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Design and Development of a Lecturer Research Information System at Politeknik LP3I Pekanbaru

Desfita Eka Putri[1]
[1] Politeknik LP3I Pekanbaru, Indonesia
* Correspondence e-mail; desfitaekaputri@plb.ac.id

* WhatsApp Number

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Abstract

The development of information technology has a major impact on the speed and accuracy of data management in various fields, including lecturer research management. LP3I Pekanbaru Polytechnic experienced challenges in processing research data that were still manual and scattered, resulting in duplication of data, loss of research documents, and difficulty in monitoring research progress. This research aims to design and build an integrated, web-based, and Lecturer Research Information System that is able to support the efficient processing of research data. The research method used is Research and Development (R&D) with a Prototyping approach. The results of the research are in the form of an information system that includes research registration modules, fund submissions, progress monitoring, and publication of research results. The system also comes with a Use Case Diagram, Activity Diagram, and Sequence Diagram to support implementation. This system is expected to be able to improve the efficiency of lecturer research management and become an accurate and well-integrated research database.

Keywords Design, Information Systems, Lecturer Research, LP3I Pekanbaru Polytechnic.

INTRODUCTION

In accordance with Article 20 of Law No. 20 of 2003 concerning the National Education System and strengthened by Permenristekdikti No. 44 of 2015, universities have a responsibility in the development of science through research and community service activities. In this case, lecturers as part of the academic community are required to actively conduct research as part of the implementation of the Tri Dharma of Higher Education (Jarti et al, 2025). One of the lecturers' performance will be assessed from the implementation of the research.

Research is an important part of the academic activities of a higher education institution. In the digital era, accurate management of research data is a strategic

need to improve academic quality, transparency, and lecturer performance reporting. At LP3I Polytechnic Pekanbaru, the process of recording, submitting, and publishing lecturers' research is still carried out manually, which has the potential to cause many operational problems, including: Redundancy of research data, Difficulty in finding documented research results, High risk of data loss, Ineffective control of research progress (Mudjisusatyo et al, 2024).

According to Laudon & Laudon (2022), information systems as a collection of components that interact with each other are able to collect, process, store and distribute information to support decision-making and control in an organization. This shows the urgency of the need for an integrated information system for the effective and efficient management of lecturer research.

The purpose of this research is to design and build a Lecturer Research Information System that is integrated into the web-based Research Information System of the LP3I Pekanbaru Polytechnic. This system is expected to facilitate the process of submitting proposals, assigning reviewers, assessing proposals, as well as monitoring and evaluation reporting until the final research report. The information system is developed using the waterfall method, which consists of the stages of needs analysis, system design, implementation, testing, and maintenance.

The system modeling was carried out using the Unified Modeling Language UML), MySQL database, as well as the codeIgniter and Bootstrap php web frameworks for the user interface. The result of this study is an information system that has undergone functional testing (*blackbox testing*) and performance testing (using JMeter), which shows that the system is able to respond well to various usage scenarios. This system makes a real contribution in supporting lecturers' research management in a digital, transparent, and structured manner, and can be further developed into a mobile platform to improve accessibility.

METHODS

This research uses a Research and Development (R&D) *approach* with *the Prototyping method*, which is to build an initial system model which is then tested and improved to meet the needs of users. The research was conducted at the LP3I Pekanbaru Polytechnic for 5 months (January-May 2025).

System Development Flow

The stages include:

1. User needs analysis
2. System planning
3. Prototype implementation

4. Testing
5. Evaluation and improvement
6. Finalization of the system

Figure 1. System Development Flow

Architecture of Information Systems for Research and Lecturer Service

The system is built in a *three-tier architecture* as follows:

Presentation Layer

Web-based User Interfaces used by:

- Lecturer
- Admin
- Reviewer

Business Logic Layer

System logic such as:

- Research proposal input
- Proposal verification
- Monitoring progres
- Management of research results

Data Layer

MySQL database that stores entities:

- Lecturer
- Research
- Publication results
- Research history.

