

SECP3744 - UTHM CASE STUDY
UTHM HOSTEL MANAGEMENT SYSTEM PROJECT REPORT

NABIL AFLAH BOO BINTI MOHD YOSUF BOO YONG CHONG

UNIVERSITI TEKNOLOGI MALAYSIA

UTHM CASE STUDY
UTHM HOSTEL MANAGEMENT SYSTEM

NABIL AFLAH BOO BINTI MOHD YOSUF BOO YONG CHONG

A Case Study Report submitted in SECP3744 of the
requirements for the award of the degree of
Computer Science (Data Engineering)

School of Computer Science (Data Engineering)
Faculty of Computing
Universiti Teknologi Malaysia

JANUARY 2026

DECLARATION

I declare that this report entitled “*UTHM Case Study UTHM Hostel Management System*” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Nabil Aflah Boo Binti Mohd
Yosuf Boo Yong Chong

Date : 12 JANUARY 2016

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my lecturer, Dr. Aryati Bakri, for her invaluable guidance and professional expertise throughout this project. Her support in Enterprise System Design and Modelling was essential in helping me navigate the complexities of Enterprise Architecture and the technical implementation of the subsystem.

My sincere appreciation goes to Universiti Teknologi Malaysia (UTM) for providing the academic resources and platform necessary for this study. I am also grateful to Universiti Tun Hussein Onn Malaysia (UTHM) for serving as the subject of my research, allowing me to apply theoretical concepts to a real-world organizational context.

Finally, I would like to thank my peers for their collaborative spirit and encouragement during our group discussions. I am also deeply indebted to my family for their unwavering love and motivation, which provided me with the strength to successfully complete this project.

ABSTRACT

This project focuses on the development of the UTHM Hostel Management System which is designed to replace inefficient manual records to keep with a streamlined digital solution. The development followed a structured methodology to ensure that user requirements were accurately addressed into functional features. By addressing the need for student violation records, the system aims to improve the administrative efficiency and data accuracy within the university's hostel management operations.

The system was implemented using SAP Build Apps, leveraging professional low-code development tools to ensure rapid delivery and a high-quality user interface. Key technical features include the creation of an on-device database containing entities for Student, Violations, and Auditlog, as well as the implementation of complex visual logic via the Logic Canvas. These features allow the user to view lists of student records and securely save new violation entries through dedicated data variables and formula bindings.

System testing was conducted iteratively using mobile preview tools to ensure that all logic flows and user interface functioned correctly on various devices. The results showed that the system can handle violation and disciplinary records with complete data accuracy because of its strong system design. Future enhancements suggest the integration of advanced data analytics of tracking violation trends and the implementation of real-time notification features to alert the university management of significant disciplinary incidents.

ABSTRAK

Projek ini memberi fokus kepada pembangunan Sistem Kolej Kediaman UTHM, yang direka untuk menggantikan penyimpanan rekod manual yang tidak cekap dengan penyelesaian digital yang lebih tersusun. Pembangunan ini mengikut metodologi berstruktur bagi memastikan keperluan pengguna diterjemahkan dengan tepat ke dalam ciri-ciri fungsian. Dengan menangani keperluan rekod disiplin pelajar yang berpusat, sistem ini bertujuan untuk meningkatkan kecekapan pentadbiran dan ketepatan data dalam operasi pengurusan kolej kediaman universiti.

Sistem ini dibangunkan menggunakan SAP Build Apps, dengan memanfaatkan alatan pembangunan kod rendah berprofesional bagi memastikan penyampaian pantas dan antara muka pengguna yang berkualiti tinggi. Ciri-ciri teknikal utama merangkumi pembinaan pangkalan data dalam peranti yang mengandungi entiti untuk Pelajar, Pelanggaran, dan Log Audit, serta pelaksanaan logik visual yang kompleks melalui Logic Canvas. Ciri-ciri ini membolehkan pengguna mencari rekod pelajar melalui senarai rekod pelajar dan menyimpan entiti pelanggaran baharu dengan selamat melalui pembolehubah data dan formula yang khusus.

Ujian sistem telah dijalankan secara berulang menggunakan alatan pratonton mudah alih bagi memastikan semua aliran logik dan antara muka pengguna berfungsi dengan betul pada pelbagai peranti. Hasil ujian mengesahkan bahawa sistem ini teguh dan mampu mengendalikan log disiplin dengan integriti data yang tinggi. Penambahbaikan pada masa hadapan mencadangkan integrasi analitik data termaju bagi memantau trend pelanggaran serta pelaksanaan ciri pemberitahuan masa nyata untuk memaklumkan pihak pengurusan universiti mengenai insiden disiplin yang penting.

TABLE OF CONTENTS

TITLE	PAGE
DECLARATION	2
ACKNOWLEDGEMENT	3
ABSTRACT	4
ABSTRAK	5
CHAPTER 1 INTRODUCTION	1
1.1 Overview	1
1.2 Problem Statement	1
1.3 Project Objectives	2
1.4 Project Scope	3
1.4.1 In-Scope	3
1.4.2 Out of Scope	4
1.5 Project Importance	4
CHAPTER 2 LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Enterprise Architecture (EA)	6
2.2.1 Definition and Concepts of EA	6
2.2.2 Review of Existing Studies Related to University Enterprise Architecture	8
2.3 Related Sub-System	13
2.3.1 Overview of the chosen sub-systems	13
2.4 Technology Used	16
2.5 Summary	17
CHAPTER 3 METHODOLOGY	18
3.1 Introduction	18
3.2 Chosen Methodology	18
3.3 Phases of Methodology	19
3.3.1 Planning Phase	19
3.3.2 Analysis Phase	20
3.3.3 Design Phase	20
3.3.4 Implementation Phase	20
3.4 Project Planning Schedule	20
3.5 Summary	21
CHAPTER 4 ANALYSIS AND DESIGN	22
4.1 Introduction	22
4.2 Organization Structure	23
4.3 Current System Analysis	24
4.3.1 Computerized Process and Infrastructure	24
4.3.2 Manual Processes and Governance	25

4.3.3 Identified System Issues	25
4.4 Comparison between Existing and Proposed System	25
4.4.1 Current Digital Infrastructure	25
4.4.2 Operational Challenges	26
4.4.3 Proposed System Enhancement	26
4.4.4 Expected Outcomes	27
4.5 System Requirements Gathering Techniques	28
4.5.1 Daily Operations & Current Process	28
4.5.2 Enterprise Architecture & Integration	28
4.5.3 Infrastructure & Performance	28
4.5.4 User Experience & Future Needs	29
4.8. System Design	29
4.8.1 Enterprise architecture EA - AS IS	29
4.8.2 Explain each component in system architecture EA-AS IS	29
4.8.4 Explain each component in system architecture EA - TO BE	37
4.8.3 System Architecture	44
4.8.4 System Architecture Component Explanation	45
4.8.5 Project Design	47
4.8.5.2.1 UC001: Use Case <Record Violation>	48
4.8.5.2.2 UC002: Use Case <Update Violation Status>	52
4.8.5.2.3 UC003: Use Case <View Violation Record>	54
4.8.6 Database Design - Violation & Disciplinary Log	56
4.8.7 Interface Design - Violation & Disciplinary Log	58
4.9 Summary	59
CHAPTER 5 SYSTEM IMPLEMENTATION	60
5.1 Introduction	60
5.2 System Development	60
5.3 Create Database	62
5.4 Coding of the system's main functions/ Process	63
5.5 Summary	69
CHAPTER 6 CONCLUSION	70
6.1 Introduction	70
6.2 System Contribution/ Achievement	71
6.3 System Constraint	72
6.4 Future Suggestion	72
6.5 Individual Reflection	73
6.6 Summary	74
REFERENCES	75

LIST OF ABBREVIATIONS

UTHM	-	University Tun Hussein Onn Malaysia
EA	-	Enterprise Architecture
SAP	-	System, Applications and Product
BTP	-	Business Technology Platform
TOGAF	-	The Open Group Architecture Framework
ADM	-	Architecture Development Method
TCIS	-	Total Campus Integration System
LMS	-	Learning Management System
UPS	-	Uninterruptible Power Supply
KPI	-	Key Performance Indicator
IPTA	-	Institusi Pengajian Tinggi Awam
IPTS	-	Institusi Pengajian Tinggi Swasta
HRD	-	Human Resource Development
SMAP	-	Student Management and Academic Planning
SAS	-	Student Assessment System
SSO	-	Single Sign On
WAF	-	Web Application Firewall
API	-	Application Programming Interface
E2E	-	End to End

CHAPTER 1

INTRODUCTION

1.1 Overview

Universiti Tun Hussein Onn Malaysia (UTHM) is a public university that provides various academic, administrative and support services to students. All these operations are made possible through a variety of information systems that are widely in use throughout the university mainly for the management of the teaching and learning processes, students' affairs, human resources, finance, and institutional management. As a large academic institution, UTHM operates in a complex business setting where applying the right tools and approaches to information systems and processes can readily result in extremely high productivity.

The goal of the project is to enhance the Enterprise Architecture (EA) of Universiti Tun Hussein Onn Malaysia (UTHM) so that there would be a great alignment of business processes and information systems throughout the university. The project aims to improve operational effectiveness and lay the framework for improved coordination across academic, administrative, and support systems by examining the current enterprise environment and using a detailed architectural approach.

1.2 Problem Statement

UTHM has successfully moved all the major academic, administrative, and support systems to the new platform, and the migration has gone over 70 percent so far. Still, the new university infrastructure of different faculties and

departments has not yet been fully integrated and aligned with business processes, thus creating challenges in the integration process. The use of independent systems and the partial integration of different systems can bring on a variety of issues such as having data stored in multiple places, having inconsistent workflows, and being slower to deliver services.

In addition, UTHM's strategic ICT goals such as strengthening the infrastructure, providing integrated applications, and developing the workforce, in spite of their setting, are still not fully accessible due to the absence of a structured EA approach, it becomes quite challenging to make sure that all the systems are in total sync with the university's operational demands, strategic goals, and sustainability in the long run. Hence, the further development of Enterprise Architecture (EA) is required to reach system integration to the fullest, hassle-free business operations, and increased efficiency at UTHM.

1.3 Project Objectives

The main objectives of this project is to analyze, design and propose an enterprise-level system architecture for Universiti Tun Hussein Onn Malaysia (UTHM) by applying enterprise architecture principles and structured system design methodologies. This project aims to address the issues of managing multiple academic, administrative and support systems within a university environment by providing a proper architectural design. The objectives of this project are as follows:

1. To analyze the existing information systems used at UTHM that support key university operations such as academic management, teaching and learning, administrative processes and student services operations.
2. To design an enterprise architecture for UTHM using the TOGAF framework focusing on the alignment between business processes, data, applications and technologies.

3. To propose an integrated system design that improves data consistency, system interoperability and operational efficiency across UTHM's academic and administrative departments.
4. To provide a structured architectural reference that can support future system development and improvement initiatives at UTHM.

1.4 Project Scope

This project focuses on the analysis and design of an enterprise-level system architecture for Universiti Tun Hussein Onn Malaysia (UTHM) with emphasis on improving the alignment between business processes and information systems within the university environment. The scope of this project is carefully defined to ensure that the study remains focused on enterprise architecture design while remaining feasible within the given timeframe and academic requirements.

1.4.1 In-Scope

The scope of this project includes the following:

1. Analysis of UTHM's organizational structure and its core operational areas, particularly academic management, teaching and learning activities, administrative functions and student support services.
2. Identification of stakeholders and system users including students, academic staff, administrative staff and university management and analysis of how information systems support their daily operations.
3. Design of enterprise architecture based on the TOGAF framework following the Architecture Development Method (ADM).
4. Analysis of existing systems currently used at UTHM such as academic management systems, learning management systems, student assessment systems, staff related systems and student support systems.
5. Comparison between the existing system environment and the proposed enterprise architecture to highlight improvements in system integration, data management and operational efficiency.

6. Development of relevant system models and diagrams, including enterprise architecture diagrams, system architecture diagrams, use case diagrams and data models to support the proposed system design.

1.4.2 Out of Scope

The scope of this project excludes the following:

1. Full-scale system development, deployment or maintenance in a real operational environment.
2. Large-scale data migration, performance optimization, advanced system tuning.
3. Complete system coding for the whole enterprise systems beyond limited prototypes or demonstration purposes.
4. Security penetration testing, load testing and user acceptance testing.
5. Ongoing system monitoring, maintenance and post-deployment support activities.

1.5 Project Importance

The project importance are listed as follows:

1. To connect all disconnected university systems into one integrated architecture.
2. Help save time and resources by making daily operations faster and reducing duplicate work across departments.
3. Improves decision making by providing accurate, real-time data without any redundancy for better management decisions.
4. Meet the digitalization goals of the university.
5. Help create better user experience for students and staff to access services.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents a detailed literature review related to the design and development of a University Enterprise Architecture (UEA) within the context of an enterprise-level information system. It commences by explaining the major concepts about the Enterprise Architecture (EA) which is the process of aligning the organizational processes, technology and information to facilitate the implementation of goals in a given institution. The chapter also reviews past research on EA applications in institutions of higher learning including the University of Lampung to learn about the most typical obstacles such as system fragmentation, data redundancy, insufficient to integrated academic or administrative systems. Then the chapter examines the chosen subsystems of the proposed university environment including student information, human resource, finance, subject registration, research management, learning management and analytics dashboards and points out how related subsystems have been used elsewhere. Lastly, it describes the technologies employed in the development of EA and these are the database solutions, development frameworks, enterprise systems and architecture standards like the TOGAF and the Zachman Framework. Altogether, this chapter establishes the theoretical and technical foundation that guides the design and implementation of the proposed enterprise system.

2.2 Enterprise Architecture (EA)

This section will explain details of the definition, concepts, and review on the related studies of EA.

2.2.1 Definition and Concepts of EA

Enterprise Architecture (EA) is a comprehensive framework or blueprint that defines structure, processes, information and technology needed to effectively achieve an organization's business goals and objectives (Ardoq, 2024). In other words, EA is widely recognized as both a strategic discipline and a practice that enables organizations to align their business objectives, processes, information systems and technology infrastructure for long-term efficiency and adaptability. Instead of having a separate process between each department, EA helps shape a big-picture plan, to ensure every part of the business moves together toward its goals.

Most frameworks such as the Zachman Framework and TOGAF organize EA into four primary domains:

1. **Business Architecture:** Define the organization's strategy, governance, business processes and capabilities.
2. **Data Architecture:** Describe the logical and physical data assets, including their structure, management and flow throughout the organization.
3. **Application Architecture:** Encompasses applications, their interactions and their alignment with business processes.
4. **Technology Architecture:** Details the technology infrastructure including hardware, networks and platforms that support applications, data and business processes.

EA provides both an "as-is", meaning the current state and "to-be", which means the future state of the organization (Tamm et al., 2011). This serves as the basis for organizational analysis and strategic transformation. Through this blueprint, EA identifies gaps, streamline processes and prioritizes investments and initiatives that support the desired target of enterprise evolution.

In simpler terms, EA is a management approach that helps an organization stay organized, aligned and adaptable. It brings together all parts of the organization from core processes, technology, people and strategies to ensure each component works smoothly with the rest. As the organization's goals or environment change, EA serves as guidance for the evolution of the enterprise so the organization can remain competitive and effective.

2.2.2 Review of Existing Studies Related to University Enterprise Architecture

Previous studies on enterprise architecture in higher education have called attention to the need for more scalable and efficient subsystems to support complex academic and administrative services in the institution. Existing literature has shown that universities all over the world have transitioned from individual silo-based information systems to unified enterprise systems to improve overall operational efficiency and institutional decision making. Several studies have been conducted on different universities around the world as described in this section.

University of Lampung (Unila) is an Indonesian public university located in Lampung (Nama et al., 2017). The university has developed and designed a more flexible and modern IT infrastructure which to address the challenges in increasing management complexity, scattered and separated systems and was driven by the university's ambition to rank among Indonesia's top 10 universities by 2025 (Nama et al., 2017). This section will examine the methodology and approaches that Unila uses to achieve these strategic goals.

The study conducted at the University of Lampung identified Unila's core processes from several aspects which are education, research and community services. Under each of these aspects there are several processes such as Students Admission, Research Activity and Alumni Services, which altogether support the institutional operation.

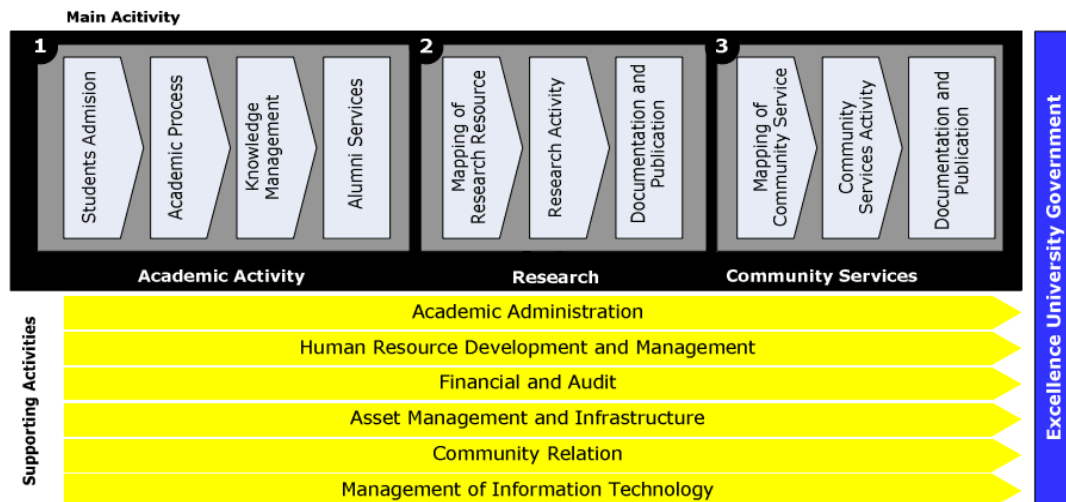


Figure 1.1: Value Chain Analysis at University of Lampung (Nama et al., 2017)

Through an in-depth analysis of the existing architecture, the result indicates that the university's information technology infrastructure was notably fragmented and lacked integration. Key information systems, such as those for academic management, financial operations and human resources were operating in isolated environments. This separated environment led to inefficiencies, data redundancy, and difficulties in making informed strategic decisions.

