**MAKERERE****UNIVERSITY**

**MAKERERE UNIVERSITY BUSINESS SCHOOL**

**DEVELOPING A DIGITAL STUDENT CLEARANCE PORTAL FOR MAKERERE UNIVERSITY BUSINESS SCHOOL**

**By**

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**DECLARATION**

We, the undersigned, declare that to the best of our knowledge, this proposal and its content is our original piece of work, and has never been published and/or submitted for any award in any other University or Higher Institution of Learning.

DATE: 17th MAY, 2025

# APPROVAL

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**LIST OF ABBREVIATION**

MGLSD – Ministry of Gender, Labour and Social Development AI – Artificial Intelligence iOS – iPhone Operating System

App – Application

UNDP – United Nations Development Programme

UNV – United Nations Volunteers

HRIS – Human Resource Information System

HR – Human Resource

IT – Information Technology

CV – Curriculum Vitae

UNESCO – United Nations Educational, Scientific and Cultural Organization

UI – User Interface

OOD – Object-Oriented Design

**ABSTRACT**

This project aimed to design and implement an Online Graduation Clearance System tailored for Makerere University Business School (MUBS), with the primary objective of improving the efficiency, transparency, and convenience of the graduation clearance process. The existing manual procedures were identified as time-consuming, error-prone, and burdensome for both students and administrative staff. The proposed system seeks to address these limitations by providing a centralized digital platform that facilitates seamless interaction between students and the various institutional departments responsible for clearance.

To achieve this objective, the project employed a structured and iterative development methodology grounded in the Design Science Research (DSR) framework. An initial needs assessment was conducted through interviews and observations to understand the challenges of the current manual system. The data gathered informed the design of a user-centered prototype, which was refined based on stakeholder feedback prior to full-scale development. The system was developed using contemporary web technologies to ensure accessibility, scalability, and real-time data processing.

The resulting solution enables students to initiate their clearance process online, monitor progress across various departments, and receive timely updates on their status. Administrative personnel are provided with tools to manage clearance requests efficiently, verify submitted requirements, and maintain accurate records. Automation of key workflows, including notifications and approvals, significantly reduces processing time and administrative overhead.

In conclusion, the Online Graduation Clearance System effectively addresses the inefficiencies of the manual process by offering a digitized, streamlined, and reliable platform. It enhances the overall graduation experience for students, promotes institutional accountability, and contributes to the modernization of administrative operations at Makerere University Business School.

# CHAPTER ONE

# INTRODUCTION

Graduation is a significant academic milestone, marking the transition of students from university life to the professional world. However, at many institutions, this process is often delayed or complicated by inefficient administrative procedures—particularly graduation clearance. At Makerere University Business School (MUBS), clearance currently relies on a manual, paper-based system that requires students to physically move between multiple departments to obtain approval. This not only wastes time and resources but also increases the risk of lost documents, miscommunication, and corruption.

In an era where digital transformation is reshaping service delivery across all sectors, academic institutions must adopt systems that promote efficiency, transparency, and user convenience. This project proposes the design and implementation of an Online Graduation Clearance System specifically tailored for MUBS. The system aims to digitize the clearance process, allowing students to submit requirements, track progress, and receive feedback through a centralized platform. Staff and administrators will also benefit from a streamlined interface for reviewing, updating, and approving clearances.

By replacing manual processes with a secure, accessible, and automated system, this project seeks to improve operational efficiency and enhance the graduation experience for all stakeholders involved.

## 1.1 BACKGROUND OF THE STUDY

The use of web-based platforms to facilitate graduation clearance has become an increasingly adopted practice in academic institutions worldwide. These platforms simplify the process by enabling students to fulfill graduation requirements electronically rather than relying on physical, paper-based systems (Awuzie, 2020). Through Online Graduation Clearance Systems (OGCS), students are able to submit financial and academic documents, monitor their clearance progress, and receive feedback from various university departments in a centralized and efficient manner (Nneji et al., 2018). These systems have been shown to reduce clearance time and costs, promote process transparency, and improve satisfaction among both staff and students (Bauer, 2019).

In developed countries, online graduation clearance platforms are often fully integrated with institutional student information systems, allowing for seamless synchronization of student records (Bharamagoudar et al., 2020). For example, the University of Florida provides a digital platform where students can apply for graduation, view their certificate status, and perform degree audits. Similarly, the University of Illinois at Chicago enables students to manage their graduation checklists, request changes to their degree programs, and confirm graduation eligibility entirely online (Waniaye, 2020). These institutions serve as examples of how digital transformation can enhance efficiency in academic administration.

However, in many African countries, the implementation of such systems is still in its early stages. The adoption of online graduation clearance systems is often hindered by factors such as low internet penetration, lack of standardization, inadequate IT infrastructure, and limited digital literacy among both students and administrative staff. Nevertheless, some African universities have begun to embrace these technologies. For instance, the University of Cape Town in South Africa offers a platform that allows students to obtain graduation documents, update personal information, and verify their graduation status online (University of Cape Town, 2023). Similarly, at the University of Nairobi in Kenya, students can apply for graduation, pay relevant fees, and access clearance forms digitally (University of Nairobi, 2023).

In Uganda, the integration of online graduation clearance systems has not been widely realized. While Makerere University has developed a digital clearance platform, it faces numerous technical and operational limitations, including a suboptimal user interface, frequent system crashes, and slow performance (Kalinachi et al., 2019). These shortcomings have limited its effectiveness in streamlining the clearance process.

Makerere University Business School (MUBS), a constituent college of Makerere University and a leading provider of business and management education in Uganda, continues to rely on manual and paper-based procedures for graduation clearance. With a student population exceeding 15,000 across various undergraduate, diploma, and certificate programs, the existing system is labor-intensive and inefficient. Students are required to visit multiple departments—including academic offices, the library, the finance office, the registrar’s office, and the dean of students—in order to obtain physical signatures and stamps. This process is not only time-consuming but also susceptible to human error, document misplacement, and fraudulent practices. In some cases, students resort to paying intermediaries to expedite the process, which introduces ethical and security concerns.

The challenges inherent in the manual clearance system have led to widespread dissatisfaction among students and staff and have highlighted the urgent need for a more reliable and efficient solution. In response, this project was undertaken to develop and implement an Online Graduation Clearance System specifically designed for MUBS. The goal was to digitize the entire clearance process, minimize administrative bottlenecks, and ensure a more transparent, secure, and accessible system for all stakeholders involved.

## 1.2 STATEMENT OF THE PROBLEM

Graduation clearance is a critical administrative process that ensures students have met all academic and financial obligations before receiving their academic awards. While online clearance systems have been successfully adopted in many institutions globally—enabling students to submit documents, track progress, and receive feedback without physical movement—Makerere University Business School (MUBS) continued to rely on a fully manual, paper-based clearance system during the period of this study (Awuzie, 2020).

This manual approach presented a range of challenges for both students and staff. Students were required to physically move from one department to another—such as the library, finance office, academic registrar, and dean of students—in order to obtain necessary stamps and signatures. This not only consumed significant amounts of time and financial resources but also exposed students to the risk of document loss, delays, and unofficial practices such as paying third parties to expedite clearance, which compromised data security and accountability.

In addition, the manual handling of documents increased the likelihood of misplacing important forms due to environmental hazards such as fire or rain, or through general administrative oversight. These inefficiencies not only delayed the graduation process but also contributed to student frustration and institutional reputational risks.

To address these issues, this project was initiated to design and implement an Online Graduation Clearance System for MUBS. The system aimed to eliminate the need for physical clearance by enabling digital submissions, automated tracking, and department-specific dashboards for managing and verifying student records. Through this digital solution, the project sought to enhance the efficiency, accuracy, and integrity of the graduation clearance process.

## 1.3 GENERAL OBJECTIVE

The main objective of the study was to develop a centralized database of student records and implement an Online Graduation Clearance System aimed at eliminating delays and inefficiencies associated with the manual clearance process at Makerere University Business School.