FINDINGS AND DISCUSSION

Use Case Diagram

Use Cases for research information systems:

- Lecturer Login
- Input Proposal
- Document Upload
- Admin Review and Validation
- Reviewers Assess Progress

The above explanation can be seen in the image below:

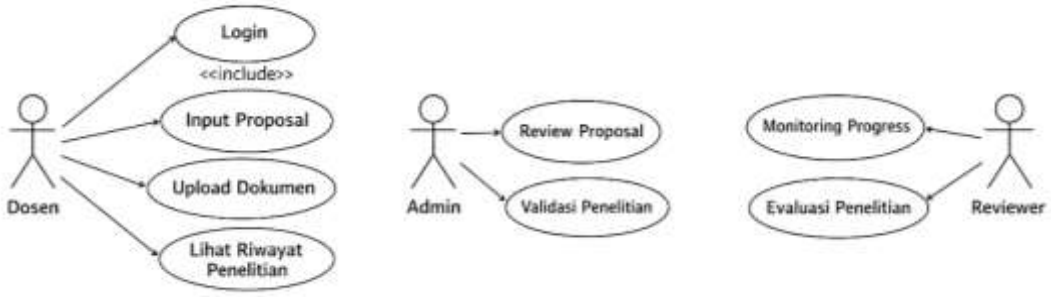

Figure 2. Use case diagram of lecturer research information system

Activity Diagram

Activity flow:

1. Lecturer login
2. Fill out the proposal form
3. Document upload
4. Admin validates
5. Reviewers monitor progress

The activity diagram can be seen in the image below:

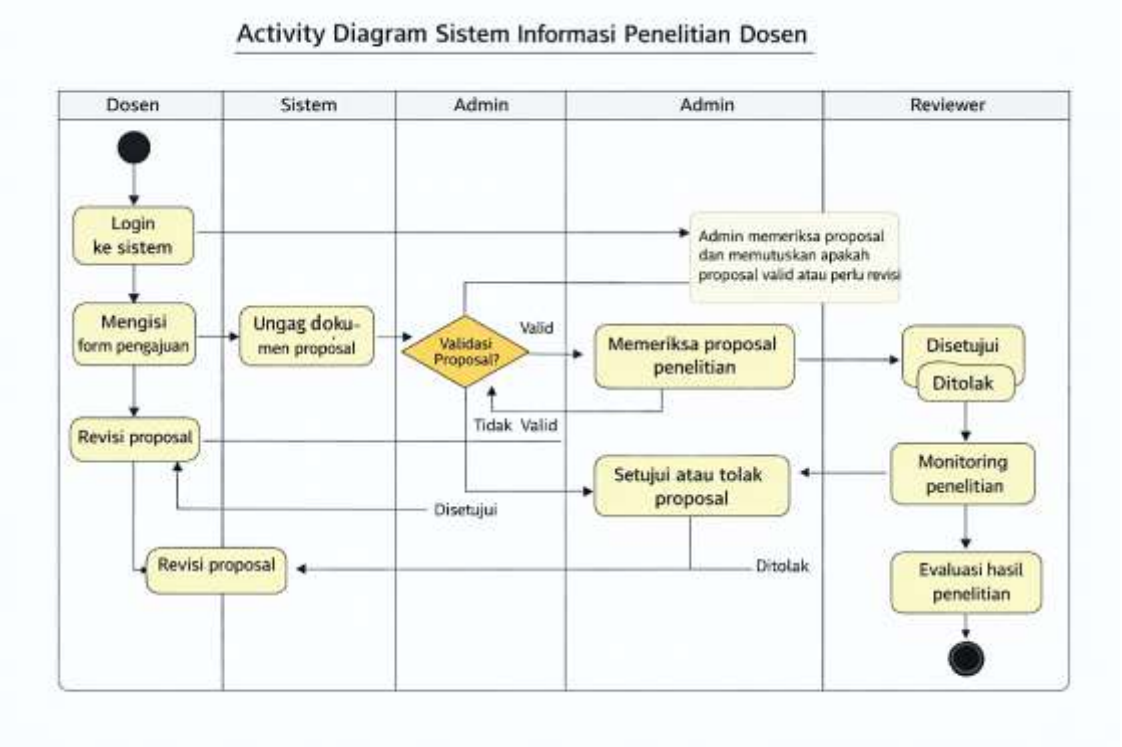

Figure 3. Activity diagram of lecturer research information system

Sequence Diagram

Sequence for research input process:

- Lecturer → Systems: Request Research Input
- Database → System : Store data
- Lecturer → System : Confirmed successful

