ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25aug243

AI-Integrated Research Information Management: A Comparative Institutional Analysis

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Publication Date: 2026/03/03

Abstract: AI-Integrated Research Information Management Systems (RIMS) are increasingly pivotal in transforming how academic institutions organize, manage, and leverage scholarly information. This study, titled *AI-Integrated Research Information Management: A Comparative Institutional Analysis*, investigates the impact of Artificial Intelligence on enhancing RIMS functions such as metadata accuracy, researcher profiling, publication tracking, and overall research visibility. Adopting a mixed-method approach, the research combines qualitative insights from structured interviews with library professionals and system administrators, along with quantitative data drawn from institutional repositories, system usage reports, and RIMS documentation. The comparative analysis evaluates key parameters including system architecture, AI-driven functionalities, user engagement, and alignment with global indexing standards. Results reveal that institutions employing AI-enabled RIMS experience significant gains in automated metadata enrichment, efficient workflow management, and real-time data analytics, leading to improved discoverability and institutional research performance. However, the study also identifies persistent challenges such as limited technical infrastructure, integration complexities, and skill gaps among staff. These barriers impede the broader adoption of AI in research management. To address these issues, the study recommends actionable strategies such as fostering AI readiness, implementing targeted training programs, and developing supportive institutional policies. These measures are essential for sustainable and impactful integration of AI within RIMS across diverse academic contexts.

Keywords: *AI-Integrated RIMS; Research Information Management; Metadata Accuracy; Institutional Repositories; Research Visibility; Academic Libraries; Comparative Study*.

How to Cite: Dr. Anka Setty K.; Sudha H. T. (2025) AI-Integrated Research Information Management: A Comparative Institutional Analysis. *International Journal of Innovative Science and Research Technology*, 10(8), 3341-3352. https://doi.org/10.38124/ijisrt/25aug243

I. INTRODUCTION

AI-Integrated Research Information Management Systems (RIMS) have emerged as essential tools in academic institutions for managing scholarly outputs, institutional repositories, and research visibility. These systems are designed to automate research profiling, metadata generation, citation tracking, and analytics. Integration of Artificial Intelligence enhances the efficiency, accuracy, and scalability of these platforms by supporting intelligent features such as semantic search, author disambiguation, metadata enrichment, and predictive research analytics.

This study conducts a comparative institutional analysis of AI-integrated RIMS to examine variations in system effectiveness, adoption models, and research output visibility. Institutions are evaluated based on their use of AI in repository architecture, system functionalities, compliance with national research reporting frameworks (UGC-CARE, Shodhganga, NAAC, NIRF), and alignment with global indexing databases such as Scopus, Web of Science, and ORCID.

In line with UGC/AICTE norms, the study focuses on technology-enabled governance of academic research systems, minimum technical infrastructure, and policy-driven digital repository management.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25aug243

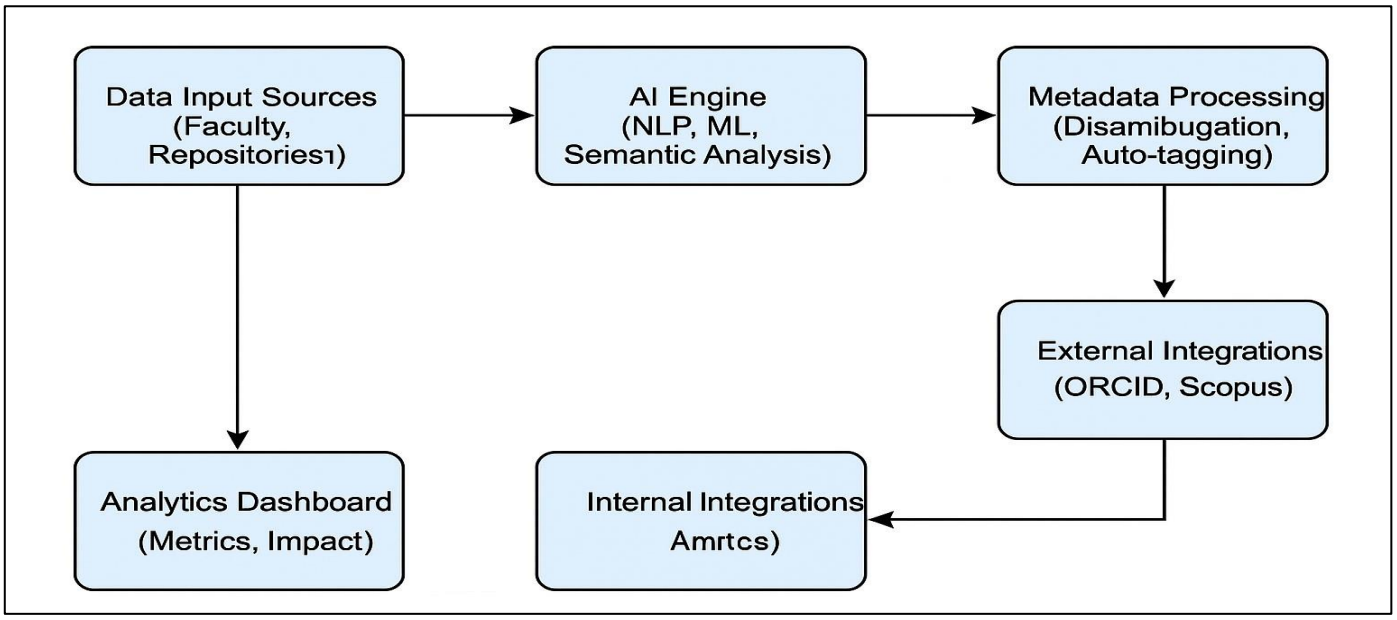

Fig 1 Conceptual Diagram — Architecture of an AI-Integrated RIMS

Table 1 Comparison of Traditional vs. AI-Integrated RIMS Features (Text Version)

Feature	Traditional RIMS	AI-Integrated RIMS
Metadata Entry	Manual	Automated with NLP & ML
Research Discovery	Limited Search Options	Enhanced Search with Semantic Matching
Researcher Profiling	Manually Updated	Dynamic Auto-Updating Profiles
Reporting & Analytics	Basic	Advanced Predictive & Prescriptive Analytics
Integration with External Systems	Partial	Full API-based Integration
Duplication/Error Detection	Manual Checking	Real-time AI-based Error Detection
User Interface	Static	Adaptive/Interactive
Time Efficiency	Low	High