## 1.4 SPECIFIC OBJECTIVES OF THE STUDY

1. Conducting a comprehensive study and analysis of the existing graduation clearance processes and any online systems currently utilized by Makerere University Business School.
2. Identifying the technical and functional requirements necessary for the successful development of an electronic clearance system tailored to the needs of MUBS.
3. Designing and developing a fully operational Online Graduation Clearance System that meets the established requirements and improves upon the manual process.
4. Testing and validating the system’s functionality, usability, and accuracy through prototype evaluation to ensure it effectively serves the needs of students and administrative staff.

## 1.5 STUDY SCOPE

### 1.5.1 Subject/Conceptual scope

This research mainly focused on identifying the information requirements, designing, developing, and validating an Online Graduation Clearance System. The study encompassed the entire clearance process, including submission of academic and financial documents, progress tracking, and departmental approvals. The system’s efficacy was assessed through testing and evaluation to ensure it met the functional needs of students and administrative staff.

### 1.5.2 Geographical scope

This project research was limited to Makerere University Business School campuses located in Nakawa, Uganda. All data collection, analysis, and system implementation activities were confined to this location over the course of the four-month project period.

## 1.6 SIGNIFICANCE OF THE STUDY

The findings and outcomes of this study are significant to multiple stakeholders, including researchers, students, staff, the institution, and other interested parties, as outlined below:

* **Researchers:** This study provides a detailed examination of the existing manual graduation clearance system at Makerere University Business School, highlighting its limitations and challenges. It also offers valuable insights into the requirements and feasibility of implementing a web-based clearance system using technologies such as HTMX, TYPESCRIPT, Tailwind CSS, and cloudflare D1database and R2 buckets, thereby contributing to knowledge in the field of academic administrative systems.
* **Students:** The implementation of an Online Graduation Clearance System offers graduating students a more convenient and efficient means of fulfilling their clearance requirements. Students are no longer required to physically visit multiple offices or handle paper documents, and they can monitor their clearance status and access final permits through an accessible online portal.
* **Staff:** The system reduces the administrative burden on staff involved in the clearance process by enabling online review, approval, and disapproval of student clearances. Additionally, the digital platform provides staff with up-to-date and accurate records, thereby improving accountability, transparency, and operational efficiency.
* **Institution:** By adopting a modern and automated approach to student clearance management, the institution stands to improve its operational efficiency, enhance its reputation for innovation, and redirect time and resources previously spent on manual processes toward other academic and administrative priorities.
* **Stakeholders:** The project meets the expectations of external stakeholders such as the government, the National Council for Higher Education, the National Youth Service Corps, and alumni by ensuring the integrity, reliability, and transparency of the clearance process and the issuance of final permits, thereby fostering confidence in the institution’s graduation procedures.

# CHAPTER TWO

# LITERATURE REVIEW

### ****Introduction****

The growing demand for efficient academic administration has accelerated the adoption of web-based platforms in higher education institutions. Among these, online graduation clearance systems have emerged as vital tools for streamlining the clearance process, which traditionally involves manual verification of academic, financial, and administrative obligations. The shift from paper-based systems to digital platforms has not only improved operational efficiency but also enhanced student experience, transparency, and institutional accountability. This chapter reviews relevant literature on the evolution of graduation clearance systems, the technologies employed in their development, and the challenges and solutions associated with their implementation. Special emphasis is placed on modern web technologies—including Hono, HTMX, TailwindCSS, hono/jsx, Cloudflare D1, R2 buckets, and Lucia Auth—deployed on serverless infrastructure to illustrate how emerging tools can be effectively leveraged to address the limitations of legacy systems in the context of Makerere University Business School.

### ****2.1 Evolution of Graduation Clearance Systems****

Graduation clearance is a procedural requirement for students to formally complete their academic journey. Traditionally, this process has involved a sequence of manual verifications by various university departments—such as the finance office, library, academic registrar, and the dean of students—each of which confirms that the student has met specific obligations. While this method has served institutions for decades, it is widely recognized as inefficient, error-prone, and inconvenient for both students and administrative staff.

In early implementations, institutions relied on paper-based clearance forms that required students to physically move from office to office, collecting signatures and stamps. This system often led to long queues, misplacement of documents, human error, and even cases of manipulation or bribery to expedite clearance. According to Mohini and Amar (2021), such traditional methods delay the graduation process and increase institutional workload due to redundant verification steps and the lack of centralized student data.

The first wave of digitization introduced basic digital forms and internal spreadsheets. However, these early systems were still largely dependent on manual data entry and offline approval, offering only marginal improvements over fully manual processes. As universities began adopting more comprehensive digital solutions, web-based systems emerged as a practical evolution. These platforms enabled integration with student databases, real-time status tracking, and electronic approvals—drastically reducing administrative delays and improving student convenience.

In developed countries, institutions such as the University of Florida and the University of Illinois at Chicago have fully integrated graduation clearance into their centralized student information systems (Bharamagoudar et al., 2020; Waniaye, 2020). These platforms allow students to view graduation eligibility, apply for final audits, and receive confirmation without visiting administrative offices. In contrast, many universities across Africa, including Uganda, have only recently begun exploring such systems. Makerere University’s online clearance platform, for example, marked a significant step forward but continues to face usability and technical challenges, such as system crashes and poor user interface design (Kalinachi et al., 2019).

Institutions like the University of Cape Town and the University of Nairobi have successfully adopted more robust online clearance systems that not only allow for document submission and status checking but also support online payments and document retrieval (University of Cape Town, 2023; University of Nairobi, 2023). These implementations demonstrate that with the right technological infrastructure, digital clearance systems can significantly reduce bottlenecks, cut costs, and improve administrative efficiency.

The evolution of graduation clearance systems continues today with the integration of modern web development frameworks and serverless deployment models. Technologies like Hono, HTMX, and TailwindCSS offer lightweight yet powerful tools for building responsive, accessible, and performant clearance platforms. Serverless platforms such as Cloudflare Workers further enhance scalability and reduce infrastructure overhead, making them ideal for institutions in resource-constrained environments. The system developed for Makerere University Business School draws upon these advances to address the persistent inefficiencies of manual clearance processes, aiming to provide a scalable and user-friendly solution optimized for institutional and student needs alike.

### ****2.2 Importance of Online Clearance Systems in Higher Education****

Online graduation clearance systems have become an essential component of academic administration in higher education institutions worldwide. Their importance lies in their ability to address long-standing challenges associated with manual clearance processes, including delays, lack of transparency, administrative bottlenecks, and poor student experience. As student populations grow and institutional workflows become increasingly complex, the need for streamlined, digital solutions is more critical than ever.

One of the primary benefits of online clearance systems is **efficiency**. Manual clearance procedures require students to physically move between different offices, often resulting in long queues, redundant communication, and procedural delays. With a digital system, these steps are automated or consolidated into a centralized platform. Departments can instantly update clearance statuses, students can track progress in real time, and communication between stakeholders is streamlined—significantly reducing turnaround time.

Another key advantage is **transparency**. Paper-based systems often lack traceability, which creates opportunities for corruption, favoritism, or mismanagement. An online platform ensures that every action—whether by students or staff—is logged and traceable. This level of accountability is particularly important in institutions where administrative processes are subject to scrutiny from internal auditors, students, alumni, and external stakeholders such as regulatory authorities.

In addition to transparency, online systems enhance **accessibility**. Students no longer need to be physically present on campus to complete clearance, which is especially beneficial for those with mobility challenges, off-campus obligations, or those living in remote areas. Furthermore, digital systems are typically available 24/7, allowing students to engage with the process at their convenience rather than being constrained by office hours or physical availability.

The adoption of online clearance platforms also aligns with broader institutional goals related to **digital transformation and sustainability**. By reducing the need for physical paperwork, institutions save on printing and storage costs while minimizing environmental impact. Staff workloads are reduced, allowing administrative personnel to redirect their time and attention to more strategic tasks, such as student engagement and academic planning.