In response to these challenges, the study proposes a comprehensive enterprise architecture made up of integrated and modular applications. Significant enhancements include the development of SIAKAD-T, an integrated academic system, alongside the establishment of a centralized library system, unified administrative platforms, a single sign-in solution, a decision support system (DSS) data warehouse, customer relationship management (CRM) tools and improved knowledge management systems (Nama et al., 2017). These solutions are designed to foster integration, support scalability and streamline the university operations.

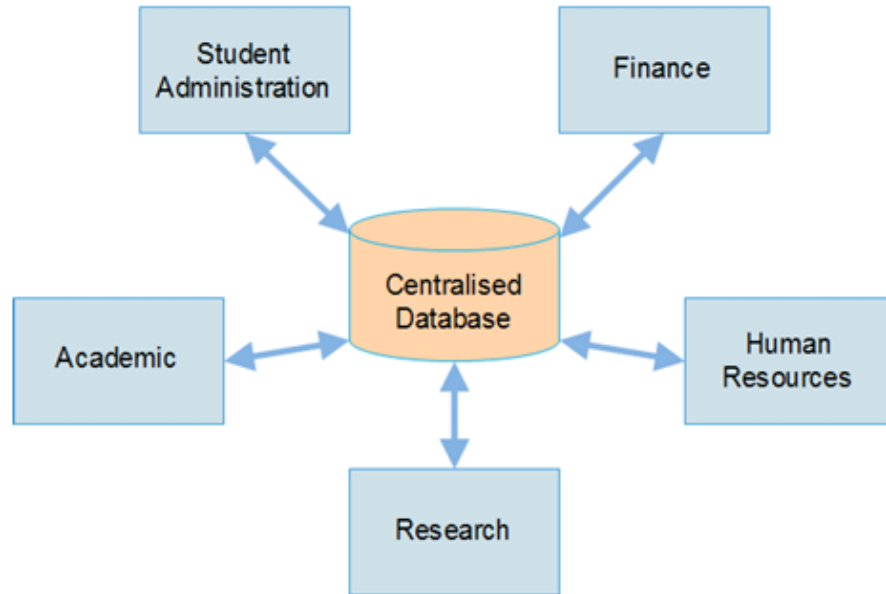


Figure 1.2: Functional Areas of a University Enterprise System at Papua New Guinea Using a Centralised Database (Daniel, 2016)

This paper examined how universities in Papua New Guinea traditionally only operate with isolated information systems that focus on one area such as student admissions, finance and human resources. This more often than not ends up resulting in duplication of data, inconsistent records and inefficient cross-departmental processes. The implementation of enterprise systems was proposed to address these problems, which include using a centralized database and integrated software modules for student admission, enrollment, payroll and procurement. This improved system can enable real-time information sharing and reduce redundancy across departments and modules (Daniel, 2016).

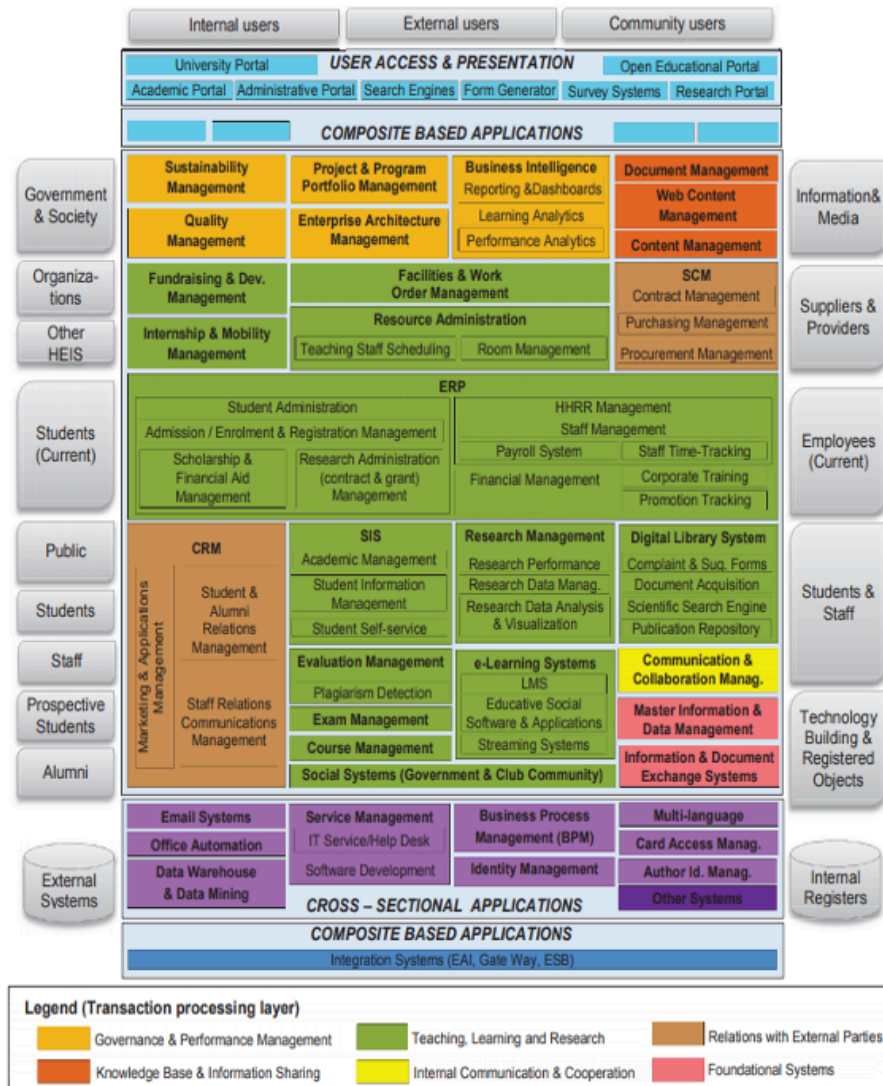


Figure 1.3: Enterprise Architecture Framework for Higher Education Institutions (Sánchez-Puchol, 2021)

The study provides a comprehensive analysis of enterprise architecture in higher education institutes (HEIs) and identifies the common challenges faced by these institutions. It is found that most universities struggle with fragmented technological environments, as these often result in inefficiencies when managing student information, academic processes, financial data, and research activities. Modern universities have adopted relevant subsystems to combat these challenges. These include student administration platforms, learning management systems, research management modules, and analytics dashboards. It is evident from the case examples provided in the study that the implementation of effective enterprise architecture has improved data accuracy, reduced administrative load, and enhanced decision support in the

institution when these subsystems are properly integrated (Sánchez-Puchol, 2021).

2.3 Related Sub-System

This section explains the chosen sub-systems and the previous system that uses a similar architecture.

2.3.1 Overview of the chosen sub-systems

The chosen subsystems for the University Enterprise Architecture are as follows:

1. Student Information System

This subsystem manages student details such as names, identification numbers, contact details, and emergency contact. It also maintains the academic records including enrollment history, course registrations, examination results, and academic achievements. The system also stores documents such as admission letters, certificates, transcripts and keeps track of graduation requirements.

2. Inventory Management System

This subsystem manages all physical assets and resources across the university. This includes necessary equipment for learning like computers, laboratory instruments, furniture and teaching aids used across all faculties. The system handles purchase requests, tracks vendor information and procurement history. It also manages asset allocation to all faculties.

3. Finance Management System

This subsystem handles all financial operations such as managing student fees based on their programs, processing tuition fees and generates receipts and invoices automatically. It also handles payroll for staff.

4. Human Resource Management System

This subsystem maintains thorough records of employees including personal details, qualifications, employment history, performance evaluations, administrative personnel and support staff. It handles recruitment workflows from job posting to hiring a candidate. The system also manages approvals

for annual leave, sick leave, and study leave and payroll calculations including salaries, allowances, deductions and benefits.

5. Subject Registration System

This subsystem manages the course registration process for each semester. This includes course codes, descriptions, credit hours, and prerequisites. It makes sure no section reaches the capacity limit and allows for add or drop courses feature for students. The system also handles the approval process from the academic advisor to proceed with the subject registration.

6. Research Management System

This subsystem tracks all research activities conducted within the university including managing research project proposals, approvals workflow, research timelines and records research grants. It also tracks postgraduate student research including thesis proposals, progress reports, defense schedules and generates research performance metrics for reporting.

7. Learning Management System

This subsystem provides the digital platform for course delivery and online learning activities. This allows for lecturers to upload and organize course materials including lecture notes and presentations. It also facilitates online assignment submission where students can upload their work by the deadlines and requirements specified by the lecturer.

8. Dashboard and Analytics System

This subsystem centralizes all data from other subsystems to provide real-time insights for decision-making across the institution. It tracks key metrics such as enrollment, retention, graduation rates, research output, finances, and satisfaction. The system supports forecasting, resource optimization, and risk analysis. It also automates reports for strategic monitoring through clear visualizations like charts and heat maps.

These 8 subsystems synergistically form a comprehensive university enterprise architecture that supports all major functions needed from a higher

education institution. Each subsystem has its own specific functionality but must integrate seamlessly with other subsystems as well to ensure the university's operations can be run efficiently, have consistent data throughout the system and provide sufficient support and meet the university's requirements.

2.4 Technology Used

This section covered main technologies that are used to develop the subsystem that was subsequently incorporated into the University Enterprise Architecture (EA). The development of the subsystem will mainly be centered on the use of SAP Business Technology Platform (SAP BTP). It is an integrated Platform-as-a-Service (PaaS) which provides a unified environment for application development, data management and process automation. SAP BTP is chosen in most of University EA as its ability to lower the gap between legacy enterprise systems and the modern cloud requirements.

2.4.1 Unified Data Management and Analytics

The SAP BTP utilizes SAP HANA Cloud as its primary database technology. This in-memory database allows the university to process numerous amounts of student and administrative data in real-time. It also helps to maintain the structural integrity of complex academic records through advanced multi-model capabilities. Through the SAP BTP service such as SAP Datasphere, the subsystem can easily access all the data from different sources without physically moving the data. This is to ensure “Single source of Truth” across the university’s EA.

2.4.2 Application Development and Integration

The development frameworks within SAP BTP facilitates both Pro-Code and Low-Code environments meanwhile the traditional frameworks like Node.js and Java are supported through the Cloud Foundry environment. This platform emphasizes the SAP Cloud Application Programming Model (CAP) which promotes best practices to ensure the subsystem remains scalable and maintainable. The SAP BTP’s Integration Suite also provides pre-built connectors for enterprise systems to reduce the complexity of API management and allow seamless data flow between departmental applications.

2.4.3 Extension of Enterprise Systems

Core systems such as SAP S/4HANA or Microsoft Dynamics functions to handle sensitive financial and student data in a university environment. The Side-by-Side Extensibility allows developers to build new features for the university subsystem on

SAP BTP without the need to modify the code of the core ERP. This is to ensure that the core system inside ERP remains clean, facilitate the future upgrading process and reduce the risk for the institution.

2.4.4 Alignment with EA Frameworks

The SAP BTP platform is designed to support structured EA frameworks like TOGAF and Zachman Framework by providing a standardized platform for four architecture layers which are business architecture, data architecture, application architecture, and technology architecture. This is to ensure the digital processes are aligned with institutional policies and have a consistent governed data handling.

2.5 Summary

On the whole, the literature reviewed in this chapter supports the need for a well-structured and integrated enterprise architecture to ensure the operational challenges of modern universities are addressed. Indeed, findings from previous research have shown that institutions with fragmented, isolated systems are characterized by inefficiencies, inconsistent data, and limited decision-making capability. Enterprise Architecture provides a strategic roadmap for addressing such challenges through clear definition of business, data, application, and technology layers.

Analysis of related subsystems reveals that the core functions of academics and administration, like student records, financial operations, HR, research, and learning management, have to work in harmony for seamless performance at an institutional level. Relational databases, new development frameworks, and enterprise solutions reviewed here provide the required features of scalability, security, and interoperability for the development of a sustainable system. In summary, the literature supports the direction of the design in this project, as it illustrates that the application of EA principles with appropriate technologies will allow the university to advance on aspects of efficiency, integration, and future digitization.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter outlines the methodology that was chosen for the development of UTHM University Enterprise Architecture. The methodology serves as a guide for the approach taken throughout the project's lifecycle. This chapter explains the chosen methodology and the justification for choosing the methodology, an explanation of each phase in the methodology and a project planning schedule is shown to determine the timeline and distribution of tasks of the project.

3.2 Chosen Methodology

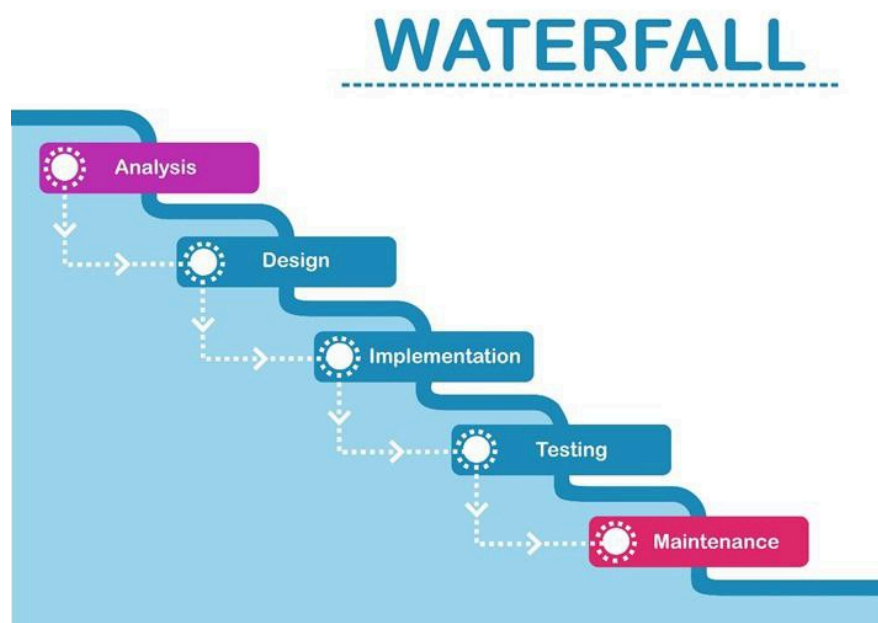


Figure 3.2 Phases in Waterfall Methodology (TechnologyAdvice, 2024)

The chosen methodology for the development of UTHM University Enterprise Architecture is the Waterfall Methodology. Waterfall methodology is a sequential life cycle model that consists of distinct phases which are analysis, design, implementation, testing and maintenance (Senarath, Udesh S., 2021). Each phase has to be completed before beginning the next phase. This methodology was chosen as its clear structure makes it simple and easy to apply to the project development of UTHM University Enterprise Architecture. Using Waterfall methodology also helps with creating a more comprehensive and complete documentation as each stage of the process produces thorough documentation (Samaratova A.K., 2024). Since the Waterfall methodology has clear and well-defined stages, it is easier to estimate timelines and provide more accurate predictions of the duration needed to complete the project.

3.3 Phases of Methodology

The Waterfall methodology for the UTHM University Enterprise Architecture project follows a linear and systematic approach. Each of the phases serves the foundational purpose to ensure the architectural requirements are fully met before moving for the next step.

3.3.1 Planning Phase

Planning phase is the foundation step where it contains all the project's scope, objectives and all the requirements. During the planning phase, the team members gather and do discussion to identify the key stakeholders at UTHM and form a detailed timeline to ensure having a better understanding and strategic planning through the progress. All of the tasks and assignees are gathered using the Gantt chart and GitHub backlog to organize the project roadmap and can track all of the project's progress.

3.3.2 Analysis Phase

The Analysis phase is more focused on gathering and documenting all the required information to complete the project requirements which is the UTHM University Enterprise Architecture (UEA). This phase includes the data collection through the questionnaires that were distributed during the industrial visit at UTHM. All the data collected provides a clear understanding of the current state of their Enterprise Architecture well known as 'As-Is' EA.

3.3.3 Design Phase

During the Design phase, the development of Enterprise Architecture models is going to start. By referring to the requirements collected during the analysis phase, the team designs the 'To-Be' EA together. The specific layer architecture inside the Enterprise Architecture being discussed together. Also, the specific SAP BTP services for example SAP Builds are being used for each subsystem to ensure the subsystem works effectively.

