Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th October 2024. Vol. 4. No. 1; e-ISSN: 2808-4519

Development of a Cloud Computing-Based Collaboration Information System

Anwar[1*], Muhammad Reza Zulman[2], Muhammad Arhami[3], Nahar[4], Safriadi[5]

[1,2,3,5] Jurusan Teknologi Informasi Dan Komputer Politeknik Negeri Lhokseumawe
[4]Jurusan Teknik Kimia Politeknik Negeri Lhokseumawe
anwarsy@pnl.ac.id*

Abstract

The rapid advancement of information and communication technology has created a demand for efficient and effective information systems to facilitate collaboration among institutions. This study develops a cloud computing-based collaboration information system designed to enhance real-time communication, data management, and collaboration among users. The system comprises key modules, including collaboration management, document management, and integrated collaboration features. Testing involved various scenarios with 10 to 100 active users simultaneously, revealing that the system maintained stable performance with response times under 3 seconds for each user request. Furthermore, security assessments utilizing encryption protocols and two-factor authentication confirmed that the managed data is protected from external threats. The findings underscore the system's potential to improve collaborative efficiency while ensuring data security, making it a valuable solution for future collaborative initiatives.

Keywords: *Cloud Computing, Scalability, Security*

1. Introduction

The rapid advancement of information technology has brought significant changes to various aspects of life [1], including collaboration and cooperation among institutions. Reliable and efficient information systems have become crucial for organizations to enhance productivity, improve communication effectiveness, and manage resources effectively [2]. In this regard, Cloud Computing technology serves as an innovative solution that enables flexible and scalable data storage, information processing, and collaboration [3]. The use of cloud computing in developing collaboration information systems presents new opportunities for managing and integrating various distributed resources.

Cloud Computing offers several advantages, including infrastructure cost efficiency, flexible access, and adjustable storage capacity according to the organization's needs [4]. Cloud-based information systems allow for geographic cross-access and real-time collaboration, facilitating efficient interactions between institutions without physical limitations. This is particularly important in the digital era, which demands speed and accuracy in information delivery and decision-making. Additionally, the high integration capability of cloud-based systems allows for automatic data synchronization across various platforms, supporting a more seamless workflow [5].

However, alongside these benefits, the application of Cloud Computing technology in developing collaboration information systems presents several challenges [6]. Data security and privacy are crucial issues that must be carefully managed. Data stored and processed in the cloud environment can be vulnerable to cybersecurity threats, including hacking attacks, data breaches, and system configuration errors. Therefore, security strategies such as encryption, appropriate access management, and the implementation of internationally recognized security policies need to be integrated into system development [7].

Moreover, system sustainability and scalability are other primary concerns that must be addressed. Systems must be designed to support an increasing number of users, data volume, and increasingly complex collaboration needs over time. Additionally, the availability and reliability of cloud services themselves are critical. Service disruptions can significantly impact organizational performance, making the choice of a reputable cloud service provider with reliable infrastructure an essential aspect.

This research aims to examine the development of cloud computing-based collaboration information systems, focusing on the analysis of benefits, technical challenges, and security implications during implementation. Special attention is also given to reviewing system architecture that supports inter-institutional collaboration and evaluating the performance of the implemented system. The results of this study are expected to make significant contributions to practitioners and system developers in designing more efficient, secure cloud solutions that meet future needs. Thus, this research plays a role in expanding insights into the potential of cloud computing to support digital transformation in the cross-organizational cooperation sector.

2. Literature Review

2.1. Cloud Computing

Cloud computing is a modern computing paradigm that enables the provision of information technology services over the internet [8]. This model allows users to access computing resources such as servers, data storage, networks, and software without having to manage the physical infrastructure directly. According to NIST (National Institute of Standards and Technology), cloud computing is defined as a service delivery model that is on-demand, with broad network access, rapid elasticity, and measured services that can be tailored to user needs. Cloud computing has become the foundation for many modern applications due to its flexibility and efficiency [9].

Cloud computing is generally divided into three main service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). IaaS provides virtual infrastructure such as storage and servers, allowing users the freedom to build and manage their own computing environments. PaaS offers a development platform where developers can build applications without worrying about managing the underlying infrastructure. SaaS is a model that allows users to access ready-to-use software via a browser, such as email or document management applications.