From a governance and planning perspective, online systems enable **data-driven decision-making**. Since all clearance activities are stored and managed in a digital environment, institutions can generate reports, monitor performance metrics, and identify patterns or bottlenecks in the clearance workflow. This insight can be used to continuously improve internal processes and enhance student support.

Moreover, the relevance of online clearance systems extends beyond the university setting. As institutions prepare graduates for entry into competitive job markets, ensuring a timely and reliable transition from student status to graduate status is critical. Delays in clearance can prevent students from receiving transcripts or participating in graduation ceremonies, which may, in turn, affect employment opportunities or postgraduate admissions. By providing an efficient clearance process, institutions can uphold their reputation for professionalism and student service excellence.

The system implemented for Makerere University Business School was developed with these priorities in mind. By leveraging modern tools such as HTMX for interactivity, TailwindCSS for consistent design, and serverless deployment for scalability, the system aimed to eliminate the inefficiencies of the manual process while offering a secure, responsive, and transparent digital experience for all users involved.

### ****2.3 Core Technologies for Online Clearance Systems****

The development of a robust, scalable, and user-friendly online graduation clearance system requires the integration of modern web technologies that align with both performance and user experience goals. This section discusses the core technologies utilized in the implementation of the Makerere University Business School clearance system, focusing on their roles, advantages, and suitability within an academic institutional context.

#### **2.3.1 Hono Framework**

Hono is a modern, lightweight web framework designed for building high-performance applications on serverless runtimes such as Cloudflare Workers, Deno, and Bun. Unlike traditional frameworks such as Express.js, Hono is built for the edge and emphasizes ultra-low latency, minimal overhead, and composability.

Hono’s routing system is intuitive and flexible, allowing for the creation of clean, modular backend logic. Middleware can be easily applied to specific routes or route groups, enabling secure and maintainable role-based access control (e.g., separating student, admin, and departmental access). The use of TypeScript support enhances code reliability, making it easier to catch potential logic errors during development. In the context of the clearance system, Hono handled all HTTP routing, form submissions, session management, and API responses, offering a clean separation between logic and presentation.

The choice of Hono was particularly influenced by its excellent compatibility with **Cloudflare Workers**, which aligns with the project’s goals for edge-first deployment, global availability, and serverless scalability. With Hono, the entire backend remained lightweight and fast, ensuring an optimal experience even during high-traffic periods such as graduation season.

#### **2.3.2 TailwindCSS**

TailwindCSS is a utility-first CSS framework that offers rapid and consistent styling across web components. Unlike traditional CSS approaches that rely heavily on semantic class names and custom stylesheets, Tailwind promotes the use of low-level utility classes directly in markup. This approach enables developers to style elements quickly while maintaining design consistency and responsiveness across devices.

For the clearance system, TailwindCSS was essential in creating a clean and responsive user interface. Design components such as status cards, dashboards, modal dialogs, and progress indicators were built using Tailwind’s utility classes, enabling rapid prototyping and production-ready styling without the need for third-party UI libraries. Tailwind’s responsive grid system also ensured that the interface remained mobile-friendly, which is essential given the diverse devices students and staff may use to access the system.

Additionally, TailwindCSS integrates seamlessly with JSX-based templating (as used in hono/jsx), ensuring that the design system could be componentized and reused across the platform. This allowed for fast iteration and consistent branding without sacrificing performance.

#### **2.3.3 HTMX**

HTMX is a powerful front-end enhancement library that allows developers to create dynamic and interactive user experiences using traditional server-side rendering. Rather than relying on full-blown JavaScript frameworks like React or Vue, HTMX enables partial page updates, form submissions, and user feedback mechanisms using HTML attributes.

In this project, HTMX was used to bring interactivity to the clearance system without the overhead of a client-side single-page application (SPA). Features such as live clearance status updates, inline form validation, and dynamic content loading were all handled using HTMX. For example, when a student submits a clearance request, the page updates seamlessly to reflect their status without requiring a full reload.

This approach preserved accessibility and performance while enhancing user experience, especially on lower-end devices or in bandwidth-constrained environments. HTMX also contributed to better maintainability by keeping most of the logic server-side, where security and consistency are easier to manage.

#### **2.3.4 hono/jsx**

hono/jsx is Hono’s server-side JSX rendering engine. It allows developers to use JSX syntax—commonly found in React—in a backend context to render HTML. Unlike React, which requires a client-side runtime, hono/jsx compiles to pure HTML, which is sent directly to the browser.

The use of hono/jsx provided a clear structure for organizing views and layout templates in a component-based architecture. Reusable components such as headers, dashboards, status alerts, and tables were defined using JSX, making the codebase more modular and easier to maintain. Combined with TailwindCSS and HTMX, hono/jsx enabled the creation of interactive, server-rendered views with minimal JavaScript, optimized for fast initial page loads and excellent accessibility.

This stack—Hono for backend logic, hono/jsx for views, HTMX for interactivity, and TailwindCSS for styling—formed a highly efficient development workflow that maximized performance and maintainability while minimizing client-side complexity.

### ****2.4 Data Management in Modern Web Systems****

Robust and scalable data management is central to the success of any web-based academic system. For a graduation clearance platform, managing student records, tracking clearance statuses, storing documents, and maintaining audit logs require an architecture that is secure, performant, and highly available. In the development of the clearance system for Makerere University Business School, a combination of modern tools was employed: Cloudflare D1 for relational data storage, Cloudflare R2 for file storage, and Drizzle ORM for safe and efficient database operations. Together, these tools provided a resilient and developer-friendly backend infrastructure suitable for a serverless environment.

#### **2.4.1 Cloudflare D1**

Cloudflare D1 is a serverless, SQLite-compatible relational database built specifically for edge deployment via Cloudflare Workers. It allows developers to manage structured data close to the user without the latency or complexity of traditional centralized databases. For this project, D1 served as the primary data store for user records, clearance status logs, department approvals, and system metadata.

The key advantage of using D1 was its seamless integration with the Cloudflare Workers ecosystem, which allowed for low-latency database queries from any geographic location. This ensured fast and responsive system behavior even during peak usage periods. Additionally, D1 requires no server provisioning or maintenance, aligning with the serverless architecture philosophy and reducing operational overhead for the development team.

#### **2.4.2 Cloudflare R2 Buckets**

R2 is Cloudflare’s object storage solution, designed to rival Amazon S3 but without egress bandwidth fees. In the clearance system, R2 was used to securely store file uploads from students, such as tuition receipts, library clearance letters, ID scans, and any supporting documents required during the clearance process.

R2 provides globally distributed, durable storage, allowing for fast and reliable access to uploaded files regardless of a student’s location. It also supports direct integration with Workers and presigned URLs, enabling secure file access and download without exposing raw paths. This made it possible to implement strict access control policies—ensuring, for instance, that only authorized departments could view or verify submitted documents.

By using R2, the system avoided the traditional cost and complexity associated with third-party storage providers, while benefiting from the scale and performance of Cloudflare’s global edge network.

#### **2.4.3 Drizzle ORM**

Drizzle ORM is a modern, type-safe, SQL-centric Object Relational Mapper tailored for JavaScript and TypeScript environments. Unlike older ORMs like Sequelize or TypeORM, Drizzle prioritizes transparency and flexibility, letting developers write declarative schemas and SQL-like queries with full TypeScript support.

Drizzle was used in this project to interact with the Cloudflare D1 database, enabling consistent, safe, and predictable database operations. Its integration helped define data models for key entities such as students, staff, departments, clearance logs, and role-based permissions. With Drizzle’s type-safe queries, the development team could avoid runtime database errors, reduce debugging time, and catch schema issues during development.

The use of Drizzle ORM also aligned well with the Hono framework and TypeScript ecosystem, creating a cohesive and developer-friendly full-stack environment. Because clearance processes require strict data validation and traceability, Drizzle’s strongly typed approach enhanced the system’s reliability and maintainability.

Collectively, Cloudflare D1, R2, and Drizzle ORM formed a modern, scalable backend stack optimized for academic workflows. This combination allowed for efficient handling of both structured data and unstructured documents, ensuring the system could support real-world use cases such as simultaneous department approvals, audit tracking, and document-based verification without compromising performance or security.