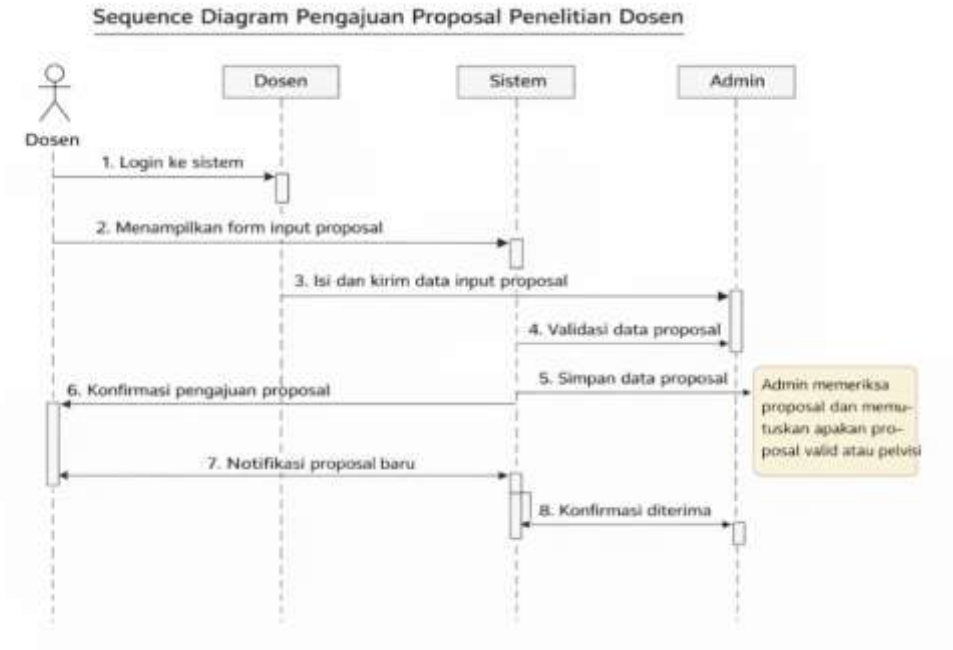

Figure 4. Sequence diagram of submission of lecturer research proposals

FINDINGS AND DISCUSSION

A comparison of previous manual systems and design results shows:

Aspects	Manual	Information Systems
Access Time	Old	Fast
Data Accuracy	Rentan Error	Valid & Integrated
Monitoring	Difficult	Real-Time
Backup Data	None	Automatic

The findings of this study demonstrate that the development of a web-based Lecturer Research Information System at Politeknik LP3I Pekanbaru represents more than a technological replacement for manual administration. The system addresses a structural problem in research management, namely fragmented information, duplicated data, difficult document retrieval, and limited monitoring of research progress. The resulting system integrates several research-management activities, including proposal submission, document uploading, administrative validation, reviewer involvement, progress monitoring, and management of research outputs. These findings indicate that the central value of the system lies in transforming research administration from a document-oriented process into an integrated information-management process.

This finding can be explained through the information systems perspective proposed by Laudon and Laudon, which conceptualizes an information system as an integrated set of components for collecting, processing, storing, and distributing information to support organizational operations and decision-making. In the context of lecturer research management, the problem was not simply the absence of software, but the absence of a common information environment in which data could be entered once, stored systematically, retrieved efficiently, and used by different actors according to their respective roles. Rather than maintaining separate documents and spreadsheets, lecturers, administrators, and reviewers interact with a shared database and workflow.

The finding that the system improves accessibility and reduces the difficulty of retrieving research information is consistent with recent studies concerning digital information management in higher education. Octaviany et al. (2024), for example, found that the development of a web-based academic management information system could reduce administrative burdens, save time, optimize resources, and support stakeholder decision-making. Their findings reinforce the argument that the contribution of a web-based system should not be measured solely by whether the

system successfully performs technical functions, but by whether the technology changes the efficiency and quality of organizational processes.

This interpretation is supported by Handayani, Rochwulaningsih, and Sulistiyono (2024), who examined the development of the SIP3MU research information system at Universitas Diponegoro. Their study showed that an integrated research information system can facilitate real-time monitoring of faculty research progress, management of research and publication data, and evaluation of research performance. They further emphasized that an integrated system contributes to the establishment of a more structured and collaborative research ecosystem. The similarity with the present study is evident in the emphasis on integration and monitoring.

The reduction of data redundancy and the improvement of data accuracy can also be understood through the concept of database integration. In a manual environment, the same research information may be repeatedly entered into different documents, spreadsheets, or administrative records. Thus, the improved accuracy reported in this study is not merely the result of users becoming more careful; it is a consequence of changing the architecture through which information is stored and managed.

