TOGAF-based higher education studies that focus primarily on transformation planning or general process optimization (Anam et al., 2021), this study produces a detailed workflow-level architectural blueprint with embedded policy-rule logic and user-facing transparency mechanisms, evaluated through structured usability walkthroughs involving direct stakeholders. This study addresses one research question: How can an enterprise-architecture-based academic management system be designed to support transparent and scalable class permission planning in a mega open and distance university? TOGAF ADM is adapted to the UT context as a structured methodological baseline (The TOGAF® Standard, 10th Edition – Architecture Development Method, 2022). Requirements are elicited from stakeholders and institutional documents. A prototype, SIMPATIK, is developed and validated through usability walkthroughs. Three contributions are offered: (i) a context-sensitive architectural blueprint for class permission planning; (ii) the translation of policy rules into consistent and auditable decision flows; and (iii) early usability evidence demonstrating that clarity and transparency can be improved for key stakeholders. The identified research gap is threefold: (i) existing EA studies in education lack workflow-level depth with user-facing validation; (ii) policy-rule transparency and automated decision traceability have not been systematically addressed in ODL governance systems; and (iii) no study has specifically applied TOGAF ADM to class permission planning in a mega open and distance university context.

METHOD

TOGAF ADM was used as the main architecture process and was adapted to the class permission planning context at UT (The TOGAF® Standard, 10th Edition – Architecture Development Method, 2022). A preliminary assessment was carried out through workflow observation, review of institutional policies and reports, and semi-structured interviews with stakeholders. An architecture vision was defined at this stage. The goal was to eliminate sequential manual approvals. A plan was developed to implement policy checks that would run as rules-based decisions against a single source of data. This direction was aligned with institutional Enterprise Architecture (EA) adoption perspectives and supported by literature describing how EA artifacts may facilitate boundary-spanning coordination (Kotusev et al., 2023).

BPMN was used to model the current (as-is) and target (to-be) workflows, identify bottlenecks, handoffs, and points of failure, and generate the business architecture. The data architecture was derived through the identification of authoritative entities (student, course, class, tutor, and permission) and stewardship responsibilities. Specifically, the application architecture consisted of modular, service-oriented components, including a request-handling module, eligibility-checking module, class-formation module, tutor-assignment module, reporting module, and notification module. This approach is widely advocated in platform-based campus services and smart-campus ecosystems (Dong et al., 2020; Polin et al., 2024; Zhu et al., 2021).

The combined and coherent data semantics and decision logic were treated as first-class design concerns to improve automation readiness. Research on higher education process automation, particularly ontology-based approaches, emphasizes the need for consistent representations and machine-executable policy checks. In addition, the potential of process mining to reveal learning and process behavior patterns was considered as a supporting analytical lens, following educational process-mining frameworks and recent research agendas in the field (AlQaheri & Panda, 2022; Semler et al., 2025). These strands were not intended to replace TOGAF ADM but rather to inform how decision rules, logs, and data relationships should be structured to support auditing and continuous improvement.

Qualitative data collection and analysis: Interview Protocol and Respondent Distribution by Architecture Phase

Ten semi-structured interviews were conducted with stakeholders purposively selected to cover all three architecture phases: business architecture (academic administration leaders, n = 4), data architecture (registrar and Student Information System (SIS) personnel, n = 3), and application/technology architecture (IT services staff, n = 3). Participant selection followed a criterion-based approach targeting roles with direct decision-making authority or operational responsibility in class permission workflows. Theoretical saturation was considered adequate given the focused scope of the study and the convergence of themes observed after the eighth interview. Sessions lasted 45–60 minutes and explored pain points, risks, priorities, and expectations regarding the new process design. Interview recordings were transcribed and analyzed thematically. Inductive codes (e.g., manual re-entry, limited visibility, and policy ambiguity) were developed and grouped into categories, including fragmented processes, data inconsistency, and weak decision traceability. Interview transcripts were coded independently by two researchers using an inductive framework, followed by comparison of codes, discussion of discrepancies, and creation of a consensus codebook through an iterative negotiation process. Intercoder agreement on the primary code set was approximately 85%, which was considered acceptable prior to reconciliation. These methods were used to enhance the credibility and reliability of the qualitative findings.

