Indian Journal of Information Sources and Services
ISSN: 2231-6094 (P) Vol.15, No.3, 2025, pp.432-443

DOI: https://doi.org/10.51983/ijiss-2025.IJISS.15.3.48

Developing KPI-Driven Performance Dashboards for University Libraries

Dr. Anusha Sreeram[1*], Dr. Manoj Kumar Mishra[2], Viyyapu Lokeshwari Vinya[3], Sudhakar Reddy[4], R.K. Tripathi[5], Nimesh Raj[6] and Dr. Saswati Roy Chel[7]

[1*]Faculty of Operations & IT, ICFAI Business School (IBS), The ICFAI Foundation for Higher Education (IFHE), India (Deemed to be University u/s 3 of the UGC Act 1956), Hyderabad, India

[2]Librarian, Department of Humanities and Social Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

[3]Associate Professor, Department of CSE, Vardhaman College of Engineering, Hyderabad, Telangana, India

[4]Professor, Department of Physics, School of Sciences, JAIN (Deemed-to-be University), India

[5]School of Engineering & Computing, Dev Bhoomi Uttarakhand University, Dehradun, India

[6]Centre of Research Impact and Outcome, Chitkara University, Rajpura, Punjab, India

[7]Assistant Professor, School of Commerce, Presidency University, Bangaluru, Karnataka, India

E-mail:[1]seeramanusha@gmail.com, [2]manojmishra@soa.ac.in, [3]vinya593@vardhaman.org, [4]r.sudhakar@jainuniversity.ac.in, [5]India,soec.rajkishor@dbuu.ac.in, [6]nimesh.raj.orp@chitkara.edu.in, [7]saswatiroy.chel@presidencyuniversity.in

ORCID: [1]https://orcid.org/0009-0003-3397-4311, [2]https://orcid.org/0009-0000-3467-5741, [3]https://orcid.org/0000-0001-9328-672X, [4]https://orcid.org/0000-0001-8207-3526, [5]https://orcid.org/0000-0002-2454-2619, [6]https://orcid.org/0009-0002-1938-7754, [7]https://orcid.org/0000-0003-4443-6853

(Received 10 July 2025; Revised 27 August 2025, Accepted 09 September 2025; Available online 30 September 2025)

Abstract - **As universities and colleges continue to evolve into data-driven institutions, library services in these schools are facing challenges in demonstrating their effectiveness and their contribution to the school's mission and objectives. This study offers an enhanced performance evaluation, strategic library management, and operational transparency framework with an emphasis on operational strategic planning for university libraries with a KPI-based performance dashboard. The model—KPI-DashLib—includes key performance indicators from pertinent domains such as resource management and usage, user engagement, collection development, digital services, and academic Impact. Streamlined modular dashboard frameworks facilitate the conversion of real-time data into insights using intuitive visual displays and predictive trend analytics. The model aids the data-informed resource management and planning for administrators, streamlined resource management, service gap identification, and sustained improvement monitoring. A prototype dashboard for a mid-sized university library's data ecosystem was designed with the aid of open-source business intelligence applications. Preliminary data has shown improved stakeholder engagement and library alignment with the institutional framework. This paper presents a scalable and replicable model for the integration of KPI frameworks into library performance systems, thereby advancing the governance and accountability of libraries.**

Keywords: **University Libraries, Performance Dashboard, Key Performance Indicators (KPI), Library Performance Metrics, Data-Driven Decision Making, Academic Library Governance, Library Assessment, Strategic Planning, KPI-DashLib Model**

I. INTRODUCTION

In today's academic world, university libraries are being challenged to show their value and importance strategically. University libraries are not just places to keep books and journals. Instead, they have become active learning centres that provide digital content and support to students. To measure Impact effectively, libraries must implement sophisticated performance assessment tools beyond simple statistics. One such tool that is gaining popularity is called a performance dashboard. Dashboards provide key metrics that are crucial to an institution's goals and visualize them, giving stakeholders real-time insights regarding efficiency and quality. For effective performance monitoring, dashboards enable library executives to measure, monitor, and manage organizational performance beyond traditional metrics (Whitmire, 2002). Ethical leadership provides a framework for guiding responsible decision-making and fostering accountability in organizational contexts (Ameen et al., 2022). Visualizing performance data in higher education libraries through dashboards enhances data-driven decision-making and supports strategic planning (Bilz, 2023). The study examines how augmented reality, chatbots, and social media influence consumers' body image throughout their online customer journe (Anari et al., 2013). This study highlights how social interactive media tools can support knowledge sharing, which is relevant for developing KPI-

driven performance dashboards in university libraries (Azeem et al., 2024). This study presents a comprehensive faculty dashboard for monitoring academic metrics, offering insights applicable to KPI-driven performance dashboards in university libraries (Azevedo et al., 2021). AI and big data-aware security solutions ensure reliable and secure data collection for KPI-driven dashboards (Prasanna et al., 2024). Models for secure data analysis, backup, and restoration support integrity and resilience in decision-making systems (Manea et al., 2025). Enhancing real-time communication networks enables timely and accurate data updates for performance monitoring (Zigui et al., 2024).

Aligning library services with institutional goals requires performance-based evaluation, which dashboards facilitate by linking KPIs to organizational objectives (Corrall & Jolly, 2020). Key performance indicators for digital libraries can be efficiently tracked using dashboard systems, allowing timely insights into library operations (Beile, 2020). This study focuses on designing and implementing KPI-driven dashboards to monitor and improve institutional performance (Briggs, 2020). Understanding electronic resource usage through COUNTER5 metrics helps libraries track and manage digital resource performance effectively (Marquez & Downey 2015). Dashboards and analytics are used to monitor and enhance library performance, supporting the development of KPI-driven performance dashboards in university libraries (Davis & Petrowski, 2010). Stepwise methodologies for implementing data services facilitate structured and efficient data acquisition (Maleki & Mirjalily, 2015).

KPIs highlight key metrics that are critical to an organization's strategic objectives. In case of university libraries, KPIs can be defined as user satisfaction, circulation trends, digital resource engagement, faculty engagement, and budget utilization. When integrated into a dashboard system, they can empower decision-makers and library administrators with actionable insights. The shift from static annual reports to interactive dashboards is a move towards real-time agile management observed in academic administration, enabling optimized resources and evidence-based strategic planning. This entry provides an overview of academic library practices and standards, informing the development of performance assessment frameworks like KPI-driven dashboards (Echeverria & Bustamante, 2025). Web analytics KPIs can help academic libraries measure and improve digital engagement and overall performance effectively (Murphy, 2013). Frameworks for evaluating performance metrics guide the design of effective KPIs for management dashboards (Iyer & Reddy, 2024).