This finding is comparable to the results reported by Pasaribu and Argadikusuma (2024) in the development of a web-based Student Information Management System. Their study found that the application of UML, structured system design, and black-box testing supported more accurate information management and improved communication among stakeholders. The similarity suggests that the benefits of web-based information systems in higher education are partly generated by formalizing organizational processes into clearly defined system functions. The difference, however, lies in the object being managed. Student information systems primarily manage relatively stable administrative data, whereas research information systems must accommodate dynamic processes, changing research statuses, document versions, reviewer assessments, and research outputs.

The integration of proposal submission, administrative validation, and reviewer activities is another important finding. The Use Case, Activity, and Sequence Diagrams show that the system distributes responsibilities among lecturers, administrators, and reviewers rather than treating research administration as a single-user process. This is important because research management involves role differentiation. Lecturers are responsible for submitting and updating research

information, administrators are responsible for verification and management, while reviewers contribute to evaluation and monitoring

This result is strongly consistent with Hartono and Wardany's study of a web-based research and community-service submission system at Nahdlatul Ulama University Lampung. Their research identified proposal submission, reviewer assignment, review processes, and research reporting as areas requiring integration, and developed a PHP-MySQL-based system using the Waterfall model and Blackbox Testing. The similarity is particularly significant because both studies respond to the same institutional problem: research administration becomes inefficient when submission, review, and reporting are handled separately. Scientifically, this convergence indicates that research information systems should be designed around the institutional workflow rather than simply around a collection of electronic forms.

The importance of workflow integration is also demonstrated by the study of Baso and Risald (2024), which developed a web-based PPM management information system at Universitas Timor. Their prototype was designed to facilitate proposal management, status tracking, evaluation, and reporting, and user feedback indicated improvements in ease of use and process transparency. The present study produces a similar pattern, particularly in relation to the value of monitoring and transparency. Nevertheless, the use of a prototyping approach in the present research offers an important methodological implication.

This aspect differentiates the present research from studies using a strictly sequential Waterfall model. Several recent Indonesian studies have used Waterfall to develop research or academic information systems. Hartono and Wardany (2024), for instance, used Waterfall to develop a research and community-service submission system, while Kaban et al. (2024) used Waterfall in developing an MBKM information system. Waterfall offers advantages in terms of procedural clarity and structured development, particularly when system requirements are relatively stable. However, research administration can involve evolving requirements because institutional policies, reviewer mechanisms, funding procedures, and reporting requirements may change. In this context, prototyping provides an advantage because it allows requirements to be validated and refined during development.

The finding that monitoring becomes easier and more responsive is arguably one of the most important contributions of the system. In the previous manual system, monitoring depended heavily on administrators collecting information from different documents and communicating with lecturers. This creates a reactive management model: administrators often discover delays only after a reporting

deadline approaches. The integrated system changes this into a more proactive model because research status can be recorded systematically and monitored according to its stage. Thus, the system does not simply store historical information; it creates an information environment that can support managerial intervention.

This finding is consistent with Handayani et al. (2024), who reported that SIP3MU supports real-time monitoring and evaluation of faculty research and publication activities. It is also consistent with the recent development of SIMPELMAS, an integrated research and community-service management information system that emphasizes data integration for performance evaluation and strategic decision-making. The scientific implication is that research information systems should be understood as management instruments rather than merely administrative repositories.

The system's backup capability also addresses an important weakness of manual information management. In a manual environment, documents may be stored on individual computers, physical files, or disconnected storage media, creating vulnerability to loss or damage. A structured database and centralized digital storage reduce this vulnerability, although backup functionality alone does not automatically guarantee data security. Recent research on research information management systems emphasizes that scalability, security, and infrastructure are increasingly important as institutional research databases grow. Oktareza and Ardiansyah (2025), in their development of the backend for the SSMI IPB Research Information Management System, specifically identified scalability, efficiency, and security as important challenges and explored cloud computing as a solution for improving the flexibility and scalability of research information infrastructure.

This point provides an important critical qualification to the findings of the present study. The statement that the system provides "automatic backup" should not be interpreted as meaning that the system has achieved comprehensive information security. Data backup protects against certain forms of data loss, but research information systems also require authentication, authorization, access control, encryption, audit trails, disaster recovery procedures, and periodic security assessment. Therefore, while the current system successfully resolves the fundamental problem of fragmented data management, future development should expand the concept of reliability from simple backup toward comprehensive information governance.