### ****2.5 Authentication and Authorization in University Systems****

In any academic information system, ensuring secure and reliable access control is critical. Online graduation clearance platforms must handle sensitive data such as academic records, financial status, personal identification documents, and departmental approvals. As such, the system must not only verify the identity of each user but also enforce strict access privileges depending on their role. This section explores the importance of authentication and authorization in university systems, with a focus on the application of Lucia Auth in the Makerere University Business School clearance platform.

#### **2.5.1 Lucia Auth: A Modern Authentication Solution**

Lucia Auth is a lightweight, modular authentication library designed for modern JavaScript and TypeScript applications. Unlike heavyweight solutions that rely on opinionated session models or third-party identity providers, Lucia offers full control over session handling and is highly framework-agnostic—making it ideal for integration with Hono and serverless architectures.

For the clearance system, Lucia Auth was implemented to provide secure authentication for students, administrators, and departmental staff. Key features included:

* **Session-based Authentication:** Lucia handles session creation and validation without requiring cookies or complex OAuth setups. This was especially suitable for server-rendered pages and Cloudflare Workers.
* **RBAC (Role-Based Access Control):** Users were assigned roles (e.g., student, staff, department head, admin), with each role having specific permissions and access scopes. Lucia enabled the enforcement of route-based access control, ensuring users could only interact with endpoints relevant to their role.
* **Secure Login & Logout Flows:** Login was implemented using secure password hashing and session tokens. All user input was validated server-side to prevent injection attacks and unauthorized access. Logout destroyed the session and cleared related tokens, fully invalidating access.
* **Minimal Client Overhead:** Since Lucia operates primarily on the server side, the system retained a lightweight front-end and avoided exposing authentication logic to the client. This aligns well with HTMX-based interactivity and server-rendered views.

#### **2.5.2 Authorization and Access Control**

In a multi-user academic system like a clearance platform, proper **authorization** is just as important as authentication. The system had to accommodate multiple access levels:

* **Students** could only view their own clearance status, upload documents, and track progress.
* **Departmental Staff** could view and manage clearances relevant to their office (e.g., library, finance).
* **Admins** had global access to manage users, view system logs, and intervene when necessary.

Lucia Auth facilitated clean separation of privileges by integrating directly with the Hono middleware layer. This made it easy to enforce access rules across routes, ensuring that no unauthorized user could spoof requests or manipulate system state.

For example:

app.get('/admin/clearance', isAdmin, handleAdminView);

app.get('/student/status', isStudent, handleStudentStatus);

This separation of concerns strengthened both **security** and **maintainability**, allowing the system to scale to more user roles or clearance units in the future without rewriting core logic.

#### **2.5.3 Security Considerations in Academic Systems**

Beyond role control, several security principles were implemented:

* **Data Protection:** All sensitive data (e.g., clearance records, document links) was encrypted at rest in D1 and R2. HTTPS enforced secure transmission.
* **Token Expiry:** Sessions had expiration policies to reduce the risk of long-lived session hijacking.
* **Rate Limiting & Throttling:** Basic rate limiting was applied to authentication endpoints to mitigate brute-force attacks.
* **Audit Trails:** All critical user actions (login, document submission, approvals) were logged to provide traceability and support for incident resolution.

By combining Lucia Auth with Cloudflare’s security infrastructure (e.g., bot mitigation, WAF), the system ensured strong protection against common attack vectors while maintaining a smooth and responsive user experience.

### ****2.6 Deployment and Scalability with Serverless Infrastructure****

Deploying academic platforms like a graduation clearance system demands high availability, rapid response times, and minimal downtime—especially during peak usage periods around graduation seasons. Traditional server-based deployment models often struggle to meet these needs due to scalability limits, cost overhead, and complex maintenance requirements. This project adopted a serverless-first approach, using **Cloudflare Workers** as the core runtime environment. This section explores the rationale behind this decision and the architectural benefits that serverless infrastructure offers in the context of Makerere University Business School’s needs.

#### **2.6.1 Why Serverless?**

**Serverless architecture** shifts infrastructure management away from developers and institutions. Instead of provisioning and maintaining servers, applications are executed in isolated, stateless environments that automatically scale in response to traffic. For universities operating in environments with limited IT support or fluctuating user demand, this model significantly reduces administrative and technical burden.

Key reasons for going serverless included:

* **Automatic Scaling:** No need to manually configure load balancers or additional servers during high traffic—Cloudflare Workers scale globally without intervention.
* **Zero Cold Start Headaches:** Unlike some other serverless platforms, Cloudflare Workers start in under 5ms, even under load, making them ideal for real-time applications like student portals.
* **Lower Costs:** MUBS doesn’t need to pay for idle server time. Billing is usage-based, which is critical for institutions with tight budgets.
* **Global Availability:** The application runs at the edge, close to the user—whether the student is accessing it from Kampala or abroad. This dramatically reduces latency.

#### **2.6.2 Cloudflare Workers**

Cloudflare Workers offer a globally distributed, JavaScript-based execution environment designed for ultra-low latency and high performance. Unlike traditional cloud providers that rely on centralized data centers, Cloudflare Workers execute code at over 300 edge locations worldwide. This is especially beneficial in Uganda and other parts of Africa where regional latency can severely impact user experience.

In this project, Workers handled:

* All route logic (via Hono)
* Middleware such as authentication enforcement
* Form submission handling with HTMX
* Dynamic rendering of pages using hono/jsx

Because Workers are stateless by design, they worked seamlessly with Cloudflare D1 for persistent data and R2 for document storage. The combination offered both high-speed processing and long-term data integrity.

#### **2.6.3 Deployment Workflow and Tooling**

The project followed a modern DevOps-lite deployment model:

1. **Local Development:** Code was written in TypeScript using Hono, TailwindCSS, and hono/jsx.
2. **Database Migration:** Drizzle ORM managed schema migrations and seeded test data into D1.
3. **Build and Test:** The project used Bun to handle fast builds and dependency management.
4. **Deployment:** Workers were deployed using wrangler, Cloudflare’s CLI tool, allowing for single-command edge deployment.
5. **Monitoring and Logs:** Cloudflare’s built-in dashboards provided visibility into usage patterns, system logs, and error reports.

This simple but powerful pipeline meant the team could ship features fast, test in production-like environments, and fix issues in real-time—all with minimal infrastructure stress.

#### **2.6.4 Scalability and Future-Proofing**

As student numbers grow or more departments adopt the system, the underlying infrastructure will not require rewriting or horizontal scaling. Cloudflare’s serverless stack can handle thousands of concurrent users without a performance hit. Additionally, since Workers integrate with Cloudflare Access and other edge tools, features like admin dashboards, analytics, or advanced permissioning can be layered in without platform migration.

Future expansions—such as adding SMS notifications, transcript PDF generation, or integration with Makerere University’s SIS—can be added incrementally without changing the core architecture.

In conclusion, the use of Cloudflare Workers and the broader serverless stack enabled the development of a highly responsive, scalable, and cost-effective clearance system. This approach not only reduced deployment friction but also ensured the system could adapt to the evolving demands of the institution without additional hardware or maintenance costs.

### ****2.7 Challenges in Adopting Serverless Web Applications in African Universities****

While serverless technologies and modern web frameworks offer powerful solutions for digital transformation in higher education, their adoption in African universities presents several unique challenges. These challenges are not primarily technical but are often rooted in infrastructural, socio-cultural, and institutional limitations. Despite the clear benefits of implementing online systems—such as efficiency, scalability, and cost reduction—many institutions still rely on outdated processes due to a combination of environmental and organizational constraints.

#### **2.7.1 Limited Internet Infrastructure**

Although internet penetration is steadily increasing across Africa, many institutions still face bandwidth limitations, unstable connections, and high data costs. For a cloud-first system like a serverless clearance platform, a reliable internet connection is essential. Students accessing the system from rural areas or low-resource communities may encounter slow page loads or incomplete submissions due to network interruptions. Similarly, administrative staff working in departments with unreliable internet may struggle to use online tools efficiently, reducing trust in the system’s reliability.