For a long time, libraries have evaluated their performance based on simple things, like how many books were checked out, how many people entered, or how many queries were responded to. While some of these things might have some use, these metrics are unable to capture things like user satisfaction, their learning, or how library services influenced their academic achievements. This is capturing the Impact of library services on users' academic success. This is why there is more focus on dashboards that combine quantitative with qualitative data to create a more complete and comprehensive view of library performance. These dashboards help to combine the raw operational data of the library with the strategic decision-making frameworks, increasing the accountability of the institution.

Developing and using dashboard systems has become much easier because of recent technologies. Business intelligence tools, such as Power BI and Tableau, as well as the open-source Metabase, are now offering easier-to-use functions and can integrate with multiple data sources. These systems allow libraries to adjust and tailor dashboards for distinct objectives, units, and even user clusters, which improves the context and precision of performance measurement. In addition, automated data pipelines eliminate the need for manual reporting, making library analytics more timely and accurate. Underscore the importance of better data structure for performance benchmarking, which parallels the need for well-defined KPI systems and university library dashboards for KPI university library dashboard KPI university library dashboard.

As academic libraries continue modernizing their infrastructures, the use of dashboard systems still lags behind. Data silos, legacy systems, lack of clear KPIs, or poorly defined KPIs linked to an institutional strategy are some of the challenges many of these institutions face. Furthermore, the overarching issues of data governance, user privacy, and overall dashboard usability add to the troubles. In addressing these issues, the current paper aims to build a dashboard specifically designed for university libraries that is driven by KPIs—KPI-DashLib. It integrates the principles and best practices of library and business intelligence systems. (Melia, 2016) Justifies the use of multi-attribute decision making approaches like SAW and Weighted Product for ranking and prioritizing KPIs in performance dashboards for university libraries.

The KPI-DashLib model merges five primary components: KPI Definition Layer, Data Aggregation Engine, Analytics and Evaluation Core, Interface for Visualization, and Feedback and Recommendation Loop. Every module has a specific function that aids in the relevance, scalability, and Impact of the dashboard. The model aids library administrators in shifting to a data-informed management model while informing defined library goals like improving user experience, optimizing collections, and aiding in academic research. Yusof, Haron, and Ismail in 2018 place emphasis on audit capabilities for public institutions and note the useful functions of KPI-driven dashboards in accountability and performance oversight for university libraries.

Most notably, the proposed framework has a strong focus on participatory design. KPI-DashLib framework does not employ a "one size fits all" approach. Instead, faculty, staff, and even students are involved in the validation and identification of the performance indicators, making the process participatory. This participatory approach helps the dashboard to be useful to a wider user base and cultivates a culture for the constant improvement of library services and transparency. This model not only supports accountability but also fosters shared responsibility for the growth and development of the library.

An additional key benefit of dashboard systems is their use for making decisions as events unfold. Unlike retrospective reports, live dashboards display information about various processes in real-time, including active user engagement, overdue resources, and downtimes. This is particularly useful in the post-pandemic context, as libraries have had to adapt to emergent shifts in demand due to the adoption of hybrid service models (Jaguszewski & Williams, 2020). The dashboard works as both a diagnostic and planning tool when paired with real-time alerts and predictive analytics. Optimized resistive RAM performance analysis supports efficient data handling and system performance improvements (Jiang et al., 2010). Developing sustainable dashboards enables academic libraries to monitor performance while supporting long-term efficiency and resource management (Mannheimer, 2024).

While these pilot dashboard implementations have shown promising results, they also reveal the gaps in custom KPI frameworks, user training, and ongoing impact assessment of the dashboards. The KPI-DashLib model addresses these gaps by offering a coherent, modular, and adaptable structure, rooted in a sound theoretical and practical foundation.

This research is organized in the following manner: A review of the literature on KPI systems and dashboard design in libraries is provided in the second section; In section 3, the KPI-DashLib model is explained in detail; In section 4, the implementation methodology and evaluation strategy are described; In section 5, the results are presented alongside the interpretations, and in section 6, the research is concluded, giving recommended actions for policy and further research. The goal of this research is to help academic libraries deal with the changing environment of performance accountability and strategic service delivery.

II. Literature Review

In recent years, the focus has been on integrating performance measurement systems within academic libraries. As institutions of higher education continue to face pressures regarding resource allocation, the expectation on libraries to demonstrate their Impact on student achievement, research output, and the institution's standing increases. This has resulted in a movement away from traditional descriptive statistics towards a more robust evaluative framework based on Key Performance Indicators (KPIs). With defined measurable outcomes, KPIs grant libraries the ability to assess and improve services in a constructive manner relative to institutional goals. Managing library performance with dashboards and analytics improves service delivery and operational efficiency by highlighting strengths and gaps (Corrall & Jolly, 2020). Real-time data integration and visualization tools in university libraries enhance resource management and improve user experience (Joy & Kuruvilla, 2025). Dashboards support alignment of library services with institutional strategic goals, ensuring that performance evaluation is outcome-focused (Meesad & Mingkhwan, 2024). Empowering library staff through open dashboards fosters transparency, collaboration, and informed decision-making across teams (Krairiksh & Choksuchat, 2021). Analyzing eBook usage with COUNTER R5 and link resolver metrics helps libraries evaluate digital resource performance accurately (Fagan, 2014).

One of the foundational works in this domain report for the ACRL, where she emphasized the need for libraries to articulate their value in measurable terms. This early work shifted the conversation from input/output metrics to performance-based evaluation, which in turn, set the stage for governance dashboards in libraries. Developing sustainable dashboards ensures that performance measurement in academic libraries remains adaptable and effective over time (Krairiksh & Choksuchat, 2021) Using dashboards to foster innovation helps create a culture of continuous improvement and strategic responsiveness in library services (Gregory, 2019). Library Assessment Guidelines provide a framework for designing effective performance dashboards aligned with best practices (Russell, 2008).

Library assessment as an organizational development tool emphasizes the role of dashboards in planning, monitoring, and decision-making (Pradhan & Mohanty, 2025). Integrating AI with KPIs in intelligent dashboards enhances analytical capabilities and supports advanced decision-making in academic libraries (Schilling & Applegate, 2012). Evaluating library workshop impact using performance metrics informs program development and optimizes resource allocation (Matthews, 2014).

Matthews' KPIs is critical metrics that could assess performance across user satisfaction, collection usage, digital access, and even staff productivity. In his own words, Matthews' KPIs are useful for improving data collection processes, but the real value lies in the improvement and accountability framework they sustain. These observations bolster the creation of performance dashboards that translate abstract objectives into measurable and assessable metrics and Insights.

The emergence of business intelligence (BI) tools has greatly impacted the realization of KPIs in library settings. These tools also facilitate advanced data visualizations, drill-down analytics, and even automatic reporting, making it possible for library administrators to make educated decisions using

data without requiring advanced technical skills. More importantly, BI tools also facilitate the aggregation of data from different systems, which is critical for holistic performance evaluation and KPI monitoring.