The use of UML diagrams in the system design also contributes to the clarity of the research findings. The Use Case Diagram defines interactions between lecturers,

administrators, reviewers, and the system; the Activity Diagram describes workflow; while the Sequence Diagram illustrates the interaction between users, application logic, and the database. This modeling approach transforms organizational requirements into a technical specification that can be understood by both developers and institutional stakeholders. Pasaribu and Argadikusuma (2024) similarly demonstrated that UML-based functional and non-functional specifications can strengthen the design of web-based information systems in higher education.

The findings further correspond with recent evidence that digital management systems can improve administrative efficiency when they integrate data and workflows. Husein et al. (2025), for example, reported that a web-based academic information system reduced input errors and improved administrative efficiency and user satisfaction. Similarly, Subandi and Kusumadiarti (2023) found that a web-based lecturer management information system could accelerate lecturer data collection, reduce risks of data loss, and facilitate monitoring of lecturer-related academic outputs. The convergence of these studies with the present findings suggests that the fundamental mechanism behind digital transformation in higher education is not simply automation, but the standardization, integration, and traceability of institutional information.

However, the findings should be interpreted cautiously because the study primarily demonstrates system development and functional benefits rather than providing extensive quantitative evidence of organizational impact. For example, the manuscript states that the system is faster, more accurate, and easier to monitor, but it does not yet report detailed pre-test and post-test measurements of processing time, error rates, user satisfaction, system usability, or research completion rates. Recent studies demonstrate the value of complementing functional testing with measurable quality indicators. Efendi et al. (2025), for example, evaluated functional suitability, usability, and performance efficiency using ISO 25010, while other higher-education information-system studies have incorporated usability and performance measures.

The findings also have implications for research governance at Politeknik LP3I Pekanbaru. Once research data are systematically captured, the institution can potentially use the system as an evidence base for research planning, lecturer performance evaluation, funding allocation, research roadmap development, and accreditation documentation. This is particularly important because research administration increasingly requires institutions to demonstrate not only the existence of research activities but also their outputs, continuity, relevance, and

impact. Consequently, the developed system can become a strategic institutional infrastructure if the data are continuously maintained and connected with broader academic information systems.

So, the findings indicate that the development of the Lecturer Research Information System solves three interconnected problems: information fragmentation, inefficient workflow, and weak research monitoring. Its similarity with previous studies confirms that integrated web-based information systems can improve administrative efficiency, transparency, data accuracy, and monitoring in higher education. Its distinctive contribution lies in applying these principles specifically to lecturer research management at Politeknik LP3I Pekanbaru through a prototyping-based development process and a three-tier web architecture.

The most important implication is therefore that the system should not be treated as a final technological product. It should be developed as an institutional research information infrastructure. Future development should include dashboard-based research analytics, automated notifications for research deadlines, integration with lecturer profiles and publication databases, stronger authentication and authorization, cloud-based backup, mobile accessibility, and standardized quality evaluation using frameworks such as ISO 25010 or the DeLone and McLean Information Systems Success Model. Such development would move the system from a transactional database toward a strategic research management platform capable of supporting evidence-based decision-making and strengthening the research ecosystem of Politeknik LP3I Pekanbaru.

CONCLUSION

The development of the *Lecturer Research Information System at Politeknik LP3I Pekanbaru* demonstrates that digital transformation can provide a substantive solution to fragmented and inefficient research administration. The developed web-based system integrates the main stages of lecturer research management, including proposal submission, document uploading, administrative verification, reviewer assessment, progress monitoring, and management of research outputs. The integration of these processes establishes a centralized and structured research database, thereby improving accessibility, data consistency, and transparency of research administration. From a scientific perspective, the study contributes a practical information-system development model that connects research-management workflows with a three-tier architecture and role-based system interaction, demonstrating that information technology can function not merely as an administrative tool but also as institutional infrastructure for strengthening research

governance and evidence-based decision-making. Nevertheless, the study has limitations, particularly because the evaluation remains predominantly focused on system functionality and performance rather than measuring the long-term organizational impact of implementation.

Future research should therefore move beyond functional system development toward comprehensive evaluation of the system's organizational and strategic impacts. Subsequent studies could employ mixed-method or longitudinal approaches involving lecturers, administrators, reviewers, and institutional decision-makers to measure usability, adoption, processing efficiency, data quality, and changes in research-management performance before and after implementation.

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