Prototype development and usability walkthroughs

A functional prototype compliant with the architecture requirements (SIMPATIK) was developed. Core user journeys were implemented, including request submission, automated eligibility checking, exception handling, class formation, and tutor assignment. The system integrated with the institutional Identity Provider (IdP) for authentication, meaning that access control and role claims reflected realistic operational scenarios.

Initial usability evaluation was conducted through structured walkthroughs involving 40 prospective users (n = 15 administrative line staff; n = 15 academic unit representatives; n = 10 IT personnel). Students, who play a central role in the class permission workflow, were not included in this initial evaluation because the prototype primarily simulated backend administrative processes; student participation is planned for subsequent validation studies. Participants were selected to ensure role-specific feedback on each component of the permission process. Participants performed realistic tasks using a think-aloud protocol. Following the walkthrough, participants completed a five-item questionnaire using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The instrument, developed by the authors, was designed to assess usability aspects most relevant to the system, including ease of use, clarity of information flow, transparency in decision-making, request-status tracking, and overall satisfaction. This should be recognized as a limitation because the instrument was not validated through psychometric testing against established instruments. Future studies should therefore consider adapting validated instruments such as the System Usability Scale (SUS) or the USE Questionnaire. The protocol was aligned with established usability-evaluation practices and prior work combining think-aloud techniques with heuristic or mixed-method assessments (Chang & Johnson, 2021; Vanicek & Popelka, 2023). Attention was also given to the known limitations of manual analysis of think-aloud sessions and to opportunities for more systematic detection of usability-problem encounters (Fan et al., 2020). Open-ended feedback was collected to capture confusing steps, missing information, and required features. Quantitative ratings were summarized using descriptive statistics, while qualitative comments were analyzed thematically. The overall research flow is summarized in Figure 1.

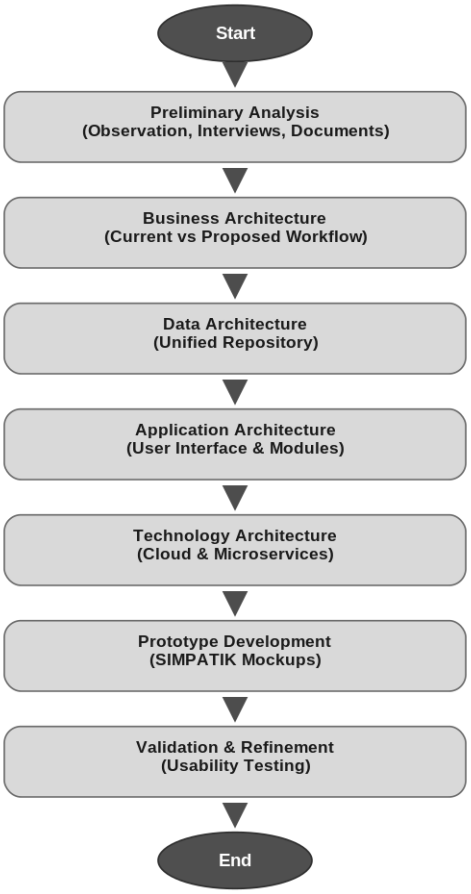

Figure 1. Research methodology flow based on TOGAF ADM
Source: research data

RESULTS AND DISCUSSION

Business Architecture (Class Permission Planning Workflow)

