PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312

International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

Optimizing Research and Extension Repositories through Integrated Decision Support Systems

Maryjes G. Calades, PhD*[1], Zaldy A. Jabiñar[2]
[1, 2] Samar State University, Catbalogan City, Philippines
*Corresponding Author e-mail: *maryjes.calades@ssu.edu.ph*

Received: 27 March 2026 **Revised**: 23 May 2026 **Accepted**: 02 June 2026

Available Online: 04 June 2026

Volume 1 (2026), Issue 2, P-ISSN – 3116-4439; E-ISSN - 3116-4447

https://doi.org/10.63498/ijictaidi4

Abstract

Aim. This study aimed to design, develop, and evaluate a Decision Support System (DSS)-integrated Research and Extension Management System (REMS) to improve data management, accessibility, analytics, and evidence-based decision-making in academic institutions. Specifically, the system was evaluated using ISO/IEC(International Organization for Standardization and the International Electrotechnical Commission) 9126 software quality indicators, including functionality, usability, efficiency, reliability, portability, and maintainability.

Methodology. The study employed a quantitative developmental research design using the Agile development model. Forty full-time faculty members from the College of Arts and Sciences of Samar State University were purposively selected as respondents. Data were collected through a validated survey questionnaire based on the ISO/IEC 9126 framework, and weighted mean was used for statistical analysis.

Results. Findings revealed that the system achieved high evaluation ratings across all software quality indicators, with weighted means ranging from 4.47 to 4.65. Reliability (WM = 4.65), efficiency (WM = 4.64), and functionality (WM = 4.62) obtained the highest ratings, indicating strong system stability, responsiveness, and operational capability. Usability (WM = 4.57) and portability (WM = 4.58) also received high ratings, reflecting user-friendly design and adaptability across platforms. Maintainability (WM = 4.47) received the lowest yet still positive evaluation, suggesting opportunities for further enhancement in long-term system sustainability and updates.

Conclusion. The study concludes that the DSS-integrated REMS is highly effective and suitable for implementation as an intelligent digital repository system. The platform has significant potential to enhance institutional data management, analytics, and ICT-enabled decision-making processes, thereby supporting digital transformation and evidence-based governance in higher education institutions.

Keywords: *decision support system, institutional repository, data analytics, software quality evaluation, ISO/IEC 9126*

INTRODUCTION

The accelerating pace of digital transformation and technological innovation has fundamentally reshaped the landscape of higher education and research ecosystems. Across the globe, academic institutions are increasingly leveraging advanced information and communication technologies (ICT), artificial intelligence (AI), and data-driven platforms to enhance knowledge creation, management, and dissemination. This transformation is driven by the exponential growth of digital data, the need for real-time decision-making, and the increasing demand for transparent, accessible, and evidence-based institutional processes (Masinde & Sanya, 2022). As universities continue to expand their research and extension functions, the effective management of scholarly outputs has become a critical component of digital innovation and institutional competitiveness.

In this context, academic institutions generate vast and diverse volumes of data, including research publications, technical reports, datasets, extension program outputs, and evaluation documents. While institutional repositories have been widely adopted as centralized digital platforms to organize and disseminate these resources, many existing systems remain limited in functionality. Most repositories are designed primarily for storage and retrieval,

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
Information · AI · Digital Innovation
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P – ISSN: 3116-4439; E – ISSN: 3116-4447

lacking advanced capabilities such as intelligent search, automated analytics, and interactive visualization. Consequently, users often encounter challenges in navigating large datasets, extracting relevant information, and transforming raw data into actionable knowledge (Masinde et al., 2022). These limitations reflect broader challenges in current ICT systems, where the integration of AI-driven analytics and user-centered design remains insufficiently developed.

The absence of intelligent functionalities becomes more critical during key institutional processes such as accreditation, program evaluation, research monitoring, and strategic planning. These activities require timely access to accurate, well-structured, and analyzable data. However, in many cases, stakeholders must manually retrieve, organize, and interpret information from fragmented or non-optimized systems. This not only reduces operational efficiency but also increases the risk of incomplete analysis and suboptimal decision-making. Despite the availability of large volumes of institutional data, the lack of integrated analytical tools and decision-support mechanisms limits the ability of organizations to fully leverage their information assets for strategic and data-driven governance.

To address these challenges, the integration of Decision Support Systems (DSS) into institutional repositories has emerged as a promising technological innovation. A Decision Support System (DSS) is a computer-based, interactive system designed to assist decision-makers by combining data, analytical models, and knowledge resources to analyze complex problems and enhance decision-making processes (Alahmadi & Jamjoom, 2022; Rizzi, 2024; Kostopoulos et al., 2024). Unlike traditional repositories, DSS-enabled platforms incorporate advanced features such as intelligent search algorithms, automated data analysis, predictive modeling, and interactive dashboards. These capabilities enable users to generate insights, identify trends, and make informed decisions more efficiently. Recent studies highlight that embedding DSS functionalities into digital platforms transforms passive information systems into intelligent knowledge environments that support institutional learning and data-driven decision-making (Mucha, 2022; Adeyemi & AlOtaibi, 2025).

Empirical evidence further supports the importance of integrating analytics, visualization, and usability features into ICT systems. For instance, Narlock et al. (2024) demonstrate that repositories enhanced with data visualization and dashboard tools significantly improve the efficiency and accuracy of institutional decision-making. Similarly, Kindling and Strecker (2022) emphasize that data validation mechanisms and well-designed interfaces enhance user trust and system reliability. Moreover, advancements in AI-driven DSS platforms, including recommendation systems and predictive analytics, have been shown to improve user engagement, facilitate knowledge discovery, and support proactive decision-making (Knoth et al., 2023; Zhang & Wu, 2024). Usability studies also indicate that user-centered design, intuitive navigation, and responsive interfaces are critical factors influencing system adoption and effectiveness (Hussein et al., 2023).

Despite these technological advancements, a significant research gap remains in the integration of DSS functionalities within institutional repositories, particularly in the context of research and extension management systems. Many existing studies focus either on repository development or DSS implementation as separate domains, with limited exploration of their combined application in academic environments. Furthermore, there is a lack of comprehensive frameworks that integrate data analytics, decision support, and user-centered design within a unified platform tailored to institutional needs.

Addressing this gap is essential for advancing digital innovation in higher education. The development of DSS-enabled institutional repositories has the potential to transform traditional digital archives into intelligent platforms that support knowledge discovery, performance monitoring, and strategic planning. Such systems can enhance the accessibility, usability, and analytical value of institutional data, enabling universities to make informed decisions, improve operational efficiency, and foster sustainable development. Ultimately, integrating DSS into repository systems represents a critical step toward achieving data-driven governance and strengthening the role of ICT in academic and research environments.