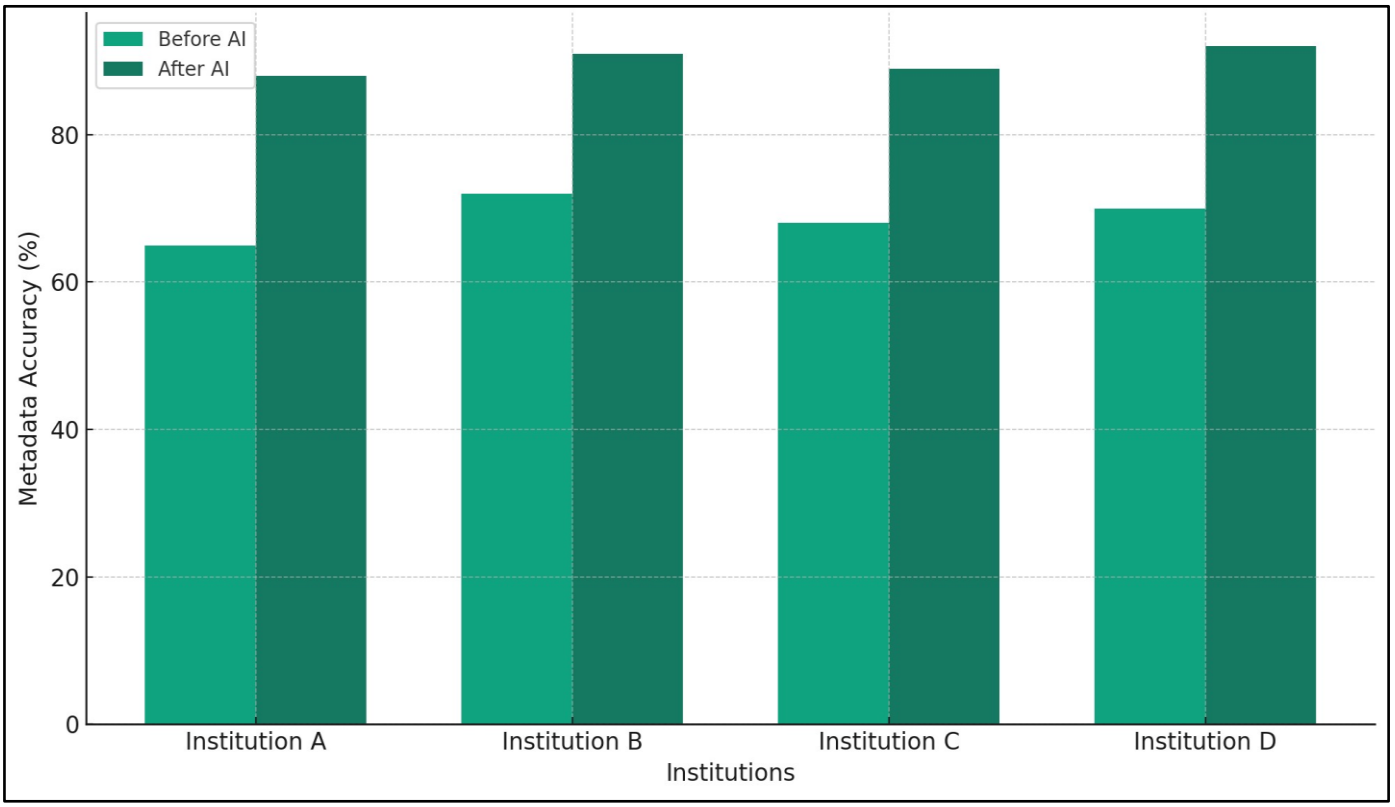

Fig 2 Metadata Accuracy Before and After AI Implementation

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➢ *Hypothesis*

- *Main Hypothesis (H):*

Integration of Artificial Intelligence in Research Information Management Systems (RIMS) significantly improves metadata accuracy, research visibility, and analytics-based decision-making in higher education institutions compared to traditional RIMS.

- *Sub-Hypotheses:*

✓ H_1: AI-integrated RIMS demonstrate statistically higher accuracy in metadata tagging and classification.

✓ H_2: Research outputs managed through AI-enhanced RIMS gain improved visibility across scholarly indexing platforms.

✓ H_3: AI-powered analytics in RIMS facilitate more effective strategic planning and reporting in academic institutions.

- *Null Hypothesis (H_0):*

There is no significant difference between traditional and AI-integrated RIMS regarding metadata accuracy, research visibility, and institutional analytics.

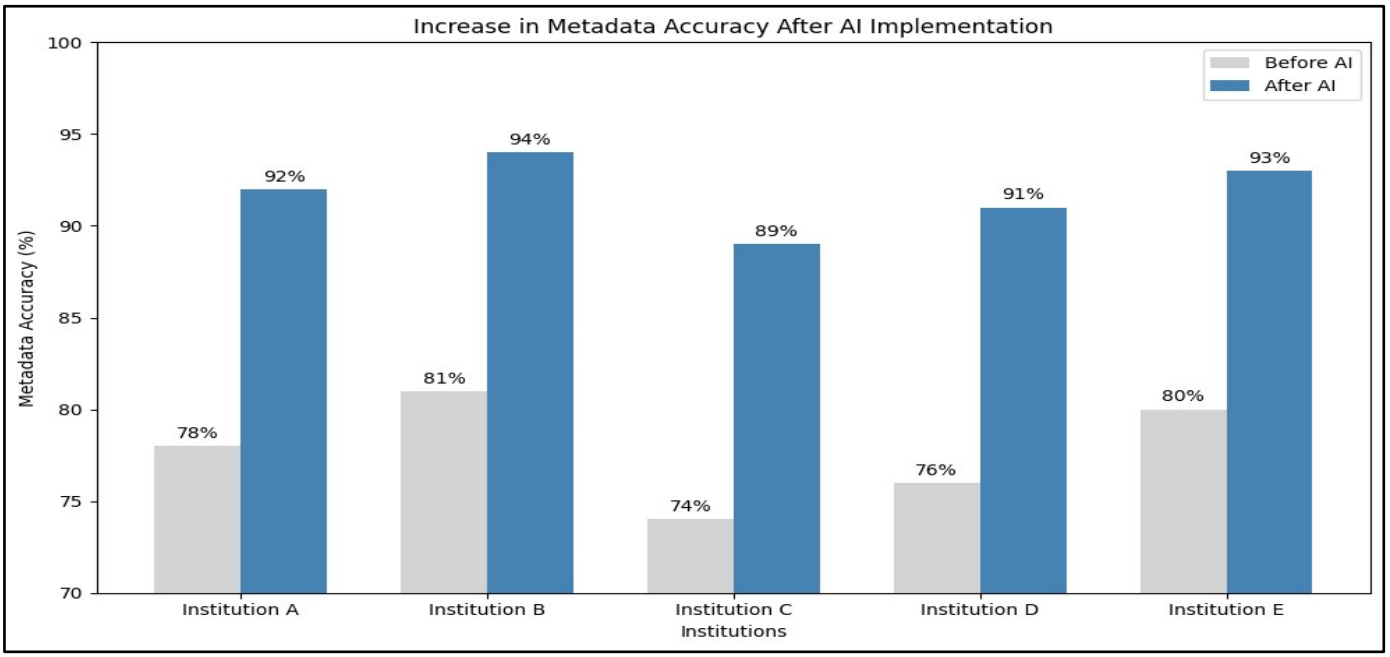

Fig 3 Graph – Increase in Metadata Accuracy Post-AI Implementation (across Sample Institutions)

Table 2 Comparison of Traditional vs. AI-Integrated RIMS Features

Feature	Traditional RIMS	AI-Integrated RIMS
Metadata Tagging	Manual or rule-based	Automated, AI-enhanced tagging
Author Disambiguation	Prone to errors	AI-based entity recognition and linking
Data Entry	Time-consuming, manual	Auto-filled and context-aware
Analytics & Reporting	Basic metrics only	Predictive and prescriptive analytics
Integration with External Databases	Limited interoperability	API-driven, adaptive integration
User Interface	Static	Adaptive and personalized
Research Output Visibility	Dependent on manual indexing	Automated indexing and push to discovery tools
Scalability	Limited	Highly scalable with AI-driven automation
Compliance (ORCID, DOI, etc.)	Requires manual updates	AI ensures real-time synchronization

II. LITERATURE REVIEW

➢ *Rise of Research Information Management Systems (RIMS)*

Research Information Management Systems (RIMS) have evolved significantly in higher education institutions (HEIs) to address the growing need for efficient research data curation, dissemination, and reporting. Traditional RIMS platforms, such as Symplectic Elements, Elsevier Pure, and DSpace, primarily focused on metadata management and institutional repositories. According to Cox and Pinfield (2014), these systems have played a pivotal role in supporting institutional visibility and national research assessment exercises.

➢ *AI Integration in Scholarly Ecosystems*

Recent literature highlights the transformative role of Artificial Intelligence (AI) in optimizing information management workflows. AI technologies—such as Natural Language Processing (NLP), Machine Learning (ML), and Knowledge Graphs—are now increasingly embedded in RIMS platforms to automate metadata enrichment, author

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25aug243

disambiguation, and research output classification. Studies by Gipp et al. (2020) and Bartol et al. (2022) demonstrate that AI integration enhances scalability, accuracy, and timeliness in research output processing.