A baseline assessment showed that class permission planning at Universitas Terbuka (UT) is still performed through sequential checks across multiple units. Email attachments and informal handoffs are relied upon. Lead time is extended. Re-entry is introduced. When courses are at peak enrollment, inconsistency is most likely. This pattern contradicts ODFL expectations, which require timely feedback and predictable outcomes for geographically dispersed learners. For the as-is business architecture analysis, we initially organized processes into four key areas: (1) Class Opening Assessment, triggered when demand data suggest interest in enrollment and multiple academic units need to check room capacity, lecturer availability, and other policy criteria; (2) Class Merging and Closure, driven when the intersection of course demand with low-enrollment thresholds requires very close coordination between academic units and administration; (3) Manual Lecturer Assignment, referencing manually compiled workload tables that are shared via email; and (4) Exception Handling, in which ad hoc escalations are routed through informal channels with no standardized documentation. Due to the fragmented nature of the data sources, it is sometimes ambiguous or unclear when decisions are made and by whom. As a result, we were able to identify bottlenecks in each category quickly. Architectural governance is part of how these categories in the to-be architecture are resolved, through automated rule engines, centralized data repositories, and dashboards with role-based, real-time status visibility for each participant in the workflow.

The proposed design introduces a more policy-driven workflow for managing the process. As discussed in the article, several academic rules are applied to portions of pending changes on demand. These changes are automatically compared against a single repository containing all prerequisites, academic standing requirements, and capacity thresholds. All normative cases are

handled immediately, while edge conditions are routed to documented exception pathways with explanations indicating that both the decision and the path taken can be easily traced.

Figure 2 illustrates the transition from a serial manual pathway to a parallel rule-based pathway. In addition to reducing cycle time, decision explanations can also be presented to users in a way that identifies which rules were satisfied or violated, thereby helping to support trust and accountability.

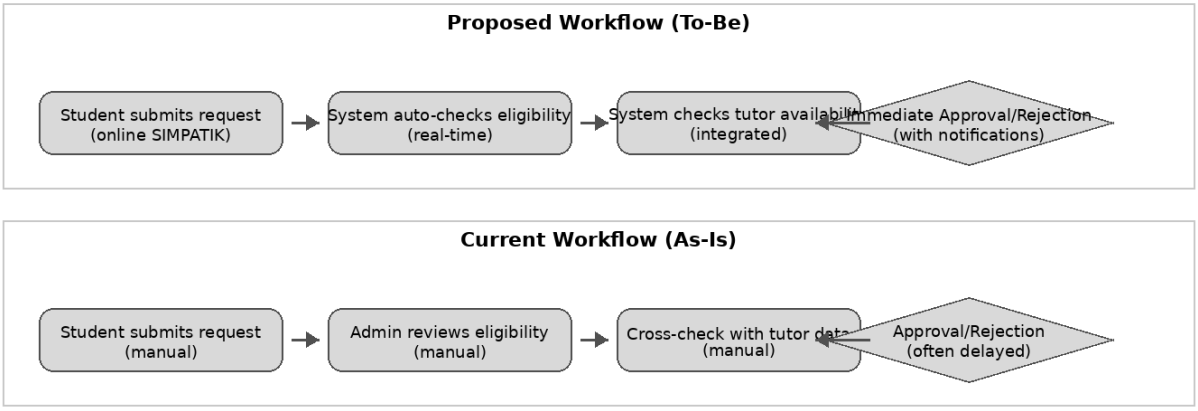

Figure 2. Existing vs proposed class permission workflow (BPMN)
Source: research data

Data Architecture

So, they found that data fragmentation was the main culprit for delays. Class records indicating the number of students who could enroll, the prerequisites, and the difficulty standing needed to be passed between systems and did not synchronize automatically. During high-demand windows, there was contention and drift in throughput. This resulted in decisions being delayed for manual revalidation.

This led to the design of a common information model (Fig. 3). The authoritative entities STUDENT, COURSE, CLASS, TUTOR, and PERMISSION were merged. The model consists of courses associated with related classes, tutors assigned to one or multiple classes, and permission-based student entry that provides specific access related to a particular class. It also includes referential constraints that maintain normalization, while eligibility rules are executed in real time.

Then, stewardship assignments were established to clarify data governance responsibilities. Course and class data were placed under academic units, while student standing classifications were assigned to the registrar. Read and write scopes were defined based on roles to prevent data corruption and reduce undocumented changes.