3.3.4 Implementation Phase

Implementation Phase is the phase that creates the subsystem by using the SAP BTP. In this phase, each team member is responsible for developing their assigned subsystem which is the Hostel Management system. This includes the use of SAP BTP cockpit to build the systems and set up the databases on device and create the logic flows specific to its functionality.

3.4 Project Planning Schedule

Project planning schedule is a structured timeline that outlines what tasks need to be done, and when they should be completed so that the project can stay organized and be delivered on time. By following the waterfall methodology as mentioned above, Figure 3.4 shows the gantt chart that needs to be completed for the project.

CHAPTER 4

ANALYSIS AND DESIGN

4.1 Introduction

This chapter presents the analysis and design phase of the proposed Enterprise Architecture (EA) for Universiti Tun Hussein Onn Malaysia (UTHM). Building upon the findings from the previous chapters, this chapter focuses on examining the current organizational and system environment, identifying existing issues, and proposing a structured system design that aligns with the university's strategic digital transformation goals.

The analysis section provides an overview of UTHM's organizational structure, existing information systems, and current operational processes. This includes both computerized and manual workflows that support academic, administrative, and student support functions. By analyzing the current "As-Is" architecture, gaps and limitations related to system integration, performance, and data consistency can be identified.

Subsequently, the design section introduces the proposed "To-Be" enterprise architecture based on the TOGAF framework. This includes the design of business architecture, information systems architecture, and technology architecture. Special emphasis is given to the Hostel Management System, specifically the Room Allocation Engine subsystem, which demonstrates how enterprise architecture principles can be applied to design an integrated, rule-based, and automated solution. Various system models such as use case diagrams, activity diagrams, sequence diagrams, database design, and class diagrams are presented to clearly illustrate the proposed solution.

Overall, this chapter serves as a bridge between conceptual enterprise architecture planning and detailed system-level design, ensuring that the proposed solution is practical, scalable, and aligned with UTHM's operational and strategic requirements.

4.2 Organization Structure

The organizational structure of Universiti Tun Hussein Onn Malaysia (UTHM) plays a critical role in shaping how information systems are planned, implemented, and governed across the institution. As a public university, UTHM operates through a hierarchical organizational structure consisting of top management, academic faculties, administrative departments, and supporting units. Each unit has specific responsibilities that collectively support the university's core functions of teaching, learning, research, and student services.

At the strategic level, the university management is responsible for setting institutional goals, policies, and digital transformation directions. These decisions influence the development and governance of enterprise systems, ensuring that information technology initiatives align with national higher education policies and the university's long-term vision. Supporting this level are central administrative departments such as academic affairs, finance, human resources, student affairs, and information and communication technology (ICT), each of which relies heavily on information systems to manage daily operations.

The ICT department plays a key role in managing UTHM's enterprise systems and infrastructure. It is responsible for system integration, data management, security governance, and the maintenance of both on-premise and cloud-based platforms. Through the implementation of centralized systems and application programming interfaces (APIs), the ICT unit ensures that data flows smoothly across different subsystems while maintaining system reliability and security.

In the context of the Hostel Management System, multiple organizational units are involved, including student affairs, hostel administration, finance, and security services. These units interact with the system to manage student accommodation,

room allocation, fee collection, maintenance requests, and reporting. Understanding this organizational structure is essential for designing an enterprise architecture that supports cross-departmental collaboration, reduces redundancy, and improves service delivery.

By aligning the proposed enterprise architecture with UTHM's organizational structure, the system design ensures that roles, responsibilities, and system access are clearly defined. This alignment enables effective governance, supports operational efficiency, and facilitates future system expansion as the university continues its digital transformation journey.

4.3 Current System Analysis

The current system operates with all present technological and operational resources which Universiti Tun Hussein Onn Malaysia (UTHM) currently possesses to build its complete digital system. The UTHM digital transformation strategy focused on its goal to create cultural transformation which would lead to digital literacy, better user experience, and modern infrastructure through advanced technology.

4.3.1 Computerized Process and Infrastructure

UTHM digital operations are powered by a modern, web-based architecture leveraging high-availability on-premise infrastructure. The university maintains on-premise data centers designed to Tier 3 standards, featuring dual power sources, Uninterruptible Power Supply (UPS), and generator backups. These critical facilities are located on the upper floors of the data center to protect against environmental risks such as flooding. The university also transformed from a legacy client-server architecture to a new unified system called CENTRAL, which utilizes the web-based technology. This allows lecturers, students and staff to access core modules via a standard web browser by eliminating the accessibility barriers that have been found in the previous system. A centralized master database manages the core student records while the UTHM Learning Management System (LMS), like AUTHOR platform, is responsible for storing all academic materials in a separate database container. These

systems are linked through the university-developed APIs and Single Sign-On (SSO) to synchronise students' credentials and monitor in real-time. UTHM also secured their network by utilizing a dual-firewall strategy and Web Application Firewalls (WAF) to defend multi-directional attacks especially from China and Europe.

4.3.2 Manual Processes and Governance

Despite the successful move to web-technology, several workflows still remain manual and semi-automated. Certain general administrative workflows still require the physical completion of forms such as Pusat Kesihatan Universiti (PKU) in UTHM still relies on the traditional manual methods for the patient appointment system. The introduction of any new system or application is strictly regulated by a formal review process as the stakeholders are required to fill a complete Feasibility Study Requirement (FSR) document and need to be approved by the responsible committee. This is to ensure the proposed system is necessary and compatible with the university's goals before the development process.

4.3.3 Identified System Issues

During the student registration for co-curricular subjects, the system expected to handle more than 1000 concurrent users at a time. This peak load performance causes the system to be slowed-down in approximately five minutes of lag times. UTHM also states that the “We Care” support system frequently receives complaints regarding the forgotten passwords for WiFi authentication and SSO which indicate a need for more streamlined identity recovery.

4.4 Comparison between Existing and Proposed System

4.4.1 Current Digital Infrastructure

UTHM has established a comprehensive digital foundation built upon industry-standard technological components. The university operates a Tier-3 standard data center with modern web-based architecture and multi-layered security protocols, including dual firewalls and Web Application Firewalls. The centralized information system (CENTRAL) and learning management system function as

integrated platforms through university-developed APIs and Single Sign-On capabilities.

This infrastructure has enhanced digital accessibility across the institution. However, several operational workflows remain dependent on manual processes, particularly administrative documentation and academic advisor appointment scheduling systems.

4.4.2 Operational Challenges

The current system exhibits notable performance limitations during high-demand periods. When concurrent user access exceeds 1,000 individuals, such as during co-curricular subject registration, the system experiences significant performance degradation, resulting in approximately five-minute response delays.

Additionally, the "We Care" support channel receives persistent password-related inquiries, indicating inadequate user identity recovery mechanisms within the existing framework.

4.4.3 Proposed System Enhancement

The proposed digital ecosystem addresses these operational deficiencies through comprehensive infrastructure improvements. The enhancement plan includes advanced load balancing mechanisms, performance optimization protocols, and potential hybrid cloud integration to accommodate increased concurrent usage.

Key development areas include:

- 1) **Complete workflow automation:** Digital transformation of remaining manual processes, including online academic advisor appointments and electronic administrative forms
- 2) **Streamlined governance processes:** Implementation of fully digital approval workflows, such as online FSR submissions and automated committee procedures
- 3) **Enhanced user experience:** Development of a unified platform interface with improved identity management capabilities

- 4) **Advanced security features:** Integration of self-service password recovery systems and multi-factor authentication options

4.4.4 Expected Outcomes

The proposed system represents a significant advancement from the current semi-digitized infrastructure. The enhanced platform will deliver improved scalability, comprehensive automation, strengthened security protocols, and optimized performance capabilities. This transformation will create a more cohesive digital environment that better serves the university community's operational and academic needs.

The transition from the existing system to the proposed infrastructure reflects a strategic move toward a fully integrated, performance-driven digital ecosystem that can effectively support the university's growing technological demands.

4.5 System Requirements Gathering Techniques

To confirm the architectural requirements, an interview session was held with the UTHM ICT team during an industrial visit. The questions targeted four major areas as shown below:

4.5.1 Daily Operations & Current Process

1. Can you describe the main tasks you perform daily using the current system?
2. Although APIs have been adopted to integrate the data, there is still manual transfer of data between the Main Student Database and the LMS. What are the technical or procedural obstacles that would not allow total automation?

4.5.2 Enterprise Architecture & Integration

1. Now that the migration of the legacy TCIS to the web-based CENTRAL architecture has reached completion of 70-80% is already made, what do you believe are the largest technical challenges that could be expected to be encountered during the remaining 20%?
2. Given that the LMS is designed to be independent and exist as a database separate on the central system, how can data consistency and integrity be ensured so that one cannot find out inconsistency including the absence of student records?

4.5.3 Infrastructure & Performance

1. The latency was observed to have a time of 5 minutes during peak Course Registration (CRS) intervals that have more than 1000 simultaneous users. What is the solution to this problem by the UTHM team?
2. You described 3 tiers power backup (TNB sources A/B, UPS, Genset). How much time will the existing UPS solution support the critical servers until the genset goes online to replace all its power?
3. Why is the Data Centre located upstairs despite the logistical convenience of a ground-floor location for loading and unloading equipment?

4.5.4 User Experience & Future Needs

1. How does the cybersecurity team protect sensitive data from cyberattack?

4.8. System Design

This section will discuss the AS-IS and TO-BE EA and focus on the individual project design for the chosen subsystem. This includes the use case, activity diagram, sequence diagram, database design, and interface design for the subsystem.

4.8.1 Enterprise architecture EA - AS IS

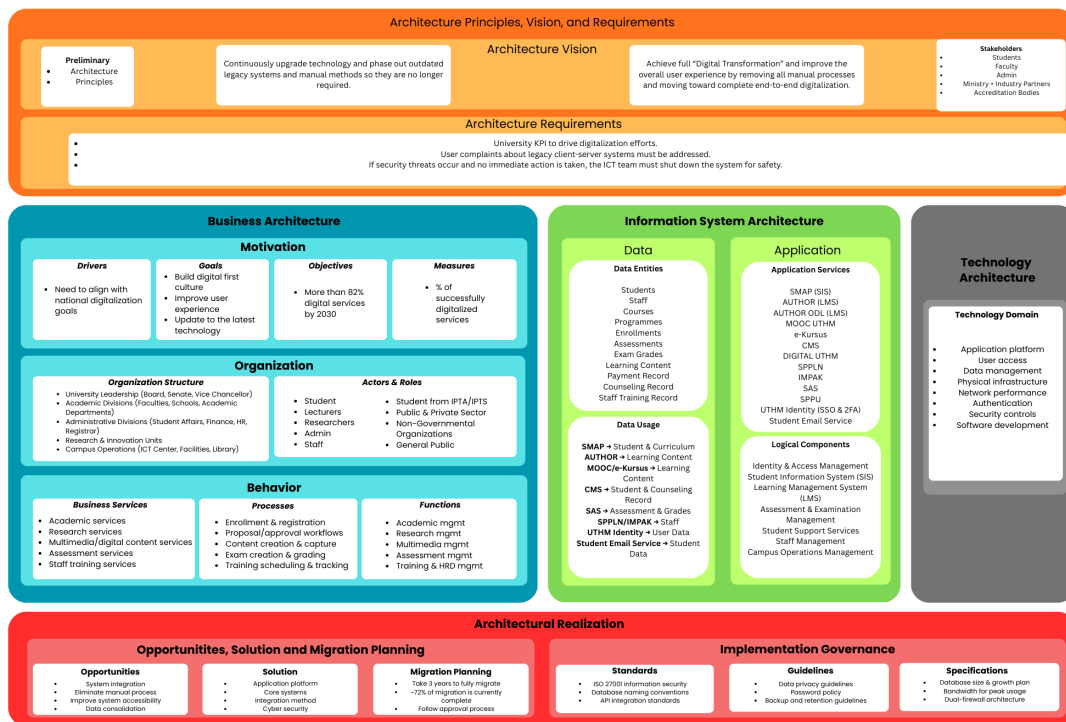


Figure 4.8.1 AS-IS Enterprise Architecture

4.8.2 Explain each component in system architecture EA-AS IS

Architecture Principles, Vision and Requirements

a. Preliminary Principle

The main order of action is focused on gradually upgrading technology and phasing out outdated legacy systems and manual

methods. This is the current transition stage of UTHM in which the institution is transitioning out of an old client-server architecture to modern web-based architecture, which is still ongoing.

b. Architecture Vision

The current vision emphasizes achieving full digital transformation by improving the overall user experience through the removal of manual processes and moving toward complete digitalization. At present, UTHM is at approximately 70-80% digital migration, meaning there is still a significant portion of operations that rely on manual or semi-automated processes.

c. Architecture Requirements

The AS-IS requirements focus on three critical areas:

1. University KPI alignment: Ensuring systems support the institution's key performance indicators and digitalization goals
2. Legacy system user complaints: Addressing issues users face with outdated client-server systems that require specific configurations
3. Security protocols: If security threats occur and no immediate action is taken, the ICT team must have protocols to shut down the system for safety

2. Business Architecture

This layer defines the existing posture of UTHM in its operations in terms of business, including organisational structure, processes, and stakeholder interactions.

A. Motivation Layer

Drivers: The existing system is driven by the need to comply with the national digitalisation goals that are set by the Ministry of Higher Education. UTHM is aware

of the fact that the outdated technology and manual procedures limit the level of operational performance and undermine user experience.

Goals:

1. Create a digital-first culture within the institution.
2. Improve the experience of both faculty and students.
3. Improve infrastructure using the latest technology to ensure that the company is up to date.

Objectives: Its main agenda is to achieve over 82-percent digital services by 2030 and thus shifting paper-based and manual workflow to complete automated digital services.

Measures: Success is currently measured using the level of services that have been successful in digitalisation. UTHM keeps track of the volume of processes moved on-line and the adoption of the new web-based CENTRAL system by the users.

B. Organization Layer

The current organisational structure of UTHM is made of:

- University Management: Vice Chancellor, Board of Directors.
- Functional Divisions: Organized in terms of faculties, schools, and academic departments.
- Administrative Departments: Student Affairs, Finance, Human Resources and Registrar departments.
- Support Units: Research and Innovation Unit, ICT Centre, Facilities management, and Library.

Actors & Roles:

There are several stakeholders that the system is serving at present:

- Students: For IPTA (public universities)/ IPTS (private institutions): primary users.

- Academic members of staff who present instructional content are known as lecturers.
- Researchers: Faculty taking part in scholarly research work.
- Administrative Personnel: Personnel who are involved with operational management.
- Personnel: General support staff.
- External users: partners in the public and non-governmental organisations as well as the general population to receive stated services.

C. Behaviour

The business services already available are:

- Academic services (enrolment, registration, grading).
- Research services (project management, grant tracking).
- Student services (counselling, support services).
- Evaluation services (examinations, evaluations).
- Staff trainer services (professional development).

Processes: Some of the major business processes that are currently in operations are enrollment and registration, proposal approval, content development and acquisition, exam construction and scoring, training organization and monitoring.

Functions: The fundamental functional areas include course scheduling, planning curriculum., research management, multimedia control, evaluation administration, staff development through training and HRD management.

3. Information System Architecture

A. Data Architecture

In data architecture, the core data and how these data relate to the others in information systems of UTHM are carefully established. Students, Staff, Courses, Programmes, Enrollments, Assessments, Grades, Learning Content, Payment Records, Counseling Records, and Staff Training Records are some of the most

significant academic and administrative entities present in the existing AS-IS environment. These organizations in totality support the academic delivery, student services and the overall operations of the institution.

This architecture makes the utilisation of the data easier through various systems that exchange and receive data to protect the continuity of operation. Student Management and Academic Planning (SMAP) is the key source of information on students and curriculum related information. The learning materials are delivered and shared on AUTHOR, MOOC UTHM and e-Kursus. The Content Management System (CMS) handles the student documentation and the data relating to counseling. The results of the assessment and records of the academic performance are stored in the Student Assessment System (SAS). Information related to staff is monitored by SPPLN and IMPAK and the authentication of users is centralised by UTHM Identity, therefore, facilitating Single Sign-On (SSO). Moreover, there is provision of Student Email Service that is used to facilitate official communication associated with student records.

B. Application Architecture

Application architecture outlines the essential systems that will be implemented to assist UTHM academics and administration processes. This includes primary applications of SMAP as the Student Information System (SIS), AUTHOR and AUTHOR ODL as Learning Management Systems (LMS), and additional applications, including MOOC UTHM and e-kursus to deliver long-distance learning. CMS, DIGITAL UTHM, SPPLN, IMPAK, SAS, and SPPU are all the administrative and support functions that are facilitated. UTHM Identity imposes identity management and secured access complemented with institutional email services.

Logically, the applications are grouped in functional components, which are Identity and Access Management, Student Information Management, Learning Management, Assessment and Examination Management, Student Support Services, Staff Management and Campus Operations Management. All these elements together form a unified ecosystem that supports the main academic and working processes at UTHM.