The main advantages of cloud computing are high scalability and elasticity. In a cloud-based application, organizations can easily adjust computing capacity according to their needs, eliminating the need for substantial investments in hardware. Additionally, cloud computing supports a pay-as-you-go pricing model, meaning that computing costs are calculated based on actual usage. This provides significant benefits for small to medium-sized businesses, as it minimizes operational and maintenance costs.

Besides scalability advantages, security is another critical aspect in the implementation of cloud computing. Cloud service providers generally offer additional security layers, including data encryption, multi-factor authentication, and disaster recovery. However, the use of cloud computing still poses challenges related to data privacy and reliance on service providers. Therefore, strong privacy policies and clear service level agreements (SLAs) become critical aspects of implementing this technology.

In the context of developing web-based collaboration information systems, such as SIMKERMA (Collaboration Information System), the implementation of cloud computing can enhance efficiency and ease of data management while supporting inter-institutional collaboration [9]. By leveraging cloud architecture, information systems can be accessed more broadly, anytime and from anywhere, which is highly relevant in today's digital era.

Research on the application of cloud computing in developing information systems continues to evolve. One study indicates that using cloud computing in developing applications based on the Laravel framework can improve efficiency in infrastructure management and application deployment, as well as support continuous integration and continuous deployment practices [10], [11]. This demonstrates that cloud computing not only provides flexibility at the infrastructure level but also supports increased productivity in software development.

2.2. Scalalbility

Scalability in cloud computing refers to the ability to dynamically adjust resources to meet varying workloads, ensuring optimal performance and cost efficiency. It is typically categorized into two types: vertical and horizontal scalability. Vertical scalability, or scaling up, involves enhancing the resources of a single machine, such as increasing CPU or RAM. While this method is straightforward, it has limitations since a single server can only be upgraded to a certain extent. In contrast, horizontal scalability, or scaling out, entails adding more machines to distribute the workload, which allows for greater flexibility and cost-effectiveness [12].

One of the key benefits of scalability is cost efficiency. Organizations can scale their resources up or down based on real-time demand, meaning they only pay for what they use. This pay-as-you-go model is particularly advantageous during periods of fluctuating demand, such as seasonal sales or unexpected traffic spikes. Additionally, scalability helps maintain consistent application performance, providing a better user experience as resources are adjusted automatically to meet user needs [12].

To implement scalability effectively, organizations often utilize auto-scaling features offered by cloud providers. Auto-scaling automatically adjusts the number of active instances based on metrics like CPU usage or network traffic, ensuring resources are available during peak times and minimized during lulls. Load balancing is another critical component, distributing incoming traffic across multiple servers to optimize resource utilization and prevent any single server from being overwhelmed [13].

Despite its advantages, scalability comes with challenges. The complexity of designing and managing scalable architectures can be daunting, requiring careful planning and expertise. Additionally, data management becomes increasingly complex as systems scale, necessitating solutions for maintaining data consistency across distributed instances. Continuous monitoring of performance metrics is essential to ensure that scaling actions are effective and aligned with user demand.

3. Research Methodology

Research methods planned to achieve the goals of system development as depicted in Figure 1.

Fig. 1: System Development Stages

The first step in the research is to conduct a thorough literature analysis. This literature analysis aims to understand the existing knowledge in the domain relevant to the research topic. Through literature analysis, researchers can identify previous studies, relevant theories, and gaps in knowledge that still need to be addressed. The results of this literature analysis will serve as the foundation for developing the conceptual framework and further research. After conducting the literature analysis, the next step is to design the research's conceptual framework. This conceptual framework includes modeling the relationships between the variables to be studied in the research. By designing a clear and structured conceptual framework, researchers can direct their research in a more focused and systematic manner. This conceptual framework will also serve as a guideline for subsequent data collection and analysis.
Once the conceptual framework is designed, the next step is to implement the system according to the established plan. This system implementation involves the development or construction of the system based on the previously established conceptual framework. This process includes coding, testing, and adjusting the system to ensure that the developed system meets the research needs and can generate relevant data.