Review of Related Literature and Studies

Institutional Knowledge Management Repositories

In academic settings, Decision Support System (DSS) functionalities enhance institutional repositories by enabling intelligent search, automated data analysis, predictive modeling, and interactive visual dashboards that summarize key institutional indicators. Learning analytics dashboards integrate descriptive and predictive analytics to generate actionable insights for academic and administrative decision-making (Susnjak et al., 2022; Ramaswami et al., 2023). Similarly, business intelligence systems transform complex datasets into visual representations that support performance monitoring and data-driven strategic planning (Tang et al., 2022). Through the integration of

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
Information · AI · Digital Innovation
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

analytics, predictive capabilities, and data visualization, traditional repositories evolve into intelligent knowledge platforms that strengthen institutional learning, planning, and decision-making processes (Ujir et al., 2025; Pandey et al., 2024).

System Usability and Design for Institutional Repositories

The usability and design of institutional repositories (IRs) are critical for their effectiveness and user adoption. Complex interfaces and poor search functions limit access to information, as many IRs are designed from a system-centered rather than user-centered perspective (González-Pérez et al., 2021; Panda & Kaur, 2023; Kalimashe, 2023). Applying user-centered design principles—such as intuitive navigation, structured content, and efficient search—enhances usability and adoption (Zhao et al., 2023). Effective metadata management, aligned with FAIR principles, further improves discoverability, interoperability, and sustainability (Martínez-García et al., 2023). Together, these approaches ensure IRs are efficient, accessible, and user-friendly.

Systems for Information Management Decision Support

Contemporary literature underscores the significant role of Artificial Intelligence (AI) and data-driven systems in enhancing Decision Support Systems (DSS) for information management. Mamun (2025) emphasized that AI-driven and data-oriented systems improve organizational decision-making by generating timely, accurate, and actionable insights. Similarly, intelligent DSS platforms integrated with advanced analytics and AI technologies have been shown to enhance institutional efficiency and decision-making effectiveness (Keshireddy, 2024). Moreover, AI-based DSS applications strengthen complex analytical processes, including risk assessment and fraud detection, although their long-term effectiveness remains dependent on organizational readiness and user acceptance factors (Goyal et al., 2025).

Decision Support System Integration with Digital Repositories

Recent research emphasizes the need to integrate analytical and decision-support capabilities into institutional repositories, which traditionally serve only as storage and access platforms. By embedding advanced data management, analytics, and dashboards, repositories can support institutional planning, evidence-based decision making, and enhanced oversight of research data flows (He & Fang, 2024; Dube, 2025). Such integrations improve usability, interoperability, and functionality, enabling administrators and researchers to generate actionable insights, monitor performance, and strengthen strategic governance.

Synthesis of Literary Works

Despite advances in repository usability, metadata management, and digital accessibility, a key gap remains in integrating advanced analytics and decision-support capabilities into institutional repositories. Most studies address design or data management independently, with limited focus on transforming repositories into intelligent, user-centered platforms that support predictive analytics, performance monitoring, and evidence-based institutional decision-making. Addressing this gap is crucial for enhancing repository functionality, accessibility, and strategic impact in higher education.

Theoretical Framework

This study is grounded in an integrative framework combining Knowledge Management Theory (KMT), Decision Support System (DSS) Theory, and the Technology Acceptance Model (TAM) to explain how institutional repositories can evolve into intelligent, user-centered, and data-driven platforms. These theories support the enhancement of repositories through analytics, artificial intelligence (AI), and user-centered design to improve knowledge utilization and institutional decision-making.

Knowledge Management Theory (Nonaka & Takeuchi, 1995) explains how knowledge is created and transformed through the SECI model. Recent studies highlight that institutional repositories function as key infrastructures for managing and disseminating knowledge but must evolve beyond passive storage by integrating analytics and intelligent systems to enable knowledge discovery and reuse (He & Fang, 2024; Dube, 2025).

DSS Theory provides the analytical foundation by emphasizing the integration of data management, modeling, and visualization to generate actionable insights. Advances in AI, predictive analytics, and dashboards have strengthened decision-making and institutional planning in academic environments (Kostopoulos et al., 2024).

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P – ISSN: 3116-4439; E – ISSN: 3116-4447

Meanwhile, TAM (Davis, 1989) explains system adoption through perceived usefulness and ease of use. Recent research confirms that user-centered design, intuitive interfaces, and efficient search functionalities significantly influence repository usability and user acceptance (Alahmadi & Jamjoom, 2022; Zhao et al., 2023).

Overall, the integration of KMT, DSS, and TAM provides a comprehensive framework for developing DSS-enabled institutional repositories that enhance knowledge management, support data-driven decision-making, and improve system usability and adoption.

Conceptual Framework

A conceptual framework diagram is presented and appropriately discussed to illustrate the study's overall structure. However, the study may be further strengthened by clearly defining key components and incorporating technical diagrams, such as the system architecture, database flow, and DSS workflow, to enhance clarity and technical presentation.

