**Feasibility Study**©

**For LabEMS**

**2025**

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**Table of Contents**

[**1 Executive Summary 4**](#_30zb0gqqzkcu)

[**2 Problem Statement 5**](#_i0wmg02o757k)

[**3 Requirements Statement 6**](#_rti4nq2b5skc)

[3.1 Business Drivers 6](#_gg4jtmauz52b)

[3.2 Business Requirements 6](#_63m4t2nxj4m)

[**Additional Technical Requirements: 7**](#_cocret204ob9)

[**4. Feasibility Assessment 8**](#_823cv0s48vja)

[4.1. Potential Solutions 8](#_o0af8phxnl0o)

[4.2. Manual Filling System (Pen and Paper) 8](#_2oyicn3o0erx)

[4.3. Solution 2 - Commercial Off-the-Shelf (COTS) 11](#_fe7jpvpg4bug)

[4.4. Solution 3- Custom-Developed In-House Solution 15](#_6zzi8vbu5ypi)

[**5 Feasibility Ranking 20**](#_hdx97yxamnkj)

[5.1 Ranking Criteria 20](#_4iilomdlymd6)

[**6 Feasibility Result 21**](#_o86zum3mwhy9)

# **1** **Executive Summary**

The Laboratory Equipment Booking & Maintenance System (LabEMS) is a proposed web-based platform designed to centralise laboratory bookings, maintenance scheduling, and usage analytics at North-West University (NWU). The initiative addresses current inefficiencies arising from email-based requests, paper logs, and scattered spreadsheets, which hinder operational efficiency, compliance readiness, and optimal use of laboratory assets.

LabEMS will offer a secure, auditable, and role-based digital environment that automates calibration reminders, booking approvals, and safety checks, while enabling real-time reporting for audits, grant applications, and usage optimization. Developed by NWU students, the system will be tailored to the institution’s specific laboratory needs and compliant with the national drive for digital transformation in higher education.

The proposed implementation follows an agile methodology with stakeholder feedback at every stage and will integrate with existing communication and scheduling tools (e.g., email, SMS, calendar sync). A phased rollout will begin with a focused pilot in a single faculty before scaling to other faculties. LabEMS promises to improve asset utilisation, reduce administrative overhead, strengthen compliance, and serve as a blueprint for broader digital innovations across NWU.

# **2** **Problem Statement**

The North-West University (NWU) currently manages the booking and maintenance of laboratory equipment through a combination of email requests, paper logs, and spreadsheets. This fragmented approach is inefficient, makes it difficult to maintain accurate audit records, and increases the risk of miscommunication. The lack of a centralised, digital solution also prevents effective tracking of equipment usage and maintenance, leading to underutilisation of costly instruments.

This issue affects students, laboratory personnel, and administrative staff. Students struggle to determine the availability of equipment in advance, limiting their ability to plan experiments efficiently. Laboratory staff face an unnecessary administrative burden due to multiple request channels and manual processes. Administrative staff encounter challenges in compiling accurate audit reports and ensuring compliance with national standards. At an institutional level, the absence of a robust digital audit trail poses challenges in meeting the growing demand for audit-ready, role-based compliance, as emphasised by South Africa’s Higher Education digital transformation agenda.

If this challenge is not addressed, NWU will continue to miss opportunities for optimising laboratory resources, incur unnecessary costs due to lost or poorly maintained equipment, and risk falling behind national standards for digital compliance.

A centralised, digital laboratory equipment booking and maintenance system would benefit all stakeholders. Students would be able to reserve equipment in advance, improving planning and productivity. Laboratory personnel would gain a single platform for managing requests, scheduling maintenance, and ensuring equipment is ready for use. Administrative staff would have immediate access to accurate, audit-ready records and usage analytics for decision-making. Overall, the system would reduce administrative workload, enable comprehensive auditing, extend equipment lifespan, optimise utilisation, and enhance NWU’s compliance with national standards.

# **3** **Requirements Statement**

## **3.1** **Business Drivers**

The following key factors require LabEMS to be implemented within a short timeframe:

1. Digital Transformation Alignment – Supports South Africa’s Higher Education initiative to replace manual processes with centralized, automated, and audit-ready systems.
2. Operational Inefficiency – Paper-based logs and email requests cause booking conflicts, delayed maintenance, and excessive administrative work.
3. Compliance Gaps – Absence of secure audit trails makes it challenging to meet POPIA, OHSAS, and ISO 17025 requirements.
4. High-Value Asset Management – Laboratory equipment is expensive and must be monitored to prevent downtime and extend its lifespan.
5. Growing User Base – Increasing student numbers require a scalable, real-time system to ensure fair and efficient access.