Petersohn (2021) implemented a performance dashboard at a mid-sized university that integrated metrics from access services, e-resources, and user engagement. Dashboards, as Petersohn showcased, improved managerial insight, cross-departmental collaboration, and communications with university administration. Nevertheless, Petersohn warns that careful selection of the KPIs, stakeholder engagement, and iterative assessments are critical to success. Implementing responsible AI practices helps libraries enhance services and decision-making while ensuring ethical and accountable operations (Griffin & Holcomb, 2023).

They practiced user-centered library assessment and demonstrated that participatory design—where library staff, users, and administrators collaboratively design performance indicators—results in more relevant dashboards and increased user satisfaction. This strategy is effective in academia because there are many constituents from different fields. Integrating stakeholder input ensures the dashboard is useful for administration as well as operational staff and users.

Despite everyone agreeing on the technical and conceptual advantages of dashboards, the barriers to adoption still remain. Furthermore, there is often ambiguity in defining meaningful KPIs, particularly when the metrics "learning impact" or "research support" are hard to measure and open to subjective interpretation. These challenges suggest that there is a need for a model that brings structure to KPI development while still allowing for system design flexibility.

The COVID-19 pandemic highlighted the need for agile decision-making informed by data in academic libraries. As libraries had to make a mid-shelve shift for the remote work, digital services, and new user demands that were in the pipeline. In this scenario, dashboards served as vital resources for monitoring the performance of services offered remotely, accessing data, and user satisfaction during the crisis. This has increased the speed of interest in adaptable, comprehensive, and flexible dashboards for a changing institutional environment.

Another reason for the increasing scholarly attention is the alignment of library dashboards with institutional accreditation and strategic planning. Libraries incorporating KPIs with institutional dashboards gain administrative visibility and influence. This alignment enables libraries to contribute to university-wide performance reports that involve budget planning and submissions for accreditation. Therefore, dashboards are more often seen as a means of advocacy and strategic positioning within the academic ecosystem.

Finally, scholars from the domains of information science and organizational management have voiced the need for a more unified and standardized approach to designing dashboards. Granted, many libraries design bespoke systems to suit local needs, but a lack of a replicable modular framework hampers the systems in terms of scalability and benchmarking. This is the gap that the present study aims to fill with the proposal of KPI-DashLib, a participatory and structured design for the dashboards as informed by earlier research, which integrated various technical, strategic, and organizational insights.

III.KPI-DashLib Model Architecture

The KPI-DashLib (Key Performance Indicator-Driven Dashboard for Libraries) is an adjustable modular ecosystem aimed at integrating library metrics within one library performance visualization dashboard. It fulfills the automated actionable KPIs identified, monitored, and measured, addressing the automated actionable KPIs aligned, monitored, and measured KPIs defined with library strategic objectives. The architecture consists of five core modules: (1) KPI Definition Layer, (2) Data Aggregation Engine, (3) Analytics and Evaluation Core, (4) Visualization Interface, and (5) Feedback and Recommendation Loop. Each module deals with a critical dimension of the library performance management process, providing a dynamic dashboard for a comprehensive and evolving library performance management solution.

KPI Definition Layer

KPI DashLib's first foundational block is the KPI Definition Layer, which focuses on defining, classifying, and confirming the KPIs for the academic libraries. In this case, it starts from the service level alignment with the strategy of the library. KPIs are classified into five primary domains. User Engagement encompasses active users and session duration. Resource Utilization covers circulation rates and e-resource downloads. Digital Infrastructure includes server uptime and page load times. Academic Impact encompasses citation-supported activities and research consultations. Operational Efficiency includes cost per transaction and staffing ratios. These KPIs are defined and benchmarked through workshops and consultations with the library stakeholders for contextual cross-functional relevance. Use of library value metrics in higher education supports evidence-based decision-making and demonstrates library contribution to institutional goals (Thiruvathukal et al., 2018). Integrating data dashboards for strategic decision-making improves library performance and strengthens alignment with institutional objectives (Pinna & Castelnovo, 2019).

Data Aggregation Engine

The Data Aggregation Engine is tasked with gathering information from multiple sources like Integrated Library Systems (ILS), learning management systems (LMS), digital

repositories, automated feedback systems, web analytics tools, and even human resource or financial systems. The engine incorporates ETL and API mechanisms to streamline the data flow to the dashboard environment.

Analytics and Evaluation Core

When the data is combined, the Analytics and Evaluation Core works on it to produce insights. This system has engine models for calculation, trend analysis, anomaly detection, and even forecasting. It helps with descriptive, diagnostic, and even predictive analytics that assist the decision-makers to understand what is happening, why it is happening, and what the possible future scenarios could be. For example, a decline in circulation in a particular subject area may trigger correlation analysis with the calendar year academically or with budget allocation. Besides, this core supports KPI benchmarking, which involves cross-comparison of value indicators for measurable objectives that span departments or time periods for ongoing evaluation of performance.