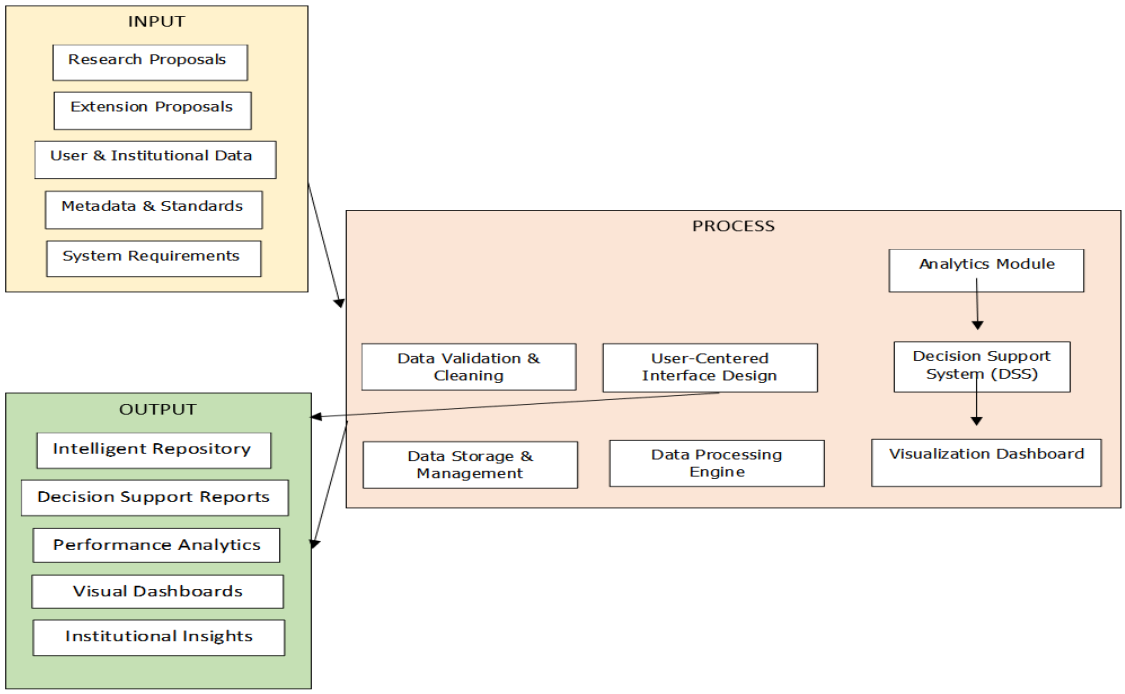

Figure 1. Conceptual Framework

Figure 1. Conceptual Framework presents an enhanced Input–Process–Output (IPO) model integrated with Analytics and a Decision Support System (DSS) to illustrate the overall architecture of the study. In the input phase, the system captures diverse institutional data, including research proposals, extension proposals, user and institutional records, metadata standards, and system requirements, which serve as the foundational datasets for analysis and processing.

The process phase involves a series of systematic operations, including data validation and cleaning, user-centered interface design, data storage and management, and advanced data processing and analytics. These are further supported by DSS functionalities that enable structured evaluation and interpretation of institutional data.

In the output phase, the processed information is transformed into actionable outputs such as an intelligent repository, decision support reports, performance analytics, visual dashboards, and institutional insights. Overall, the framework demonstrates how institutional data is systematically transformed into meaningful, analytics-driven outputs that support evidence-based decision-making, enhance operational efficiency, and strengthen strategic planning within the organization.

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
P - ISSN: 3116-4439; E - ISSN: 3116-4447

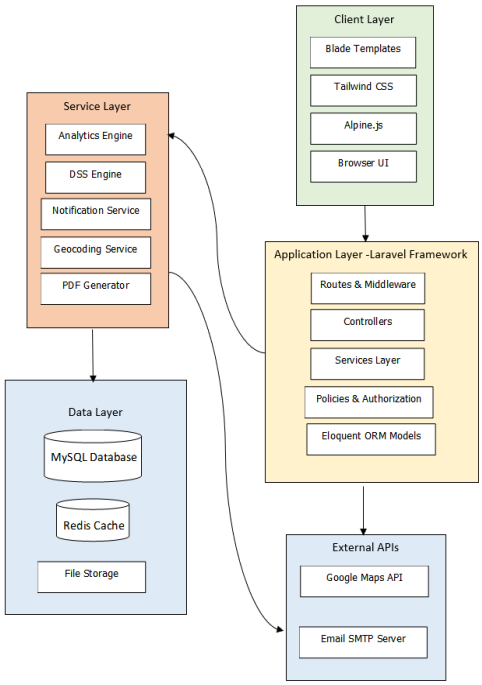

Figure 2. System Architecture Diagram

Figure 2. System Architecture Diagram illustrates the overall technical architecture of the proposed system, highlighting the interaction among the Client Layer, Application Layer, Service Layer, Data Layer, and External APIs. The Client Layer manages user interaction through Blade Templates, Tailwind CSS, Alpine.js, and the browser interface, providing a responsive and user-friendly front end. The Application Layer, powered by the Laravel Framework, handles routing, controllers, services, authorization, and database models to ensure structured application logic and secure processing. The Service Layer delivers core system functionalities, including analytics, decision support, notifications, geocoding, and PDF generation. The Data Layer manages persistent storage using MySQL, Redis Cache, and file storage, ensuring efficient data organization and retrieval. External APIs, such as Google Maps API and Email SMTP Server, extend system capabilities by enabling location-based services and communication features. Overall, the architecture demonstrates an integrated and secure flow of data, efficient transaction processing, and seamless decision-support functionality across system components.

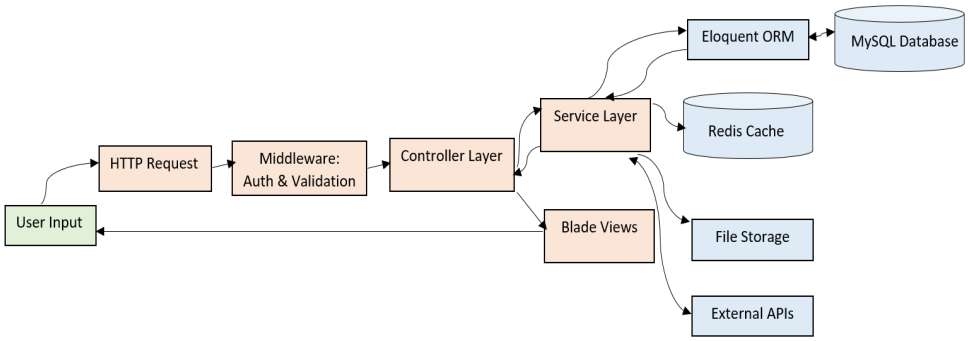

Figure 3. Database Flow Diagram

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

Figure 3. Database Flow Diagram presents the structured movement and optimization of data within the system through two complementary processes: transaction flow and data enrichment flow. The transaction flow describes how a user request is processed in a sequential manner from the user interface through the controller, service layer, ORM, and database, before returning a structured response, ensuring consistency, reliability, and traceability of data operations. In parallel, the data enrichment flow illustrates how the service layer enhances system performance by integrating caching mechanisms for faster data retrieval, file storage for document management, and external APIs for supplementary data such as mapping and geolocation services. Together, these processes define a scalable and high-performance database architecture that improves system responsiveness, efficiency, and overall data management using MySQL and supporting technologies.

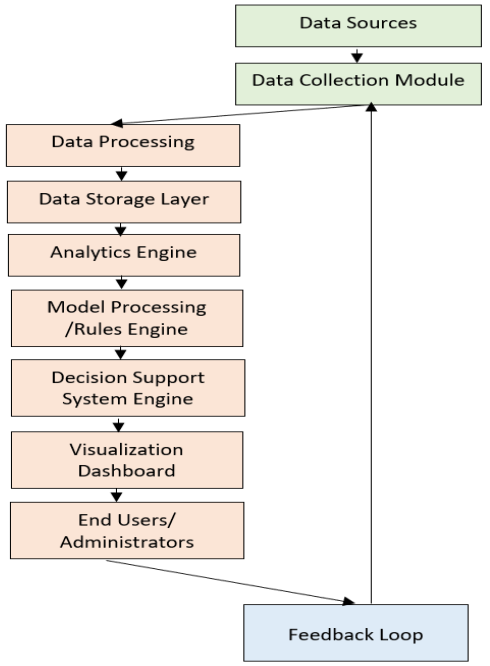

Figure 4. DSS workflow architecture

Figure 4. DSS Workflow Architecture depicts the end-to-end decision support process of the system, illustrating how raw institutional data is transformed into actionable insights through interconnected stages. The process begins with data acquisition, where research proposals, extension outputs, and user interactions are collected as primary inputs. This is followed by the processing and analytics stage, where data undergo cleaning, aggregation, and statistical computation to ensure accuracy and consistency. The refined data is then evaluated by the DSS engine, which applies rule-based evaluation, performance scoring, and trend analysis to generate meaningful interpretations. In the output generation stage, results are presented through dashboards, reports, and institutional insights that support evidence-based decision-making. Finally, a feedback loop continuously refines the system by improving future data inputs and strengthening the learning cycle, ensuring that the DSS remains adaptive, intelligent, and data-driven over time.