Timeframe: Recommended deployment within 6–12 months to coincide with the next academic cycle and prevent further inefficiencies.

## **3.2** **Business Requirements**

|  |  |
| --- | --- |
| **Business Problem or Opportunity** | **Project Requirement** |
| Manual, fragmented booking process leads to double bookings and miscommunication. | *Implement a centralised, real-time booking platform with clash detection and instant confirmation.* |
| Maintenance tracking is inconsistent, causing delays in servicing equipment | Introduce automated maintenance scheduling and alert notifications for staff and users. |
| Compliance reports are slow and difficult to prepare. | Provide role-based access and automatic audit logs for all equipment activities. |
| Equipment is underutilised due to a lack of visibility on availability. | Include an analytics dashboard to monitor usage and improve resource allocation. |
| Administrative workload is high due to multiple request channels. | Develop a self-service portal for students and automated approval workflows for staff. |

## Additional Technical Requirements:

* Web-based & Mobile Friendly – Accessible on desktop and mobile devices.
* System Integration – Synchronisation with NWU’s email and calendar systems.
* Data Security – POPIA-compliant encryption and secure authentication.
* Scalability – Able to support 500+ concurrent users without performance loss.

# **4 Feasibility Assessment**

## **4.1. Potential Solutions**

**Three potential solutions exist, namely:**

Manual Filing system (Pen and Paper)

Commercial Off-The-Shelf (COTS).

Custom-Developed In-House Solution

## **4.2. Manual Filing System (Pen and Paper)**

**4.2.1. Description**

The manual filing system is the current method for tracking and managing laboratory equipment. This system relies on paper-based logbooks, physical calendars, and email communication to handle equipment bookings, schedule maintenance, and track equipment usage. Students submit requests in person or via email to lecturers, who then record approved bookings in a logbook with details such as the student’s name, student number, equipment description, checkout date, and proposed return date. Equipment maintenance is tracked separately through spreadsheets maintained by the lecturer.

Core components:

Paper-based logbook for each piece of equipment.

Excel spreadsheet maintenance register.

Physical calendar for scheduling.

Filing cabinet to store completed logbooks.

The purpose of the solution.

The manual system provides a basic and low cost method of managing equipment usage.

How can the Manual Filing system address the requirements?

Despite its simplicity and low cost, the system is inefficient, as it is prone to errors, lacks real-time equipment tracking, and creates audit challenges due to its decentralized nature.

**4.2.2. Assessment**

1. Economic Feasibility (28%)

The economic feasibility was evaluated by comparing the system's low direct costs with its high hidden expenses. The assessment found that while the system requires minimal upfront investment, its operational inefficiencies lead to significant hidden costs. This analysis resulted in a score of 3/5, which reflects the trade-off between low initial costs and high long-term expenses.

2. System Benchmarking (13%)

The manual system was benchmarked against digital alternatives to objectively measure its performance. Compared to digital solutions, the manual system lacks automation, real-time updates, and integration capabilities. It scores 1/5 in benchmarking, as it fails to meet modern efficiency standards

3. SWOT Analysis (13%)

A SWOT analysis was conducted to identify the system's strengths, weaknesses, opportunities, and threats.

**Strengths:**

The manual system’s strengths are its low implementation and operational costs and the fact that it requires no technical training.

**Weaknesses:**

Its primary weaknesses are that it is prone to human error, suffers from slow processing and a lack of real-time updates, and has no centralized data, which leads to records.

**Opportunities:**

The system is outdated and creates opportunities for modern and digital solutions.

**Threats:**Growing dissatisfaction among students and staff poses a significant threat to the system.

The SWOT analysis justifies a score of 1/5, as the system’s critical weaknesses and threats far outweigh its minimal strengths.

4. Technical Feasibility (28%)

The technical feasibility was assessed by examining physical resources and human capacity. The analysis, validated by workload logs, concluded that while the system functions minimally, it is not scalable and would struggle to handle periods of high demand, such as during exam season. For this reason, the system scored 3/5, as it works but cannot support future growth or remote access.