#### **2.7.2 Digital Literacy Gaps**

While students tend to adapt quickly to new digital platforms, not all university staff are comfortable with modern web tools, dashboards, or even basic user interfaces. Clerical and administrative staff, many of whom are accustomed to paper-based systems, may view digital transformation as an added burden rather than a simplification. This digital divide creates friction in the adoption process and can lead to resistance, delays, or even sabotage of the system's use.

Training and continuous technical support are essential for overcoming this barrier. Without adequate onboarding, even a well-designed system may fail to achieve its intended goals simply because users don’t know how to interact with it properly.

#### **2.7.3 Institutional Resistance to Change**

Bureaucratic inertia is a significant obstacle in many public institutions. The introduction of a new digital system can be perceived as a threat to established routines, workflows, or even informal practices that benefit certain stakeholders (e.g., students paying “facilitation” fees for signatures). Resistance may also arise from fear of job displacement or a perceived loss of control over decision-making.

Successfully implementing a serverless system requires strong leadership support and change management strategies. It is not enough to provide a tool—the institution must also commit to changing the culture around how clearance is handled.

#### **2.7.4 Policy and Regulatory Hurdles**

Many universities operate without clear internal IT policies or data governance frameworks. In some cases, there are no formal protocols on how digital records are validated, archived, or used as official evidence of clearance. This lack of regulation can limit the legal or institutional recognition of digital clearance forms.

Moreover, there is often uncertainty about where data is stored, how it is protected, and whether cloud services hosted outside the country comply with national data privacy laws. These concerns, if not addressed, can delay or even block deployment at the institutional level.

#### **2.7.5 Funding and Technical Capacity**

Serverless infrastructure reduces operating costs, but initial system development still requires investment—in skilled developers, training sessions, and deployment pipelines. Institutions without in-house technical teams may depend on external contractors, which introduces challenges in system maintenance, feature updates, and long-term sustainability.

Additionally, platforms like Cloudflare Workers, while free at lower usage levels, may require budgeting for higher-tier plans as the system scales. Without clear funding models, institutions may hesitate to commit fully to serverless technologies, fearing future vendor lock-in or escalating costs.

#### **2.7.6 System Integration Constraints**

Universities often run fragmented IT systems. Clearance data might be stored separately from student information systems, finance tools, or library databases. Without APIs or standardized data exchange protocols, integrating the new clearance system into the existing ecosystem becomes a technical challenge. This can lead to duplication of effort or inconsistencies across platforms—undermining the benefits of automation.

In summary, while serverless and modern web technologies offer clear advantages for universities, successful adoption requires more than just deploying code to the cloud. Addressing infrastructural gaps, building institutional trust, and ensuring human capacity are just as important as the technical implementation. These challenges, while significant, are not insurmountable—and this project demonstrates a practical model for navigating them within the context of Makerere University Business School.

### ****2.8 Summary and Research Gaps****

The review of existing literature reveals a growing global trend toward digitizing graduation clearance processes using online platforms. Institutions in developed countries have successfully implemented integrated systems that connect student records, financial status, academic audits, and administrative workflows into cohesive, web-accessible tools. These systems have been shown to reduce clearance times, improve user satisfaction, and enhance institutional transparency.

In the African context, particularly in Uganda, progress has been slower. While universities such as Makerere University, the University of Nairobi, and the University of Cape Town have made commendable strides toward online clearance solutions, several challenges persist. These include inadequate infrastructure, low digital literacy, resistance to institutional change, and a lack of unified IT policy frameworks. As a result, many institutions continue to rely on manual, paper-based systems that are time-consuming, error-prone, and vulnerable to inefficiencies and corruption.

The literature also highlights key considerations for building effective clearance systems: a user-friendly interface, real-time status tracking, secure document management, and role-based access control. However, few studies explore the application of **modern serverless web technologies**—such as Cloudflare Workers, Hono, HTMX, D1, R2 Buckets, and Lucia Auth—in solving these challenges at scale.

Most documented systems depend on monolithic, client-heavy architectures or hosted platforms with significant setup and maintenance costs. Very little research addresses how **lightweight, server-rendered, and edge-deployed solutions** can be adapted to the resource constraints and usage patterns typical in African universities. Likewise, few case studies demonstrate successful integration of full-stack solutions that use modern JavaScript tooling with minimal infrastructure requirements.

This gap presents a unique opportunity.

The graduation clearance system developed for Makerere University Business School directly addresses this lack of practical, low-cost, scalable solutions by leveraging an edge-first, serverless architecture. It demonstrates how current technologies can be used to create a secure, responsive, and maintainable platform without the overhead of traditional hosting environments. By combining modern tools like Hono, TailwindCSS, HTMX, and Drizzle ORM with Cloudflare’s distributed infrastructure, this system offers a replicable model for other institutions facing similar challenges.

In conclusion, while literature has established the value of digital clearance systems, there remains a need for **lightweight, context-aware, and cost-efficient solutions** specifically designed for the realities of African higher education. This project contributes to filling that gap by not only designing but fully implementing and deploying such a system in a live institutional context.

# CHAPTER THREE

# METHODOLOGIES

## 3.1 INTRODUCTION

This chapter outlines the research design and methodologies used to achieve the goals of the project. It details the research approach, system analysis and design methods, system development methodology, data sources, data collection tools, project limitations, and ethical considerations. The project employed a qualitative approach, using purposive sampling to gather requirements for the system through focused discussions and observation.

### ****3.1 Research Design / Research Approach****

This project adopted the **Design Science Research (DSR)** paradigm, which focuses on the design, development, and evaluation of information technology artefacts to solve real-world problems (Vaishnavi & Kuechler, 2015). DSR combines rigorous inquiry with practical application and emphasizes stakeholder involvement, iterative design, and continuous evaluation. The aim was to develop a functional Online Graduation Clearance System tailored to Makerere University Business School’s needs, while also contributing to academic knowledge about system design in institutional contexts.

DSR was appropriate for this project because it provides a structured framework for developing innovative IT solutions. The artefact—in this case, the clearance system—was iteratively designed, tested, and refined through user feedback and technical evaluation. By focusing on solving a defined problem through artefact creation, DSR aligned well with both the academic and practical goals of the study.

### ****3.2 Sampling Technique****

The study employed **purposive sampling**, a non-probability sampling technique that allows for the selection of information-rich participants based on their roles and experiences. This method was suitable given the project’s goal of gathering system requirements from those directly affected by and involved in the graduation clearance process.

Participants were selected from various stakeholder groups within Makerere University Business School, including:

* 1 representative from the School Registrar’s Office
* 1 Guild Education Minister
* 1 Guild Representative Council (GRC) Member from each of the 15 degree programmes
* 1 representative of postgraduate students
* 1 GRC from diploma students
* 2 class leaders from the largest diploma programme (Diploma in Business Administration - DBA)
* 1 former student who had previously undergone the graduation clearance process

In total, **38 individuals** were invited to participate in an **online discussion forum (Dicoss Channel)** where they provided insights on system requirements and challenges of the current manual clearance process.

### ****3.3 Data Sources****

#### **3.3.1 Primary Data Sources**

Primary data was collected through **semi-structured Focus Group Discussions (FGDs)** conducted within the online forum. The FGDs were designed to gather user experiences, expectations, and feedback regarding graduation clearance. Participants shared insights on challenges they faced with the manual system, and suggested features they deemed necessary for the new platform.

Additionally, **observation** was employed to understand how graduation clearance is currently handled across MUBS departments. Researchers documented how information was processed, approved, and stored during the clearance workflow.

#### **3.3.2 Secondary Data Sources**

Secondary data was obtained from books, scholarly articles, technical documentation, online system reviews, and previous research on digital clearance systems. These sources provided contextual background and guided best practices for system development, particularly regarding user interface design, system architecture, and security protocols.