Statement of the Problem

The rapid advancement of digital transformation, intelligent information systems, and data-driven governance has significantly changed how higher education institutions manage research and extension activities. Despite the increasing adoption of institutional repositories and digital platforms, many academic institutions continue to rely on manual or semi-digital processes for storing, monitoring, and evaluating research and extension outputs. These

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

fragmented approaches often result in inefficient data management, delayed reporting, limited accessibility, inconsistent data validation, and reduced capability for evidence-based decision-making.

At Samar State University's College of Arts and Sciences, research and extension records are largely managed through manual documentation and isolated digital processes. This situation limits the institution's ability to efficiently monitor project lifecycles, generate real-time analytical reports, track institutional performance indicators, and support accreditation and quality assurance requirements. Existing repository systems also lack intelligent functionalities such as automated analytics, visualization dashboards, predictive monitoring, and integrated decision support capabilities.

The absence of a centralized and DSS-enabled repository constrains institutional capacity for data-driven governance, operational efficiency, and strategic planning. Furthermore, the limited integration of analytics, intelligent reporting, and user-centered digital tools reduces the overall effectiveness and usability of institutional information systems. These technological gaps highlight the need to design, develop, and evaluate an intelligent Decision Support System (DSS)-integrated Research and Extension Management System (REMS) that enhances data accessibility, analytical processing, system reliability, and evidence-based institutional decision-making.

Research Objectives

General Objective

To design, develop, and evaluate a Decision Support System (DSS)-integrated Research and Extension Management System (REMS) that enhances data management, accessibility, analytics, and evidence-based decision-making in higher education institutions.

Specific Objectives

Specifically, this study aims to:

1. Develop a DSS-integrated repository using institutional research and extension data with functionalities for advanced search, analytics, visualization, and reporting.
2. Design the system architecture, database structure, user interface, and visualization components to ensure usability, efficiency, and interoperability.
3. Implement systematic data management processes, including data collection, validation, storage, retrieval, and processing, to ensure data accuracy and consistency.
4. Integrate Decision Support System (DSS) functionalities such as data analytics, automated reporting, real-time dashboards, and performance monitoring tools to support institutional decision-making.
5. Enhance user interaction and accessibility through responsive dashboards, visualization tools, and user-centered interface design.
6. Evaluate the developed system using ISO/IEC 9126 software quality standards in terms of:
   6.1 functionality,
   6.2 usability,
   6.3 efficiency,
   6.4 reliability,
   6.5 portability, and
   6.6 maintainability.

Research Questions

1. How can a Decision Support System (DSS)-integrated Research and Extension Management System (REMS) be developed using institutional research and extension data?
2. What system architecture, database structure, user interface, and visualization components are appropriate for ensuring usability, efficiency, and interoperability of the system?
3. How can systematic data management processes such as data collection, validation, storage, retrieval, and processing be implemented to improve data accuracy and consistency?
4. How can DSS functionalities such as analytics, automated reporting, dashboards, and performance monitoring support evidence-based institutional decision-making?
5. How do interactive dashboards and visualization tools enhance user interaction, accessibility, and data interpretation?

ETCOR's Website : https://etcor.org
Facebook Page : https://www.facebook.com/EmbracingTheCultureOfResearch
Twitter Account : https://twitter.com/ETCOR_research
YouTube Channel : https://tinyurl.com/YouTubeETCOR
E-mail Address : embracingthecultureofresearch@etcor.org
Mobile Number : 0939-202-9035

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

6. How may the developed system be evaluated using ISO/IEC 9126 software quality standards in terms of:
   6.1 functionality,
   6.2 usability,
   6.3 efficiency,
   6.4 reliability,
   6.5 portability, and
   6.6 maintainability?

Hypothesis

H0: There is no significant positive evaluation of the developed DSS-integrated Research and Extension Management System (REMS) in terms of functionality, usability, efficiency, reliability, portability, and maintainability based on ISO/IEC 9126 software quality standards.

METHODS

Research Design

This study used a quantitative developmental research design combined with system development methodology to create and evaluate a DSS-integrated research and extension repository. The Agile Development Model was selected because it supports iterative refinement, rapid prototyping, continuous user feedback integration, and flexible system enhancement, which are essential in developing intelligent and user-centered DSS platforms. Consistent with these principles, the development process adopted an iterative and adaptive approach that enabled continuous improvement throughout the project lifecycle. The Agile framework guided the system through four major phases: (1) needs assessment and requirements analysis, (2) system design including database, interface, and DSS integration, (3) development and implementation, and (4) testing and evaluation, ensuring that the system remained aligned with user needs, functional requirements, and institutional objectives.

The study is supported by several interconnected frameworks and technical models that collectively describe the structure, functionality, and decision-support capabilities of the proposed system. The Conceptual Framework presents an enhanced Input–Process–Output (IPO) model integrated with Analytics and a Decision Support System (DSS), illustrating how institutional data from research and extension activities are processed through validation, management, analytics, and DSS functions to produce intelligent repositories, dashboards, reports, and institutional insights for evidence-based decision-making and strategic planning. Complementing this, the System Architecture Diagram illustrates the interaction among the Client, Application, Service, and Data Layers, together with External APIs, demonstrating how Laravel Framework, MySQL, Redis Cache, and modern web technologies support secure transactions, efficient data processing, analytics, and DSS integration. The Database Flow Diagram further explains the structured movement of data through transaction processing and data enrichment mechanisms, highlighting the role of controllers, service layers, ORM, caching systems, file storage, and external APIs in improving scalability, responsiveness, and system performance. Meanwhile, the DSS Workflow Architecture describes the complete transformation of institutional data into actionable insights through stages of data acquisition, processing and analytics, DSS evaluation, and output generation via dashboards and reports, followed by a feedback loop that continuously enhances system learning, adaptability, and decision-support effectiveness.