5. Technology Architecture

The technology architecture of UTHM mainly focuses on transitioning from a legacy client-server model to a modern, fully web-based platform. This is to ensure that their technology has ubiquitous access for students and staff in the university. UTHM has a high-availability infrastructure that is built on a very solid foundation. It has three internal data centers that place compliance and internal control above cloud services. In an order of priority for business continuity, UTHM has put in place a three-tier power redundancy system made up of a dual-power source, Uninterruptible Power Supplies (UPS) for immediate backup, and Gensets for long-term outages. Security, being an essential factor, UTHM has adopted a multi-brand dual-firewall architecture and Web Application Firewall (WAF) which altogether protect the institutional portals. This layer also standardizes API integration and Single Sign-On (SSO) to facilitate a seamless communication between the centralized core database and peripheral learning systems like AUTHOR.

6. Architectural Realization

This layer explains the opportunities, solution, and migration planning, and the implementation governance that UTHM has implemented.

A. Opportunities, solutions, and migration planning

Opportunities: This section identifies the key improvements that UTHM must enable to derive from their strategic goals and identified problems. The institution focuses on the system integration and eliminating the manual processes to reduce the administrative work, aiming for an End-to-End (E2E) digital goal by 2030. UTHM also prioritizes improving their system accessibility by replacing the legacy client-server architectures with fully web-based systems and ensuring their data consolidation by maintaining a single, centralized database linked to separate systems like AUTHOR.

Solutions: The solution defines the final desired state for UTHM's

technology, application and data architecture. The application platform must be fully web-based for ubiquitous access, while core systems utilize a centralized system for the core data and AUTHOR as the LMS. The integration method of UTHM relies on the API and SSO supported by the UTHM data center infrastructure which focuses on the internal infrastructure and compliance. For reliability, UTHM maintains a 3-tier power redundancy and a multi-brand security layer featuring dual firewalls alongside a Web Application Firewall.

Migration planning: This outlines the strategy to execute the transition to the target state. UTHM has utilized a “face-to-face” migration strategy where the old system runs concurrently with the new implementation. The UTHM has estimated their migration duration is about 3 years as they have reached approximately 72% of completion. All new applications must strictly follow the UTHM approval process including filling out a complete MSR requirements and committee check.

B. Implementation governance

Standards: This component is to define a formal, mandated criteria to ensure the quality and consistency across UTHM systems. The ISO 27001 information security helps the UTHM to formalize the commitment to robust their security systems. UTHM also mandates the database naming conventions to manage the centralized but segmented data environment and API integration standards to ensure the smooth data transfer between the core database and the LMS.

Guidelines: Data privacy guidelines helps the UTHM to ensure compliance with PDSA standards for sensitive student data and academic marks. A structured password policy is established to address user experience issues meanwhile the backup and retention guidelines are implemented in UTHM to protect the centralized data and ensure infrastructure continuity.

Specifications: These include the database size and growth plan to ensure the

centralized system does not degrade as the university moves toward 2030 digital goals. The UTHM has also addressed their bandwidth for peak usage specifically targeting bottlenecks that have been observed during the student co-curricular registration.

4.8.3 Enterprise architecture EA-TO BE

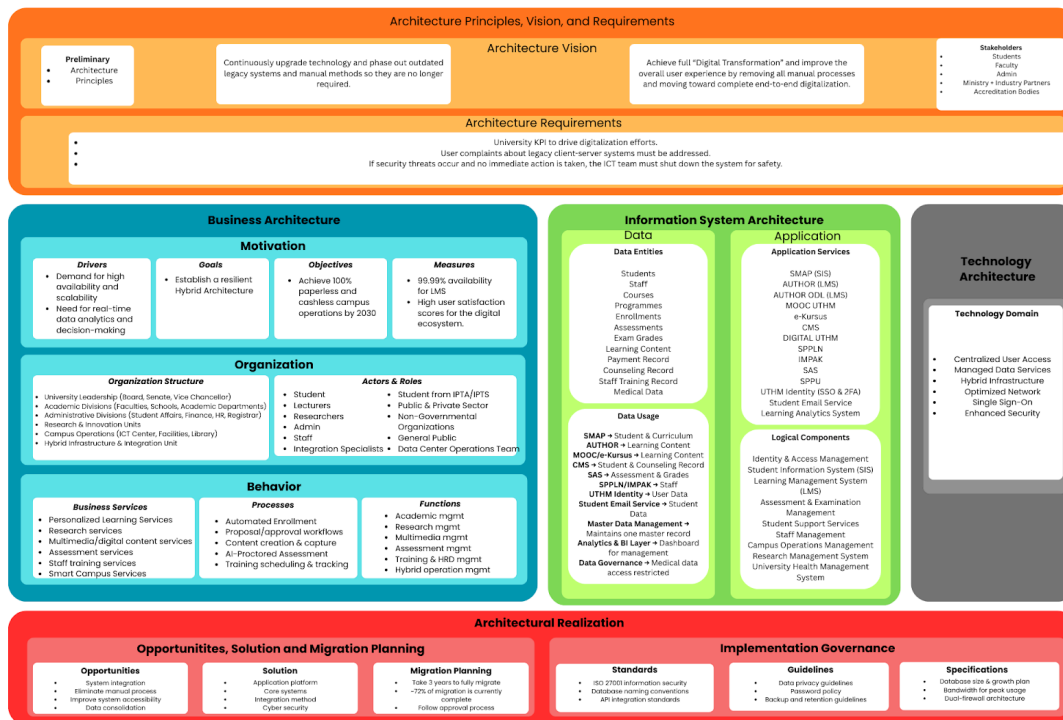


Figure 4.8.3.1 TO-BE Enterprise Architecture

4.8.4 Explain each component in system architecture EA - TO BE

The elements of a TO-BE architecture of a university are usually based on the TOGAF layers but are directed to optimization and future possibilities. There are some of the components in the EA TO-BE:

1. Architecture Principle, Vision, and Requirements

This layer determines the objectives of the transformation at the high level.

i. Architecture Principle:

Architecture Principles are the rules and guidelines, which guide UTHM in developing and managing its IT resources. The principles are focused on interoperability, which will mean that different systems such as Finance and Academic records can communicate with each other without issues, and agility, which will enable the infrastructure to expand as the university grows.

These principles are focused on a user-centric concept and they make sure that all the technological developments are meant to enhance the performance and experience of students and staff instead of complicating their day to day activities.

ii. Architecture Vision:

The Architecture Vision serves as the North Star to the university and is the description of the way it wants to be fully integrated into Digital UTHM. The first objective is to become 82% digital by 2030, to move to the modern digital ecosystem, frontrunner of fragmented legacy systems and paper-based workflows. The vision will focus on ensuring that there is a single experience where all stakeholders can use a single secure portal to access all the university services and create a culture of data-drivenness that will ensure the mission of excellence of TVET education is achieved by the university.

iii. Architecture Requirements:

Architecture Requirements are measurable, specific, "must-haves" which the system has to fulfill in order to be declared successful. They comprise a high level of compliance with security measures, including the use of Multi-Factor Authentication (MFA) and ISO 27001 standards to keep safe institutional data. Also, these requirements will guarantee that the IT strategy is optimally aligned with the Ministry of Higher Education (MOHE) KPIs and directly responds to user pain points, as the new applications should be stable, high-performing and address the real needs of the campus community.

2. Business architecture

This layer justifies the motivation, organization, and behaviour required in the future Hybrid Architecture of UTHM.

A. Motivation Layer

Drivers: The university is under pressure by external forces to offer systems that are online at all times and capable of expanding with the needs of the students. The management team must also have real-time data analytics that will enable them to

make decisions instantly rather than depending on manual reports which are very slow. These drivers push UTHM out of simple web sites to robust, scalable web sites.

Goals: The first objective is to create a Hybrid Architecture that will integrate the security of on-premise servers. This guarantees safety of UTHM data and still produces the same efficiency and accessibility of academic applications.

Objectives: UTHM is also aiming at going 100 percent paperless, cashless by the year 2030. This will mean the elimination of all the physical forms of operations and cash transactions to smoothen the day-to-day operations. This will save time and efficiency of administration.

Measures: The success measure will be to achieve the 99.99 percent system availability, this implies that the Learning Management System (LMS) is practically never offline. The other key sign is the high user satisfaction rates and it proves that the new digital ecosystem is not a waste of time to students and employees. These steps imply that the technology will offer real value and not new features.

B. Organization Layer

In order to facilitate the new hybrid architecture, we have introduced a new Hybrid Infrastructure and Integration Unit to take care of the key relationship between the on-premise servers at UTHM and the cloud. This department will work alongside current departments but will add new professional skills such as Integration Specialists whose duty will be to make sure that the system is not only interoperable but also with a Data Center Operations Team that focuses on the physical Tier 3 infrastructure.

C. Behaviour

Business Services: We incorporate Personalized Learning Services whereby the content is adjusted to the needs of individual students rather than having a general lesson. Besides that, we include a new service known as Smart Campus Services which uses IoT technology to access such facilities as smart parking and smart libraries. This changes the emphasis on the delivery of basic services to intelligent and user-friendly experience.

Processes: We replaced the manual processes with Automated Enrollment whereby we could regulate instantly without the delay of the human approval. The introduction of AI-Proctored Assessment is also aimed to provide the control of online examinations, which are autopiloted and avoid bodily invigilators. These procedures are more focused on expediency and automation as opposed to manual data input.

Functions: Hybrid Operation Management has now been incorporated into the management functions in order to manage the cloud services and the on-premise hardware at the same time. This provides a single perspective of the overall IT health of the university. It enables IT teams to easily and proactively manage problems in various environments.

3. Information System Architecture

The Information system architecture level connects between the business strategy at the high level and the technology. It consists of two major fields: Data Architecture that describes what needs to be known, and Application Architecture that describes the computer programs that manage that information.

a) Data architecture

Data architecture involves defining important data objects and the flow of information within the organization in order to maintain data integrity and security.

The most basic units of the UTHM information ecosystem are data entities. It could be subdivided into their particular role:

- Essential Academic Branches: Students, personnel, courses, and programs.
- Academic history: classifications, examinations, and grades.
- Operational Assets: Learning material and payment history.
- Sensitive Records: Special training and medical history records.

The movement of data between systems is called data usage. It involves the data being utilised to bring value to the various stakeholders.

- LMS Integration: Learning Management Systems draw on student and curriculum information to load the online classrooms.

- Administrative Management: Content Management Systems (CMS) is used to align student records with learning materials.
- Security & Identity: Identity systems are used to control credentials of users to make sure the correct individuals can access the correct data.
- Strategic Intelligence: Business intelligence (BI) tools combine data to provide a management dashboard.
- Governance: The medical data access is highly divided and limited to the privacy policies.

b) Application architecture

Application architecture is a concept that is used to describe the software services and logical modules, which facilitate user interaction with the data.

Application services is the functional software platforms deployed:

- Learning Platforms: SMAP, AUTHOR and MOOC LMS suites.
- Administrative Platforms: CMS and e-Kursus in managing the curriculum.
- Enterprise Services: Learning Analytics, Identity management and Email systems.

Logical component represents the central driver of the digital operations of the university:

- Identity & Access Management: Authentication and user rights.
- Student Information System (SIS): This is the database of student lifecycle.
- Learning Management (LMS):The teaching, learning, and collaboration interface.
- Assessment and examination:Intensity course modules: grading and exam integrity.
- Campus Operations: Systems: Research and day-to-day logistical systems.
- Health Management:A safe university medical service system.

In general the comparison between the information system architecture of EA as-is and EA to-be is that the To-Be architecture added completely new modules that the As-Is does not have, namely the University Health Management System. Then, implements a special Master Data Management layer and Data Governance

framework to manage limited access, especially of medical records. Finally, includes an Analytics and BI Layer to convert the raw data into actionable dashboards to the university management.

4. Technology Architecture

This layer defines the software and hardware infrastructure required to support the deployment of business, data, and application services. The TO-BE technology architecture for UTHM shifts from fragmented, legacy hardware to a resilient, high-performance hybrid environment.

i. Hybrid Infrastructure

The core of the TO-BE model is a Hybrid Cloud environment. This combines UTHM's on-premise Tier 3 Data Center for sensitive localized data (like medical and financial records) with Scalable Cloud Services such as AWS or Azure for student-facing applications like the LMS and MOOC. This ensures the university can handle massive traffic spikes during enrollment or exam periods without system crashes.

ii. Centralized Architecture & Managed Data Services

Unlike the previous decentralized "silo" approach, the TO-BE architecture utilizes Centralized Management. All server resources, storage, and databases are governed under a unified framework. Managed Data Services are implemented to automate backups, database tuning, and high-availability clustering, ensuring that the "Master Data" remains consistent across all campus departments.

iii. Optimized Network & Connectivity

To support the "Smart Campus" and IoT goals (smart parking/libraries), the network infrastructure is upgraded to High-Density Wi-Fi 6 and a 10Gbps Fiber Backbone. This optimization ensures low latency for AI-proctored assessments and seamless connectivity for thousands of simultaneous mobile users across the UTHM campus.

iv. Single Sign-On (SSO) & Identity Management

To solve login fatigue issue faced by students and staffs, the technology layer implements a Unified Identity Provider (IdP). Using protocols like SAML or OpenID Connect, the Single Sign-On (SSO) allows students and staff to access the LMS, Finance, HR, and Medical systems using a single set of UTHM credentials, significantly improving the user experience and reducing password-reset tickets.

v. Enhanced Security (Zero Trust & Dual-Firewall)

Security is integrated directly into the infrastructure through a Zero Trust Architecture.

- Dual-Firewall Design: Traffic is inspected through both external perimeter firewalls and internal micro-segmentation firewalls to protect sensitive data zones.
- Encryption at Rest & in Transit: All data moving between the cloud and on-premise servers is encrypted using TLS 1.3, and databases are encrypted to meet ISO 27001 standards.

5. Architectural Realization

i. Opportunities & Solutions:

Opportunities and Solutions are the next phase where UTHM establishes the What by assessing the disconnect between the existing legacy systems and the envisioned new digital future. This element is aimed at bundling together similar business requirements into rational work packages i.e. consolidating the manual leave and claims processes into one "HR Digital Module." Within the framework of this project, it explains the manner in which UTHM decides on the outdated client-server applications that need to be removed or upgraded to achieve its 82% digitalization goal in the university.

ii. Migration Planning:

Migration Planning determines the "When" through creating a time-based roadmap of IT transformation of the university. As shown in the EA diagram, UTHM is at stage of polishing with 72 percent of the migration already accomplished as part of the 3-year strategic plan. The component is aimed at having digital projects prioritized effectively depending on their available budget as well as the urgency of security threats and accomplishment of critical university KPIs, so that there is a smooth transition to the target architecture.

iii. Implementation Governance:

The Implementation Governance is the How by implementing the rules and standards that make sure that new systems are safe and well-integrated. UTHM is employing ISO 27001 as a reference to the information security benchmark and fully demands technical control by means of specifications, such as the so-called Dual-Firewall design. This element plays a policeman role, making sure that new development is done to the standards of the institution, such as requiring the use of UTHM Identity (SSO/2FA), so as to not create an insecure or fragmented system of logging in.

4.8.3 System Architecture

The Cloud System Architecture relies on the SAP Business Technology Platform (BTP). The design uses a Low-Code/No-Code strategy to ensure efficiency and scalability. The system comprises four key layers. The Presentation Layer utilizes SAP Build Apps to provide role-specific interfaces for students, wardens, and security staff. The Application Layer leverages SAP Build Process Automation to handle core logic like room allocation. Additionally, the SAP Integration Suite connects securely to external systems like payment gateways. The Data Layer centralizes all information using SAP HANA Cloud to store live records. Finally, the Analytics Layer uses SAP Analytics Cloud to visualize key metrics through dashboards. This setup ensures a complete workflow from user input to strategic reporting.

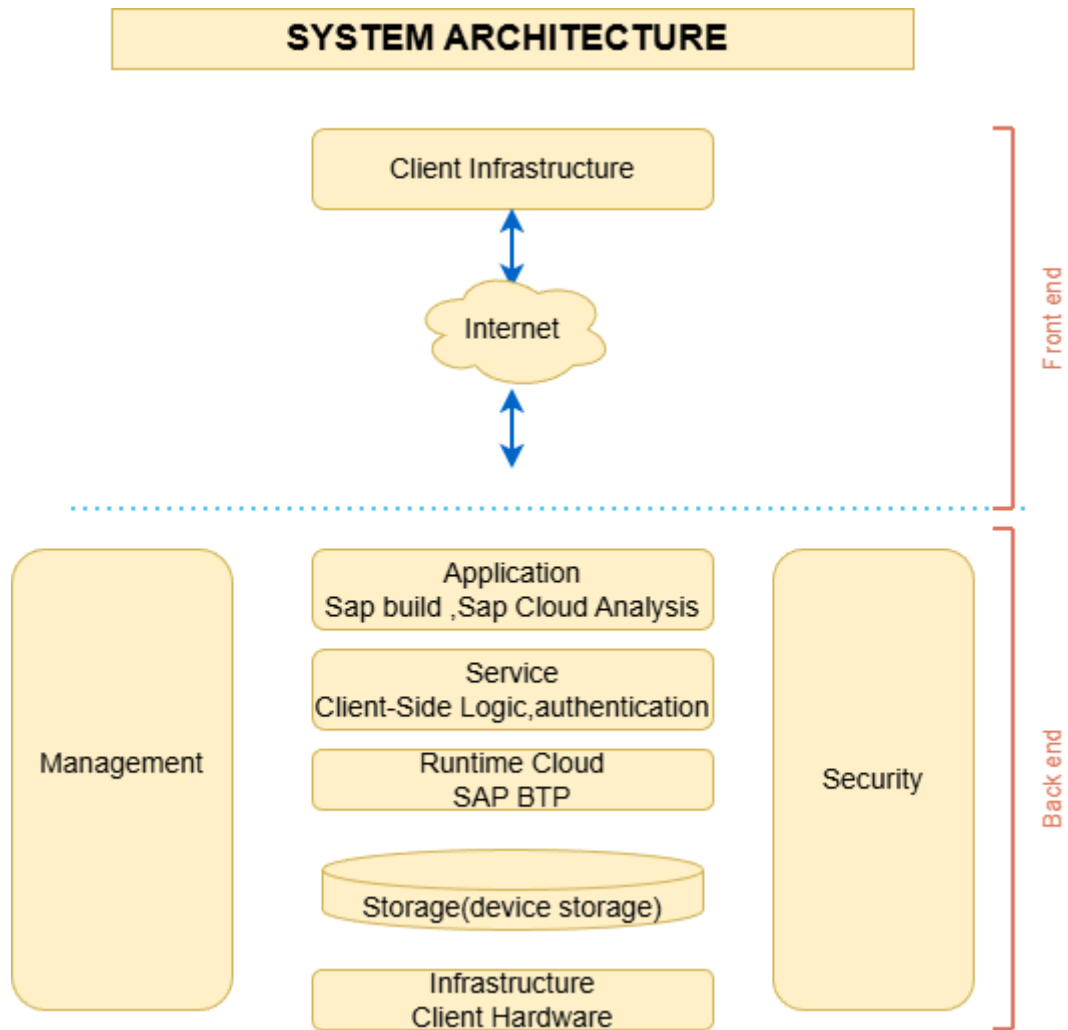


Figure 4.8.3.1 System Architecture of Hostel System

4.8.4 System Architecture Component Explanation

It is segregated into 2 broad parts; Front End (Client-side) and Back End (Server-side).