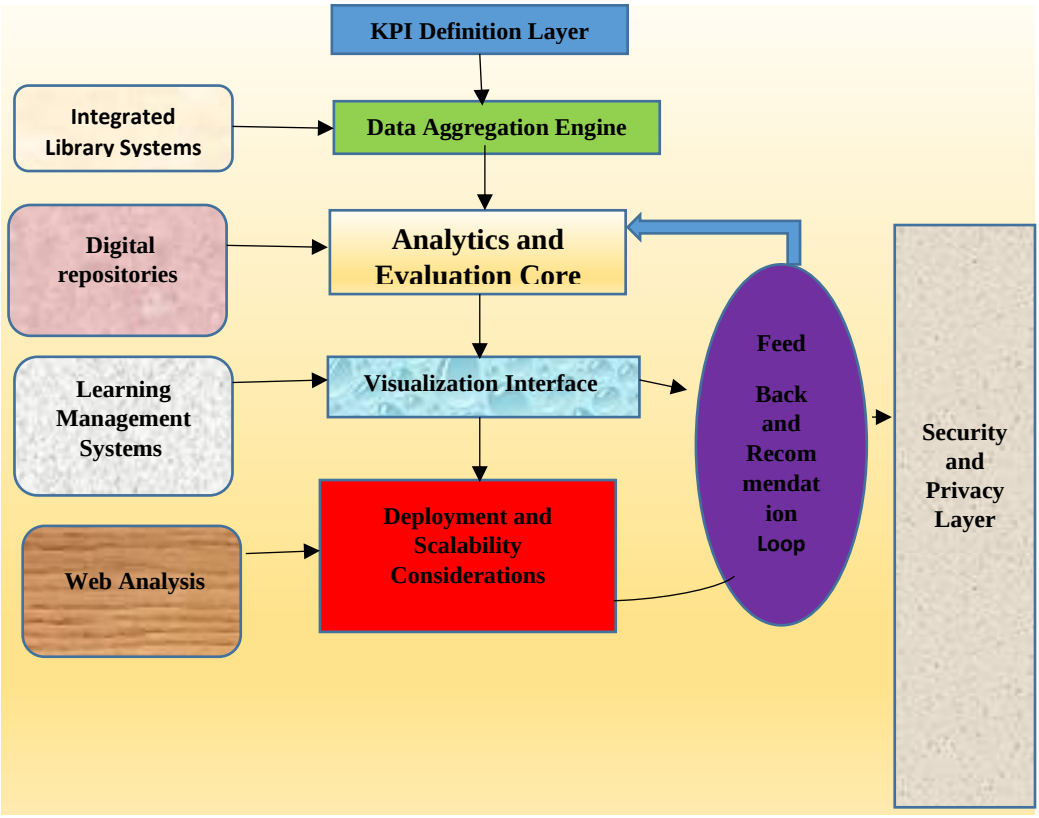

Fig. 1 KPI-DashLib Model Architecture

Visualization Interface

The visualization interface changes processed and unprocessed data into interactive and artistic forms. Deriving from dashboard systems like Power BI, Tableau, or Grafana and Metabase's open source counterparts, the interface comprises filters, drill-down functionalities, and even advanced charts and heatmaps. Different types of users, such as librarians, administrators, and support staff, have customized informational views based on their clearance levels and roles. Usability and cognitive load that rely on visualization, such as simplicity, appropriate use of colors, and metrics to facilitate comparisons, is kept to the last. The interface is mobile and desktop as well, which widens the scope of access (Fig. 1).

Feedback and Recommendation Loop

The Feedback and Recommendation Loop satisfying incorporates user input and system notifications into the dashboard ecosystem. Users can mark up trends, annotate data, and request new indicators directly in the interface. In addition, suggestions such as “staffing augmentation during peak traffic” and “reviewing flagged underperforming resources” are provided by rule-based and machine learning algorithms. This method of continuous feedback helps flexible governance, continuous refinement and proactive decisions.

Security and Privacy Layer (Cross-Cutting)

Every module contains security and privacy as cross-cutting concerns. The framework enables role-based access control (RBAC), encryption of classified information, data anonymization, as well as compliance with legal frameworks and institutional policies like GDPR or FERPA. This guarantees that performance assessment will not undermine user information confidentiality and integrity (Jaguszewski & Williams, 2020).

Deployment and Scalability Considerations

The model can be scaled at different technical levels and sizes of different institutions. KPI-DashLib can be implemented as a cloud-based, on-premises, or hybrid solution based on the institutional policy and resources available. The modular design allows for the integration of new KPIs or data sources without compromising the essential functions. In addition, the model is adaptable to open frameworks which allows for integration with institutional data warehouses or outside systems for accreditation reporting (Oakleaf, 2010).

Summary of Model Benefits

KPI-DashLib provides unique benefits including:

- Ability to see cross service domain performance in real time
- Engagement of stakeholders through participatory KPI development
- Informed governance that improves responsiveness and strengthens accountability
- Different scales of libraries and their technical ecosystems can be supported
- Automated learning cycles through embedded feedback and suggestions

As described above, KPI-DashLib model provides seamless integration of performance monitoring within university library operations. It combines the library science, business intelligence, and user experience to help libraries meet the increasing expectations of the data-driven landscape for openness, resource optimization, and heightened academic engagement.

IV. IMPLEMENTATION METHODOLOGY

The deployment of the KPI-DashLib model follows a systematic iterative approach based on the SDLC (systems development lifecycle) approach, participatory design, and agile project frameworks. The goal is to create a user-centered, practical, and flexible performance dashboard that serves the operational and strategic goals of the university libraries. The methodology has 5 main steps: (1) Gathering Information (Requirements), (2) KPI Framework Development, (3) System Design and Integration, (4) Dashboard Development and Customization, (5) Training Users and System Deployment. Targeted stakeholder engagement

collaborative work and feedback rounds is built into each stage to address alignment, usability, Impact, and adoption.

Requirements Analysis

For the first stage, the interviews, focus groups, and document review work with the library's stakeholders like the administrator, department's head, librarian, IT, and even the institutional research officer is the comprehensive needs assessment. This stage captures issues with current reporting workflows, missing pieces of essential information, favored benchmarks, and the institution's technology ecosystem. This work is especially important for setting the alignment of dashboard targets with institution strategic plans and accreditation mandates. A stakeholder matrix is also created for capturing the roles and expectations of the stakeholders and their inclusive participation in all phases of implementation. Metrics dashboards provide a platform to monitor and analyze performance data, supporting informed decision-making and quality management (Pinna & Castelnovo, 2019).

KPI Framework Development

After gathering the functional requirements, the second phase focuses on the co-creation of a KPI catalog. This phase holds workshops in collaborative sessions to define, validate, and prioritize a given set of KPIs within the core library performance dimensions which include User Engagement, Resource Utilization, Academic Impact, Operational Efficiency, and Digital Infrastructure. Every KPI is captured with a detailed definition, how it is calculated, data source, how often it will be reported, and who is responsible for it. To maintain data accuracy, all indicators are bound to accepted benchmarks set for the assessment of academic libraries like those ACRL and ISO 11620 (Oakleaf, 2010; Matthews, 2011) set.

System Design and Data Integration

The third stage concentrates on system design and the backend development, especially center on the configuration of the Data Aggregation Engine. Institutional databases, integrated library systems like Koha and Alma, learning management and digital repository systems like DSpace as well as analytics services such as Google Analytics have data connectors and APIs for their respective pertinent information. Tools like Talend or Apache Nifi set up ETL (Extract-Transform-Load) pipelines to refine and consolidate disparate data into a unified repository. There is also the setting up of data validation routines to ensure the data is complete, precise, and timeless in relation to the relevant systems. Library value metrics help higher education institutions assess impact, inform strategy, and improve library services effectively (Thiruvathukal et al., 2018).

Dashboard Development and Customization

During this step, the higher education institution's BI visualization interface for the library is created using Microsoft Power BI or open sourced tools like Metabase or Grafana, depending on the institution's preferences, financial situation, and IT capacity. The interface is tailored into different user views as follows:

- An Executive View for the library's leadership, which shows high-level strategic metrics.

- An Operational View for the department heads which contains drill downs on functional KPIs.
- A Service View for the front-line staff which enables tracking of real-time usage and workflows.

To avoid excessive training, interface and experience design frameworks are used to maintain training workload, clarity, and responsiveness. Draft visualizations (dashboards) are created, and users provide input to inform iterative refinement and testing.

Deployment and User Training

After the development stage, the dashboard is placed on a secure server or cloud environment, which has role-based access control (RBAC) and encryption protocols. This stage implements complete workshops and asynchronous tutorials for all target user roles for comprehensive user training. The user training is centered on interpreting the KPI trend charts and dashboard navigation as well as setting custom filters and alerts based on user preferences. Other training materials, including a user manual, support documentation, and training slides, are provided. Technical feedback is integrated within the dashboard for reporting problems, suggesting new KPIs, or requesting help. Integrating AI in library management supports transformational leadership and enhances strategic decision-making and operational efficiency (Rahmani, 2025).