System Description

The developed system is a web-based institutional repository integrated with DSS functionalities, designed to manage research and extension data while providing analytical and decision-support capabilities. The system incorporates modules for data storage, metadata management, search and retrieval, analytics, and reporting. Key DSS features include interactive dashboards, automated report generation, and performance monitoring tools, which enable users to analyze research outputs and generate insights for institutional planning and decision-making.

Population and Sampling

The study involved 40 full-time faculty members from the College of Arts and Sciences at Samar State University, selected through purposive sampling. Inclusion criteria required respondents to have at least one year of service and active involvement in research and extension activities. This ensured that participants possessed sufficient experience and familiarity with institutional processes, thereby enhancing the reliability and validity of the evaluation results.

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
Information · AI · Digital Innovation
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

Instruments

Data were collected using a structured survey questionnaire adapted from the ISO 9126 software quality model, which evaluates system performance across six dimensions: functionality, usability, efficiency, reliability, portability, and maintainability. The instrument consisted of three sections: (1) respondent profile, (2) system evaluation using a five-point Likert scale, and (3) open-ended feedback for system improvement. The instrument was reviewed and validated to ensure content relevance and clarity.

Tools and Technologies

The system was developed using modern web-based technologies to ensure scalability, interoperability, and efficient performance. Core application logic was implemented using PHP and JavaScript, while MySQL served as the primary relational database management system for secure and structured data storage. The user interface was built using HTML, CSS, and AJAX to deliver a responsive and interactive user experience. Integrated analytics and dashboard components supported data visualization, performance monitoring, and evidence-based decision-making.

The system employed rule-based DSS functionalities combined with descriptive analytics to generate structured insights from institutional data. Collectively, these technologies formed a robust, scalable, and user-friendly DSS-enabled repository that supports efficient data management, reporting, and institutional decision support.

Data Collection and System Testing

Data collection followed a structured and ethical procedure. Respondents were oriented on the system's functionalities and study objectives, and informed consent was obtained prior to participation. The evaluation instrument was administered in either digital or printed format to gather user feedback.

System testing was conducted using a multi-layered approach to ensure reliability, functionality, and performance of the developed system. This included user acceptance testing (UAT), where end-users evaluated the system based on ISO/IEC 9126 software quality criteria. In addition, black-box testing was applied to validate system functionality against expected outputs without reference to internal code structure, while integration testing ensured that system modules functioned seamlessly together.

Furthermore, load testing and performance benchmarking were performed to assess system stability under varying user demands and to measure response time, throughput, and resource utilization. A system response evaluation was also conducted to determine efficiency in query handling and dashboard rendering. Feedback from all testing phases was incorporated into iterative improvements, consistent with the Agile development approach, ensuring continuous refinement and system optimization.

Data Analysis

Quantitative data were analyzed using descriptive statistical methods, specifically mean and standard deviation, to assess system performance across the six quality dimensions. These metrics were used to determine the overall acceptability and effectiveness of the system.

Additionally, qualitative feedback from open-ended responses was analyzed using thematic analysis to identify common usability issues and improvement recommendations. This combined approach provided both statistical evaluation and user-centered insights.

Ethical Considerations

The study adhered to established ethical standards in ICT and data-driven research. Ethical clearance was obtained from the appropriate institutional authority prior to data collection. Participants were fully informed about the purpose of the study, and voluntary participation was ensured through informed consent, including the right to withdraw at any stage without penalty.

To ensure data privacy and confidentiality, all responses were anonymized, securely stored, and used strictly for academic purposes. No sensitive personal information beyond the scope of the study was collected. In addition, the study incorporated cybersecurity and system protection measures to safeguard institutional data, including secure authentication protocols, encryption practices, and controlled access mechanisms to prevent unauthorized use. Access control policies were implemented to restrict user permissions based on defined roles, ensuring that only authorized users could view, modify, or manage repository data. Repository security was further strengthened through secure database management practices, regular monitoring, and protection against data breaches and system vulnerabilities.

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
Information · AI · Digital Innovation
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P – ISSN: 3116-4439; E – ISSN: 3116-4447

Furthermore, responsible DSS usage was emphasized to ensure that decision-support outputs are used ethically, transparently, and solely for academic and institutional decision-making. The system was designed to promote accountability, data integrity, and responsible interpretation of analytics results. Overall, these measures ensure that the study not only complies with ethical research standards but also aligns with best practices in secure and responsible information systems development.

RESULTS and DISCUSSION

The Research and Extension Management System (REMS), an integrated Decision Support System (DSS) repository, was developed to optimize the tracking, monitoring, and evaluation of research and extension initiatives. The system comprises two core components: Research Proposal Tracking and Extension Project Monitoring. The Research Proposal Tracking module enables users to submit, update, and monitor the progress of research proposals, providing real-time visibility into each project's status (Figure 5). The Extension Project Monitoring module similarly facilitates the management of extension activities, allowing both administrators and clients to track project submissions, progress, and outcomes efficiently (Figure 6). Complemented by analytical and reporting tools, REMS provides timely access to aggregated data, performance indicators, and filtered insights. Collectively, these components enhance workflow transparency, operational efficiency, and evidence-based decision-making, aligning with the study's primary objectives.

Research Proposal Tracking. This feature allows users to update the status of submitted research proposals within the system. It also enables client users who have filed a proposal to conveniently monitor and view the current progress and status of their submissions.