Front End (Top Section)

This is the part that the user interacts with the system.

Client Infrastructure This describes the environments and devices the end-users are operating (e.g., laptops, smartphones, web browsers). It acts as a point of entry to the user in the application.

Internet: The medium of communication. It links the Client Infrastructure and the Back End services and data flows in both directions (which are indicated by the blue double-headed arrows).

Back End (Bottom Section)

This is the nub of the system on which processing, logic and data storage occur. It is surrounded by two vertical pillars (Management and Security) and a technology stack at the center.

These layers are organized in a downward manner starting with the software application to the physical hardware.

Application:

SAP Build: It indicates that the application was built on the low-code/no-code environment of SAP. It enables the development of enterprise apps in a short time.

SAP Analytics Cloud: this element manages data visualization, reporting and business intelligence (BI) in the app.

Service:

Client- Side Logic: Although it is written on the Client- Side the fact that this is placed in the backend indicates that this layer handles the serving or coordination of business rules which determine how the client will behave.

Authentication: This service is a service that identifies user identities before they are allowed to access the application hence only authorized users can access the application.

Runtime Cloud:

SAP BTP (Business Technology Platform): It is the core of the architecture. SAP BTP is a Platform-as-a-Service (PaaS) which is used to host the applications, carry out integration, and offer environment where the apps can be executed.

Storage (Device Storage):

This is the persistence layer and data is stored in the form of a database cylinder. The term device storage normally refers to the actual physical or virtual disk space in which the data are stored.

Infrastructure:

Client Hardware: This is the physical computing hardware that is used in supporting storage and runtime environments.

4.8.5 Project Design

This section outlines the functional requirements of the system through the use case diagram and detailed specifications including the use case descriptions, sequence diagrams, and activity diagrams.

4.8.5.1 Use Case Diagram - Violation & Disciplinary Log

The following shows the use case diagram of the violation and disciplinary log subsystem with its specific modules. There are three actors that are responsible for this subsystem, which includes Staff, Hostel Admin, and College Student Committee. The staff serves as the central power user as they are the only individuals that were granted access to every functional module in this use case. They act as the primary point of data entry by using the Record Violation to log all new incidents that occur within the college residents. Beyond that, they also have the authority to manage the lifecycle through Update Violation Status and can perform audit or history checks using the View Violation Record.

While the staff handles an entire range of tasks, the other two actors have much more specialized roles. The Hostel Admin focuses specifically on the Update Violation Status, which suggests their role is centered on reviewing existing records and making final administrative decisions. The College Student Committee can only access the View Violation Record as they must be visible to the current log to

monitor or be aware of their work but not be able to establish new disciplinary data or change the existing disciplinary data.

Essentially, the system is constructed in such a way that the Staff initiates the workflows to the end, the Hostel Admin will be the one furnished with the administrative conclusions needed, and the Student College Committee will serve as a monitored observer.

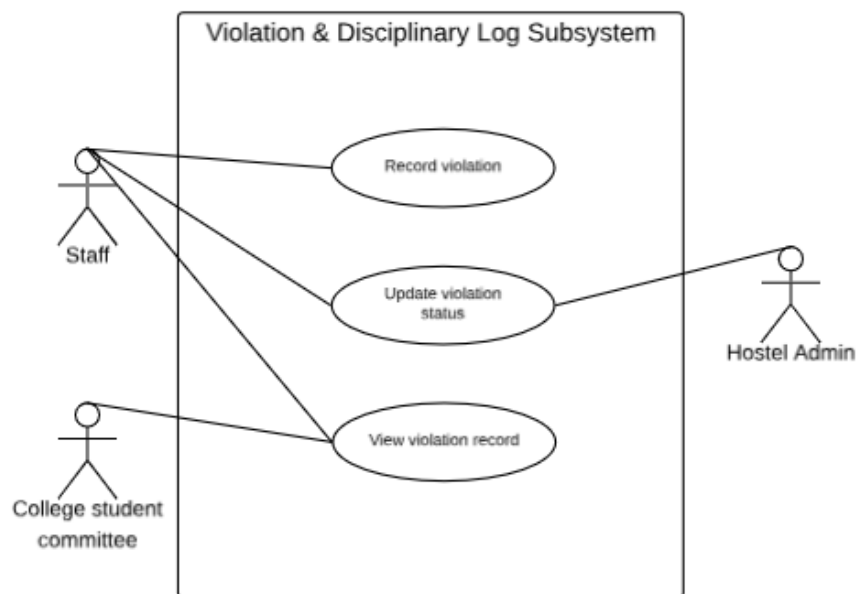


Figure 4.8.5.1 Use Case Diagram of Violation and Disciplinary Log System

4.8.5.2 Use Case Details - Violation & Disciplinary Log

The use case details will give a thorough insight on the flows for each of the use case modules including the use case description, activity diagram, and sequence diagram.

4.8.5.2.1 UC001: Use Case <Record Violation>

The Record Violation module is identified as UC001 which serves as the primary data entry for the subsystem where the Staff members document all disciplinary records. The module is designed for direct manual entry that allows the staff to identify a student by entering their name, matric number, and contact information without a pre-existing profile in the database. The module captures the specific

incident through violation type, date and location. To ensure the data integrity, the system also includes the alternative flow to prevent any error occurring.

Use Case: Record Violation
ID: UC001
Actors: Staff
Preconditions: 1. Staff must be logged into the system and granted access to the record violation page.
Flow of events: 1. The staff enters student name, matric number, and contact number to identify the student. 2. The staff selects violation categories whether it is minor, major, or critical violation, and inputs specific violation date and location. 3. The staff adds notes to the violation form if necessary. 4. The staff clicks on the submit button to save. 5. The system saves the violation record and confirms success.
Alternative flow 1: If there is invalid inputs, the system will display an error message and request correction.
Postcondition: The violation is recorded and stored in the system. The violation record is ready for review.

Table 4.8.5.2.1.1: Use Case Description for Record Violation

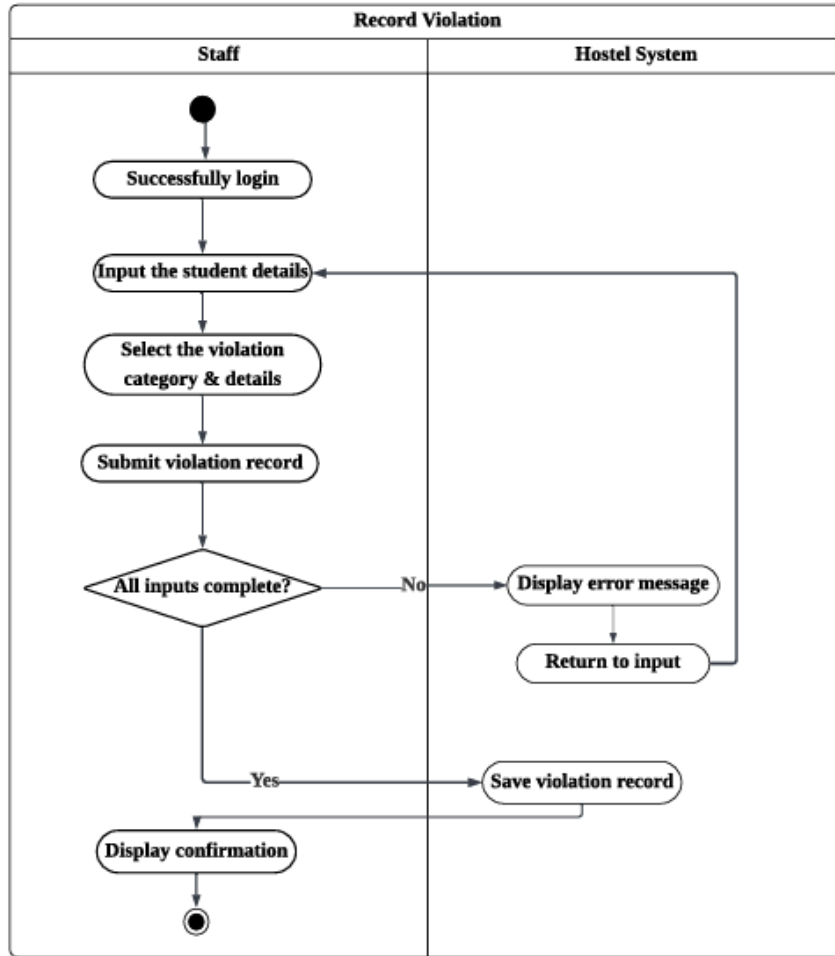


Figure 4.8.5.2.1.1: Activity Diagram for Record Violation

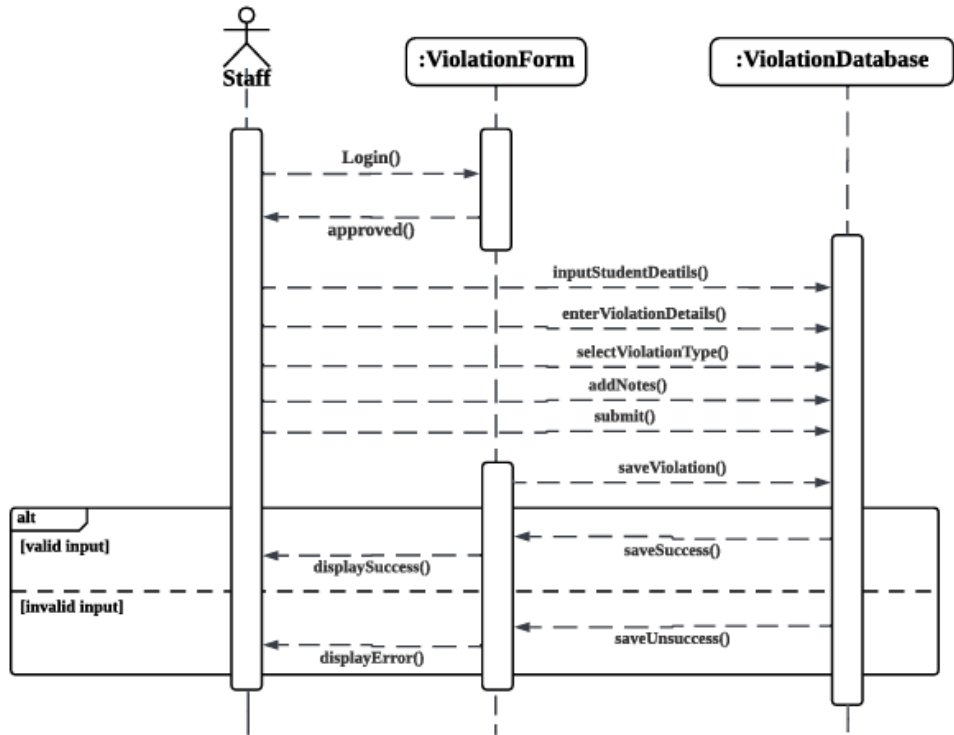


Figure 4.8.5.2.1.2: Sequence Diagram for Record Violation

4.8.5.2.2 UC002: Use Case <Update Violation Status>

The second module will be the Update Violation Status and its name is UC002 that will be the management and resolution point of the subsystem. It enables the Staff and Hostel Admins authorized to adjust the incident recorded depending on the disciplinary actions or investigations being conducted. The diagrams below illustrate the steps of the module in case all the records of violation are maintained to be accurate and to represent their most recent status by meeting the postcondition of maintaining the log at up to date state in the future.

Use Case: Update Violation Status
ID: UC002
Actors: Staff and Hostel Admin
Preconditions: <ol style="list-style-type: none">1. The violation records must exist in the system.2. The actors need to log in and be authorized.
Flow of events: <ol style="list-style-type: none">1. The system displays the violation details of the record.2. The actors review the violation details.3. The actors select the status of the violation whether it is pending, resolved or flagged.4. The actor adds notes to the violation if necessary.5. The actor clicks on the update status button to save the updates.6. The system updates the violation status and confirms the update.7. The status will then appear at the list of violation records with its respective colors.
Alternative flow 1: The actor can click the Cancel button to discard changes and stop the update process.
Alternative flow 2: If the system detects unauthorized access, the system will deny any updates and prompt errors.
Postcondition: Status and the details of the violation are updated and saved for the user to review.

Table 4.8.5.2.2.1: Use Case Description for Update Violation Status

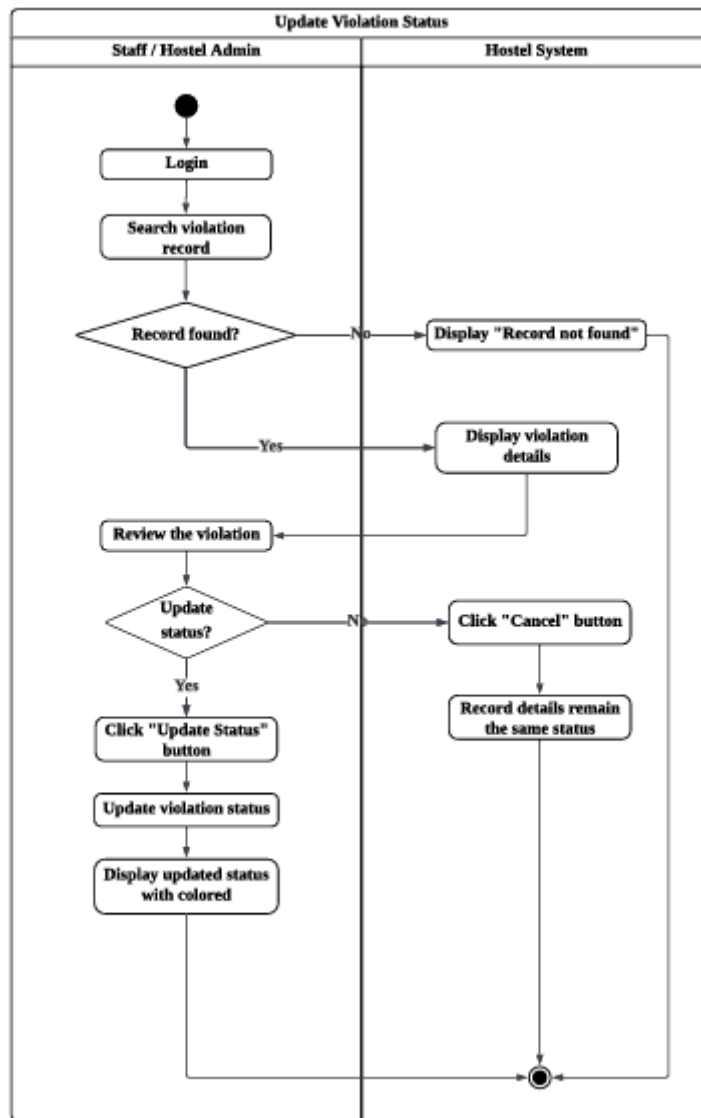


Figure 4.8.5.2.2.1: Activity Diagram for Update Violation Status

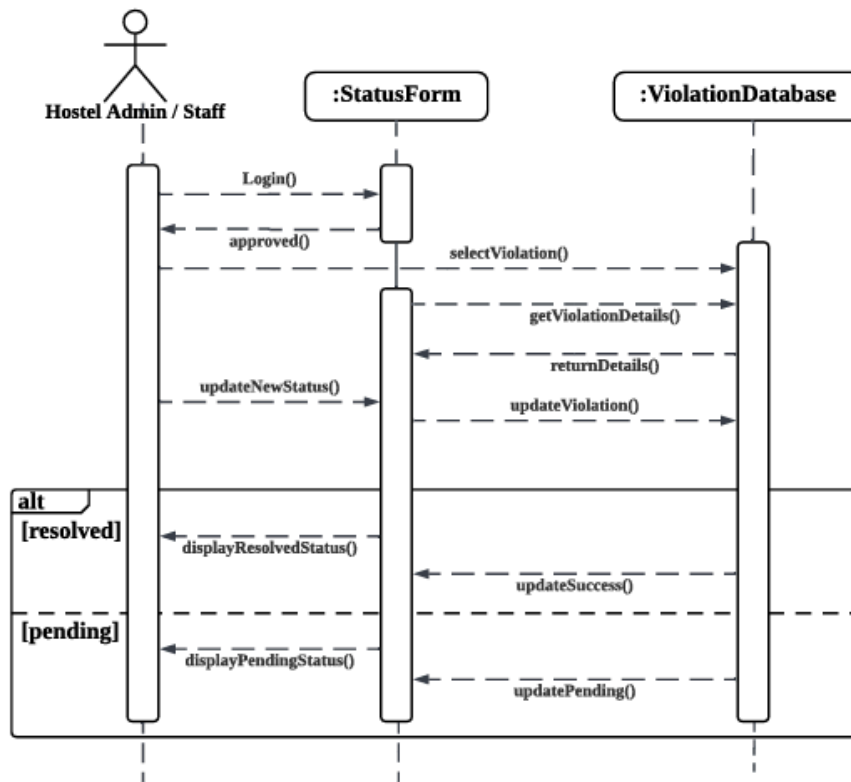


Figure 4.8.5.2.2.2: Sequence Diagram for Update Violation Status

4.8.5.2.3 UC003: Use Case <View Violation Record>

This module, View Violation Record is referred to as UC003 which is the informational and auditing element of the subsystem. It has a user-friendly read-only interface with a broader scope of actors, including Staff, Hostel Admin, and College Student Council can view disciplinary records without the chance of unintentional or unauthorized modifications. The diagrams below indicate the entire processes that are required to satisfy the postcondition of presenting the data without modification to ensure the subsystem has a consistent and unalterable audit trail of all the violations of students.