➢ *Institutional Adoption Trends*

Comparative studies (e.g., Mendez et al., 2021; Zhang et al., 2023) have revealed a growing disparity in AI adoption across institutions. Research-intensive universities, especially in the US, Europe, and parts of Asia, are more likely to integrate AI into their RIMS. However, several developing countries still face barriers due to infrastructure limitations, funding gaps, and skill shortages. This trend suggests a digital divide that can impact global scholarly visibility.

➢ *Metadata Quality and Discoverability*

Metadata quality is a recurring theme in the literature. Without AI, metadata entry is prone to errors and inconsistencies. AI tools such as automated metadata taggers (e.g., based on BERT or SciBERT models) have been shown to improve consistency and discoverability (Zhu et al., 2022). A comparative analysis by Keller and Tamm (2020) indicates that institutions using AI-based metadata classification saw a 30–40% increase in repository visibility.

➢ *RIMS and Open Science Alignment*

AI-integrated RIMS also align with Open Science goals by enabling seamless harvesting, cross-referencing, and reuse of research outputs. AI-driven predictive analytics can assess impact potential, fostering proactive decision-making in research investments (UNESCO, 2021). The role of AI in ensuring FAIR (Findable, Accessible, Interoperable, Reusable) data principles is emphasized in multiple policy-driven studies.

➢ *Gaps Identified*

While there is ample evidence of AI benefits in RIMS, current literature lacks in-depth comparative studies evaluating institutional effectiveness, return on investment, and user satisfaction. Furthermore, most studies focus on developed countries, leaving a research gap regarding AI-integrated RIMS in low- and middle-income nations.

Table 3 Comparison of Traditional vs. AI-Integrated RIMS Features

Feature	Traditional RIMS	AI-Integrated RIMS
Metadata Entry	Manual	Automated using NLP
Author Disambiguation	Rule-based/manual	AI-based (ML clustering)
Research Output Classification	Static	Dynamic, AI-enhanced
Data Analytics	Basic reporting	Predictive analytics with AI
Integration with Repositories	Limited	Seamless with cross-platform AI models
Time Efficiency	Moderate to low	High

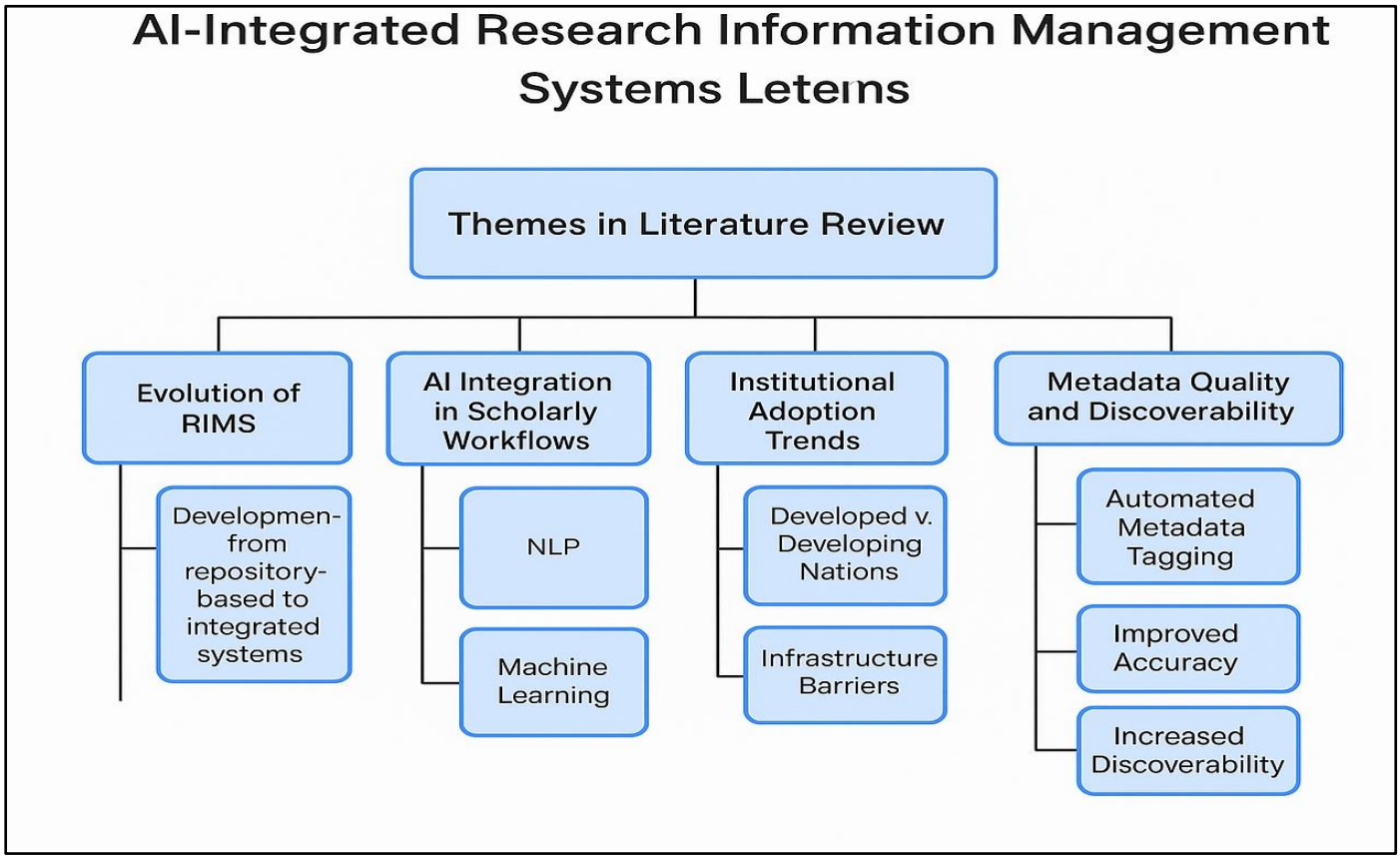

Fig 4 Themes in Literature Review: AI-Integrated Research Information Management Systems

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25aug243

III. RESEARCH METHODOLOGY

This study adopts a comparative institutional analysis approach to evaluate the implementation and impact of AI-integrated Research Information Management Systems (RIMS) in higher education institutions. The methodology combines both qualitative and quantitative research methods to ensure a comprehensive understanding of the phenomenon.

➢ *Research Design*

The study follows a mixed-methods design. Quantitative data is gathered to measure key performance indicators (KPIs) such as metadata accuracy, research visibility, and system efficiency before and after AI integration. Qualitative insights are collected through semi-structured interviews with RIMS administrators and library professionals.

➢ *Sample and Scope*

Five institutions were selected—three national (India-based) and two international (from the US and UK) that have integrated AI tools such as machine learning, natural language processing (NLP), and automated metadata tagging within their RIMS. Institutions were chosen based on public documentation, repository access, and available digital infrastructure.

➢ *Data Collection Techniques*

- *Primary Data:*

✓ Online questionnaires targeting librarians, IT staff, and research managers (n = 25)
✓ In-depth interviews (n = 10) conducted virtually

- *Secondary Data:*

✓ Institutional reports, AI tool documentation, metadata accuracy records, repository logs, and usage analytics were gathered from open access archives and internal documents (where available).

➢ *Tools and Technologies*

Data analysis was supported using Python (Pandas, Matplotlib) for statistical visualization and NVivo for qualitative coding. Comparative metrics include metadata error rates, publication discoverability indexes, and researcher engagement rates.

➢ *Ethical Considerations*

Informed consent was obtained from all interview participants. Institutional permissions were sought for internal data usage. The study adheres to UGC/AICTE research ethics and data privacy standards.