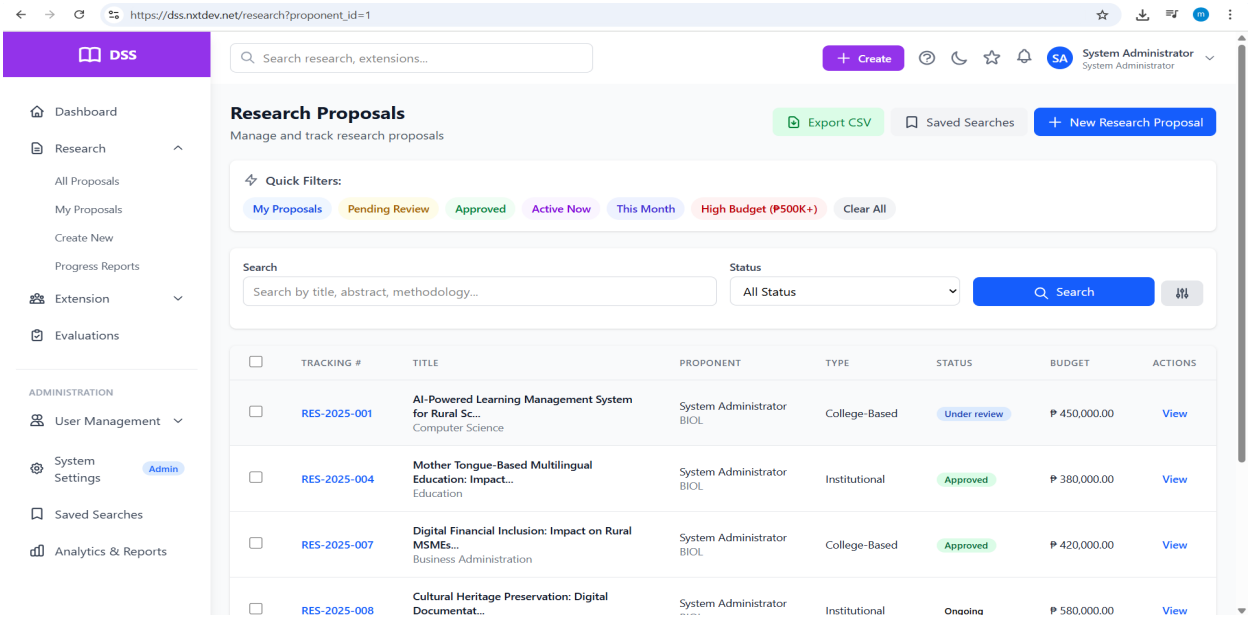

Figure 5. Research Proposal Tracking.

Extension Project Tracking. This feature enables authorized users to update the status of submitted extension projects within the system. It also allows client users who have submitted their project requests to easily view and monitor the current progress and status of their extension projects.

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

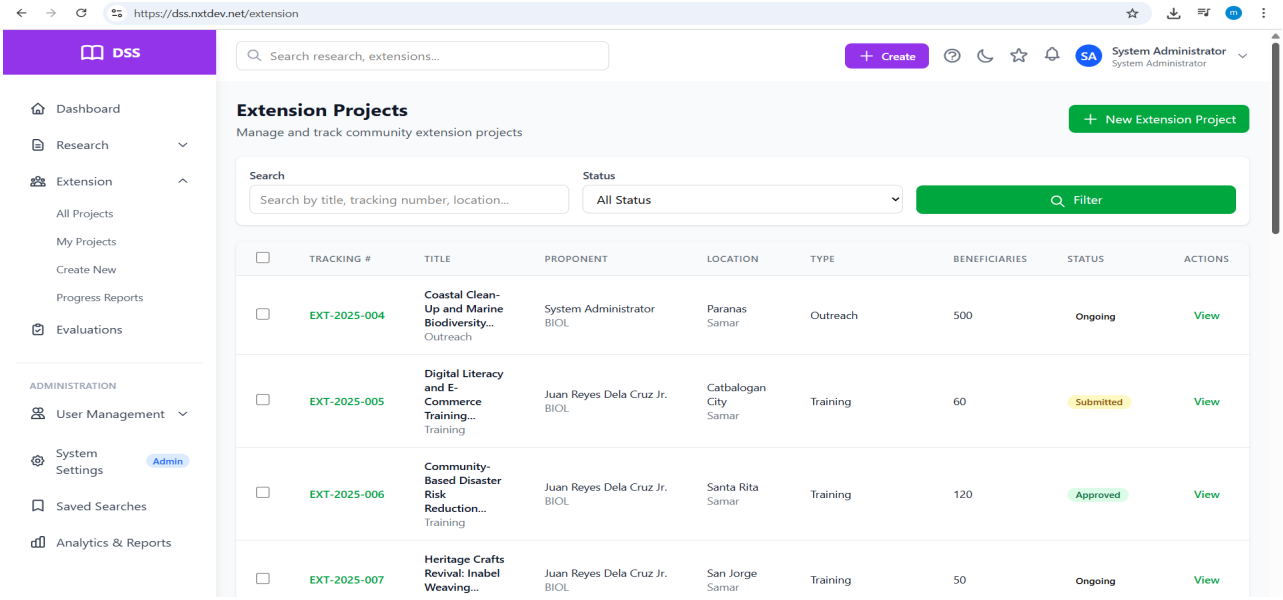

Figure 6. Extension Project Tracking

Presentation, Analysis and Interpretation of Data

This section presents the evaluation outcomes, analysis, and interpretation of the Decision Support System (DSS) for Research and Extension based on the six ISO/IEC software quality characteristics: functionality, usability, efficiency, reliability, portability, and maintainability. The assessment aligns with the study's objective to determine the system's technical performance and readiness for departmental implementation.

As shown in Table 1, the DSS received high user ratings across quality indicators, with weighted mean scores ranging from 4.47 to 4.65, where most criteria were rated as "Strongly Agree," reflecting strong user satisfaction and perceived system quality. This distribution suggests that the system meets core expectations for operational use in research and extension management.

Table 1.

Summary of Weighted Means per Software Quality Indicator

Software Quality Indicator	Grand Mean (WM)	Verbal Interpretation
1. Functional	4.62	Strongly Agree (SA)
2. Usability	4.57	Strongly Agree (SA)
3. Efficiency	4.64	Strongly Agree (SA)
4. Reliability	4.65	Strongly Agree (SA)
5. Portability	4.58	Strongly Agree (SA)
6. Maintainability	4.47	Agree (A)

Reliability obtained the highest rating (WM = 4.65), indicating that users perceive the system as stable and consistent under normal use conditions. Reliability is a fundamental determinant of user confidence and sustained system adoption in decision support environments, as dependable performance reduces errors and supports uninterrupted workflows (ISO/IEC 25010 framework acknowledges reliability as key for quality systems (ISO/IEC, 2023)).

Efficiency (WM = 4.64) and functionality (WM = 4.62) were also strongly rated, suggesting that the system operates with fast response times and offers comprehensive features essential for research and extension workflows. These findings are consistent with research showing that DSS platforms with robust analytical capabilities and responsive interfaces improve user productivity and operational effectiveness in academic information systems (e.g., Sarwosri et al., 2023, in systems quality evaluation).

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
Information · AI · Digital Innovation
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P – ISSN: 3116-4439; E – ISSN: 3116-4447

Portability (WM = 4.58) and usability (WM = 4.57) reflect that users find the system accessible across different environments and easy to navigate. This confirms that the interface design and cross-platform accessibility support broader adoption and align with usability research emphasizing intuitive design as a key enabler in technology uptake (Sarwosri et al., 2023).

Although maintainability received the lowest rating (WM = 4.47), it remains positive, indicating acceptable support for updates and modifications. Lower maintainability is not uncommon in increasingly complex systems integrating analytics and decision-support technologies, where evolving requirements and technological change necessitate ongoing refinement (ISO/IEC 25010 identifies maintainability as critical for long-term sustainability).