### ****3.4 Data Collection Tools****

#### **3.4.1 Focus Group Discussions (FGDs)**

FGDs were used to engage participants in structured, yet open-ended conversations. Discussions were held online and guided by a pre-developed question schedule. Participants were encouraged to share their experiences, pain points, and suggestions. This interactive format enabled the collection of rich, qualitative data about user needs and system requirements.

#### **3.4.2 Observation**

Observation was used to gather insights on how the current paper-based clearance process operates. Researchers visited different departments, noting workflows, data handovers, communication gaps, and potential inefficiencies. An observation guide was used to ensure consistency and relevance in data gathering.

### ****3.5 System Analysis and Design Approach****

The project adopted an **Object-Oriented Analysis and Design (OOAD)** methodology, which organizes the system as a collection of interacting objects representing real-world entities (Booch, 2015). OOAD supports modularity, reuse, and ease of maintenance—attributes that are essential for a scalable academic system.

During the analysis phase, researchers identified system actors (students, staff, admins), use cases (submit document, track status, approve clearance), and functional requirements (file upload, notification, role-based access). These were translated into system models and design artifacts, such as class diagrams and data flow mappings.

### ****3.6 System Development Methodology****

The system was developed using the **Joint Application Development (JAD)** prototyping model. JAD emphasizes stakeholder collaboration during all phases of system development. It includes six iterative stages: preparation, session, documentation, implementation, reflection, and contribution. Each phase involved constant interaction between developers and users to ensure the final system aligned with user expectations.

#### **3.6.1 Importance of Prototyping**

Prototyping enabled the team to quickly build and test a functional model of the clearance system. This iterative process ensured that user feedback was incorporated early and often, improving the system’s usability and effectiveness. According to Btechvibes (2023), prototyping enhances satisfaction, accelerates development time, and improves software quality by reducing errors before full deployment.

### ****3.7 Limitations of the Project****

The project faced several limitations. First, while purposive sampling enabled the collection of rich data, the insights may not fully represent the views of the entire student or staff population. Second, the reliance on online platforms for FGDs may have excluded voices of individuals with limited digital access or availability. Third, the tight project timeline constrained the scope of system testing and refinement prior to deployment.

### ****3.8 Ethical Considerations****

Ethical standards were upheld throughout the project. Participants were informed of the purpose, scope, and benefits of the study and gave their **informed consent** before taking part. Anonymity and **confidentiality** were maintained by coding responses and storing data securely. The research team committed to **academic integrity**, ensuring that all findings were accurately reported and all external sources properly cited. No coercion, fabrication, or falsification was employed at any stage of the study.

# CHAPTER FOUR

# SYSTEM ANALYSIS AND DESIGN

### ****4.1 System Overview****

The Online Graduation Clearance System developed for Makerere University Business School (MUBS) is a centralized, web-based application designed to digitize and streamline the graduation clearance process for students and administrative staff. The system was created in response to the inefficiencies and delays associated with the existing manual process, which required physical document submission and in-person verification across multiple departments. The newly developed system allows students to initiate their clearance process online, upload required documents, monitor clearance progress in real time, and receive official clearance confirmation upon completion. Administrative staff and department representatives can access a secure portal to review submissions, approve or reject documents, and communicate feedback to students. The system was built with a modern web stack comprising Hono as the backend framework, TailwindCSS for styling, hono/jsx for server-rendered views, HTMX for client-side interactivity, Cloudflare D1 for relational database management, Cloudflare R2 for document storage, and Lucia Auth for authentication and role-based access control.

### ****4.2 System Architecture****

The system architecture was designed with modularity, scalability, and maintainability in mind. It is composed of several interconnected layers that work together to deliver a seamless user experience. At the core is the application logic, handled by the Hono framework running on Cloudflare Workers, which enables low-latency, serverless execution at the edge. The presentation layer consists of pages rendered with hono/jsx and styled using TailwindCSS, ensuring consistency and responsiveness across all devices. Interactivity is enhanced using HTMX, which allows partial updates and asynchronous interactions without relying on client-side JavaScript frameworks. The backend integrates with Cloudflare D1 to store structured data, including user profiles, clearance statuses, and departmental approvals. Additionally, Cloudflare R2 is used to manage uploaded documents such as receipts and clearance forms, offering secure and cost-efficient object storage. Authentication and authorization are handled by Lucia Auth, which provides a secure session-based login system and enforces role-based access control across the application.

### ****4.3 User Roles and Permissions****

The system supports a role-based access control mechanism to ensure that users only have access to functionalities relevant to their roles. Three primary user roles were defined: student, department staff, and administrator. Students are the main users of the system; they can log in, view their clearance status, upload required documents, and initiate clearance requests. Department staff, such as representatives from the finance office, library, or academic registrar, are responsible for reviewing the submissions relevant to their departments. They can approve or reject student documents and provide comments or feedback where necessary. Administrators have overarching privileges and are able to manage user accounts, oversee clearance processes across all departments, and intervene in cases of disputes or escalations. This structured permission system is enforced through middleware integrated into the routing logic of the Hono framework, leveraging Lucia Auth’s role tagging and session handling capabilities.

### ****4.4 Functional Modules****

The system is composed of several functional modules that work together to support the clearance workflow. The student dashboard serves as the primary interface through which students interact with the system. It displays the current status of their clearance, submission deadlines, and the list of documents required by each department. From the dashboard, students can upload files, receive feedback from departments, and track their progress until full clearance is granted. The clearance submission module provides a structured form for submitting required documents, and includes validations to ensure completeness and correctness. The departmental review module enables staff members to access student submissions filtered by department, review attached files, and issue approval or rejection decisions with optional comments. Finally, the administrative panel allows authorized users to manage department configurations, monitor the overall clearance process, generate reports, and view audit logs.

### ****4.5 Database Design****

The system's data model was implemented using Cloudflare D1 and managed through Drizzle ORM, a modern and type-safe Object Relational Mapper for JavaScript and TypeScript applications. The database schema was designed to reflect the real-world relationships between users, departments, documents, and clearance statuses. Key tables include users, clearances, departments, approvals, and uploaded documents. Each user has an associated role, which determines their permissions within the system. Clearance records track the progress of a student through various departmental checkpoints, while the approvals table stores decision records tied to specific departments. The documents table references metadata for files stored in R2, such as file name, upload date, and associated user ID. The use of Drizzle ORM enabled the team to define these relationships in a declarative and type-safe manner, reducing the likelihood of logic errors and improving maintainability across development stages.

### ****4.6 Security Considerations****

Security was a key concern during the design and implementation of the system, given the sensitive nature of the data involved. Authentication is handled through Lucia Auth, which supports secure, session-based login workflows. Each session is cryptographically signed and expires after a defined time period, minimizing the risk of unauthorized access. Role-based access control is strictly enforced at the routing level, ensuring that users cannot access functions outside their scope. For example, a student cannot view another student’s clearance progress or access department review pages. Additionally, file uploads are stored in Cloudflare R2 and accessed through signed URLs, preventing unauthorized downloads or tampering. Input validation is performed server-side to prevent injection attacks, and all data is transmitted over secure HTTPS connections. Sensitive data, including login credentials and student records, are encrypted at rest and during transmission. All major actions—such as logins, approvals, rejections, and file uploads—are logged for auditing and traceability purposes, ensuring accountability for every transaction within the system.

### ****4.7 System Interface and User Experience****

**This is your part to continue.**  
You’ll now describe how the system actually looks and feels in action. Here’s how to go about it:

* Walk through the **Login Page** — what fields are present? How does the user know it’s secure?
* Describe the **Student Dashboard** — what are they seeing on first login? How is the clearance progress displayed?
* Explain the **Clearance Submission Flow** — what documents are submitted, and how? Any upload confirmations or error messages?
* Outline the **Department Staff View** — what filters, review tools, or approval buttons are available?
* Detail the **Admin Panel** — what can the admin do? View users? Generate reports? Override decisions?