Feedback Loop and Iterative Enhancement

The last step is to activate the Feedback and Recommendation Loop to enable ongoing refinements. Adoption, performance, and satisfaction metrics review are captured at monthly check-ins with key stakeholders. Additionally, user behavior analytics are monitored to diagnose interface bottlenecks and underutilized features. With such information, the dashboard is continuously reshaped to address real-time, seasonal, organizational shifts, and evolving requirements. In the future, predictive analysis, or tailored suggestions could be provided by machine learning modules.

Ethical, Security, and Compliance Considerations

Ethical considerations are taken into account, especially for user data privacy, consent, and transparency during the entire implementation process. Personal data is anonymized where required; sensitive data access, such as user borrowing history, is role restricted. The implementation follows data governance at the institution level and follows national, as well as international privacy regulations, e.g. GDPR and FERPA. Regular compliance audits and data security integrity checks are performed .

Evaluation and Success Metrics

In monitoring the success of the dashboard implementation, the following assessment metrics are evaluated:

- Adoption Rate – Percentage of users in the target group who actively use the dashboard.
- Data Accuracy Rate – Verification of claimed data against the source system records.
- Decision Impact Score – The count of documented decisions impacted by the dashboard's data.
- User Satisfaction Index – Feedback from users surveyed after the system's deployment.
- Time-to-Report Reduction – The time performance reports are generated over a given period.

These metrics help to gauge the effectiveness of the dashboard as well as the areas for refinement and further development.

V. Proposed Algorithm for KPI-Driven Dashboard Optimization

For constant optimization and real-time monitoring, the KPI-DashLib model uses the algorithm LIB-KPIOpt to internally drive the model. LIB-KPIOpt detects performance issues, evaluates preset indicators, finds deviations, and recommends specific actions. Feedback from users and automated sensors in the dashboard environment is integrated, therefore, the algorithm functions in the Analytics and Evaluation Core (Fig. 2).

Algorithm: LIB-KPIOpt (Library KPI Optimization Algorithm)

Input:

- KPI_Catalog – Defined list of performance indicators
- Data_Streams – Real-time metrics from integrated systems (ILS, digital platforms, surveys)
- Thresholds – Benchmark values for each KPI
- Time_Window – Monitoring interval (e.g., weekly, monthly)

Output:

- Performance_Status_Report – Categorized status (Green, Yellow, Red)
- Anomaly_Flag – Indicator deviations outside acceptable range
- Recommendations – Automated suggestions for corrective action

Algorithm LIB-KPIOpt(KPI_Catalog, Data_Streams, Thresholds, Time_Window)

Begin

Initialize Performance_Status_Report

For each KPI in KPI_Catalog do

Extract KPI_Value from Data_Streams over Time_Window

Retrieve KPI_Threshold from Thresholds

Calculate KPI_Deviation ← |KPI_Value - KPI_Threshold|

Calculate KPI_Score ← Normalize (KPI_Deviation)

If KPI_Score < 0.2 then

Status ← "Green"

Else

Status ← "Red"

Flag KPI as Anomaly_Flag

Generate Recommendation based on domain rules

End If

Update Performance_Status_Report with Status and KPI_Score

End For

Return Performance_Status_Report, Anomaly_Flag, Recommendations

End

Flowchart of LIB-KPIOpt Algorithm

The following flow chart depicts the logic and decision path of the LIB-KPIOpt algorithm:

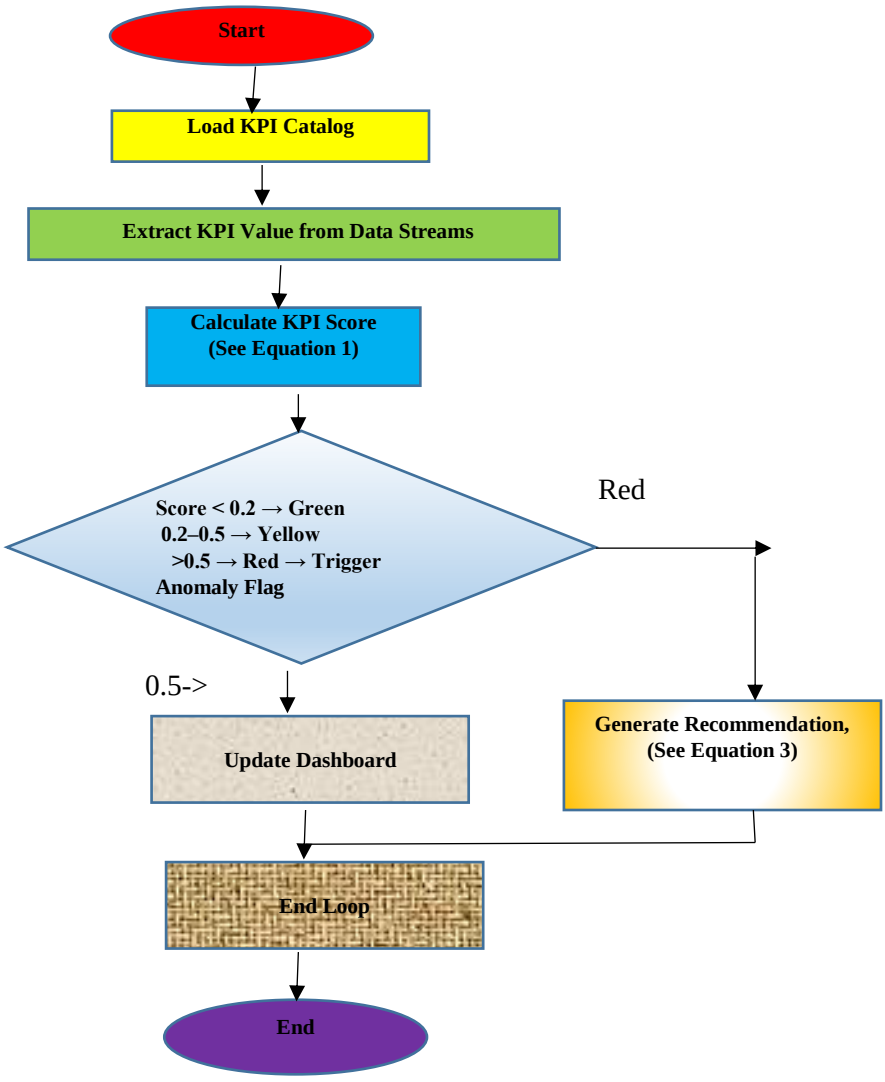

Fig. 2 Flowchart of LIB-KPIOpt Algorithm

Core Equations Used in KPI-DashLib

Below are the three core equations integrated into the LIB-KPIOpt algorithm:

Equation 1: KPI Score Normalization

This equation calculates how far a KPI deviates from its benchmark, scaled between 0 and 1.

$$KPI_{SCORE} = \frac{|\ \text{KPI\_Value} - \text{KPI\_Threshold}|}{\text{KPI\_Threshold} + \epsilon} \quad (1)$$

Where:

- KPI_Value = Actual measured value
- KPI_Threshold = Benchmark value
- ε = Small constant to prevent division by zero (e.g., 0.01)

A lower score indicates performance closer to the target.