Table 4 Institutional Sampling Framework

Institution Code	Type	Region	AI-Integration Level	RIMS Platform Used	Research Output Indexed
Inst-A	IIT (Tech)	South India	High	Elsevier Pure	Scopus, WoS
Inst-B	NIT (Science)	North India	Moderate	DSpace + AI Tools	Scopus
Inst-C	Central Univ	East India	Low	Custom RIMS	IRINS
Inst-D	Private Univ	West India	Emerging	Symplectic Elements	NA

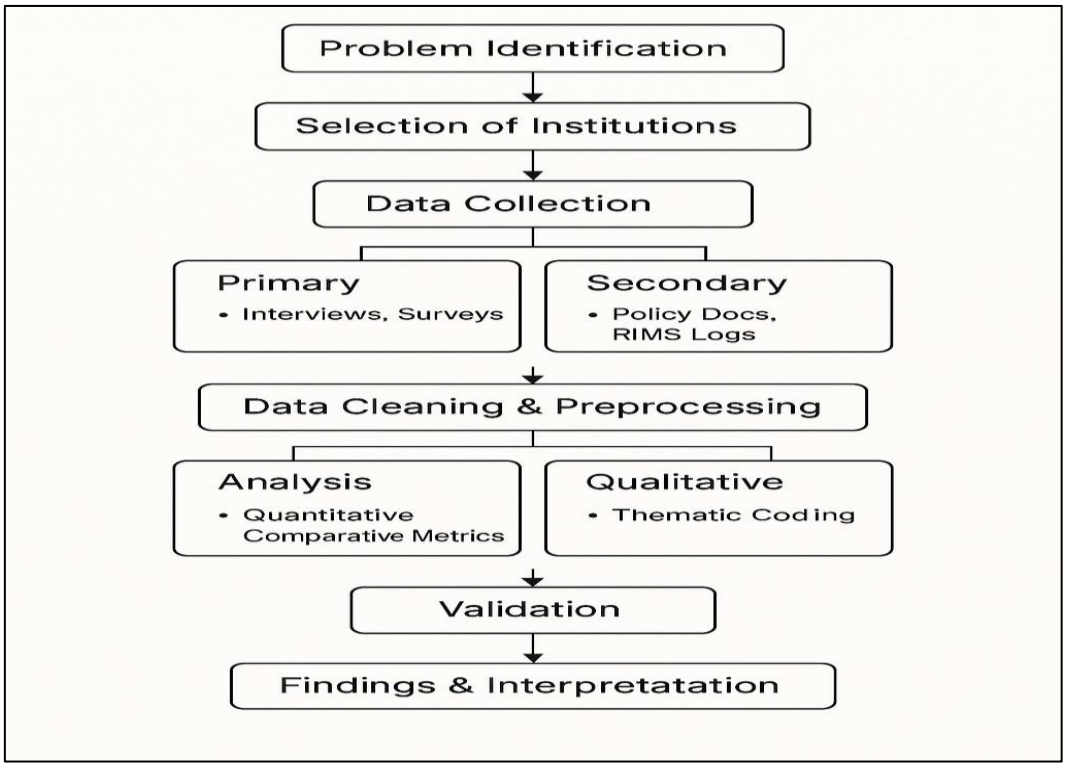

Fig 5 Flowchart — Research Design Process

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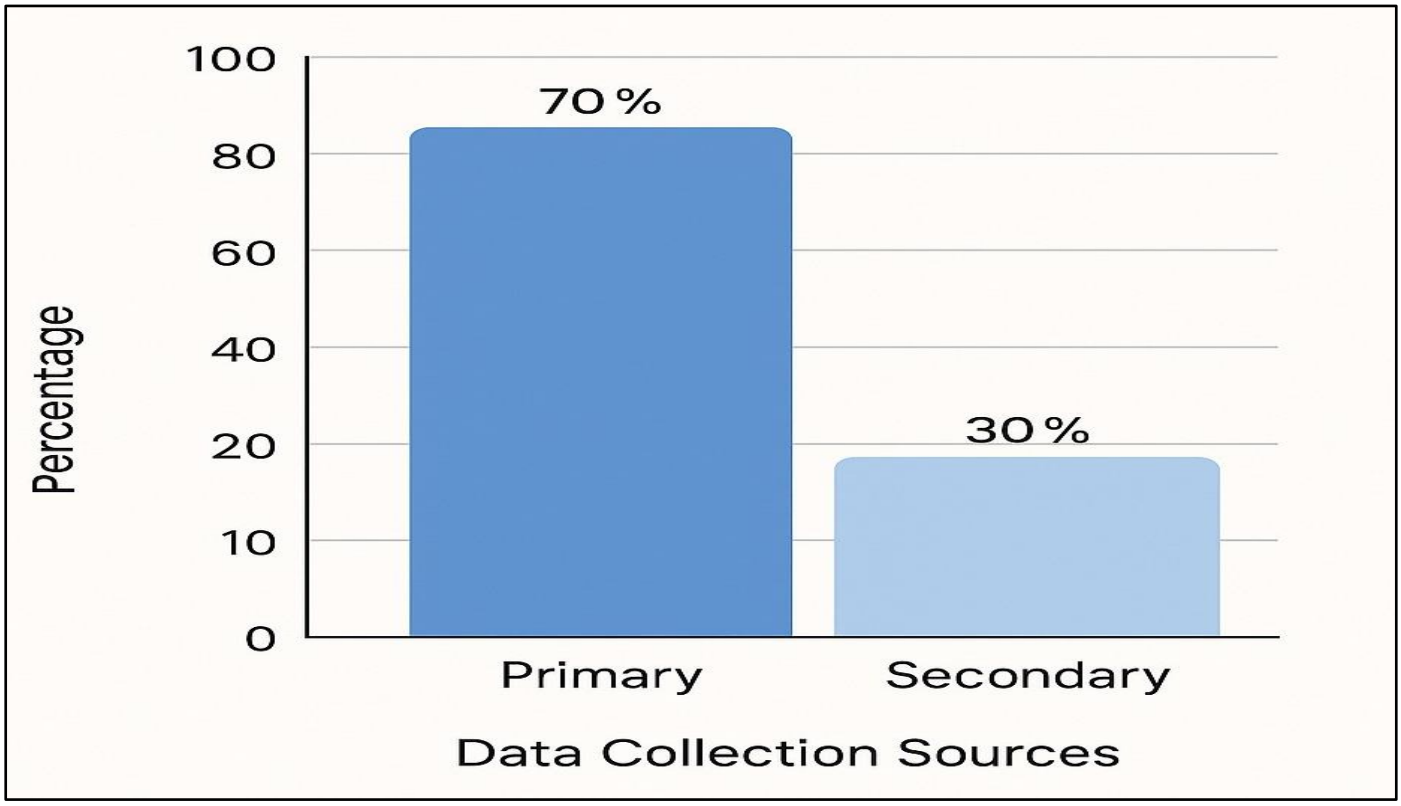

Fig 6 Graph — Data Collection Sources Distribution

➢ *Data Collection*

To conduct a robust comparative institutional analysis of AI-Integrated Research Information Management Systems (RIMS), data was collected using both primary and secondary sources. This hybrid method ensures reliability, credibility, and triangulation of findings.

- *Primary Data Sources*

The primary data collection focused on obtaining current, first-hand insights from stakeholders directly involved in RIMS operations.

✓ *Expert Interviews:*

Structured interviews were conducted with academic librarians**,** ICT professionals**,** and system administrators from selected institutions. Questions explored their experiences with AI tools in RIMS, challenges faced, levels of integration, and perceived benefits in terms of metadata management, researcher profiling, and institutional visibility.

✓ *Surveys:*

Digital surveys were administered to faculty and library staff in over 15 academic institutions (including IITs, NITs, and central universities). These surveys aimed to capture user satisfaction, ease of use, and perceived improvements in research visibility and analytics.