Use Case: View Violation Record
ID: UC003
Actors: Staff, Hostel Admin, College Student Council (CSC)
Preconditions: 1. The actor needs to log into the system.

2. The violation record must exist in the system.
<p>Flow of events:</p> <ol style="list-style-type: none"> 1. The system retrieves all violation records. 2. The actor selects an existing record. 3. The system displays the details of the selected record. 4. The actor reviews the details of the violation record.
<p>Alternative flow 1: If there is no violation exists in the system, the system will display “No record is found”.</p>
<p>Alternative flow 2: If the system detects unauthorized users logged into the system, the system will deny the access and prompt error.</p>
<p>Postcondition: Violation data is being displayed and no modification occurs to the violation record.</p>

Table 4.8.5.2.3.1: Use Case Description for View Violation Record

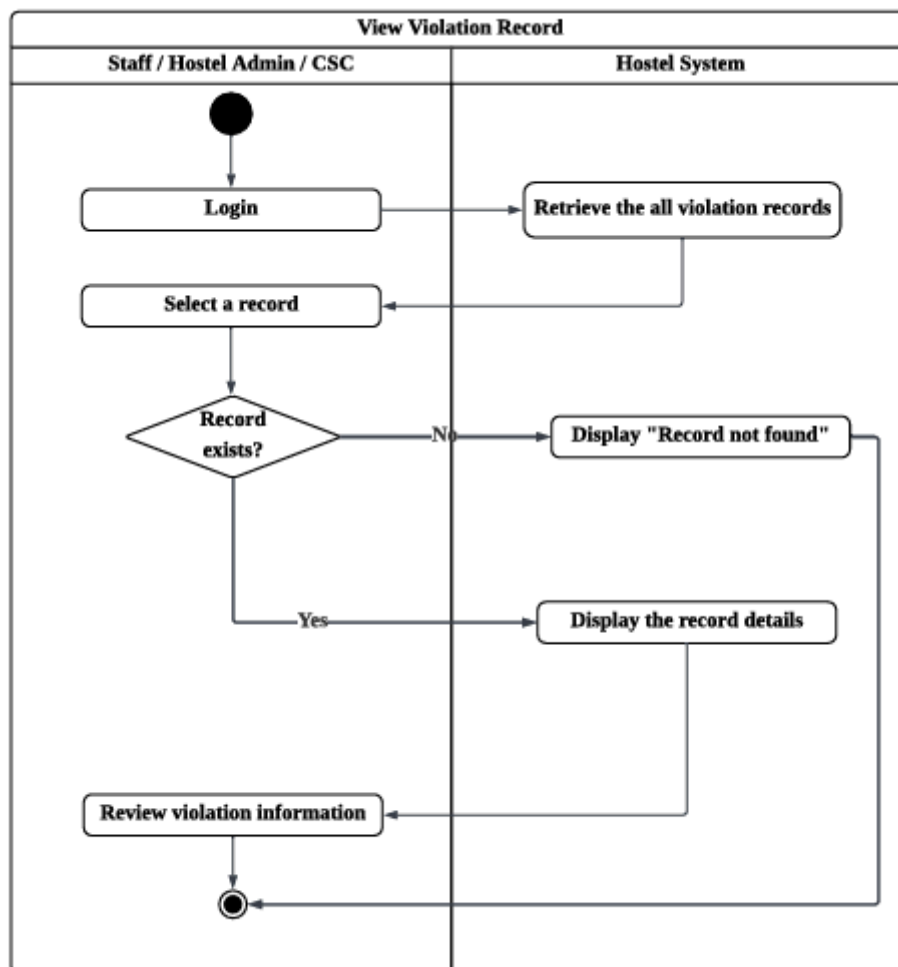


Figure 4.8.5.2.3.1: Activity Diagram for View Violation Record

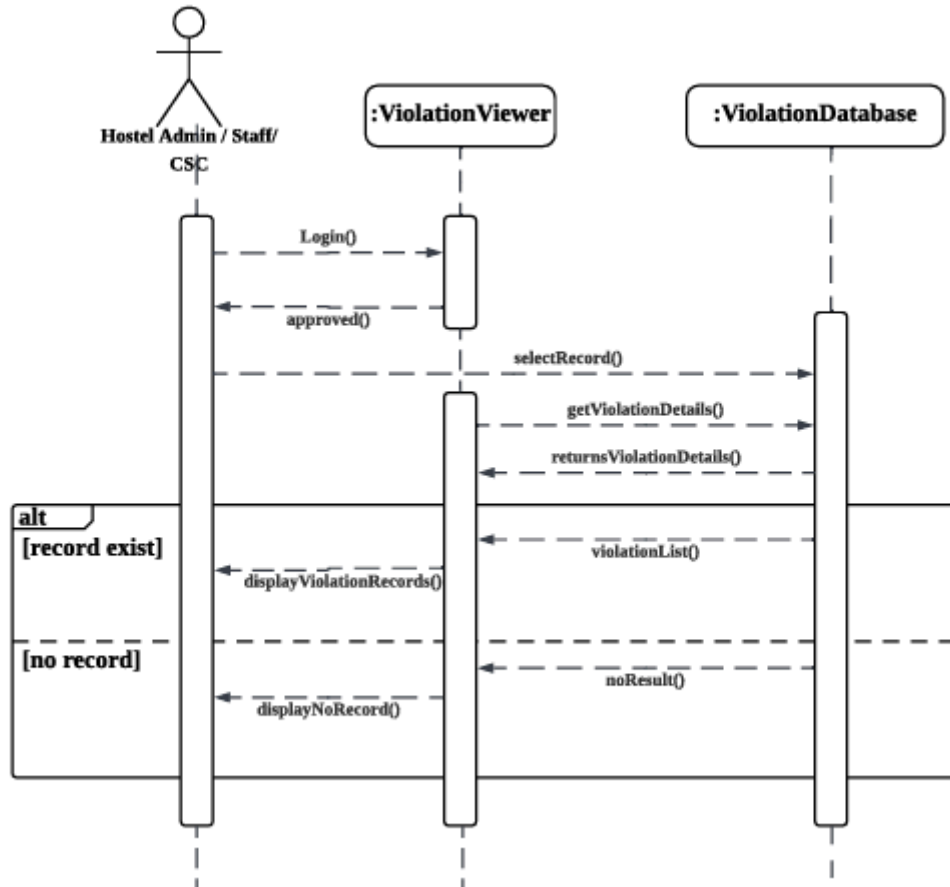


Figure 4.8.5.2.3.2: Sequence Diagram for View Violation Record

4.8.6 Database Design - Violation & Disciplinary Log

Entity Relationship Diagram (ERD) of the Violation and Disciplinary Log Subsystem is a defined database which is aimed at providing accountability and data integrity of the system. The Violation entity is at the center and the repository of the essential information of an incident such as the date, location, type, and notes are recorded with the current status of the case being recorded as well. This table correlates with Student entity through foreign key that enables the system to have many records that belong to the same profile of a person. In order to keep a standard in the organization, ViolationCategory entity offers a set of predetermined levels of severity like minor or critical, that is allocated to each violation record in such a manner that it is consistently classified. The User and Auditlog entities are used to manage the system security and administrative oversight. The User is where the credentials and the roles of the Staff and Admins are stored and these can be created

or edited by authorized personnel. The Auditlog will automatically record the action each time a change is made to allow it to identify the user who carried out the change. Such organization of relations will make all disciplinary measures completely traceable between the student and the administrative personnel, who has given a permission to the update.

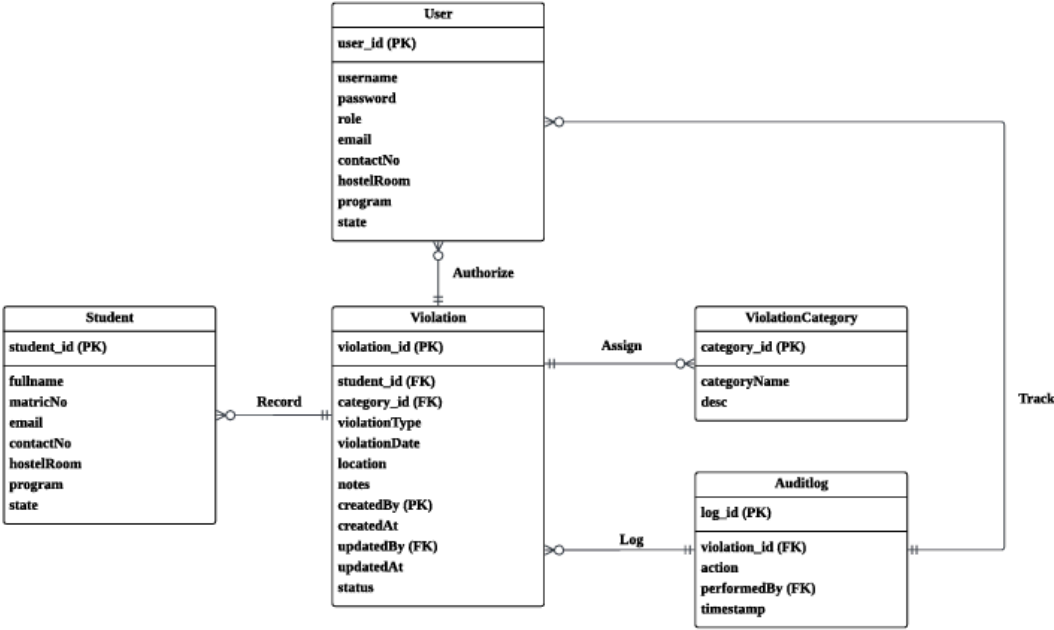


Figure 4.8.6: Entity Relationship Diagram of Violation and Disciplinary Log

4.8.7 Interface Design - Violation & Disciplinary Log

This section showcases the subsystem's interface design by illustrating the visual layout and user experience elements to ensure intuitive navigation and functionality.

Figure 4.8.1.2: Interface Design for Record Violation

Record Violation

Student Name
Name..

Matric No
matric no..

Contact No
no hp..

Violation Type
Select type

Violation Date
YYYY-MM-DD

Location
Type here...

Notes (optional)
Type here...

Save Reset

Figure 4.8.2.2: Interface Design for Update Violation Status

Update Violation Status

Student	Matric No	ContactNo	Violation	Location	Status
helo	A23CS0001	01234343434	Major	M31, KTDI	Completed
mimi	A23CS0002	01245454545	Minor	M22, KTDI	Pending
abx	A23CS0023	011-2233445	Major	M18	Pending
zuzu	A23CS0004	01267676767	Critical	M27, KTDI	Pending
nana	A23CS0089	012-34567788	Major	M23	Pending
nabil	A23CS0003	01256565656	Critical	M27, KTDI	Pending
ninini	A23CS0005	01278787878	Minor	M11, KTDI	Completed
test1	A23CS0006	01278797979	Minor	M31, KTDI	Completed
alfah	A23CS0007	0123456789	Minor	M21, KTDI	Failed
bdiczkid	A23CS0909	0123456789	Minor	M23	Completed
boo	A23CS0008	01289898989	Major	M22, KTDI	Pending

Details

Student
Type here...

Matric No
Type here...

Contact No
Type here...

Violation Type
Select type

Violation Date
YYYY-MM-DD

Location
college

Notes
issues

Status
Select status

Update Status Cancel

Figure 4.8.3.3: Interface Design for View Violation Record

Violation Records							
Student	MatricNo	ContactNo	Category	Date	Location	Status	Notes
helo	A23CS0001	01234343434	Major	2026-01-01	M31, KTDI	Resolved	balik lewat malam
mimi	A23CS0002	01245454545	Minor	2026-01-02	M22, KTDI	Pending	dilaporkan bising
abx	A23CS0023	011-2233445	Major	2026-01-12	M18	Pending	noisy
zuzu	A23CS0004	01267676767	Critical	2025-06-01	M27, KTDI	Pending	bising masa org study
nana	A23CS0089	012-34567788	Major	2026-01-14	M23	Pending	smoking
nabil	A23CS0003	01256565656	Critical	2026-01-04	M27, KTDI	Pending	tak tutup kipas keluar bilik
ninini	A23CS0005	01278787878	Minor	2025-12-25	M11, KTDI	Resolved	balik lewat malam
test1	A23CS0006	01278797979	Minor	2025-12-25	M31, KTDI	Resolved	balik lambat
afiah	A23CS0007	0123456789	Minor	2025-12-24	M21, KTDI	Flagged	noisy after hours
bdkcbkd	A23CS0909	0123456789	Minor	2025-12-23	M23	Resolved	smoking
boo	A23CS0008	01289898989	Major	2026-01-09	M22, KTDI	Pending	smoking

4.9 Summary

The proposed system has been provided with an extensive architectural and logical framework through this chapter which acts as the main connection between the technical realization and the business problems that have been identified. The chapter elucidates a better way of analyzing the organizational structure and the processes which are currently existing in UTHM, it also points out the specific areas where the systems in use presently are inefficient and where there are bottlenecks. The design was of a modular nature, therefore, the system was split into a collection of particular individual subsystems so that each one could have its own special functions. For each of the subsystems, project design tools were used including use case, activity, and sequence diagrams to depict logic and user workflows specific to the subsystem. This was complemented by a single database design that was meant to keep data consistent over the whole platform.

CHAPTER 5

SYSTEM IMPLEMENTATION

5.1 Introduction

The implementation stage is a very significant step in the project lifecycle during which all the designs and requirements developed in the earlier chapters are converted into a working software solution in this chapter. This chapter will pay specific attention to the UTHM Hostel Violation and Disciplinary Log Subsystem development that will serve to simplify the process of registering and monitoring the disciplinary history of the students in colleges.

The subsystem is developed on SAP Build Apps that is a professional low-code development platform with visual tools that can be used to create an application fast. As explained in this chapter, the implementation of the system will be presented in detail that includes the logic configurations that describe how the system acted, the variables in data representing how the system stored and retrieved the information each time a session was underway, and the testing of the core processes of the system to make sure that everything is running fine.

5.2 System Development

UTHM Hostel Violation and Disciplinary Log Subsystem was done through SAP Build Apps, which was used to move the system design to a workable implementation in a professional-level low-code platform. The implementation of the system follows the following approach:

- **Platform:** The User Interface (UI) of the system is developed by drag-and-drop elements on the SAP Build Apps and the traditional hand-coded system is greatly minimized.

- **Preview Tools:** SAP Build Apps Previewer was applicable to make sure that the system would fulfill functional requirements in real-time. This is used to make sure that the system is responsive to link the logic to its linked compounds and friendly user interfaces to the users.
- **System Design:** The development of the system followed a modular approach setting up the data scheme, the UI design, and the logic workflow implementation to process the data inputs and navigation.

5.3 Create Database

For this subsystem, the database was created using on-device storage integration of the SAP Build Apps based on the provided Entity Relationship Diagram (ERD) in the previous chapter. This ensures the system remains consistent and can be handled locally before syncing the data. The following entities were created to manage the Violation and Disciplinary Log process:

1. **User:** Stores all information regarding the system administrators which includes their credentials, roles, and assigned hostel areas to manage the authorization.
2. **Student:** This stores all student profiles to capture essential data such as student fullname, matric number, and contact number.
3. **Violation:** This stores the violation details including the date, location, type of violation that was encountered and so on. It linked directly to the student and the reporting user.
4. **ViolationCategory:** To categorize different types of violations such as minor, major, and critical to ensure standardized reporting.
5. **Auditlog:** To track every action that is performed within the system such as the user that is responsible and the timestamp to ensure a full accountability for every disciplinary entry.