Overall, REMS demonstrates robust technical performance and high user satisfaction, confirming its suitability to support research and extension management processes. High ratings in reliability, efficiency, and functionality suggest that the system can handle operational demands and analytical workloads effectively — essential qualities for modern information systems in academic settings. The integration of real-time analytics and visualization tools elevates the system from a static repository to an intelligent DSS platform, enabling stakeholders to generate actionable insights, monitor trends, and support evidence-based strategic planning — a capability noted as transformative in higher education analytics research. Analytical dashboards and visual tools are increasingly recognized as central to institutional decision making, empowering users to interpret complex datasets and derive strategic value (Masiello et al., 2024).

The relatively lower maintainability score highlights the importance of implementing continuous improvement practices, such as modular architecture design, robust version control, and automated update pipelines, to support long-term sustainability. As DSS components become more sophisticated, ensuring that systems remain scalable and adaptable becomes essential for maintaining long-term operational effectiveness and technological sustainability.

The results align with current ICT literature emphasizing reliable, user-friendly, and analytics-capable platforms as enablers of effective institutional processes. For example, ISO-based quality evaluations of academic information systems have also demonstrated that reliability and usability strongly influence user satisfaction and system performance (Nofiyati et al., 2022; Januhari et al.,2024). Likewise, quality assessment studies using ISO models consistently report that usability and efficiency are key determinants of system acceptability, reinforcing the importance of integrating user-centered design principles in software development.

Relative to similar systems evaluated in comparable studies, REMS's performance in reliability and efficiency confirms that DSS integration enhances information system functionality and supports data-driven institutional management, complementing findings in research on quality evaluation models and decision support system applications.

A review with related DSS and institutional repository studies further confirms the strong performance of REMS in terms of reliability, usability, and efficiency. The system's ratings for reliability (WM = 4.65), efficiency (WM = 4.64), and usability (WM = 4.57) are comparable to or higher than ISO/IEC-based evaluations reported by Nofiyati et al. (2022) and Januhari et al. (2024), where these factors were identified as key determinants of user satisfaction and system effectiveness. Consistent with Sarwosri et al. (2023), the results also show that DSS platforms with responsive interfaces and strong analytical capabilities improve productivity and user acceptance. Compared with conventional repository systems, REMS demonstrates enhanced functionality through integrated analytics dashboards and DSS features, supporting the findings of Masiello et al. (2024) on the importance of intelligent analytics for institutional decision-making. Overall, the results indicate that REMS performs competitively with existing DSS-enabled systems in academic environments.

Conclusions

The findings demonstrate that the developed Decision Support System (DSS) for Research and Extension achieved a high level of software quality across the evaluated ISO/IEC indicators. The consistently high weighted mean scores (4.47–4.65) confirm strong user acceptance and indicate that the system meets the technical and functional requirements for institutional deployment.

In particular, the system's high ratings in reliability, efficiency, and functionality confirm its capability to perform accurately, respond efficiently, and support core research and extension workflows. These results indicate that the system can effectively handle operational demands and provide stable performance in real-world academic environments. Likewise, strong usability and portability scores validate that the system is accessible, user-friendly, and adaptable across different user contexts, supporting broader adoption among faculty users.

However, the comparatively lower rating in maintainability highlights a specific area for improvement. While still acceptable, this finding indicates the need for enhanced system flexibility, structured update mechanisms, and long-term sustainability planning. Overall, the results confirm that the DSS-integrated repository is suitable for implementation and has the capacity to improve data management, monitoring, and evidence-based decision-making

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
Information · AI · Digital Innovation
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

in research and extension activities. The study further contributes to ICT system development by demonstrating how DSS integration, analytics dashboards, and user-centered repository design may improve institutional data governance and operational efficiency in higher education environments.

Recommendations

1. Academic institutions and system developers may adopt modular architecture, version control mechanisms, and automated update pipelines to improve system scalability, maintainability, and long-term sustainability.
2. The developed DSS-integrated repository may be fully deployed and integrated with existing institutional information systems to support centralized, analytics-driven, and evidence-based academic operations.
3. Institutions may conduct user training programs and implement data validation, access control, backup management, and cybersecurity measures to enhance effective system utilization and protect institutional data integrity.
4. Future researchers and developers may explore predictive analytics, machine learning integration, advanced visualization tools, and cross-institutional implementation to further improve intelligent system capabilities and scalability.

REFERENCES

Adeyemi, T. O., & AlOtaibi, N. F. (2025). Designing a feedback-driven decision support system for dynamic student intervention (arXiv Preprint No. arXiv:2508.07107). arXiv. https://doi.org/10.48550/arXiv.2508.07107

Alahmadi, D. H., & Jamjoom, A. A. (2022). Decision support system for handling control decisions and decision-makers in supply chain management. *Journal of Big Data, 9*(1),114. https://doi.org/10.1186/s40537-022-00653-9

Bashir, S., Gul, S., Bashir, S., Nisa, N. T., & Ganaie, S. A. (2021). Evolution of institutional repositories: Managing institutional research output to remove the gap of academic elitism. *Journal of Librarianship and Information Science, 54*(3), 518–531. https://doi.org/10.1177/09610006211009592

Bhat, A., & Wani, Z. A. (2025). The FAIRification process for data stewardship: A comprehensive discourse on the implementation of the FAIR principles for data visibility, interoperability and management. *Journal of Librarianship and Information Science*. https://doi.org/10.1177/03400352241270692

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dube, T. V. (2025). Research data management in academic libraries: Institutional repositories as a reservoir for research data. *Library Management, 46*(5), 319–331. https://doi.org/10.1108/LM-06-2024-0070

Goyal, K., Garg, M., & Malik, S. (2025). Adoption of artificial intelligence-based credit risk assessment and fraud detection in banking services: A hybrid approach (SEM-ANN). *Future Business Journal, 11*(1). https://doi.org/10.1186/s43093-025-00464-3

González-Pérez, L. I., Ramírez-Montoya, M. S., & García-Peñalvo, F. J. (2021). Improving institutional repositories through user-centered design: Indicators from a focus group. *Future Internet, 13*(11), 282. https://doi.org/10.3390/fi13110282

He, Z., & Fang, W. (2024). Research data management in institutional repositories: An architectural approach using data lakehouses. *Digital Library Perspectives, 41*(1), 145–178. https://doi.org/10.1108/DLP-02-2024-0022

Hussein, O. A., & Mousa, A. H. (2023). Toward measuring the usability of decision support applications in fog computing environment. *Indonesian Journal of Electrical Engineering and Computer Science, 30*(3), 1689–1698. https://doi.org/10.11591/ijeecs.v30.i3.pp1689-1698

International Organization for Standardization. (2023). *Systems and software engineering—Systems and software quality requirements and evaluation (SQuaRE)—System and software quality models (ISO/IEC 25010)*. https://www.iso.org/standard/78176.html