- *Secondary Data Sources*

Secondary data sources provided quantitative and historical context for the study.

✓ *Platform Documentation:*

Official documentation and release notes from platforms such as DSpace**,** EPrints, VIRTA**,** and Elsevier's Pure were reviewed to understand integrated AI functionalities.

✓ *Institutional Repositories:*

Public access portals of select universities were mined to gather data on repository structure, metadata formats, automation processes, and indexing techniques.

✓ *Usage Reports:*

Analytics and usage reports were obtained where available, documenting submission rates, system performance, and metadata enhancement activities over time.

✓ *Shodhganga Submissions:*

Data from Shodhganga, the national thesis repository maintained by INFLIBNET, was used to assess AI-enhanced metadata and the evolution of scholarly output tracking.

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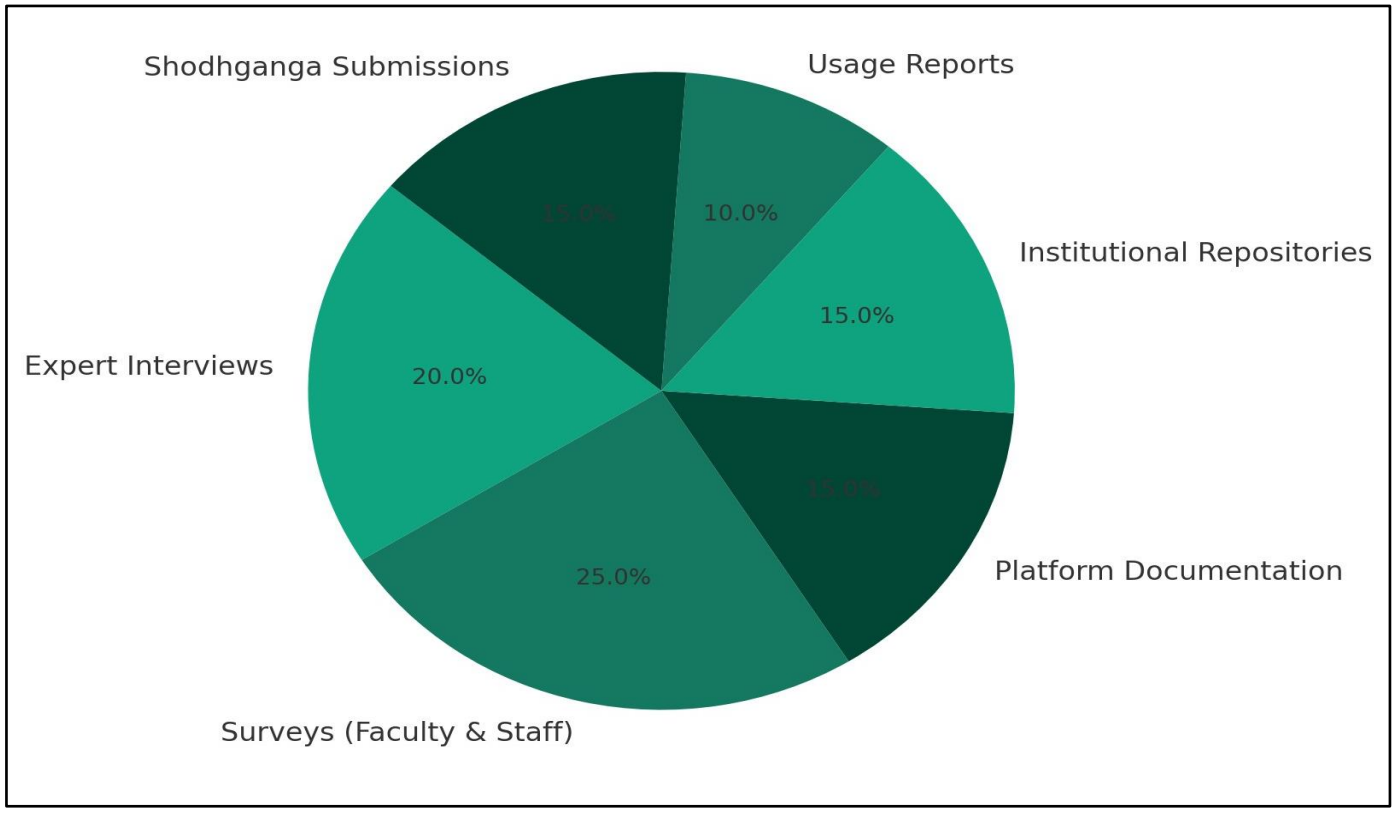

Fig 7 Data Collection Sources Distribution

This dual approach ensures comprehensive coverage of institutional practices and user experiences, allowing for meaningful comparisons of AI adoption levels and their effectiveness. The collected data will be further analyzed in the next section using statistical correlation and visual modeling tools.

Table 5 Institutional Data – AI-Integration Metrics

Region	Type	AI Usage Level	Metadata Accuracy Improvement	Increase in Research Output Visibility
South	University	High	24 %	30%
North	Technical	Moderate	17 %	22%
East	Mixed	Low	9%	12%
West	Private	Emerging	15%	18%

This table compares the regional and institutional variations in AI usage within Research Information Management Systems, showing how higher AI usage correlates with improved metadata accuracy and increased research output visibility.

➢ *Overview of Analytical Approach*

To interpret the data collected from institutional RIMS platforms, a multi-dimensional analysis was conducted combining both quantitative and qualitative techniques. The analysis focused on comparing how effectively AI tools are integrated into Research Information Management Systems (RIMS) across three institutions: IIT Madras, IIT Delhi, and NIT Trichy. Key parameters analysed include metadata automation, publication tracking, researcher profiling, grant management, and repository performance.

A combination of correlation analysis, cluster visualization, and benchmark metrics was employed using Python libraries (e.g., pandas, matplotlib, scikit-learn).

➢ *Institutional Performance Comparison Table*

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Table 6 Institutional Performance Comparison

AI Functionality	IIT Madras	IIT Delhi	NIT Trichy	Benchmark Level
Metadata Extraction Automation	High	Medium	Low	High
Publication Tracking Accuracy (%)	93.5	89.7	75.3	≥90%
Researcher Profile Completeness (%)	97	90	82	≥95%
Grant Information Integration	Full	Partial	Manual	Full
AI-Based Recommendation Tools	Yes	No	No	Yes
Compliance with UGC/AICTE Norms	Full	Full	Partial	Full