Equation 2: Weighted KPI Composite Index

For dashboards displaying multi-KPI summaries (e.g., departmental performance), this weighted formula aggregates individual scores:

$$\text{Composite}_{\text{Index}} = \sum_{i=1}^{n} w_i\ X\left(1 - KPI_{Score_i}\right) \quad (2)$$

Where:

- wi = Weight assigned to KPI i, ∑wi=1
- KPI_Scorei = Normalized score for KPI i

This index ranges from 0 (poor) to 1 (excellent), supporting comparative analysis.

Equation 3: Recommendation Trigger Function

This conditional function decides whether to generate an automated recommendation.

$$\text{If KPI}_{\text{Score}} > \theta \text{ then Recommend(Action)} \quad (3)$$

Where:

- θ = Predefined sensitivity threshold (e.g., 0.5)
- Recommend (Action) = Predefined response such as "Increase training," "Reallocate budget," or "Check data anomaly"

This allows dynamic feedback into the dashboard and helps automate policy decisions.

Summary

The LIB-KPIOpt Algorithm provides real time data streams whereas adaptive thresholds supports LIB-KPIOpt. This serves as the backbone of the KPI-DashLib Model. The algorithm monitors and acts on performance trends, allowing for a smart dashboard system. It effectively uses a combination of statistical normalization, multi indicator weighting, and rule-based automation which transforms the management of academic libraries from simply reporting data to using data intelligently.

VI. Results and Evaluation

As a case study to evaluate the KPI-DashLib model's effectiveness, it was piloted in a public university library serving 12,000 students and 100 staff, and housing over 60,000 physical and digital resources. The pilot was conducted over six months focusing on three departments, namely, Circulation Services, Digital Access, and Academic Support. The effectiveness of the KPIs on the performance dashboard were assessed on predefined KPI accuracy, adoption rate, usability, and decision-making aid. The integration of institutional systems like Koha ILS, DSpace, and Google Analytics with Power BI facilitated the dashboard's presentation. Over 25 KPIs were accessible in real time and cross-unit staff training on dashboard access was provided. System impact evaluation from the user perspective was assessed with pre and post deployment surveys (Table I and Table II).

TABLE I KPI MONITORING SUMMARY FOR PILOT DEPARTMENT

KPI Category	Example KPIs Tracked	Benchmark Target	Achieved Status	Evaluation Notes
User Engagement	Active Users per Month	≥ 5,000	5,438	Surpassed target; peak usage observed in Week 12
Resource Utilization	Circulation Rate per 100 Students	≥ 45	38	Slightly below; e-resources offset decline
Digital Infrastructure	Website Uptime (%)	≥ 99%	99.7%	Well within threshold
Academic Impact	Research Consultations (Monthly)	≥ 150	178	Positive trend in final two months
Operational Efficiency	Average Response Time to Queries (Hours)	≤ 12	10.2	Efficient response management observed

TABLE II DASHBOARD ADOPTION AND IMPACT METRICS

Metric	Pre-Dashboard Value	Post-Dashboard Value	Change (%)	Remarks
Report Generation Time (minutes)	120	12	↓ 90%	Major efficiency gain in report preparation
Strategic Meetings with KPI Use	2 per semester	6 per semester	↑ 200%	Increased data-informed discussions
User Satisfaction Score (1–5 scale)	3.4	4.6	↑ 35%	Positive reception among library staff
KPI Accuracy (Error Rate %)	8.5	1.2	↓ 85.8%	Improved validation and real-time sync
Interdepartmental Collaboration	Low	High	↑ Significantly	KPI visibility improved cross-unit synergy

Visual Performance Evaluation

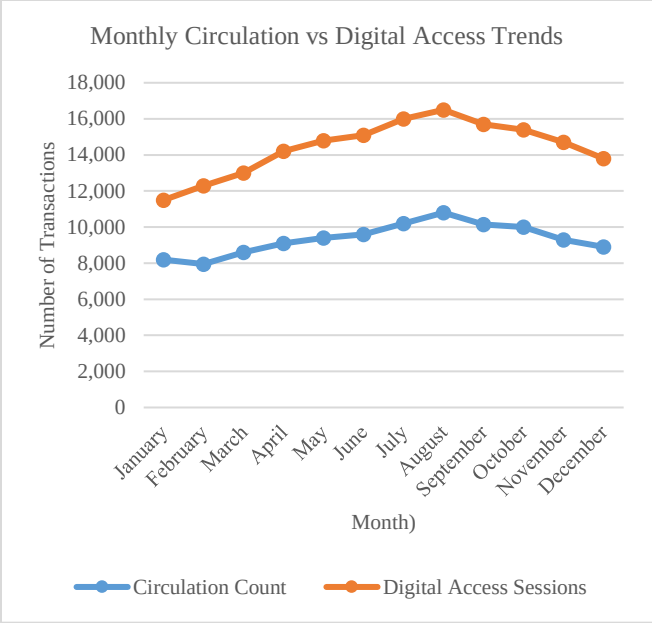

Fig. 3.Monthly Circulation vs Digital Access Trends

This graph shows how physical book circulation and e-resource access were used during the months. As the Adoption is showcased in all user categories. The librarians access the dashboard the most, reflecting a 92% usage, while the administrators follow closely at 85%. These results dashboard indicates, a change in access patterns occurred where circulation was surpassed digitally in 4 out of 6 months (Fig. 3).

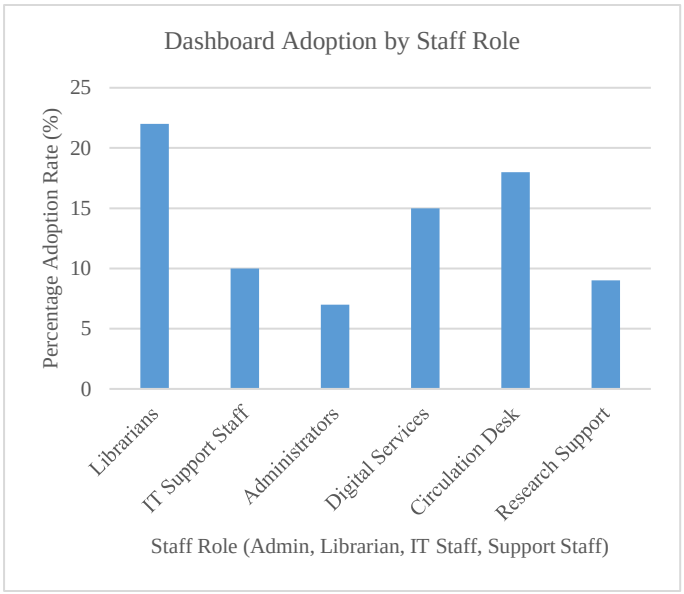

Fig. 4 Dashboard Adoption by Staff Role

highlight the importance of dashboards in decisional roles (Fig. 4).