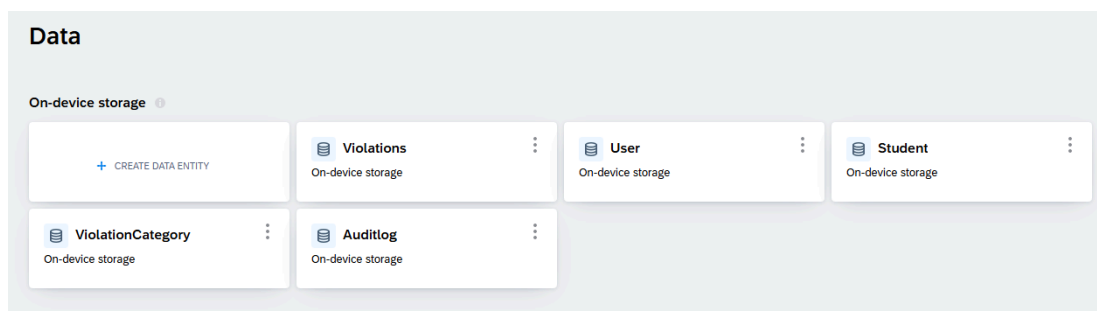


Figure 5.3.1 Database of Violation and Disciplinary Log Subsystem

5.4 Coding of the system's main functions/ Process

This section will show the implementation of the system's using core logic in the Logic Canvas and the backend process that was handled within the low-code environment. It helps to ensure all the functions work correctly within the system.

Home Page:

The Figure 5.4.1, 5.4.2, and 5.4.3 shows the Logic Canvas for each component in the Homepage of Violation and Disciplinary Log Subsystem. In Figure 5.4.1, the logic of the "Record New Violation" components connected to the Open Page, which will navigate to the "Create Violation" page. It also same with the Figure 5.4.2 and 5.4.3, where each of them will navigate to each of the correspondent page.

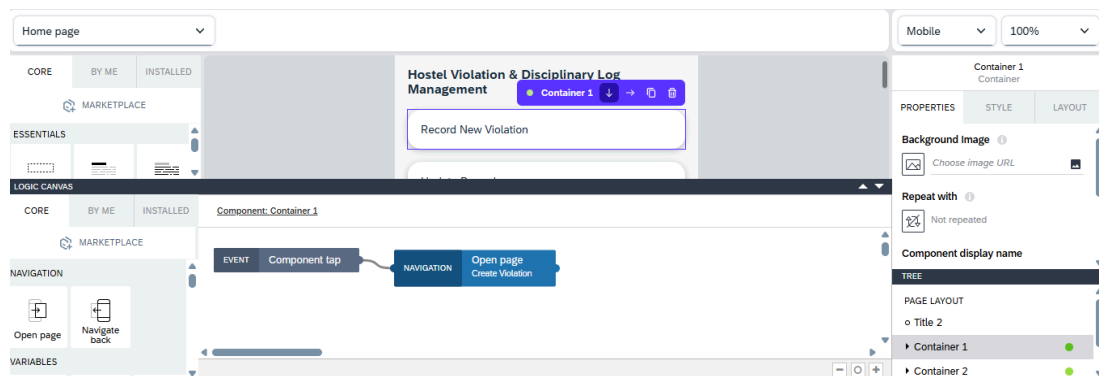


Figure 5.4.1 Homepage Logic Canvas

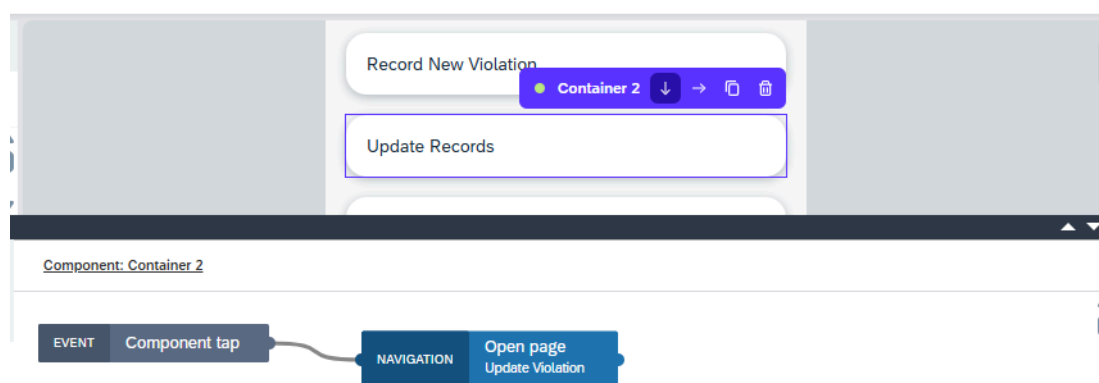


Figure 5.4.2 Homepage Logic Canvas

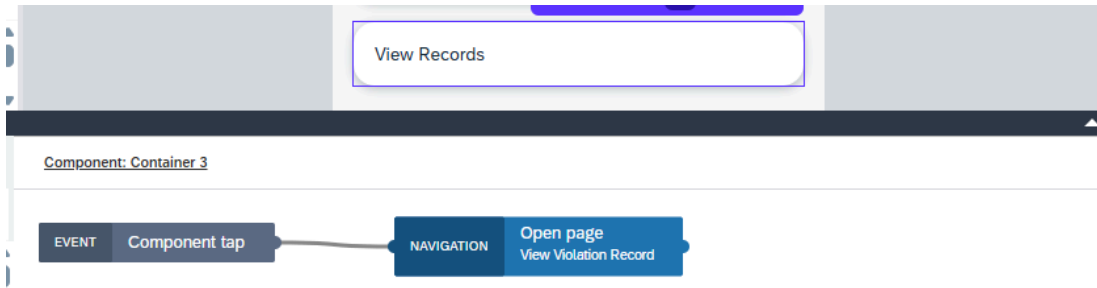


Figure 5.4.3 Homepage Logic Canvas

Create Violation Page:

In this page, users can create the violation record by input details such as student name, violation type, violation date and more. The Figure 5.4.4 shows the Data Variable with name newViolation which was created from the Violations data resource to hold all of the information entered by the users. The Figure 5.4.5 shows the data binding process for the student name to ensure that the form is correctly mapped to the correct field in the violation record. This process also applies to the rest of the input components in the Create Violation page. The Figure 5.4.6 and 5.4.7 shows the button logic for the save and reset button to ensure whether the record is successfully saved and reset by the users.

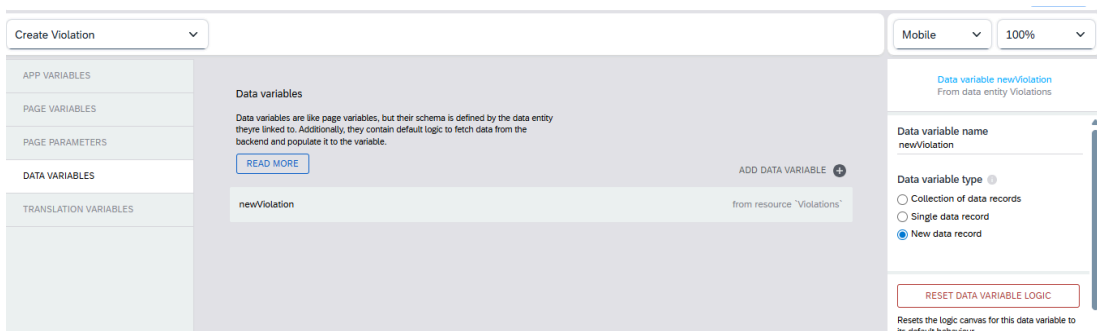


Figure 5.4.4 Data Variables of Create Violation

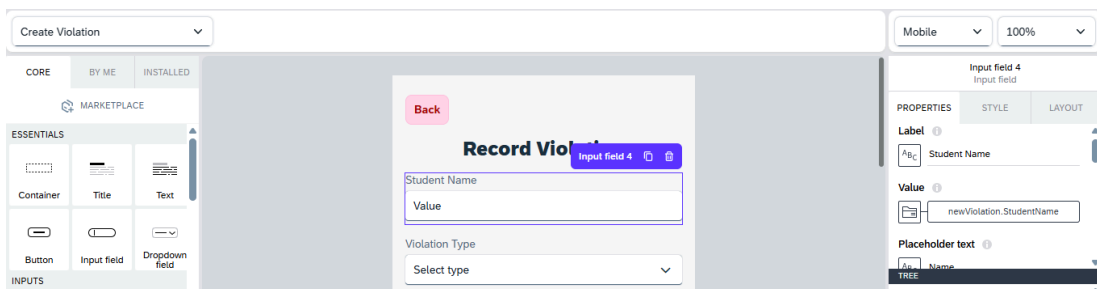


Figure 5.4.5 Value of Properties in Create Violation Components

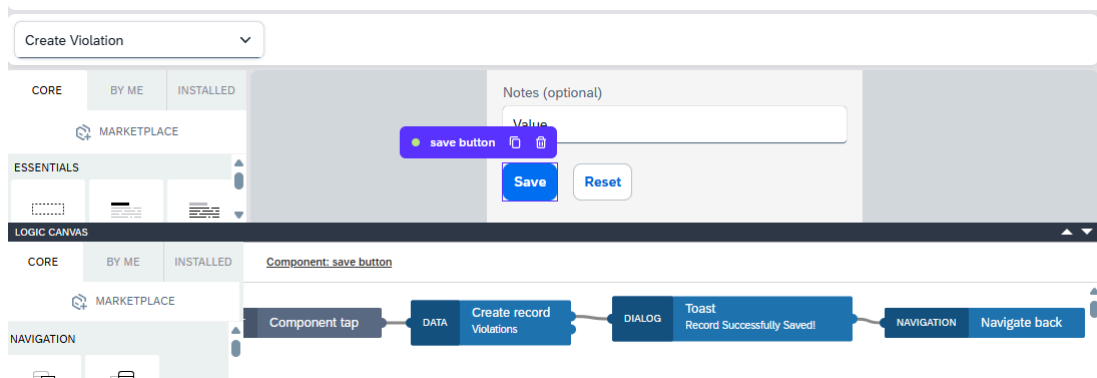


Figure 5.4.6 Save Button Logic in Create Violation

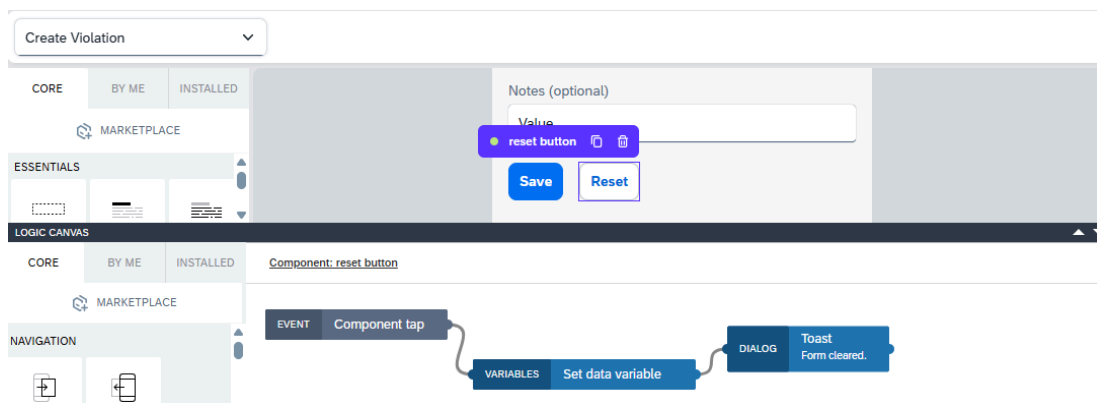


Figure 5.4.7 Reset Button Logic in Create Violation

Update Violation Record Page:

In this page, the users get to review the list of violations recorded and update the violation status. The variables that are included in this page consist of page parameters in Figure 5.4.8, and data variables in Figure 5.4.9. The Figure 5.4.10 shows the properties of the components that bind to the current data which ensure the item retrieves the record of the violation details. Figure 5.4.11 shows the formula that has been applied to the status badge to ensure each status is applied according to its color such as “Pending” for yellow, “Flagged” for red, and “Resolved” for green. The Figure 5.4.12 and 5.4.13 shows the logic that has been implemented in the update and cancel button to ensure the details have been updated successfully or canceled.