# CHAPTER SIX

# EVALUATION, VALIDATION & RECOMMENDATIONS.

### ****5.1 Introduction****

This chapter presents the evaluation of the Online Graduation Clearance System developed for Makerere University Business School. The purpose of the evaluation was to determine the extent to which the system met the functional and non-functional requirements identified during the research phase. Emphasis was placed on assessing usability, system performance, stakeholder satisfaction, and alignment with user expectations. Given the design science research paradigm adopted, the system was tested through an iterative feedback loop involving real users from the target stakeholder groups, including students, staff, and administrators.

### ****5.2 Evaluation Methodology****

The system was evaluated using **qualitative methods**, in line with the overall research design. Feedback was collected through **semi-structured Focus Group Discussions (FGDs)** with a purposive sample of 38 participants, as outlined in Chapter Three. The participants included class representatives, GRC members, staff from the Registrar’s office, and a former student who had previously undergone the manual graduation clearance process. Additionally, system testing was carried out internally to validate core functionality such as authentication, document upload, status tracking, and role-based access control.

A prototype of the system was deployed in a test environment and shared with participants via an online link. Participants interacted with the system over a specified period and were encouraged to provide feedback on their user experience, system performance, and perceived value. The feedback was collected through discussion threads on the Discord Channel, informal interviews, and follow-up chats with selected users.

### ****5.3 Evaluation Criteria****

The following criteria were used to evaluate the system:

* **Usability**: Was the system easy to navigate? Were users able to complete tasks such as uploading documents and checking clearance status without confusion?
* **Functionality**: Did all core features (e.g., logins, file submissions, staff approvals) work as expected?
* **Performance**: Did pages load quickly? Were actions processed with minimal delay?
* **Accessibility**: Was the system usable on mobile devices and accessible to users with varying technical skills?
* **User Satisfaction**: Were users generally satisfied with the experience? Did they feel it improved over the manual system?

### ****5.4 Results and Findings****

Feedback from participants was overwhelmingly positive, with many expressing relief at the prospect of avoiding long queues and manual processes. Students appreciated the simplicity of the dashboard and the clarity of the clearance progress indicators. The ability to upload documents directly from a phone and receive approval notifications was highlighted as a major improvement. Staff members praised the structured review interface, which allowed them to process submissions quickly and track decisions centrally.

Several students noted that the system was intuitive even without training. Users reported that page transitions and form submissions were fast, with minimal delays. Staff reviewers also appreciated the ability to view student details and uploaded documents from one screen, rather than sorting through physical files.

However, some areas for improvement were identified. A few users requested tooltips or short guides to explain certain icons and buttons. Others suggested adding a confirmation popup before submitting documents, to avoid accidental uploads. One department staff member recommended a feature for bulk approvals during high-volume periods. These suggestions were noted and planned for future system updates.

### ****5.5 Alignment with Project Objectives****

The evaluation confirmed that the system met its primary goals, including:

* **Eliminating manual paperwork and office-to-office movement**
* **Allowing real-time clearance tracking by students**
* **Providing staff with a centralized platform to process approvals**
* **Improving transparency and reducing clearance time**

The results demonstrate that the Online Graduation Clearance System is a viable and scalable solution for addressing the challenges previously faced under the manual clearance model. The system’s lightweight architecture and serverless deployment also confirmed its potential to scale without incurring high infrastructure costs—an important consideration for MUBS and similar institutions.

### ****5.6 Limitations Noted During Evaluation****

While the feedback was generally positive, a few limitations were encountered during testing. Some users with older smartphones experienced layout issues on smaller screens, particularly when uploading files. Others encountered delays when internet connectivity was poor, especially outside urban areas. These limitations point to the need for additional mobile optimization and possible offline support for future versions. Despite these issues, the system functioned reliably under normal conditions and successfully demonstrated the feasibility of a fully online clearance process.

# REFERENCES

Andy Patrizio (2021). Retrieved from [https://www.techtarget.com/whatis/feature/The-history-andevolution-of-video-conferencing](https://www.techtarget.com/whatis/feature/The-history-and-evolution-of-video-conferencing)

Career Builder (n.d.). Candidate Experience, How to Improve It. Retrieved from

<https://www.careerbuilder.com/employer/resource/hr-tips-and-trends/candidate>

Claire Balungi (2022, May 17). Top 10 Job Search Websites & Apps in Uganda. Retrieved from <https://ugtechmag.com/top-10-job-websites-for-ugandans/>

Datta, A., Tschantz, M.C., and Datta, A. (2015). Automated Experiments on Ad Privacy Settings: A Tale of Opacity, Choice, and Discrimination. Proceedings on Privacy Enhancing Technologies, 1, pp. 92-112.

El Ouirdi, M., El Ouirdi, A., Segers, J., and Paillé, P. (2018). Data Protection and Privacy-Related Issues in E-Recruitment: A Systematic Literature Review. Employee Relations, 40(5), pp. 851-870.

Glassdoor (n.d.). Mobile Job Search Trends and Best Practices. Retrieved from

[https://www.glassdoor.com/employers/blog/mobile-job-search-trends-and-best-practices/](https://www.glassdoor.com/employers/blog/mobile-job-search-trends-and-best-practices)

Husna Munirah (2016, February 29). E-Recruitment Technology: The Effective Source of Recruitment.

Retrieved from

[https://www.textroad.com/pdf/JAEBS/J.%20Appl.%20Environ.%20Biol.%20Sci.,%206(1S)8489,%202016.pdf](https://www.textroad.com/pdf/JAEBS/J.%20Appl.%20Environ.%20Biol.%20Sci.,%206(1S)84-89,%202016.pdf)

International Journal of Human Resource Management (2015). A study of the impact of e-recruitment on older workers. Retrieved from

<https://www.tandfonline.com/doi/abs/10.1080/09585192.2015.1084993>

International Labor Organization (2016). E-recruitment and Labor Market Intermediation in the Philippines. Retrieved from [https://www.ilo.org/wcmsp5/groups/public/---asia/---robangkok/documents/publication/wcms\_528090.pdf](https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/publication/wcms_528090.pdf)

John Almeida (2013). Recruitment Technology Tools in 2023: All the Tools You Need. Retrieved from <https://www.starred.com/blog/recruitment-technology>

Keith D. Foote (2021). Retrieved from <https://www.dataversity.net/brief-history-cloud-computing/>

Mayuri Chaudhary (2023). Retrieved from [https://www.spiceworks.com/hr/future-work/articles/chatgptcan-be-a-game-changer-in-hrm/](https://www.spiceworks.com/hr/future-work/articles/chatgpt-can-be-a-game-changer-in-hrm/)

Mike Abia & Irwin Brown (01 April 2020). Retrieved from

<https://link.springer.com/chapter/10.1007/978-3-030-45002-1_32>

Nina Dhirasasna and Oz Sahin (2019). E-Recruitment: A Comparison with Traditional Recruitment and the Factors Affecting Cyprus University Graduates' Intention to Use. Retrieved from <https://www.mdpi.com/2079-8954/7/3/42>

Personnel Review (2018). Emotional intelligence and e-recruitment: a new challenge for HRM. Retrieved from <https://www.emerald.com/insight/content/doi/10.1108/PR-01-2017-0020/full/html>

Pew Research Center. (2016, October 6). The State of American Jobs. Retrieved from

<https://www.pewsocialtrends.org/2016/10/06/1>

Prof. Priya Unadkat (2015, March 17). Need of e-recruitment strategies in emerging scenario.

Randy Watts (2023). Retrieved from [https://www.forbes.com/sites/randywatts/2023/01/26/artificialintelligence/?sh=61a4e7b12216](https://www.forbes.com/sites/randywatts/2023/01/26/artificial-intelligence/?sh=61a4e7b12216)

Richardson, B. and Wilsdon, K. (2019). The Future of Recruitment: Trends, Challenges, and Opportunities. Industrial and Organizational Psychology, 12(1), pp. 17-20.

Saleh Alamro, Huseyin Dogan, Deniz Cetinkaya, Nan Jiang and Keith Phalp (2018, October 29).

Problem-Oriented Conceptual Model and Ontology for Enterprise e-Recruitment.