This also creates long-term analytics through data integration. It helps monitor request patterns, capacity bottlenecks, and recurring prerequisite failures. These insights may aid in capacity planning, curriculum modification, and risk stratification for student support.

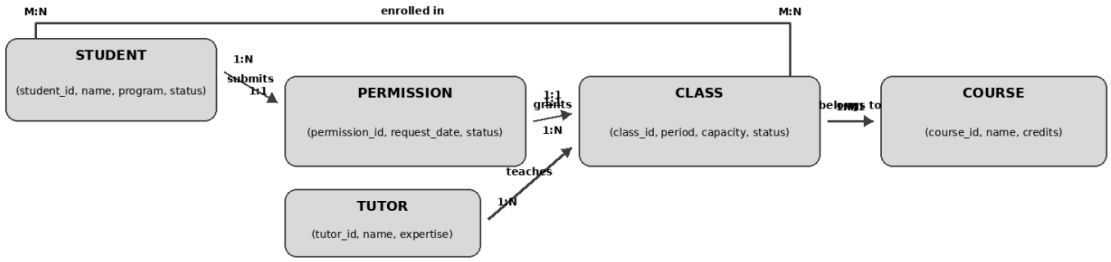

Figure 3. Simplified Data Architecture of Academic Management System
Source: research data

Application Architecture

Actors' responsibilities are mapped at the Application Layer (Fig. 4). Requests can be submitted by students, and these are tracked in real time. Administrators handle exceptions and reporting oversight. Classes are formed, and tutors are assigned by the various academic units. The system runs automated checks and sends notifications.

The mapping was conducted to validate end-to-end coverage, from request initiation through class formation, while maintaining a single source of truth across roles.

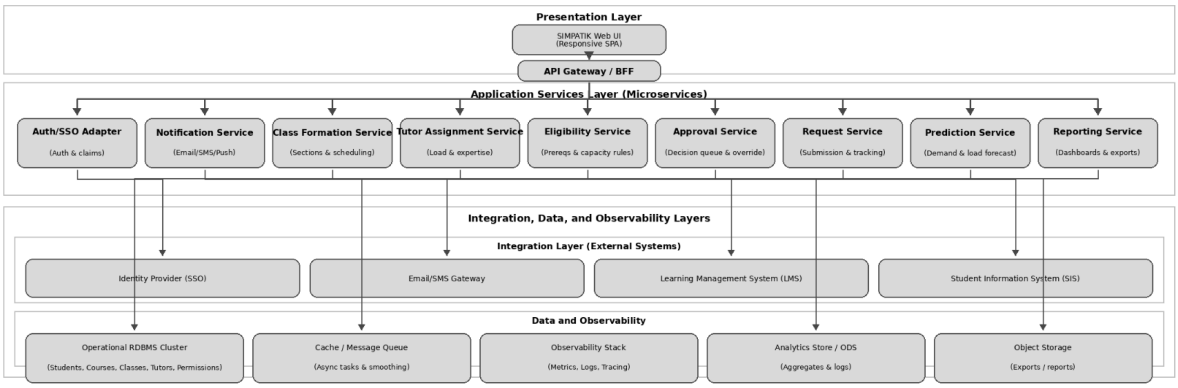

Figure 4. Application Architecture of the Academic Management System (SIMPATIK)
Source: research data

The SIMPATIK prototype implements these use cases through shared interfaces. The submission form performs inline validation of prerequisites. In addition, rule explanations for each decision are displayed alongside an administrative queue. Dashboards are included to support tutor allocation management with capacity warnings and to surface throughput, aging, and anomalies.

Governing rules are not buried on a back-end screen but are instead surfaced directly in the user interface. Loop closure time was also reduced during walkthroughs, and the first-time resolution rate for standard cases improved significantly. Instead of repeated status inquiries triggered by visibility gaps, those gaps are addressed through real-time notifications. All roles follow a common action timeline, and decision traces are maintained for quality auditing.