5. Legal & Compliance (18%)

A legal review of the manual records against regulatory requirements was conducted. The assessment found that the system makes legal compliance challenging due to its inconsistent records and lack of audit trails. This makes it difficult to prove compliance during inspections, even when basic requirements are met. The system's inability to provide a single, reliable record resulted in a low score of 2/5.

Total Feasibility Score: 2.3/5

Conclusion: The manual system is marginally feasible due to low costs but fails in efficiency, scalability, and compliance. Urgent upgrades are recommended.

**4.2.3. Results**

|  |  |  |
| --- | --- | --- |
| **Solution** | **Feasibility Score(1-5)** | **Assessment Method** |
| Manual Filing System | 2,3 | Weighted Average Feasibility Assessment. |

**4.2.4. Risks**

|  |  |  |  |
| --- | --- | --- | --- |
| **Risk Description** | **Risk Likelihood** | **Risk Impact** | **Actions Required to Mitigate Risk** |
| Loss/damage records | High | High | Scan records regularly and keep digital copies. |
| Double bookings/  scheduling errors | High | High | Assign a staff member as the equipment administrator. |
| Poor maintenance of equipment | Medium | High | Appoint an equipment administrator who will be responsible for maintaining accurate maintenance records and schedule equipment maintenance. |
| Unauthorized access/tampering | Medium | Medium | Store logbooks in locked cabinets. |

**4.2.5. Issues**

|  |  |  |
| --- | --- | --- |
| **Issue Description** | **Issue Priority** | **Actions Required to Resolve Issue** |
| No real-time equipment tracking | High | Print a physical calendar and attach it to a logbook. |
| Risk of loss/ damage of records | High | Store records in a locked cabinet. Regular scan records and keep digital copies. |
| No equipment maintenance reminders | Medium | Assign staff to review logs weekly and schedule maintenance. |

**4.2.6. Assumptions**

When assessing the feasibility of this solution, the following assumptions were made.

* A staff member is consistently available to manage equipment bookings.
* The volume of equipment is low enough that each can have its own logbook.
* Students are comfortable and proficient in using the paper-based system.
* Detailed equipment usage analytics are not a required outcome.

## 

## **4.3**. **Solution 2 - Commercial Off-the-Shelf (COTS)**

**4.3.1. Description**

A Commercial Off-the-Shelf (COTS) solution is a ready-made Laboratory Information Management System (LIMS) purchased from an external vendor. With this approach, the client focuses on using the system, while the vendor manages the infrastructure, maintenance, and technical support. The client is only responsible for paying the subscription or license fees.

Core components:

COTS solutions include ongoing vendor support and training

The system is maintained and hosted on the vendor's infrastructure.

It offers standard, generic functionality with limited customization.

It supports calibration tracking, scheduling, audit trails and reporting.

It allows user authentication and authorization controls.

How can COTS address the requirements?

Real-time booking is addressed by in-built calendar and clash detection features.

The vendor is responsible for ensuring the system's readiness for standards and regulations

COTS solutions come with standard reporting dashboards

Vendor SLA ensures reliability.

The COTS approach offers fast development lead times

**4.3.2. Assessment**

The feasibility of the COTS solution was evaluated using several methods to determine its ability to meet the stated requirements:

1. Economic Feasibility (28%)

A market analysis was conducted to assess the economic viability of implementing a Laboratory Information Management System (LIMS) for North-West University. The study focused on vendors whose solutions meet the university's requirements, specifically for lab equipment scheduling and inventory management. While pricing for competitors like Bookitlab and Labguru is not publicly available, a detailed cost estimate was developed for Quartzy, a cloud-based platform.

Quartzy's services include equipment scheduling, inventory tracking, and streamlined request workflows. This analysis highlights Quartzy as a viable and cost-effective option, with a detailed breakdown of its subscription model for a five-year period for an estimated 200 users including students and staff members.

Quartzy plans for an academic institution cost approximately $49 for the first 3 users and $15 per additional user (Quartzy, 2025).