International Organization for Standardization. (2023). *Systems and software engineering—Systems and software quality requirements and evaluation (SQuaRE)—Product quality model (*FAIR principles*)*. https://www.iso.org/obp/ui/en/#iso:std:iso-iec:25010:ed-2:v1:en

Januhari, N. N. U., Ronda, P. A. P., & Wijaya, I. G. G. P. (2024). Software quality evaluation using ISO/IEC 9126 on the ITB STIKOM Bali online academic information system (SION). *International Journal of Engineering Technologies and Management Research, 11*(5), 76–83. https://doi.org/10.29121/ijetmr.v11.i5.2024.1454

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
IJICTAIDI
Information · AI · Digital Innovation
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation (IJICTAIDI)
P - ISSN: 3116-4439; E - ISSN: 3116-4447

Kalimashe, H. (2023). User experience of an institutional repository: A study of OpenUCT with a focus on postgraduate students (Master's thesis, University of Cape Town). OpenUCT. http://hdl.handle.net/11427/39570

Keshireddy, S. R. (2024). Intelligent decision support systems in management information systems using hybrid AI models. *Research Briefs on Information and Communication Technology Evolution, 10*, 211–230. https://doi.org/10.69978/rebicte.v10i.207

Kindling, M., & Strecker, D. (2022). Data quality assurance at research data repositories: Survey data. *Data Science Journal, 21*, 18. https://doi.org/10.5334/dsj-2022-018

Knoth, P., Herrmannova, D., Cancellieri, M., Anastasiou, L., Pontika, N., Pearce, S., Gyawali, B., & Pride, D. (2023). CORE: A global aggregation service for open access papers. *Scientific Data, 10*, Article 408. https://doi.org/10.1038/s41597-023-02208-w

Kostopoulos, G., Kotsiantis, S., & Pintelas, P. (2024). Artificial intelligence-enhanced decision support systems: A review and future directions. *Electronics, 13*(14), 2842. https://doi.org/10.3390/electronics13142842

Mamun, M. N. H. (2025). *Role of AI and data science in data-driven decision-making for IT business intelligence: A systematic literature review*. SSRN. https://doi.org/10.2139/ssrn.5402976

Martínez-García, A., Alvarez-Romero, C., Román-Villarán, E., Bernabeu-Wittel, M., & Parra-Calderón, C. L. (2023). FAIR principles to improve the impact on research data management outcomes. *Heliyon, 9*(5), e15733. https://doi.org/10.1016/j.heliyon.2023.e15733

Masiello, I., Mohseni, Z. A., Palma, F., Nordmark, S., Augustsson, H., & Rundquist, R. (2024). A current overview of the use of learning analytics dashboards. *Education Sciences, 14*(1), 82. https://doi.org/10.3390/educsci14010082

Masinde, J., & Sanya, O. (2022). Analysis of interoperability, security and usability of digital repositories in Kenyan institutions of higher learning. *Data and Information Management, 6*(4), 100011. https://doi.org/10.1016/j.dim.2022.100011

Mucha, H., Robert, S., Breitschwerdt, R., & Fellmann, M. (2022). Usability of clinical decision support systems. *Zeitschrift für Arbeitswissenschaft, 77*(1), 92–101. https://doi.org/10.1007/s41449-022-00324-8

Narlock, M. R., Calvert, S., Taylor, S., Priesman, R. P., & Parkman, A. (2024). Knowledge infrastructures are growing up. *Data Science Journal, 23*, 46. https://doi.org/10.5334/dsj-2024-046

Nofiyati, N., Nugroho, A. K., & Wijayanto, B. (2022). Evaluation of the quality of academic information system Unsoed using ISO 9126 and MOS. *Jurnal Teknik Informatika (JUTIF), 3*(3), 771–779. https://doi.org/10.20884/1.jutif.2022.3.3.366

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford University Press. https://doi.org/10.1016/0024-6301(96)81509-3

Pandey, J., Hannawi, S., & Dattana, V. (2024). Learning analytics and knowledge management systems for higher education. *International Journal of Research and Scientific Innovation*. https://doi.org/10.51244/IJRSI.2024.1114SDAICO14

Panda, S., & Kaur, N. (2023). Enhancing user experience and accessibility in digital libraries through emerging technologies. In K. P. Sinhamahapatra et al. (Eds.), *Digital libraries: Sustainable development in education* (pp. 676–703). SSRN. https://ssrn.com/abstract=4645610

Ramaswami, G., Susnjak, T., Mathrani, A., & Umer, R. (2023). Use of predictive analytics within learning analytics dashboards. *Technology, Knowledge and Learning, 28*, 959–980. https://doi.org/10.1007/s10758-022-09613-x

Rizzi, M. (2024). Decision support systems for disease detection and diagnosis. *Applied Sciences, 14*(17), 7501. https://doi.org/10.3390/app14177501

Sarwosri, S., Rochimah, S., Yuhana, U. L., & Hidayat, S. B. (2023). Software quality measurement using analytical hierarchy process. *International Journal on Informatics Visualization, 7*(4), 2421–2426. https://doi.org/10.62527/joiv.7.4.2441

Subiyakto, A., Rahmi, Y., Kumaladewi, N., Huda, M. Q., Hasanati, N., & Haryanto, T. (2021). Investigating quality of institutional repository website design using usability testing framework. *AIP Conference Proceedings, 2331*, 060016. https://doi.org/10.1063/5.0041677

Susnjak, T., Ramaswami, G., & Mathrani, A. (2022). Learning analytics dashboard: A tool for actionable insights. *International Journal of Educational Technology in Higher Education, 19*, 12. https://doi.org/10.1186/s41239-021-00313-7

Tang, Y. W., Toh, S., & Leow, A. S. (2022). Dashboards for decision making in higher education. https://doi.org/10.14742/apubs.2019.279

PRC-CPD Accredited Provider: PTR-2025-749
NBDB Registration as Book Publisher (Print & Digital): 6312
International Journal of Information and Communication Technology, Artificial Intelligence, and Digital Innovation
P – ISSN: 3116-4439; E – ISSN: 3116-4447

Ujir, H., Sulaiman, M., Hipiny, I., & Salleh, S. F. (2025). Harnessing data analytics for smart academic management. *EDUCATUM Journal of Social Sciences*. https://doi.org/10.37134/ejoss.vol11.sp2.9.2025

Zhang, F., & Wu, S. (2024). Predicting citation impact of academic papers across research areas using multiple models and early citations. *Scientometrics, 129*(7), 1–30. https://doi.org/10.1007/s11192-024-05086-0

Zhao, Y., Zhang, L., Zeng, C., Lu, W., Chen, Y., & Fan, T. (2023). Aspect-level sentiment analysis model for online medical reviews. *Information Processing & Management, 60*(6), 103513. https://doi.org/10.1016/j.ipm.2023.103513