Technology Architecture

The deployment view (Fig. 5) consists of service-oriented services for eligibility, scheduling, reporting, notifications, and authentication. An API gateway/load balancer sits in front of the services. Container orchestration is implemented to achieve horizontal scaling during enrollment spikes and to support rolling updates. An RDBMS cluster is used for persistent authoritative records, while cache and message queue services handle asynchronous tasks, such as bulk notifications. Reports and exports are stored in object storage.

Resilience controls are applied to handle faults. Timeouts, retries, and circuit breakers help minimize cascading failures and enable graceful degradation when dependencies fail. Metrics, tracing, and structured logs provide operational observability during system failures. Role-Based Access Control (RBAC), secrets management, and end-to-end audit trails are implemented to enforce the principle of least privilege and maintain compliance posture. Dedicated services externalize policy rules so that updates can be made without redeploying the entire system.

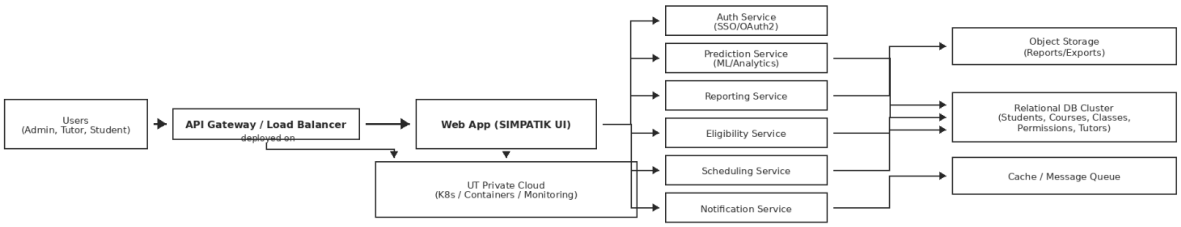

Figure 5. Proposed Technology Architecture
Source: research data

Use Case Analysis

The use-case model (Fig. 6) includes four human roles: students, administrators, academic units, and teachers. We integrate external platforms for identity management (SSO), authoritative academic records (SIS), and class delivery (LMS).

The student is authenticated, after which he or she submits a canonical request. Eligibility and capacity checks occur automatically as part of the same workflow. The system responds with either an approval or rejection, along with a rule-based reason, and logs the result for auditability.

Requests that fail because of ambiguity or insufficient data are routed to an administrative queue. The rationale for each decision is recorded as final. Overrides sanctioned by policy are rare and are always recorded in an audit log.

Once demand thresholds are met, class formation and tutor assignment are managed by the academic unit. Capacity and scheduling data are synchronized with the SIS, which provisions class shells in the LMS, since rosters and teaching resources must remain aligned.

Status tracking and notifications provide a comprehensive overview of all actions across roles. The system reports volume, latency, utilization, and exception patterns. These outputs feed into governance forums and policy iteration.