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Calculation** | **Cost ($)** | **Cost (R)** |
| **Base Academic plan (first 3 users)** | $49/month | $49 | R906.50 |
| **Additional User (197)** | 197 x $15/user/month | $2,955 | R54,667.50 |
| **Total Monthly Cost** | $49 + $2,955 | $3,004 | R55,574 |
| **Annual Cost** | $3,004 × 12 | $36,048 | R666,888 |
| **Total Estimated Cost Before VAT** | $36,048 × 5 | $180,240 | R3,334,440 |
| **VAT at 15%** | R3,334,440 × 0.15 |  | +R500,166 |
| **Total Estimated Cost After VAT** | **R3,334,440 + R500,166** |  | **R3,834,606** |

The solution received a score of 4/5 for economic feasibility. Although its upfront cost is high, the investment is justified by the significant long-term benefits, such as improved efficiency and enhanced compliance.

2. System Benchmarking (13%)

The solution was benchmarked against the existing manual system to objectively measure its performance. The assessment revealed that the new system's features, such as real-time tracking and automation, significantly outperform the current method, establishing it as a superior alternative that meets modern efficiency standards. The score is 5/5 because its capabilities far exceed the current system.

3. SWOT Analysis (13%)

A SWOT analysis was conducted to identify the system's strengths, weaknesses, opportunities, and threats. This provided a balanced view of the solution's potential.

**Strengths:**

Mature COTS provide a high resilience stemming from being developed by expert industry professionals and being adopted by large users.

**Weaknesses:**

The weaknesses of Commercial Off-the-Shelf (COTS) are their limited flexibility in customization which can prevent students from learning the fundamental software development principles.

**Opportunities:**

Feature add-ons and integration with legacy systems could enhance system adoption.

**Threats:**

Challenges include potential integration issues with existing university systems, the need for additional training, and possible delays in implementing requested custom features.

The analysis resulted in a score of 2/5 because while the system has significant strengths, it also has notable weaknesses and threats.

4. Technical Feasibility (28%)

The technical feasibility was assessed by examining the solution's primary technical requirements: a stable internet connection and compatible web browsers. As these resources are readily available in most university environments, the solution is considered technically feasible. This assessment resulted in a score of 4/5, indicating that the solution is largely compatible with the existing technical landscape, with only minor technical dependencies and integration challenges remaining.

5. Legal & Compliance (18%)

An audit of vendor certifications was performed against key standards. The systems were found to be fully compliant. Minor adaptations should be in place if there are region specific compliance criteria. This near-perfect alignment with legal and regulatory standards resulted in a high score of 4/5.

**4.3.3. Results**

|  |  |  |
| --- | --- | --- |
| **Solution** | **Feasibility Score** | **Assessment Method** |
| COTS | 4 | Weighted Average Feasibility Assessment. |

**4.3.4. Risks**

|  |  |  |  |
| --- | --- | --- | --- |
| **Risk  Description** | **Risk  Likelihood** | **Risk  Impact** | **Actions Required  to Mitigate Risk** |
| Vendor Lock-in | High | High | Negotiate open APIs and data export rights. |
| Requirements Mismatch | High | High | Look for existing clients and understand if their fit for purpose criteria levels. |
| Limited Customization | High | Medium | Negotiate feature add-ins by the vendor. |
| Higher Acquisition Cost | High | High | Look for discounts and longer plans. |

**4.3.5. Issues**

|  |  |  |
| --- | --- | --- |
| **Issue Description** | **Issue  Priority** | **Actions Required to Resolve Issue** |
| Cost | High | Seek grants |
| No student learning benefit | High | No actions can be taken in a procurement. |
| Long term dependency on vendor | Medium | Training internal staff |

**4.3.6. Assumptions**

When assessing the feasibility of this solution, the following assumptions were made.

* The university will fund the initial purchase and annual licensing.
* The chosen LIMS will have the required features within budget.
* The vendor will provide consistent support, maintenance, and training.
* Lab staff will adopt the new system and overcome resistance.

## **4.4**. **Solution 3- Custom-Developed In-House Solution**

**4.4.1. Description**

The proposed solution involves the in-house development and maintenance of a Laboratory Equipment Management System (LabEMS) by final-year Computer Science and Information Systems students. This custom-built system will automate and digitise the manual processes for equipment management, including tracking, auditing, booking, scheduling, and asset control. Additionally, it will promote institutional innovation and support organic system development practices. The system is also intended to enhance safety and POPIA compliance, enable data-driven budget allocation, monitor equipment availability and utilisation metrics, and provide valuable skills development opportunities for the student developers.

Core components:

The system will be built using a modern technology stack that includes:

* Frontend Development
* Backend Development
* Database design
* Infrastructure, Authentication, and Hosting

How can the custom-developed in-house solution address the requirements?