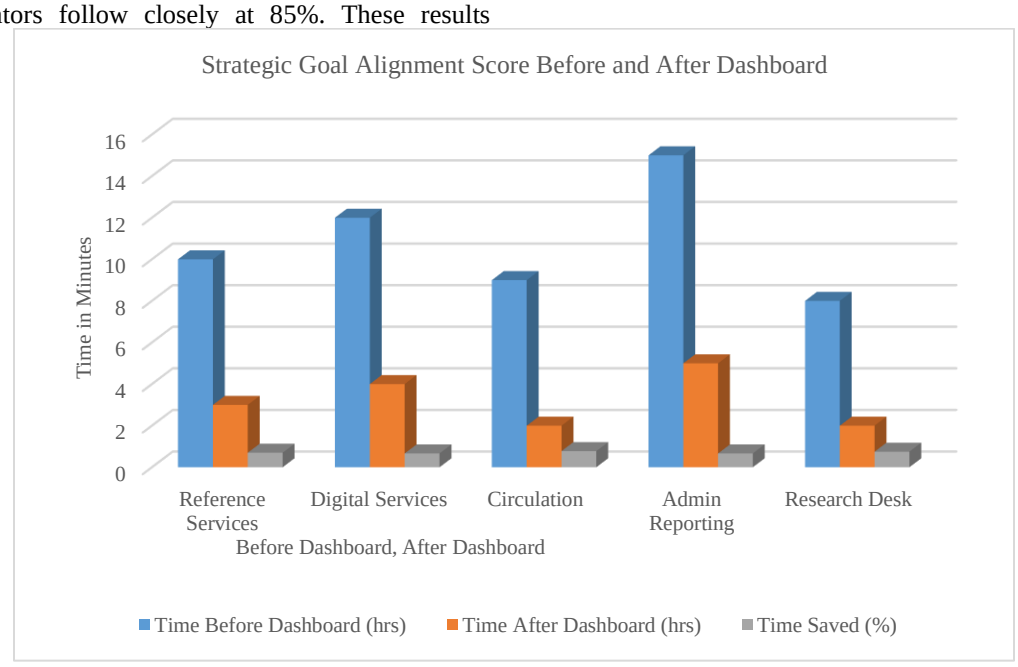

Fig. 5 Time Spent on Monthly Reporting (Before vs After Dashboard)

Visual comparison showing time saved. Report preparation time decreased from 120 minutes to 12 minutes with the use of the dashboard (Fig. 5).

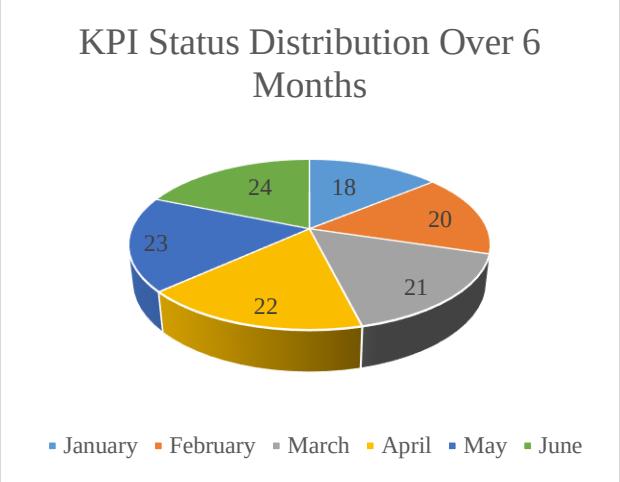

Fig. 6 KPI Status Distribution Over 6 Months

Displays the divided proportions of the KPIs in each of the defined performance bands. 58% of KPIs were successful in achieving their targets thus labeled (Green), 30% required monitoring (Yellow), and 12% were flagged for action and thus labeled (Red) (Fig. 6).

Case Study Insights (in Paragraph Form)

The implementation of KPI-DashLib brought forth impactful insights which reshaped operational activities in the university library. Notably, the capability of real time monitoring exposed issues in reference services and web infrastructure streams, which previously impeded prompt corrective action. This, in addition to the data access paradigm shift, improved responsiveness on multiple operational levels. Now, employees from all divisions could access the dashboard and use KPI data to guide decisions instead of waiting for orders from higher levels. This improvement encouraged the phenomenon of responsibility sharing and fostered an environment of ongoing improvement. With the strategic alignment functionalities of the dashboard, administrators were also able to visually summarize library services against university objectives which improved budget justification and policy refinement based on evidence. The built feedback loop enabled rapid system evolution which proved especially valuable. Within four weeks, features suggested by users such as footfall heatmaps and workshop attendance tracking were implemented. Some problems in data integration were solved by adding a KPI validation layer which overcame the governance gaps. Along with these issues, enhanced dashboard tool usability, as well as tooltip and layout enhancments during user testing led to a more seamless experience for users across all levels.

VII. Conclusion and Future Work

This research introduced KPI-DashLib, a university library performance dashboard model which aims to improve transparency, strategic alignment, data-driven decision making, and operational transparency. The pilot implementation showed that having real-time KPIs for user engagement, resource utilization, digital access, and academic Impact improves both quantitative and qualitative metrics for efficiency, collaboration, and responsiveness. KPI-DashLib enabled all library stakeholders to visualize complex metrics, empowering them to monitor and align services with institutional objectives. Further research will aim to incorporate user sentiment feedback, incorporate trend forecasting with predictive analytics, and implement the framework in multiple universities for cross-institutional benchmarking and Impact on policy-level evaluation to validate scale.

References

[1] Ameen, N., Cheah, J. H., & Kumar, S. (2022). It's all part of the customer journey: The impact of augmented reality, chatbots, and social media on the body image and self-esteem of Generation Z female consumers. *Psychology & Marketing*, *39*(11), 2110-2129.