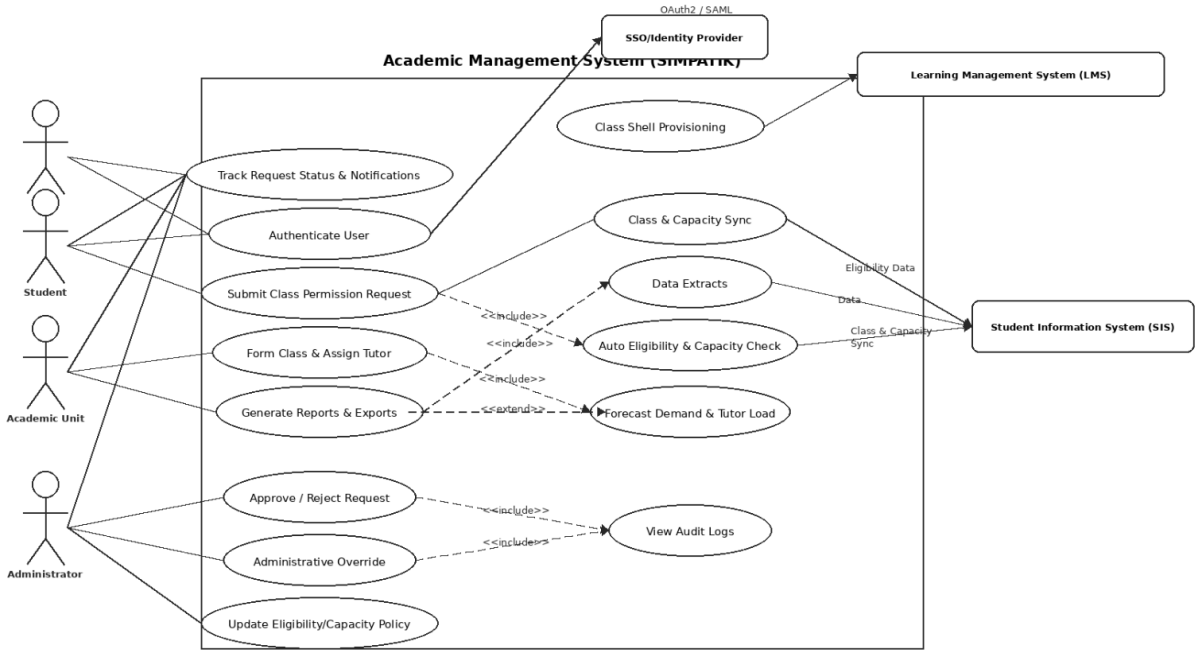

Figure 6. Use Case Diagram of Academic Management System
Source: research data

Discussion

Evaluation Results and Architecture Layer Discussion

Below, we contextualize each layer of the architecture with respect to similar prior work. In the domain of business architecture, the move to parallel rule-based processing instead of sequential manual approval is consistent with observations by (Anam et al., 2021) et al. ·7 A case study by Morrison et al. also supports this finding. One of the main benefits of our proposed design compared to that of (Anam et al., 2021). is the enforcement of policy at request time, eliminating the need for multistep manual eligibility verification through automated processing. However, a limitation remains in that TOGAF ADM does not provide a native approach to continuous process monitoring and would require additional tools, such as process mining (AlQaheri & Panda, 2022), to support continuous enhancement of processes after deployment. For data architecture, the unified entity model (STUDENT, COURSE, CLASS, TUTOR, and PERMISSION) expands typical higher education data models by adding explicit stewardship boundaries and machine-readable referential integrity constraints. In contrast, ontology-based automation methods (Alrehaili et al., 2021) are much more complex to implement and rely heavily on semantic reasoning. The role-based actor mapping with inline decision explanations in application architecture improves transparency beyond dashboard-centric designs documented in smart campus literature (Dong et al., 2020; Polin et al., 2023). While the microservices and API gateway model is beneficial for providing scalability similar to platform-oriented campus service designs (Zhu et al., 2021), reliance on container orchestration creates operational complexity that may be less viable in institutions with limited DevOps capacity.

The design received initial empirical support through the analysis of usability walkthrough data. Forty participants executed realistic activities in SIMPATIK and scored five usability indicators on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Table 1 summarizes the ratings.

The prototype was received positively overall. The mean scores varied from 4.25 to 4.55, indicating agreement with all statements consistently. The highest ratings were for clarity of process flow and ease of use (M = 4.55; SD = 0.50).

Decision-rule transparency also received high scores (M = 4.25; SD = 0.44), and request-status visibility was rated at M = 4.50 (SD = 0.51). Overall satisfaction levels were very high (M = 4.43; SD = 0.50).

Qualitative comments reinforced these results. Participants saw value in having a single interface for submitting and tracking the status of requests. Inline rule explanations reduced uncertainty, and notifications were found to reduce follow-up inquiries during peak periods.