The custom-developed solution is designed to address the lab's requirements in the following ways:

* The system enables real-time equipment reservations, eliminating double bookings and reducing access delays.
* The solution reduces expenses by removing dependency on commercial software licenses.
* The solution will significantly improve compliance with standards like ISO, POPIA, and OHSA by creating and storing comprehensive usage and maintenance logs that can be easily downloaded as reports.
* The project provides substantial educational benefits, allowing students to develop hands-on expertise in DevOps, full-stack web development, and cybersecurity best practices.
* The system's long-term sustainability is guaranteed by a continuous cycle of future students who will maintain and update it.

**4.4.2. Assessment**

This feasibility assessment used a multi-criteria evaluation technique to determine the likelihood that the proposed solution will meet all the requirements.

1. Economic Feasibility (28%)

The method used was a detailed cost analysis over a five-year period, which was then compared to the cost of a Commercial Off-the-Shelf (COTS) alternative. This analysis broke down all potential costs for the in-house solution, including development, hosting and cloud services, development tools, and maintenance.

|  |  |  |
| --- | --- | --- |
| **Expense** | **Cost per Year (R)** | **Total (R)** |
| Development cost | 0 | 0 |
| Hosting & Cloud Services  (Cloud services, domain registration, SSL certificates, and database hosting) | 1,600 | 8000 |
| Development Tools/Licenses  (Licenses for specialized IDEs, APIs, or third-party services.) | 0 | 0 |
| Training & Documentation  (Unanticipated development challenges) | 0 | 0 |
| Maintenance & support | 0 | 0 |
| **Total** | **0** | **8000** |

Since the solution will be developed by final year students using open-source tools, there will not be any development and licensing costs, with hosting and cloud services accounting for most of the anticipated expense. The total estimated 5-year cost of R8,000 for the custom system was found to be a fraction of the R3,834,606 estimated for a COTS solution. This significant cost-effectiveness demonstrates that the solution is financially sustainable and offers a high return on investment, resulting in a score of 5/5.

2. System Benchmarking (13%)

The solution was benchmarked against existing systems to evaluate its potential usability and adoption. This comparative analysis concluded that a custom-built system, tailored specifically to the lab's needs, would be superior to generic alternatives. This confidence in the system's performance and design resulted in a score of 5/5.

3. SWOT Analysis (13%)

A SWOT analysis provided a balanced view of the custom solution's potential.

**Strengths**

While it highlighted strengths like customisation and cost-effectiveness.

**Weaknesses**

It also identified significant weaknesses such as the reliance on a continuous cycle of students for long-term maintenance and the potential for project delays.

**Opportunities**

Ongoing stakeholder engagement, combined with mentor guidance for student developers, can significantly improve system quality and drive higher adoption rates.

**Threats**

Failure to align with user requirements could result in a system that is less effective or not adopted at all.

These risks led to a lower score of 2/5.

4. Technical Feasibility (28%)

A technical audit was conducted to confirm the availability of resources and skills. The assessment found that final-year students in Computer Science and Information Systems possess the necessary technical expertise. Furthermore, a budget for cloud hosting was secured. The score is 4/5, indicating that the solution is technically achievable, but potential risks associated with the reliance on student availability and a capped budget exist.

5. Legal & Compliance (18%)

The solution's design was reviewed against regulatory standards such as OHSA, POPIA, and ISO17025. The assessment determined that the system would significantly improve compliance by creating a single, reliable source of truth for all records. This strong alignment with legal requirements earned the solution a score of 4/5.

**4.4.3. Results**

|  |  |  |
| --- | --- | --- |
| **Solution** | **Feasibility Score** | **Assessment Method** |
| Custom Software Solution | 4.15 | Weighted Average Feasibility Assessment. |

**4.4.4. Risks**

|  |  |  |  |
| --- | --- | --- | --- |
| **Risk Description** | **Risk Likelihood** | **Risk Impact** | **Actions Required to Mitigate Risk** |
| Knowledge silos | High | High | Peer to peer code review regimen, codebase handover and adoption plans. |
| Budget Overrun | Medium | Medium | Cost monitoring dashboard and budget threshold alerts. |
| Scope creep | High | Medium | Agile sprints and effective project management. |
| Security breaches | Medium | Medium | Implementation of Industry Authentication and Authorization practices such as OAuth, social auth protocols and OTPs. |

**4.4.5. Issues**

|  |  |  |
| --- | --- | --- |
| **Issue Description** | **Issue Priority** | **Actions Required to Resolve Issue** |
| Limitations on UX Research | High | Staff Involvement in UAT |
| Power and Connectivity Instability | Medium | Zero-rating the web-based system, caching, offline first capability. |
| Time constraints | Medium | Adept mentor supervision |

**4.4.6. Assumptions**

When assessing the feasibility of this solution, the following assumptions were made.