4. Result and Discussion

The cloud-based collaboration information system developed has been successfully implemented with several main modules designed to support collaboration between institutions. The user interface of the system is designed with a focus on ease of use and efficiency, allowing users from various technical backgrounds to easily access and manage existing collaboration data.

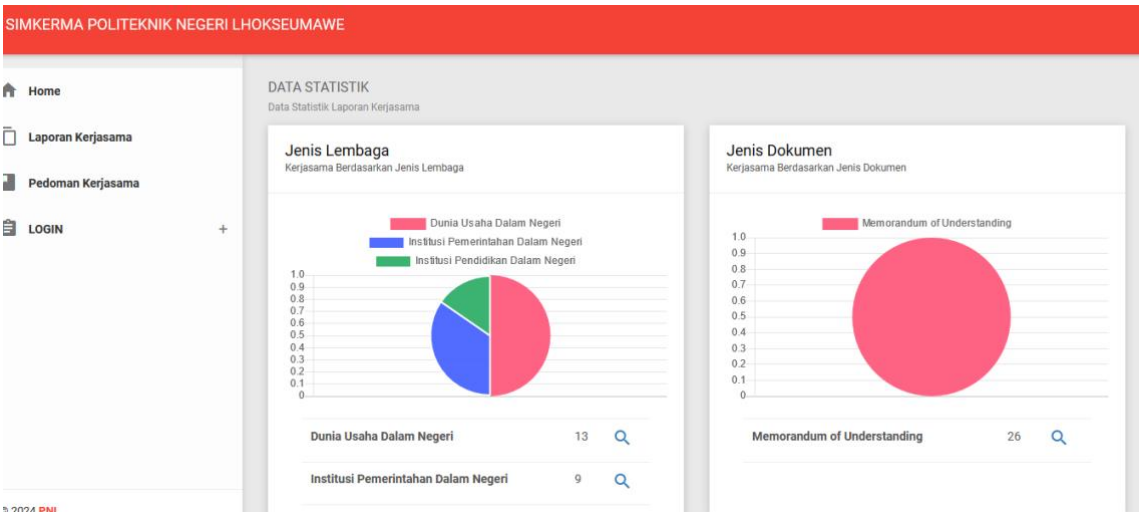

Fig. 2: Dashboard Pages

The main page of the Collaboration Information System (Simkerma) is the collaboration dashboard, which serves as a control center for users to manage all activities and information related to collaboration. This dashboard is designed to provide a concise and informative view, displaying important data such as project status, schedules, and the latest developments in one place. With an intuitive interface, users can easily navigate and access various features, such as submitting new proposals, reviewing ongoing proposals, and reporting on collaboration outcomes.

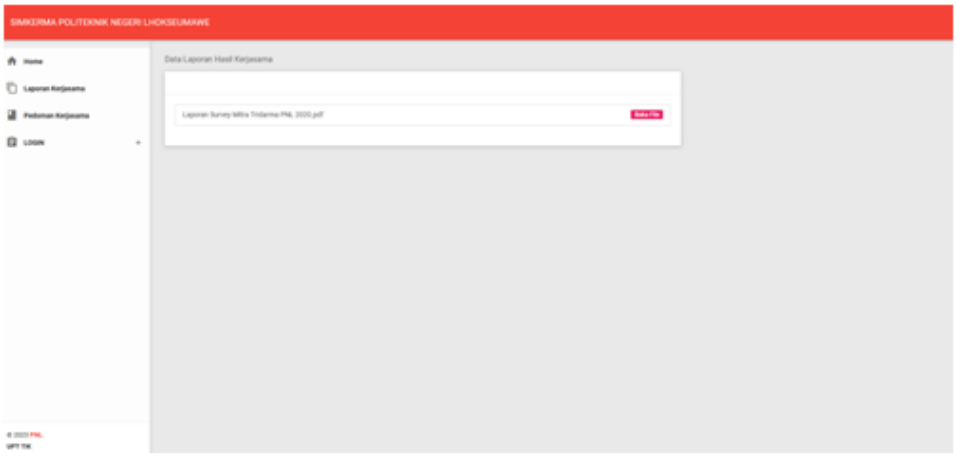

Fig. 3: Report Pages

The Collaboration Report Page in the Collaboration Information System (Simkerma) serves as a repository for storing and accessing annual collaboration reports in PDF format. This page is designed to provide easy access for users to view and download important reports related to collaborations that have taken place during specific years. Each annual collaboration report is presented neatly, accompanied by comprehensive information about the projects, achievements, and evaluations of the collaboration outcomes. Users can utilize the search feature to find specific reports based on certain criteria, such as year, type of collaboration, or partners. Additionally, navigation links and a folder-based structure make it easier for users to navigate and manage the various reports available.