Table 1. Summary of usability evaluation

No	Indicator	Item Statement	N	Mean	SD
1.	Clarity of process flow	It was easy to understand the end-to-end class permission process	40	4.55	0.503
2.	Ease of use	The SIMPATIK interface was easy to use.	40	4.55	0.503
3.	Transparency of decision rules	The system clearly explained why a request was approved or rejected.	40	4.25	0.438
4.	Visibility of request status	I could easily track the status of my (or students') permission requests.	40	4.50	0.506
5	Overall satisfaction	Overall, I am satisfied with the SIMPATIK prototype.	40	4.43	0.500

Source: processed data

This study is constrained by a single-institution case and an early-stage assessment that investigated perceptions of usability rather than long-term operational outcomes. It may not necessarily capture the regional aspects of how policies are interpreted. Future work is expected to include a pilot deployment that measures cycle time and error rates based on system logs, as well as a comparison with the legacy process under realistic enrollment loads.

CONCLUSION

A design for class permission planning in a mega open and distance university was developed based on an enterprise architecture framework and subsequently validated. It shifted from sequential, email-driven checks to policy-based decisions at the time of request, supported by a single information model, modular application services, and a flexible deployment view. The usability walkthroughs indicated that perceived clarity, ease of use, and visibility of request status were high because of both clear rule explanations and consistently designed interfaces, thereby supporting trust in academic decision-making. At the implementation level, the architecture illustrates how to avoid bottlenecks, improve traceability, and support governance in ODFL services at scale. With respect to knowledge domains, there are also significant recommended disadvantages related to the application of enterprise architecture in academic settings, namely: architectural documentation and stakeholder alignment can require substantial person-day investments; over-engineering of both solutions and artifacts (viz. excessive formality in practices that exceed the institution's record-keeping capacity); a tendency for enterprise architecture (EA) frameworks to reward formalized workflows at the expense of the informal knowledge and adaptive judgment required by experienced administrators (as Peters explained), thereby affecting bureaucratic responsiveness; and outdated architectural artifacts as policies evolve from full-time enrollment through post-secondary transformations in participation patterns. These limitations ought to be explicitly acknowledged in any deployment plan developed after October 2023. The research would benefit from expansion beyond a single case study, and longitudinal operational metrics are not yet available; hence, future work should further develop the design through pilot implementation, measurement of decision latency and workload reduction, as well as multi-institutional replication to evaluate generalizability.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the Lembaga Penelitian dan Pengabdian kepada Masyarakat Universitas Terbuka (LPPM UT) for funding this research.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed to the development and completion of this study. The first author was responsible for conceptualization, methodology, data collection, data analysis, and drafting the original manuscript. The second and third authors contributed to system design, usability review, and manuscript revision. The fourth and fifth authors supported validation, supervision, and critical review of the manuscript. All authors reviewed and approved the final version of the article for publication.

REFERENCES

Alghamdi, H. (2024). Assessing the impact of enterprise architecture on digital transformation success: A global perspective. *Sustainability*, *16*(20), 8865.

AlQaheri, H., & Panda, M. (2022). An education process mining framework: Unveiling meaningful information for understanding students' learning behavior and improving teaching quality. *Information (Basel)*, *13*(1), 29.

Alrehaili, N. A., Aslam, M. A., Alahmadi, D. H., Alrehaili, D. A., Asif, M., & Arshad Malik, M. S. (2021). Ontology-based smart system to automate Higher Education Activities. *Complexity*, *2021*(1), 1–20.

Anam, M. K., Nasution, T., Erlinda, S., Efrizoni, L., & Susanti, S. (2021). The analysis and optimization of business processes for students in higher education based on togaf 9.2. *Sci. J. Inform.*, *8*(2), 230–243.

Antonopoulou, K., Begkos, C., & Zhu, Z. (2023). Staying afloat amidst extreme uncertainty: A case study of digital transformation in Higher Education. *Technol. Forecast. Soc. Change*, *192*(122603), 122603.

Bisri, A., Putri, A., & Rosmansyah, Y. (2023). A systematic literature review on digital transformation in higher education: Revealing key success factors. *Int. J. Emerg. Technol. Learn.*, *18*(14), 164–187.