Software Advice (2017). How Candidates Experience Your Applicant Tracking System. Retrieved from <https://www.softwareadvice.com/resources/candidate-experience-report-2017/>

The Independent (2020). e-Recruitment: The Pros and Cons for Uganda's Job Market. Retrieved from <https://www.independent.co.ug/e-recruitment-the-pros-and-cons-for-ugandas-job-market/>

The Observer (2015). Unemployed Youth Struggle with e-Recruitment. Retrieved from

<https://observer.ug/news-headlines/39995-unemployed-youth-struggle-with-e-recruitment>

The Observer (2015). Unemployed Youth Struggle with e-Recruitment. Retrieved from

<https://observer.ug/news-headlines/39995-unemployed-youth-struggle-with-e-recruitment>

Thomas Cottereau, SightCall (2014). Retrieved from [https://www.shrm.org/hr-today/news/hrmagazine/pages/1114-video-recruiting.aspx](https://www.shrm.org/hr-today/news/hr-magazine/pages/1114-video-recruiting.aspx)

Uganda Revenue Authority (2019). URA Online Recruitment Portal. Retrieved from

<https://ura.go.ug/URA-Portal/Careers/URA-Online-Recruitment-Portal/>

University Utara Malaysia (2015). The Effect of E-Recruitment on the Recruitment Process: Evidence from Case Studies of Three Danish MNCs. Retrieved from

<https://journals.sagepub.com/doi/abs/10.1177/2158244015582135>

Wikipedia on Technology (2023). Retrieved from <https://en.wikipedia.org/wiki/Technology>

Xref on ChatGPT (2023). HR and Recruitment. Retrieved from [https://www.xref.com/blog/chatgpt-in-hrand-recruitment](https://www.xref.com/blog/chatgpt-in-hr-and-recruitment)

Zhaopin (2019). 2019 White Paper on China's Online Recruitment Industry. Retrieved from <https://research.zhaopin.com/2019/white_paper/>

# APPENDICES

## Appendix I: Research Budget

|  |  |
| --- | --- |
| ITEM | COST (SHS) |
| COMPACT DISK | UGX 5,000 |
| FLASH DRIVE | UGX 35,000 |
| INTERNET BUNDLES | UGX 50,0000 |
| VOICE BUNDLES | UGX 250000 |
| PRINTING | UGX 20,0000 |
| TRANSPORTATION | UGX 100,000 |
| STATIONARY | UGX 50,000 |

## Appendix II: Interview Guide

INTERVIEW GUIDE

AN INTERVIEW GUIDE FOR DATA COLLECTION TO ASSIST IN DEVELOPING AN E-

RECRUITMENT MOBILE APPLICATION

Dear respondent

We are students of Makerere University Business School conducting research for a mobile application about e-recruitment. We would love to learn more about your experience with job searching and hiring to help us create a more effective application. We are hoping to create a platform that streamlines the recruitment process and makes it easier for the job seeker and employers to connect. Your insights and feedback would be incredibly valuable to us, and we appreciate you taking the time to speak to us.

Question 1

What are some of the biggest challenges you’ve faced when searching for a job or hiring someone?

………………………………………………………………………………………………………………

Question 2

How do you typically search for job openings or candidates?

………………………………………………………………………………………………………………

Question 3

What features would you like to see in a mobile recruitment application.?

………………………………………………………………………………………………………………

Question 4

What do you think are the most important factors to consider when evaluating a job opening?

………………………………………………………………………………………………………………

Question 5

Have you used any mobile applications or online platforms for job searching or hiring? If so. What would you like or dislike about them?

………………………………………………………………………………………………………………

Question 6

How do you think technology can improve the recruitment system?

………………………………………………………………………………………………………………

Question 7

Are there any particular industries or job types that you think would benefit the most from a mobile application for e-recruitment?

………………………………………………………………………………………………………………

Question 8

What are some of the qualities you look for in a potential employer or employee?

………………………………………………………………………………………………………………

Question 9

How do you think the recruitment has changed over the past few years, and where do you see it heading in the future? ………………………………………………………………………………………………………………

Question 10

What role do you think social media plays in job searching and hiring?

………………………………………………………………………………………………………………

Question 11

Are there any particular challenges you’ve experienced during the recruitment process that you think could be solved by a mobile application?

………………………………………………………………………………………………………………

Thank you so much for your time & the valuable information provided.

## Appendix III: Codes

***Code for the App.js File***

import { StatusBar } from 'expo-status-bar'; import { StyleSheet, Image } from 'react-native';

import { NavigationContainer } from '@react-navigation/native'; import { createStackNavigator } from '@react-navigation/stack'; import Homepage from './components/Homepage'; import Loginpage from './components/Loginpage'; import Navigationbar from './components/Navigationbar'; import Joblistings from './components/Joblistings'; import JobsInput from './components/JobsInput'; import Loginpage2 from './components/Loginpage2'; import Applicationform from './components/Applicationform'; import LoginScreen from './components/LoginScreen'; import Select from './components/Select';

import RegisterScreen from './components/RegisterScreen'; import Developers from './components/Developers';

const Stack = createStackNavigator (); export default function App() { return (

<*NavigationContainer*>

<*Stack.Navigator*>

<*Stack.Screen* name="Home" component={Homepage} />

<*Stack.Screen* name="Login" component={LoginScreen} />

<*Stack.Screen* name="Applicants Login page" component={Loginpage} />

<*Stack.Screen* name="Joblistings" component={Joblistings} />

<*Stack.Screen* name="Organizations Login page" component={Loginpage2} />

<*Stack.Screen* name="JobsInput" component={JobsInput} />

<*Stack.Screen* name="Applicationform" component={Applicationform} />

<*Stack.Screen* name="Select" component={Select} />

<*Stack.Screen* name="Register" component={RegisterScreen} />

<*Stack.Screen* name="Developers" component={Developers} />

</*Stack.Navigator*>

<*StatusBar* style="auto" />

<*Navigationbar* />

</*NavigationContainer*>

);

}

const styles = StyleSheet.create({ container: { flex: 1,

backgroundColor: '#fff', alignItems: 'center',

justifyContent: 'flex-start', paddingTop: 60,

},

titleContainer: { backgroundColor: '#2D2D2D', paddingHorizontal: 20, paddingVertical: 10, borderRadius: 10, marginVertical: 20,

}, title: { fontSize: 28, fontWeight: 'bold', color: '#fff',

},

navbarContainer: { backgroundColor: '#fff', width: '100%', height: 60, flexDirection: 'row', justifyContent: 'space-between', alignItems: 'top', paddingHorizontal: 20, borderBottomWidth: 1, borderBottomColor: '#ccc',

},

navbarTitle: { fontSize: 20, fontWeight: 'bold', color: '#333',

},

loginContainer: {

flex: 1, alignItems: 'center', justifyContent: 'center', backgroundColor: '#fff', padding: 20,

}, loginTitle: { fontSize: 24, fontWeight: 'bold', marginBottom: 20,

},

inputContainer: { width: '100%', marginBottom: 20,

},

inputLabel: { fontSize: 16, marginBottom: 5, color: '#333',

}, inputField: { backgroundColor: '#f5f5f5', height: 50, paddingHorizontal: 10, borderRadius: 5,

},

loginButton: { backgroundColor: '#2D2D2D', padding: 10, borderRadius: 5,

marginTop: 20,

},

loginButtonText: {

color: '#fff', fontSize: 18, fontWeight: 'bold', textAlign: 'center',

},

joblistingsContainer: { flex: 1, alignItems: 'center', justifyContent: 'flex-start', backgroundColor: '#fff', padding: 20,

}, joblistingsTitle: { fontSize: 24, fontWeight: 'bold', marginBottom: 20,

},

jobCardContainer: { backgroundColor: '#f5f5f5', width: '100%', borderRadius: 10, padding: 20, marginBottom: 20,

},

jobCardTitle: { fontSize: 18, fontWeight: 'bold', marginBottom: 5,

},

jobCardCompany: { fontSize: 16, color: '#666', marginBottom: 5,

},

});