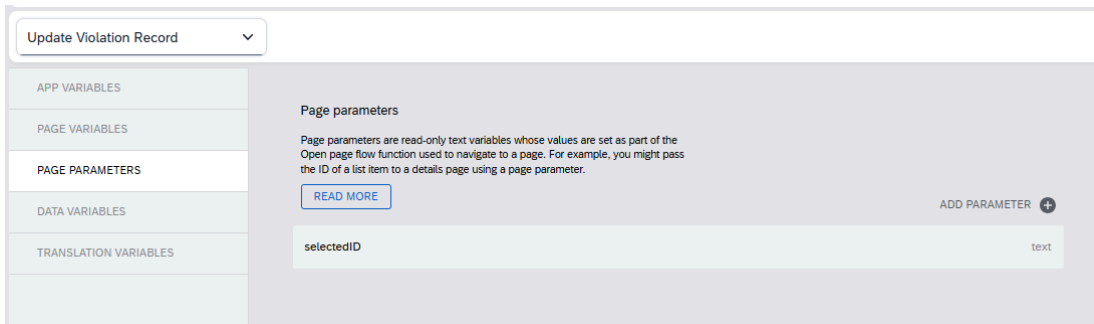


Figure 5.4.8 Page Parameters of Update Violation Record

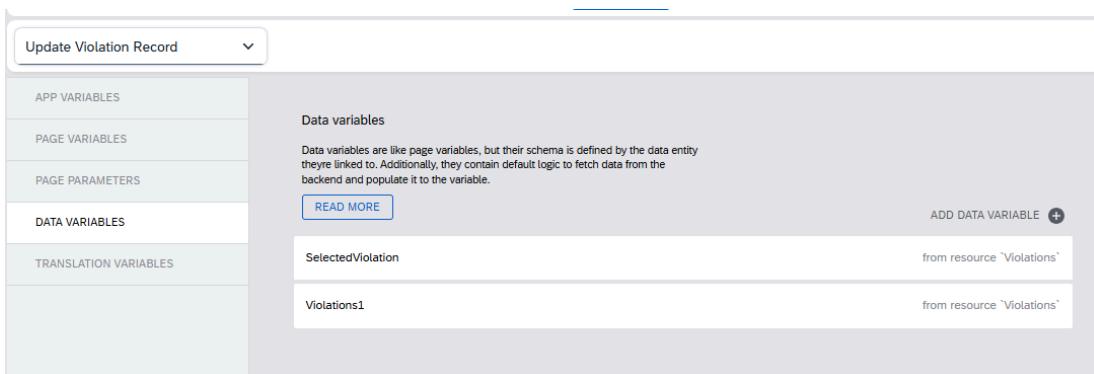


Figure 5.4.9 Data Variables of Update Violation Record

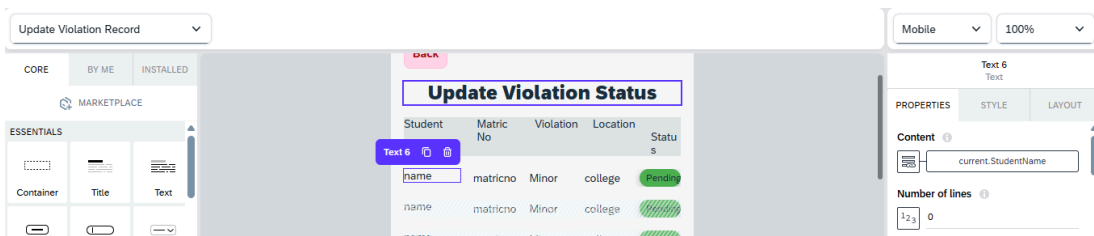


Figure 5.4.10 Properties of Update Violation Record

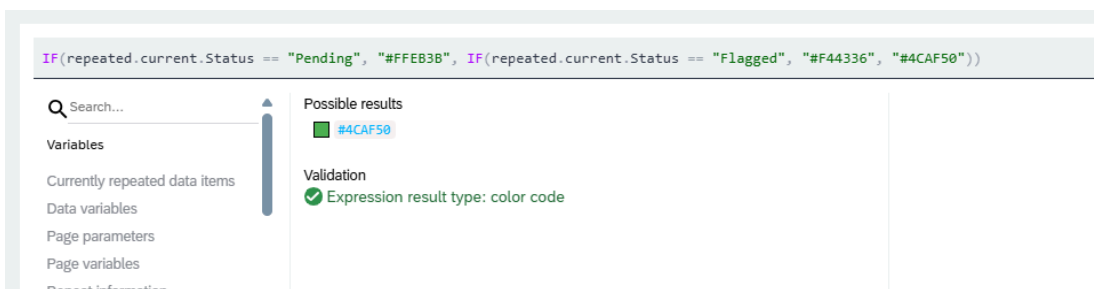


Figure 5.4.11 Color Formula of Status Button

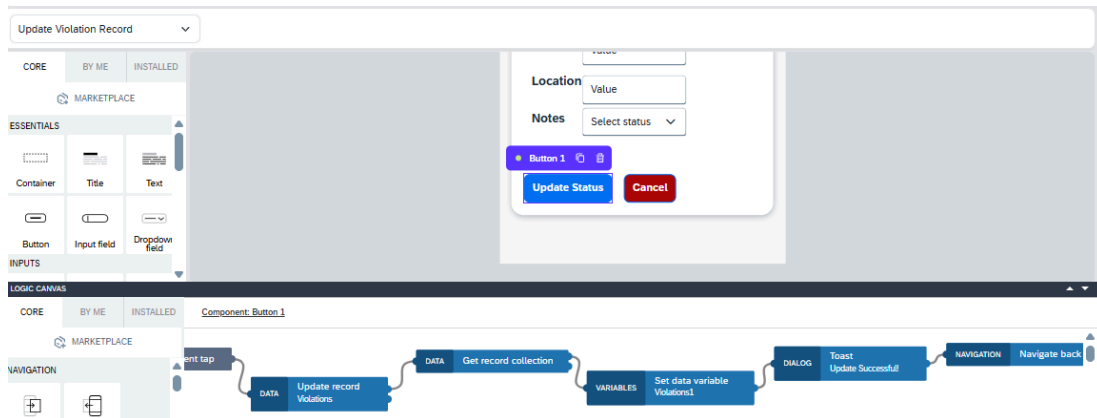


Figure 5.4.12 Update Status Button Logic

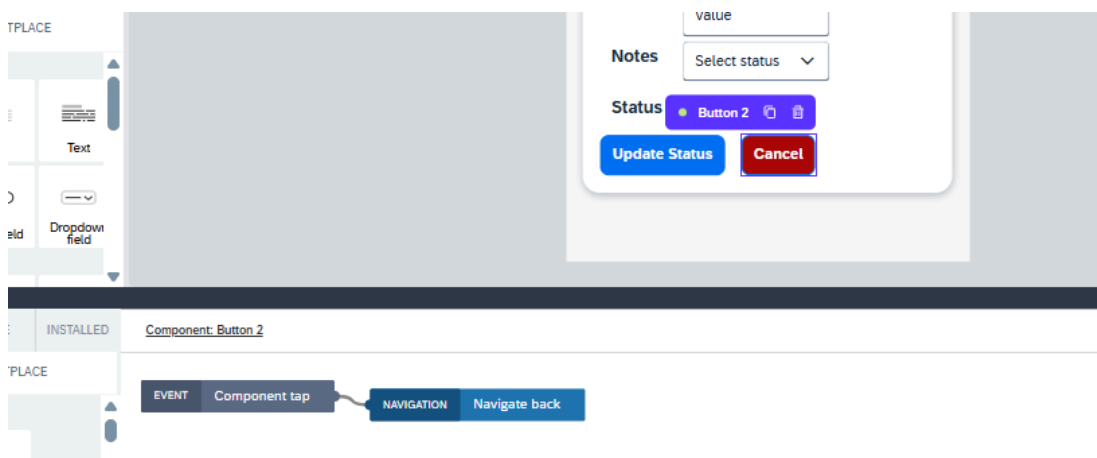


Figure 5.4.13 Cancel Button Logic

View Violation Record Page:

In this page, the users get to view all the records of the violations and when they click on the specific row, it will navigate them to the details in the Update Violation Record page. The Figure 5.4.14 shows the data variables of the View Violation Record page, which is set to collection of data records to retrieve all the records available and the logic of the data variables. The Figure 5.4.15 shows the logic of the navigation of each of the rows in violation records and the Figure 5.4.16 shows that each of the components bind to the current data accordingly.

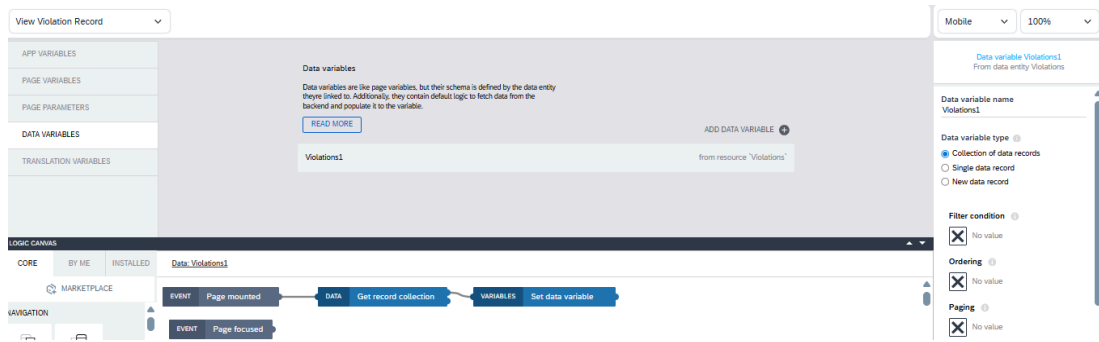


Figure 5.4.14 Data Variables of View Violation Record

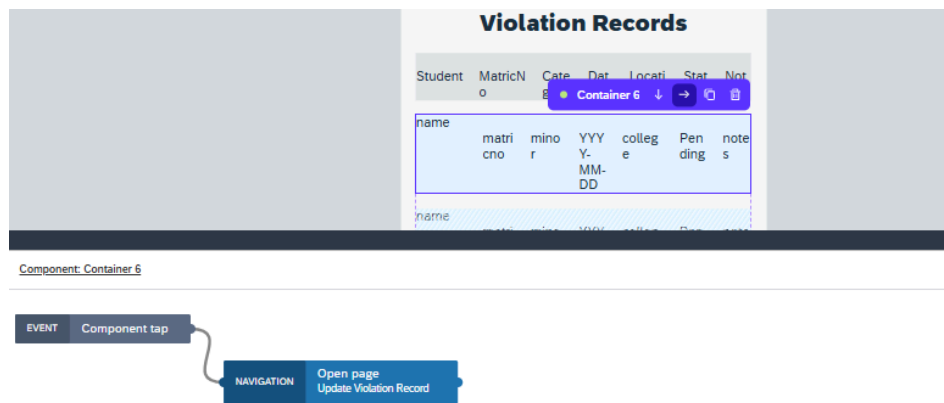


Figure 5.4.15 Logic of Row in View Violation Record

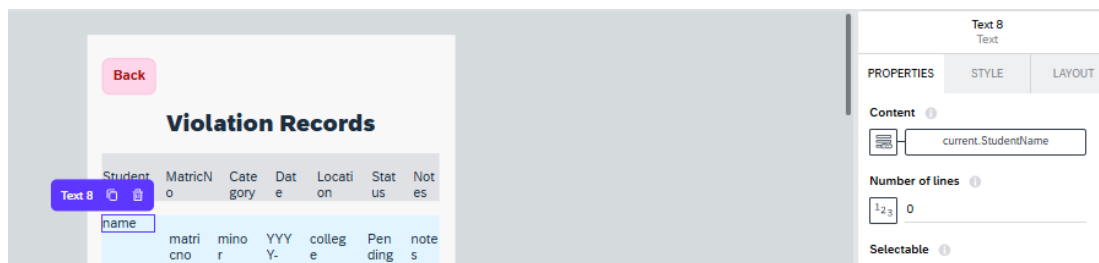


Figure 5.4.16 Properties of the List In Each Component

5.5 Summary

This chapter focuses on the technical implementation of the UTHM Hostel Violation and Disciplinary Log Subsystem which marks the transitions from the conceptual designs in the Chapter 4 to a functional application subsystem. By utilizing the SAP Build Apps low-code platform, the development process of the system focused on the rapid assembly, professional user interface design, and seamless data integration.

The database was successfully established using on-device storage with configurations for critical data entities including User, Student, Violation, and Auditlog to ensure high data integrity and accountability for every record managed within the system. The coding of the system's main functions was also achieved through the implementation of Visual Logic Programming by replacing the traditional syntax with intuitive flows in the Logic Canvas, and the use of Data Variables to secure all violations entries. In conclusion, the implementation of these components helps to ensure the subsystem is a robust and efficient tool for streamlining the management of student violation and disciplinary logs at UTHM.

CHAPTER 6

CONCLUSION

6.1 Introduction

The chapter serves as a conclusion of the Enterprise Systems Design and Modeling project, which is a summary of the building of the University Enterprise Architecture (UEA) of University Tun Hussein Onn Malaysia (UTHM). The main aim of this paper was to examine the shortcomings of the current (As-Is) information architecture of the university and develop a robust (To-Be) (UEA) Enterprise Architecture design that would support the vision of UTHM in the year 2030.

The project analyzed the four most important areas of enterprise architecture which are Business, Data, Application, and Technology based on TOGAF. This helped to reveal the major operational problems such as the data redundancy, fragmentation of the systems and manual administrative processes. To solve these problems, hybrid architecture was proposed to be built on the SAP Business Technology Platform (BTP) to integrate these fragmented functions into a unified system.

The project ended with technical implementation of the Hostel Management System to approve the viability of this architectural design. There are 8 subsystems for the hostel management system. These subsystems show the prototype of how the integration of packages, central databases and responsive user interfaces can effectively solve the inefficiencies of older environments. The chapter will also give a summary of the system key contributions, evaluate the constraints that were faced during the development phase and give a strategic roadmap on how the proposed architecture can be fully implemented in future.

6.2 System Contribution/ Achievement

The new enterprise architecture (EA) and its built in subsystems are going to make an impact on the digital transformation process of UTHM. The main successes and contributions are the following ones:

- **Digital Goal Strategic Alignment:** The system is direct to Digital UTHM vision of the university, which seeks to be 82% digitalized by 2030. It also correlates IT infrastructure and the KPIs of the Ministry of Higher Education (MOHE), as well as it can make the university top in the field of modern digital systems.
- **Better Operational Performance:** The architecture eliminates most manual and paper-based systems by integrating the disjointed systems into the rational work packages. This can save the time used by the administration and avoid any duplication of work among departments.
- **Enhanced End-User Experience:** Login feature has been addressed by using the Unified Identity Provider (IdP) and Single Sign-On (SSO). Students and staff are able to receive various services through a single safe portal with high security.
- **Transition to Paperless and Cashless Campus:** The UTHM system achieves dual benefits through its automatic enrollment process and digital payment record integration into Smart Campus Services because it decreases the university's carbon emissions while updating student-vendor financial transactions.
- **Data Governance and Privacy Stronger:** The To-Be architecture is putting in a formal data governance framework for PKU data access protocols and data API integration standards. This ensures all sensitive details are secured and handled according to global best practices.
- **Centralized and Managed IT Infrastructure:** The shift from a client-server model to a centralized user access marks a major technical milestone which helps to optimize the university's network and adoption of the hybrid

infrastructure to allow their ICT team to manage the entire digital ecosystem from a single point of control. This results in faster troubleshooting, more efficient software development, and a more stable digital environment.

6.3 System Constraint

According to the system architecture presented, the system will work within limitations that are stipulated by the fact that the system will be based on the SAP Business Technology Platform (BTP) ecosystem and will be low-code. The architecture is directly tied to the functionality of particular SAP implementations, SAP Build Apps to interface, SAP HANA Cloud to centralized storage and SAP Analytics Cloud to reporting- that is, any non-standard low-code customization could be restricted. Also, though the system itself is modeled as able to operate in real time with cloud-native scalability, the current implementation stage is based on a dummy data model to model high load cases (e.g. annual trends), which suggests that the overall analysis of historical data is at the moment limited by the lack of a filled live database. Lastly, cloud connectivity of the system to facilitate real-time synchronization between the student and warden apps presupposes the reliance on the availability of sound internet connection on all operational layers.

6.4 Future Suggestion

The planned Enterprise Architecture (EA) should be gradually expanded throughout all major university areas, such as academic management, finance, human resources, research administration, and alumni services, as a top priority for future improvements. The design will help UTHM to decrease its dependency on old systems while it continues its daily operations.

The system will become more powerful by linking historical data with current operational data which enables SAP Analytics Cloud to produce accurate and conduct trend assessments and make predictions. This would enhance both administrative functions and strategic decision-making processes. Future

development will explore regulated custom extensions and API connectors to meet specific functional requirements while maintaining platform stability as the existing solution utilizes low-code development on SAP BTP. User interaction and administrative efficiency will benefit from automation together with artificial intelligent chat-based services.

The network stability and cybersecurity measures and continuous user training should receive improvements to support UTHM's 2030 goal of becoming a highly digitalized university.

6.5 Individual Reflection

Through the development of UTHM Enterprise Architecture (EA), I have gained an understanding of viewing the university as a cohesive ecosystem rather than a collection of separate departments. By analyzing the "As-Is" state of UTHM EA, I recognized how the manual workflows and fragmented data will lead to operational bottlenecks such as data silos and login fatigue. I also get to learn how to align the IT infrastructure with strategic institutional goals by designing the "To-Be" model of the UTHM EA. This phase has taught me that one effective change requires a high-level blueprint to ensure that all future systems are integrated, scalable, and move the organization towards a unified digital future.

In addition, the technical implementation of the Hostel Violation and Disciplinary Log Subsystem allowed me to bridge the gap between abstract design implementation and functional software. By using the low-code environment, I learned that a modern development is more focused on the logic and its data structure on the interface design. I gained practical skills in translating the Entity Relationship Diagram (ERD) into a secure database to ensure that all of the information remains accurate and accountable through audit logging. This process highlighted the importance of visual logic and data variables in creating a user-friendly tool that can solve specific administrative challenges.

This project also provided me with a holistic understanding of how individual subsystems serve as the building blocks for a wider enterprise strategy. I realized that the success of a digital solution is measured not just by its features, but also by its ability to support data-driven decision making to enhance the user experience. This experience has equipped me with the mindset of handling both complex details of the system development and broad requirements of university-wide digital management.

6.6 Summary

Chapter 6 concludes the Enterprise Systems Design and Modeling project by summarizing the development of the University Enterprise Architecture (UEA) for UTHM. The project successfully transitioned from an analysis of the disjointed As-Is architecture to a salad To-Be design based on the Digital UTHM 2030 vision. The proposed hybrid architecture will use the TOGAF framework and the SAP Business Technology Platform (BTP) to overcome such important inefficiencies as data duplication and manual operation.

In terms of Strategic Impact, this project is in line with the Ministry of Higher Education (MOHE) KPIs where in a bid to create a paperless and cashless campus and enhance operational efficiency by creating unified systems, and Single Sign-On (SSO) features.

Secondly, regarding operation improvements, switching to a centralized IT Infrastructure and formal data governance framework, the university would have a more dominant control over its own digital ecosystem, which would provide privacy of the data and can reduce the time of troubleshooting.

Lastly, the implementation of the Hostel Management System and its eight subsystems is one of the successful prototypes. It can demonstrate that a central database and integrated packages can solve the shortcomings of a legacy system.

REFERENCES

- Nama, G. F., Tristiyanto, & Kurniawan, D. (2017). *An enterprise architecture planning for higher education using The Open Group Architecture Framework (TOGAF): Case study University of Lampung*. University of Lampung.
- Syynimaa, N. (2019). *Enterprise architecture: To business or not to business? That is the question!* In Proceedings of the 20th International Conference on Enterprise Information Systems (ICEIS 2018) (pp. 623–631). SCITEPRESS – Science and Technology Publications. <https://doi.org/10.5220/0006685106230631>
- Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011). How Does Enterprise Architecture Add Value to Organisations?. *Communications of the Association for Information Systems*, 28, pp-pp. <https://doi.org/10.17705/1CAIS.02810>
- Nur Shabrina Meutia, Sulistiyani, E., Budiarti, R. P. N., & Sari, R. (2022). Enterprise Architecture Framework in Higher Education: Systematic Literature Review. *Applied Technology and Computing Science Journal*, 5(2), 33–39. <https://doi.org/10.33086/atcsj.v5i2.3751>
- Hidayah, I., & Nugroho, H. W. (2024). Pengembangan Enterprise Architecture Berbasis Zachman Framework Pada Sistem Akademik Universitas Bandar Lampung. *Explore: Jurnal Sistem Informasi Dan Telematika*, 15(1), 86. <https://doi.org/10.36448/jsit.v15i1.3524>

What are ERP Universities? Benefits, Features, and Top Platforms. (2025, September 16).

Spacebasic.com. <https://www.spacebasic.com/blogs/erp-universities>

Daniel, M. & Divine Word University. (2016). Enterprise systems: An emerging technology for Papua New Guinea universities. Contemporary PNG Studies: DWU Research Journal, 18–22. <https://www.researchgate.net/publication/304348282>

Sanchez-Puchol, F. (2022). Enterprise reference architectures for higher education institutions: Analysis, comparison and practical uses. Universitat Oberta de Catalunya (UOC). <https://hdl.handle.net/10609/146795>

Senarath, Udesh S.. (2021). Waterfall Methodology, Prototyping and Agile Development. 10.13140/RG.2.2.17918.72001.

Samaratova A.K. (2024). FEATURES OF USING WATERFALL METHODOLOGIES IN PROJECT MANAGEMENT. Вестник науки, 4 (10 (79)), 39-48. doi: 10.24412/2712-8849-2024-1079-39-48

TechnologyAdvice. (2024, january 29). What Is Waterfall Project Management? Retrieved December 27, 2025, from <https://technologyadvice.com/blog/project-management/what-is-waterfall-project-management/>