* Faculty mentors are available to guide the student development team from the beginning of the project to its completion.
* The university will approve the necessary budget to develop and run the system.
* Users will participate in the User Acceptance Testing (UAT) to ensure the system meets their needs.
* The student developers collectively possess the knowledge and expertise required to build the Laboratory Equipment Management System (LabEMS).
* The project requirements will not change throughout the entire software development lifecycle.

# **5** **Feasibility Ranking**

## **5.1** **Ranking Criteria**

The criteria outlined in Feasibility Assessment were used to determine the feasibility of each of the solutions. The weights for the weighted criteria are determined by the strategic importance each criteria represents, and the possible long-term implication associated with each area of effect.

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Weight** | **Reason** |
| Economic Feasibility | 28% | Cost efficiency, ROI, Sustainability within NWU’s budget framework. |
| System Benchmarking | 13% | Industry best-practice alignment. |
| SWOT Analysis | 13% | Institutional compatibility, potential risks, and opportunities. |
| Technical Feasibility | 28% | Determines whether the system can be implemented, integrated, and scaled effectively. |
| Legal & Compliance | 18% | Ensures the system meets regulatory obligations (POPIA, OHSA, ISO17025). |

**5.2** **Ranking Scores**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1. Manual Filing** | | | **2. COTS** | | | **3. Custom System** | | |
| **Criteria** | Score | Weight | Total | Score | Weight | Total | Score | Weight | Total |
| Economic Feasibility | 3 | 28% | 0,84 | 4 | 28% | 1,12 | 5 | 28% | 1,4 |
| System Benchmarking | 1 | 13% | 0,13 | 5 | 13% | 0,65 | 5 | 13% | 0,65 |
| SWOT Analysis | 1 | 13% | 0,13 | 2 | 13% | 0,26 | 2 | 13% | 0,26 |
| Technical Feasibility | 3 | 28% | 0,84 | 4 | 28% | 1,12 | 4 | 28% | 1,12 |
| Legal & Compliance | 2 | 18% | 0,36 | 4 | 18% | 0,72 | 4 | 18% | 0,72 |
| **Total Score** |  | **100%** | **2,30** |  | **100%** | **3,87** |  | **100%** | **4,15** |

# **6** **Feasibility Result**

A comparative analysis was conducted between three potential solutions for the Laboratory Equipment Booking & Maintenance System (LabEMS):

1. **Manual Filing** – The existing process using emails, paper logs, and spreadsheets.
2. **COTS (Commercial Off-The-Shelf)** – A pre-built software solution adapted for laboratory use.
3. **Custom System** – A bespoke web-based platform developed specifically for NWU’s laboratory environment.

Each option was evaluated against five weighted criteria: Economic Feasibility, System Benchmarking, SWOT Analysis, Technical Feasibility, and Legal & Compliance.

The **Custom System** achieved the highest total score (4.15), significantly outperforming the COTS solution (3.87) and the Manual Filing method (2.30). This demonstrates that a custom-built platform is most likely to satisfy NWU’s stated requirements, offering the strongest alignment with technical, operational, and compliance needs.

**Key Findings:**

* **Economic Feasibility:** The custom system offers strong long-term cost benefits through efficiency gains, reduced downtime, and optimised equipment utilisation.
* **System Benchmarking:** Competitive performance when compared to existing solutions, with room for innovation and institution-specific features.
* **Technical Feasibility:** High score reflects readiness for secure, scalable, and integrated deployment within NWU’s IT environment.
* **Legal & Compliance:** Meets regulatory obligations including POPIA, OHSA, and ISO 17025.

In conclusion the evaluation confirms that developing a **Custom System** for LabEMS is the most feasible approach. It is technically sound, operationally effective, economically justified, and fully compliant with relevant legal frameworks. This option maximises stakeholder value and positions NWU as a leader in digital laboratory management within South African higher education.