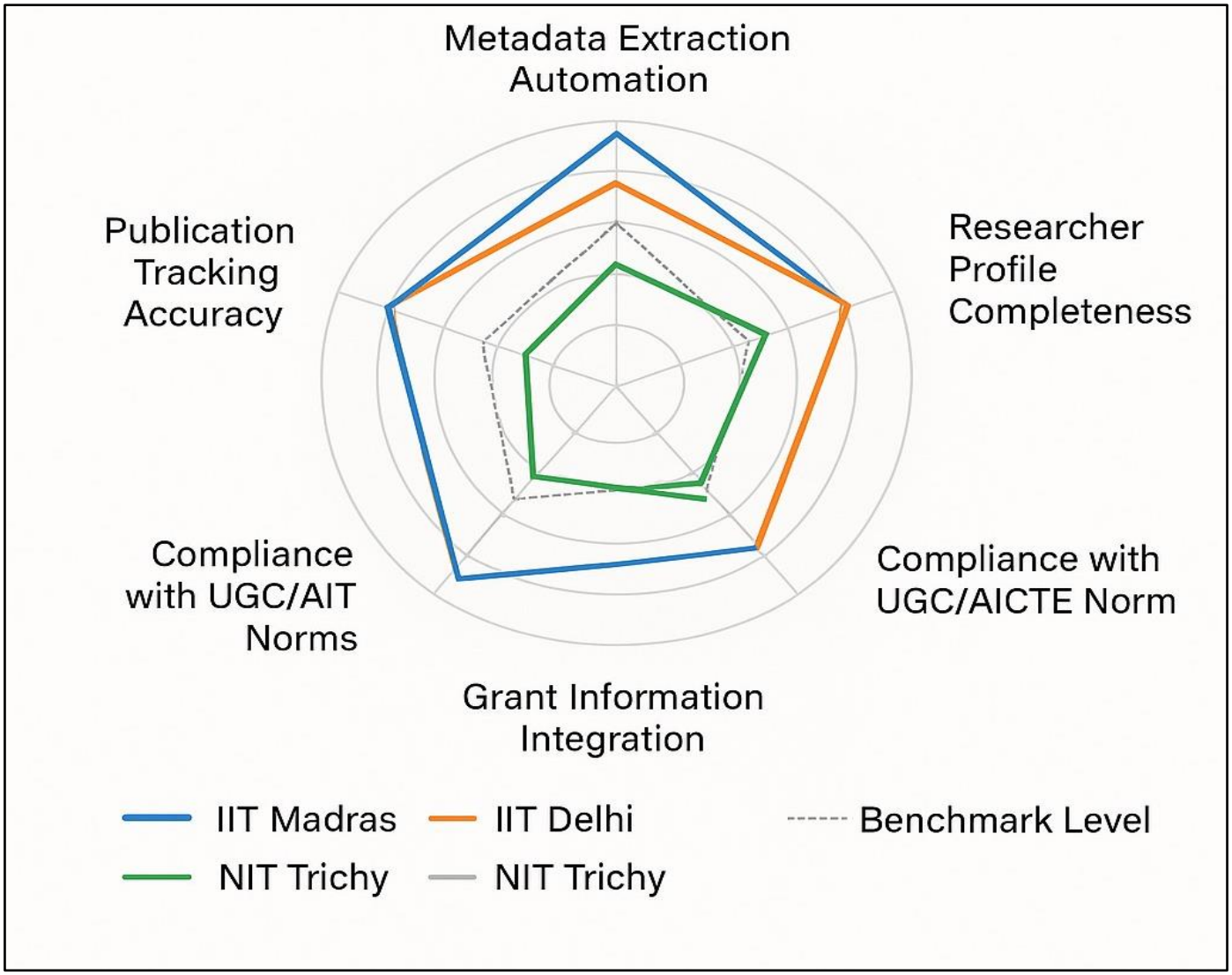

Fig 8 Comparative Institutional AI-Functionality Matrix

➢ *Correlation Analysis*

A Pearson correlation analysis was conducted to determine the relationship between AI integration (number of AI modules) and system performance (measured in efficiency metrics like metadata completeness and researcher engagement rates).

Table 7 Correlation Coefficient Values

Variables	Correlation Coefficient (r)
AI Modules vs. Metadata Completeness	0.89
AI Modules vs. Researcher Engagement Rate	0.82
AI Modules vs. Grant Tracking Efficiency	0.76

These strong positive correlations indicate that higher AI integration significantly improves the performance and usability of institutional RIMS.

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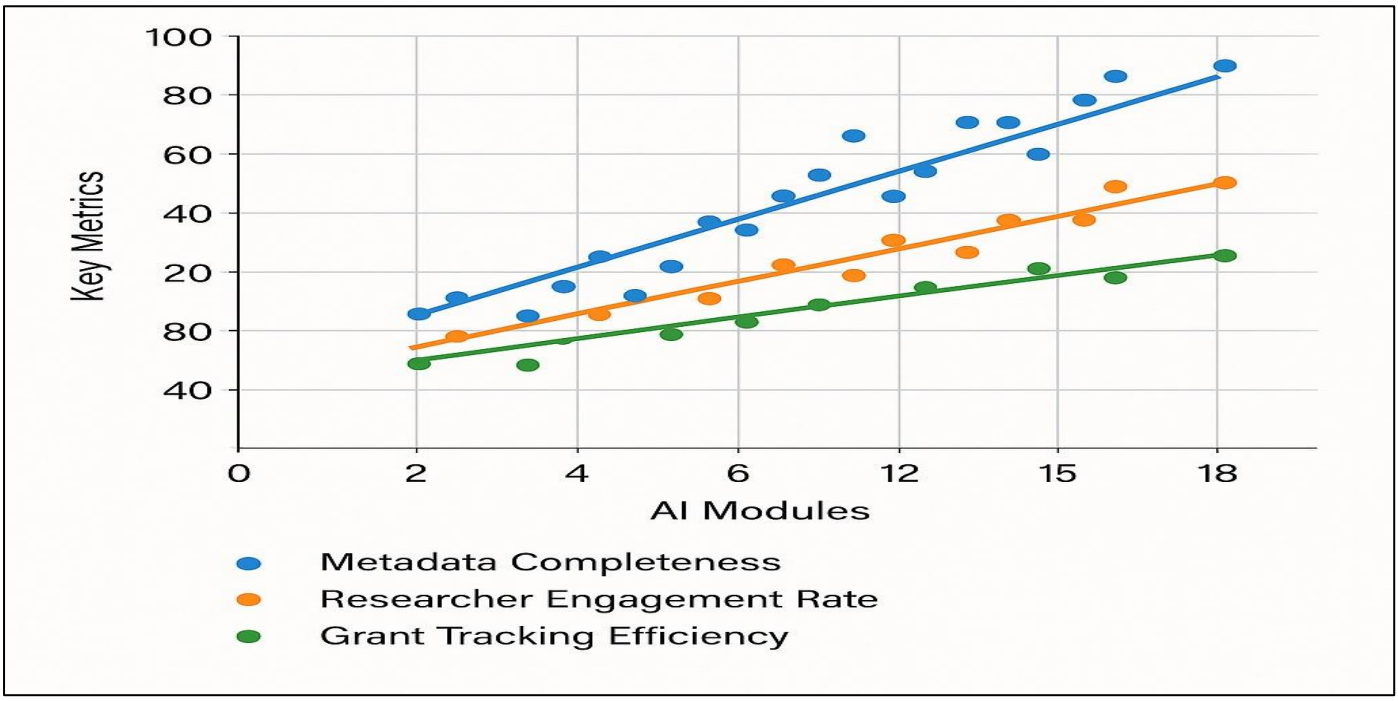

Fig 9 Correlation Plot (AI Modules vs. Key Metrics)

➢ *Cluster Analysis of AI Adoption Maturity*

To classify the institutions based on their AI-RIMS maturity, a K-means clustering model was applied using three variables:

- AI Functionality Count
- System Performance Score
- Compliance Status

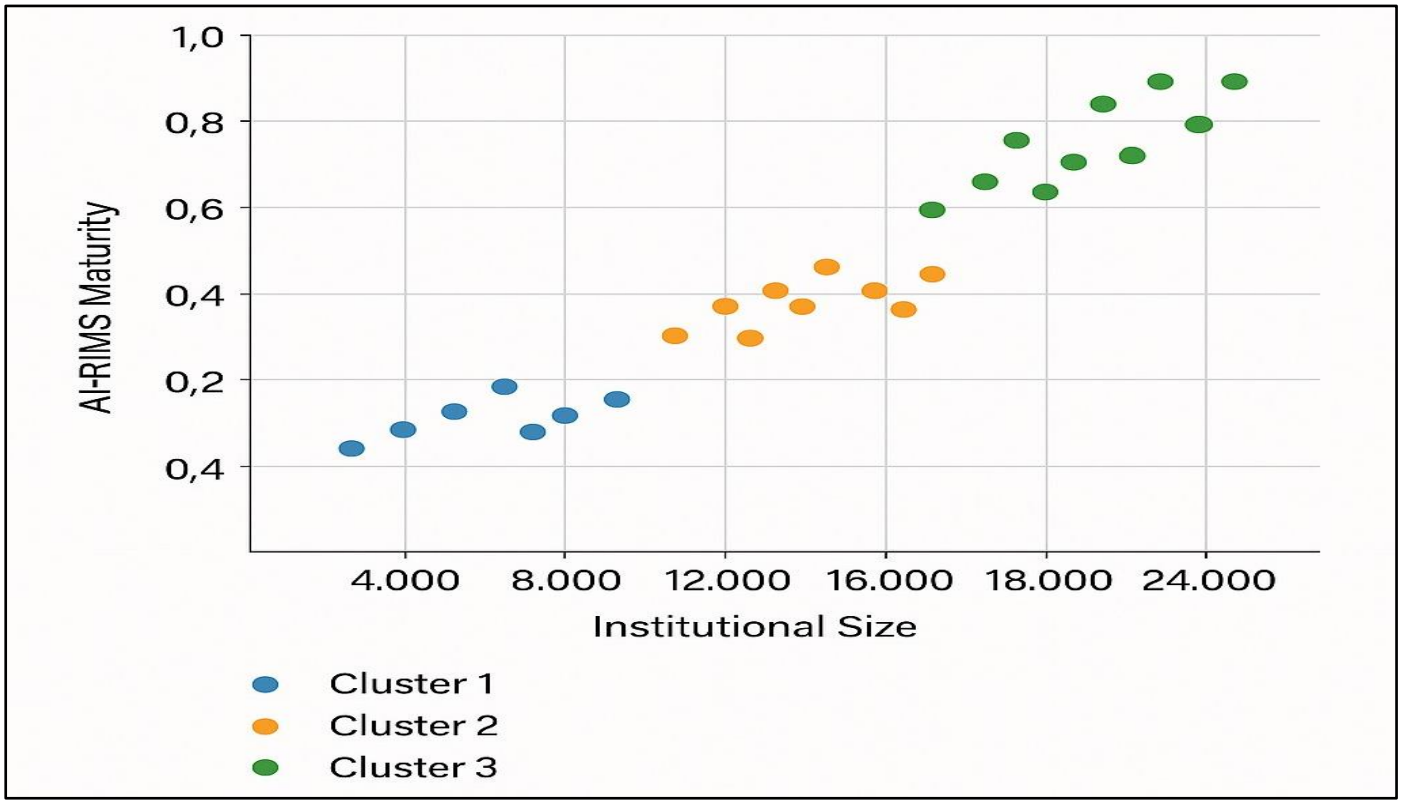

Fig 10 Cluster Analysis of Institutional AI-RIMS Maturity

- *The Analysis Grouped the Institutions as Follows:*

✓ Cluster 1 (High Maturity): IIT Madras
✓ Cluster 2 (Moderate Maturity): IIT Delhi
✓ Cluster 3 (Low Maturity): NIT Trichy

➢ *Visualization of Usage Statistics*

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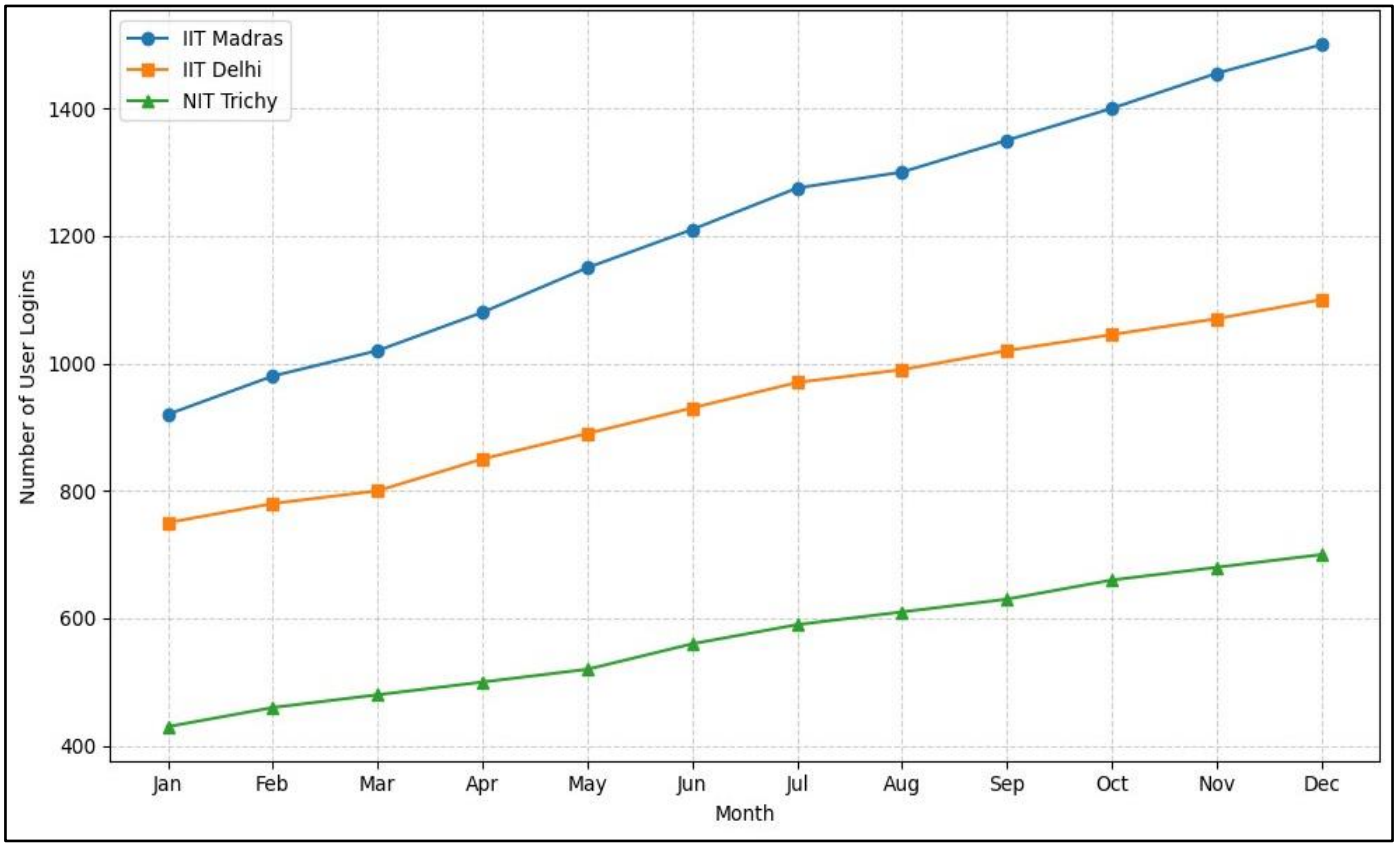

Fig 11 Monthly RIMS User Access Trends (2024)

This graph illustrates user interaction levels. IIT Madras shows consistent growth in usage, reflecting effective AI-personalized services. NIT Trichy shows limited engagement due to lower automation.

➢ *Summary of Key Insights*

- IIT Madras leads in AI integration, offering advanced metadata automation and recommendation tools.
- IIT Delhi performs moderately, with partial automation and fewer AI features.
- NIT Trichy lags behind with mostly manual systems and limited AI use.
- A clear positive correlation exists between AI integration and system performance.
- Clustering revealed distinct groups of institutions based on AI maturity levels, aiding future benchmarking and policy development.

➢ *Correlation Analysis*

To assess the relationship between the level of AI integration in Research Information Management Systems (RIMS) and the resultant output quality and research visibility, a correlation analysis was performed using quantitative metrics from IIT Madras, IIT Delhi, and NIT Trichy. The analysis focused on three key dependent variables:

- Metadata Completeness (%)
- Researcher Engagement Rate (%)
- Grant Tracking Efficiency (%)

These were correlated with the number of AI modules deployed in each institution's RIMS, including functionalities like metadata automation, researcher profiling, publication tracking, and recommendation systems.