Bourmpoulias, S., & Tarabanis, K. (2020, June). A systematic mapping study on Enterprise Architecture for the Education domain: Approaches and Challenges. *2020 {IEEE} 22nd Conference on Business Informatics ({CBI})*.

Castro, B., L. M., Tamayo Arias, J. A., Arango Serna, M. D., Branch Bedoya, J. W., & Burgos, D. (2020). Digital transformation in higher education institutions: A systematic literature review. *Sensors (Basel)*, *20*(11), 3291.

Chang, C.-C., & Johnson, T. (2021). Integrating heuristics and think-aloud approach to evaluate the usability of game-based learning material. *J. Comput. Educ.*, *8*(1), 137–157.

Dang, D., & Pekkola, S. (2020). Institutional perspectives on the process of enterprise architecture adoption. *Inf. Syst. Front.*, *22*(6), 1433–1445.

Dong, Z. Y., Zhang, Y., Yip, C., Swift, S., & Beswick, K. (2020). Smart campus: definition, framework, technologies, and services. *IET Smart Cities*, *2*(1), 43–54.

Fan, M., Li, Y., & Truong, K. N. (2020). Automatic detection of usability problem encounters in think-aloud sessions. *ACM Trans. Interact. Intell. Syst.*, *10*(2), 1–24.

Ferdousi, F., Ahmed, A., & Momen, M. A. (2022). Evolution of quality assurance practices in enhancing the quality of open and distance education in a developing nation: a case study. *Asian Assoc. Open Univ. J.*, *17*(2), 147–160.

Kotusev, S., Kurnia, S., & Dilnutt, R. (2023). Enterprise architecture artifacts as boundary objects: An empirical analysis. *Inf. Softw. Technol.*, *155*(107108), 107108.

Lamey, A., Abdelkader, H., Keshk, A., & Eletriby, S. (2023). A realistic and practical guide for creating intelligent integrated solutions in higher education using enterprise architecture. *Sustainability*, *15*(11), 8780.

Matheus, R., Faber, R., Ismagilova, E., & Janssen, M. (2023). Digital transparency and the usefulness for open government. *Int. J. Inf. Manage.*, *73*(102690), 102690.

Mohamed, H. M. A., Tlemsani, I., & Matthews, R. (2022). Higher education strategy in digital transformation. *Educ. Inf. Technol.*, *27*(3), 3171–3195.

Mukul, E., & Büyüközkan, G. (2023). Digital transformation in education: A systematic review of education 4.0. *Technol. Forecast. Soc. Change*, *194*(122664), 122664.

Polin, K., Yigitcanlar, T., Limb, M., & Washington, T. (2023). The making of smart campus: A review and conceptual framework. *Buildings*, *13*(4), 891.

Polin, K., Yigitcanlar, T., Washington, T., & Limb, M. (2024). Unpacking smart campus assessment: Developing a framework via narrative literature review. *Sustainability*, *16*(6), 2494.

Semler, R. F., Semler, J. R., Wehrmeister, M. A., Southier, L. F. P., Casanova, D., & Teixeira, M. (2025). Educational process mining: literature classification, gaps, and emerging opportunities. *Front. Educ.*, *10*(1543761).

The TOGAF® Standard, 10th Edition – Architecture Development Method. (2022).

Vanicek, T., & Popelka, S. (2023). The think-aloud method for evaluating the usability of a regional atlas. *ISPRS Int. J. Geoinf.*, *12*(3), 95.

Wanner, J., Herm, L.-V., Heinrich, K., & Janiesch, C. (2022). The effect of transparency and trust on intelligent system acceptance: Evidence from a user-based study. *Electron. Mark.*, *32*(4), 2079–2102.

Zhu, X., Ge, S., & Wang, N. (2021). Digital transformation: A systematic literature review. *Comput. Ind. Eng.*, *162*(107774), 107774.

Zuhairi, A., Raymundo, M. R. D. R., & Mir, K. (2020). Implementing quality assurance system for open and distance learning in three Asian open universities: Philippines, Indonesia and Pakistan. *Asian Assoc. Open Univ. J.*, *15*(3), 297–320.