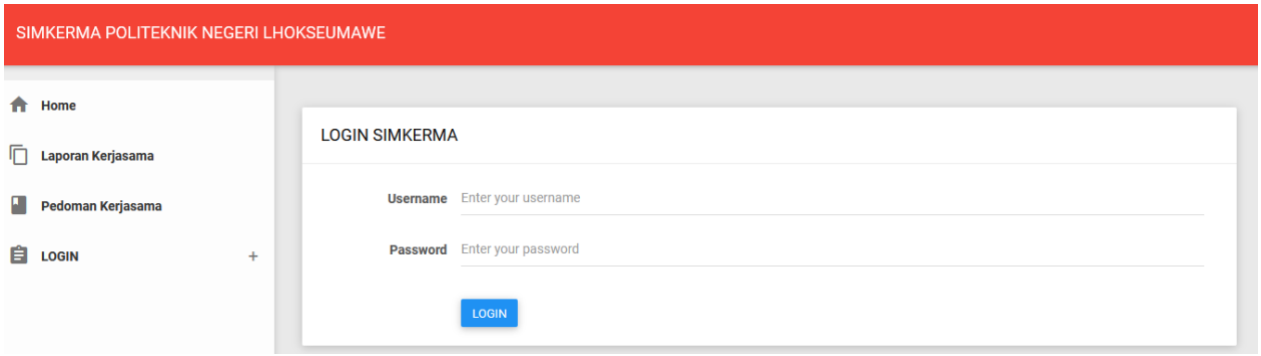

Fig. 4: Login Pages

The Login Page in the Collaboration Information System (Simkerma) is an essential access point for users who want to manage collaboration data. This page is designed to secure access to the system, ensuring that only authorized users can manage sensitive information related to collaborations. On the Login Page, users are prompted to enter their username and password. Once this information is verified by the system, users can access various features and functions provided by Simkerma, such as submitting new proposals, reviewing project status, updating collaboration information, and more. Security is a top priority in the design of this Login Page. Login information is encrypted and securely stored in the database, and the authentication process uses encrypted methods to protect against unauthorized access. Additionally, the system is typically equipped with additional security policies such as login attempt restrictions, automatic logout sessions, and activity logs to monitor and track user activities.

Table 1: Results of Application Response

Number of Users	Response Time	Note
10	1.2	Sistem berjalan stabil
25	1.3	Sistem berjalan stabil
50	1.5	Sistem berjalan stabil
75	1.8	Sistem berjalan stabil
100	2.1	Sistem berjalan stabil

System testing is conducted to measure the performance and security of this cloud-based collaboration information system. Performance testing indicates that the system can effectively handle varying workloads. Trials were conducted under several usage scenarios with different numbers of users, ranging from 10 to 100 active users simultaneously. The results show that the system remains stable with consistent response times of under 3 seconds for each user request. The results of the website response time testing are shown in Table 1.

5. Conclusion

Conclusion of the Development of a Cloud Computing-Based Collaboration Information System:

1. Efficiency and Flexibility: The use of cloud computing technology in the development of the collaboration information system has proven to enhance efficiency and flexibility in data access. This system allows real-time collaboration between institutions with access available from various locations and devices.
2. Performance Stability: Based on trials with varying numbers of active users (ranging from 10 to 100 users), the system demonstrated stable performance with consistent response times of under 3 seconds. This indicates that the system can handle a large user load without significant performance degradation.
3. Guaranteed Data Security: The implementation of SSL/TLS encryption protocols and two-factor authentication (2FA) ensures data security during transmission and system access. Security testing did not reveal any significant vulnerabilities, thus the system is deemed secure and compliant with the necessary security standards for managing sensitive data.
4. Scalability and Sustainability: The system is designed to support future growth in terms of both user numbers and data volume. This ensures that the system can continue to evolve alongside the increasing complexity and number of collaborations being managed.