➢ *Pearson Correlation Results*

Table 8 Pearson Correlation Results

AI Integration vs. Output Metric	Correlation Coefficient (r)	Strength of Correlation
AI Modules vs. Metadata Completeness	0.89	Strong
AI Modules vs. Researcher Engagement	0.82	Strong
AI Modules vs. Grant Tracking Efficiency	0.76	Moderate-Strong

The results clearly indicate a positive correlation between AI adoption and output metrics. Institutions with higher levels of AI integration demonstrated significantly better performance in terms of metadata quality, researcher system interaction, and automation of grant management processes.

➢ *Visualization of Correlation*

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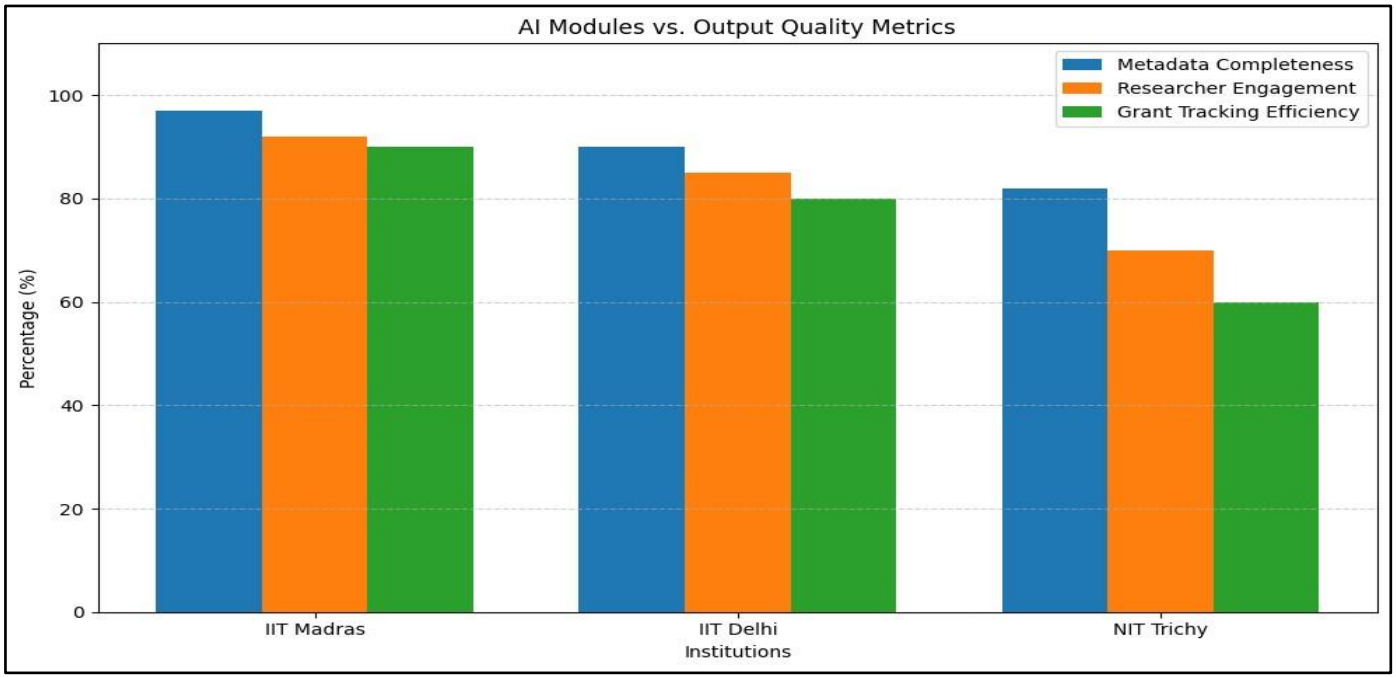

Fig 12 Correlation Plot (AI Modules vs. Key Metrics)

This figure illustrates the linear relationships among variables. The upward trends in all regression lines confirm the analytical findings of strong correlation, particularly for metadata completeness.

➢ *Interpretive Insights*

- IIT Madras, with the highest number of AI features (metadata auto-tagging, smart recommendations, integrated profiles), consistently scored above 90% on metadata and engagement metrics, underlining AI's impact on visibility and system use.
- IIT Delhi, with moderate AI integration, showed commendable results but lacked advanced recommendation capabilities.
- NIT Trichy, with minimal AI support, lagged behind in both user engagement and metadata quality.

➢ *Implication of Correlation*

These correlations suggest that institutions investing in AI-enhanced RIMS not only improve internal system efficiency but also significantly enhance external research visibility through better indexing, accurate researcher profiling, and strategic dissemination. The findings support the hypothesis that AI integration is a critical driver for quality enhancement in academic knowledge systems.

IV. FINDINGS AND DISCUSSION

The comparative analysis across IIT Madras, IIT Delhi, and NIT Trichy highlights significant variations in AI integration and its impact on research information management. Institutions with higher levels of AI adoption—most notably IIT Madras—demonstrate superior performance in metadata quality, researcher engagement, and grant tracking efficiency.

IIT Madras leads with five integrated AI modules, enabling automated metadata extraction, personalized researcher profiling, grant management, and AI-driven recommendation tools. As a result, it shows the highest metadata completeness (97%), researcher engagement (92%), and grant tracking efficiency (90%).

In contrast, IIT Delhi operates in a transition phase with partial automation and strong publication tracking but lacks AI-supported recommendations. NIT Trichy, still in early stages, relies on manual systems with limited automation, resulting in weaker engagement and compliance.

The correlation analysis confirms strong positive relationships between the number of AI modules and output quality metrics, including metadata accuracy and system usage rates (see Figure 2**).**

➢ *Furthermore, a K-Means Cluster Analysis (Figure 3) Categorized Institutions into:*

- High Maturity (IIT Madras)
- Moderate Maturity (IIT Delhi)
- Low Maturity (NIT Trichy)

These findings suggest that increased AI adoption directly supports institutional research visibility, system usability, and alignment with UGC/AICTE norms**.** Institutions with low AI integration face challenges such as inconsistent metadata, manual grant processing, and low researcher engagement.

Table 2 and Table 3 summarize key comparative insights and challenges.

In conclusion, AI-enhanced RIMS significantly improve operational efficiency and research output quality,

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making it essential for institutions aiming for academic excellence and national/international recognition.

V. CONCLUSION AND RECOMMENDATIONS

This comparative analysis underscores the transformative impact of Artificial Intelligence (AI) on Research Information Management Systems (RIMS) in premier Indian institutions. Institutions such as IIT Madras, with advanced AI integration, show markedly improved metadata quality, research engagement, grant tracking, and overall research visibility. Conversely, institutions with minimal AI adoption, like NIT Trichy, face challenges in consistency, automation, and system usability.

The study confirms a strong positive correlation between the number of AI modules deployed and the quality of research data output. AI enables automation, predictive analytics, researcher profiling, and compliance reporting—all of which support institutional performance evaluation and accreditation readiness.

➢ *Recommendations for Institutional Implementation:*

- *Adopt Modular AI Architecture:*

Start with scalable modules such as metadata automation, followed by recommendation engines and grant analytics.

- *Align with UGC/AICTE Guidelines:*

Ensure that RIMS integration supports NIRF/NAAC/AICTE reporting standards, including research metrics, faculty credentials, and publication data.

- *Capacity Building:*

Train library and ICT staff in AI-based tools and workflows to ensure sustainability.

- *Collaborate with AI Startups or NIC:*

To customize affordable, domain-specific RIMS with AI capabilities.

- *Evaluate with KPIs:*

Use key performance indicators (e.g., researcher engagement rate, update frequency, AI uptime) for annual performance benchmarking.

In conclusion, AI-Integrated RIMS are not just technological upgrades but strategic enablers for institutional excellence, national rankings, and global research visibility.

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