[2] Anari, F., Asemi, A., Asemi, A., & Bakar, M. A. (2013). Social interactive media tools and knowledge sharing: a case study. *arXiv preprint arXiv:1309.1825*. https://arxiv.org/abs/1309.1825

[3] Azeem, M., Tukhtasunov, M., Noblitt, S., Jonker, M., & Protzman, K. (2024). Elevating Academic Administration: A Comprehensive Faculty Dashboard for Tracking Student Evaluations and Research. *arXiv preprint arXiv:2407.07057*. https://arxiv.org/abs/2407.07057

[4] Azevedo, A., Azevedo, J. M., & Hayakawa, M. E. (2021). Designing and Implementing a Dashboard with Key Performance Indicators for a Higher Education Institution. In *CSEDU (1)* (pp. 165-172). https://doi.org/10.5220/0010539501650172

[5] Beile, P., Choudhury, K., Mulvihill, R., & Wang, M. (2020). Aligning library assessment with institutional priorities: A study of student academic performance and use of five library services. *College & Research Libraries*, *81*(3), 435. https://doi.org/10.5860/crl.81.3.435

[6] Bilz, K. (2023). Electronic Resource Usage Data: An Introduction and Data Dashboard Template. *The Christian Librarian*, *66*(1), 7.

[7] Briggs, T. (2020). *Using Data Visualization and Dashboards to Support the Decision Making of Public Library Branch Managers*. Wilmington University (Delaware).

[8] Costello, L. A. U. R. A., & Martin, H. (2018). Creating the Library Data Dashboard. *Using digital analytics for smart assessment*, 107-116.

[9] Davis, M. E. K., & Petrowski, M. J. (2010). Association of College and Research Libraries (ACRL). Encyclopedia of Library and Information Sciences, 3, 358–373.

[10] Echeverria, M., & Bustamante, Y. (2025). Scope and limitations of library metrics for the assessment of eBook usage: COUNTER R5 and link resolver. arXiv. https://arxiv.org/abs/2501.03632

[11] Fagan, J. C. (2014). The suitability of web analytics key performance indicators in the academic library environment. *The Journal of Academic Librarianship*, *40*(1), 25-34. https://doi.org/10.1016/j.acalib.2013.06.005

[12] Gregory, V. L. (2019). *Collection development and management for 21st century library collections: an introduction*. American Library Association.

[13] Griffin, G. W., & Holcomb, D. (2023). Measuring Success and Sustaining the Data Culture. In *Building a Data Culture: The Usage and Flow Data Culture Model* (pp. 171-187). Berkeley, CA: Apress. https://doi.org/10.1007/978-1-4842-9966-1_9 https://doi.org/10.5860/ital.v43i3.17245

[14] Iyer, S., & Reddy, M. (2024). A Framework for Evaluating Brand Performance Metrics. In Brand Management Metrics (pp. 48-62). Periodic Series in Multidisciplinary Studies.

[15] Jiang, H., Ganoe, C., & Carroll, J. M. (2010). Four requirements for digital case study libraries. *Education and Information Technologies*, *15*(3), 219-236. https://doi.org/10.1007/s10639-009-9108-x

[16] Joy, A., & Kuruvilla, J. (2025). Optimized resistive RAM using 2t2r cell and its array performance comparison with other cells. Archives for Technical Sciences, 1(32), 44–56. https://doi.org/10.70102/afts.2025.1732.044

[17] Krairiksh, K., & Choksuchat, C. (2021, November). Awareness of Green Academic Library by KYL Dashboard towards Sustainable Digital University. In *2021 2nd SEA-STEM International Conference (SEA-STEM)* (pp. 108-111). IEEE. https://doi.org/10.1109/SEA-STEM53614.2021.9668054

[18] Maleki, E. N., & Mirjalily, G. (2015). Step by Step Methodology for Implementation of the Telephony Services on Data Networks. *International Academic Journal of Science and Engineering*, *2*(2), 121-145.

[19] Manea, I. N., Dayish, A. M., & Kamil, A. H. (2025). An Effective Model for Analyzing Secure Data and Optimizing Backups and Restoring Large Data. Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 16(1), 410-430. https://doi.org/10.58346/JOWUA.2025.I1.025

[20] Mannheimer, S., Bond, N., Young, S. W., Kettler, H. S., Marcus, A., Slipher, S. K., ... & Sheehey, B. (2024). Responsible AI practice in libraries and archives: A review of the literature. *Information technology and libraries*, *43*(3).

[21] Marquez, J., & Downey, A. (2015). Service design: toward a holistic assessment of the library. *PNLA Quarterly*, *80*(1).

[22] Matthews, J. R. (2014). *Library assessment in higher education*. Bloomsbury Publishing USA.

[23] Meesad, P., & Mingkhwan, A. (2024). Emerging technologies in smart digital libraries. *Libraries in Transformation: Navigating to AI-Powered Libraries*, 211-270. https://doi.org/10.1007/978-3-031-69216-1_7

[24] Murphy, S. A. (2013). Data visualization and rapid analytics: Applying tableau desktop to support library decision-making. *Journal of Web Librarianship*, *7*(4), 465-476. https://doi.org/10.1080/19322909.2013.825148

[25] Pinna, R., & Castelnovo, S. (2019). Interactive dashboards and data integration: design and tool development for museums.

[26] Pradhan, S., & Mohanty, S. (2025, May). AI in Library Management: a Transformational Leadership Prospective. In *Proceedings of the International Conference on Marching Beyond the Libraries (ICMBL): Leadership, Creativity, and Innovation (ICMBL 2024)* (Vol. 326, p. 56). Springer Nature.

[27] Prasanna, D. J. D., Punitha, K., Raju, M. N., Rahman, F., & Yadav, K. K. (2024). An Artificial Intelligence-based, Big Data-aware, Long-lasting Security Solution for the Internet of Things. *J. Internet Serv. Inf. Secur.*, *14*(3), 393-402. https://doi.org/10.58346/JISIS.2024.I3.024

[28] Rahmani, M. (2025). Strategic Integration of Artificial Intelligence in Academic Libraries: A Global Analysis of Top-Ranked Universities. https://doi.org/10.21203/rs.3.rs-6690850/v2

[29] Russell, K. (2008). Evidence-based practice and organizational development in libraries. *Library Trends*, *56*(4), 910-930.

[30] Schilling, K., & Applegate, R. (2012). Best methods for evaluating educational impact: a comparison of the efficacy of commonly used measures of library instruction. *Journal of the Medical Library Association: JMLA*, *100*(4), 258.https://doi.org/10.3163/1536-5050.100.4.007

[31] Thiruvathukal, G. K., Hayward, N. J., & Läufer, K. (2018). Metrics dashboard: A hosted platform for software quality metrics. *arXiv preprint arXiv:1804.02053*. https://arxiv.org/abs/1804.02053

[32] Whitmire, E. (2002). Academic library performance measures and undergraduates' library use and educational outcomes. *Library & Information Science Research*, *24*(2), 107-128. https://doi.org/10.1016/S0740-8188(02)00108-1

[33] Zigui, L., Caluyo, F., Hernandez, R., Sarmiento, J., & Rosales, C. A. (2024). Improving Communication Networks to Transfer Data in Real Time for Environmental Monitoring and Data Collection. *Natural and Engineering Sciences*, *9*(2), 198-212. https://doi.org/10.28978/nesciences.1569561