References

[1] A. R. Muttaqin, A. Wibawa, and K. Nabila, "Inovasi Digital untuk Masyarakat yang Lebih Cerdas 5.0: Analisis Tren Teknologi Informasi dan Prospek Masa Depan," *Jurnal Inovasi Teknologi Dan Edukasi Teknik*, vol. 1, no. 12, pp. 880–886, 2021.

[2] A. Andini and A. Saleh, "Optimalisasi Pengacakan Soal Latihan Pada Aplikasi Belajar Ielts Menggunakan Metode Fisher Yates Shuffle Design and Build an IELTS Learning Application Using the Fisher Yates Shuffle Method Based on Android," *Jurnal Info Digit (JID)*, vol. 2, no. 2, 2024, [Online]. Available: http://kti.potensi-utama.ac.id/index.php/JID

[3] E. Barus, K. M. Pardede, and J. A. P. B. Manjorang, "Transformasi Digital: Teknologi Cloud Computing dalam Efisiensi Akuntansi," *Jurnal Sains Dan Teknologi*, vol. 5, no. 3, pp. 904–911, 2024.

[4] Z. Zainul and N. H. Romadhan, "Cloud Storage Sebagai Pengganti Arsip Manual Dalam Penunjang Aktifitas Sehari-Hari," *Kohesi: Jurnal Sains dan Teknologi*, vol. 1, no. 6, pp. 20–30, 2023.

[5] D. Yatimah *et al.*, *Pemanfaatan Platform Digital Untuk Pembelajaran Kreatif dan Inovatif*. Bayfa Cendekia Indonesia, 2024.

[6] R. Subekti *et al.*, *Transformasi Digital: Teori & implementasi Menuju Era Society 5.0*. PT. Sonpedia Publishing Indonesia, 2024.

[7] R. Ramanda and J. N. U. Jaya, "Audit Tata Kelola Teknologi Informasi Menggunakan Framework Cobit 4.1 Pada Telkom Penajam," *Journal of Software Engineering and Information System (SEIS)*, pp. 63–75, 2024.

[8] M. S. Rumetna, "Pemanfaatan cloud computing pada dunia bisnis: studi literatur," *Jurnal Teknologi Informasi dan Ilmu Komputer (JTIIK)*, vol. 5, no. 3, pp. 305–314, 2018.
[9] D. K. Wibowo, A. Luthfi, and N. Widiyasono, "Investigation of Fake Insider Threats on Private Cloud Computing Services," *International Journal of Science, Technology & Management*, vol. 3, no. 5, pp. 1484–1491, 2022.
[10] M. Muliawati, H. T. Hidayat, S. Safriadi, and A. Anwar, "Penerapan E-Raport Kekurangan Energi Kronis (KEK) dengan Cloud Computing pada Smart Village di Desa Uteunkot," *Journal of Artificial Intelligence and Software Engineering*, vol. 4, no. 1, pp. 34–41, 2024.
[11] D. S. Wayan, P. I. Nyoman, and P. W. Buana, "Integrasi Infrastructure as Code dengan Continuous Integration/Continuous Deployment di Google Cloud Platform," *JURNAL FASILKOM*, vol. 14, no. 2, pp. 346–354, 2024.
[12] M. Abdi, A. Amru, S. F. Rafiqa, and S. Safriadi, "Implementasi Algoritma Fisher-Yates untuk Pengacakan Dinamis Soal TOEFL dalam Ujian Online Berbasis Web," *Jurnal Nasional Komputasi dan Teknologi Informasi (JNKTI)*, vol. 7, no. 5, 2024.
[13] S. Ponnusamy and P. Gupta, "Scalable Data Partitioning Techniques for Distributed Data Processing in Cloud Environments: A Review," *IEEE Access*, vol. 12, pp. 26735–26746, 2024, doi: 10.1109/ACCESS.2024.3365810.