

## Literature Review study of Data Replication Methods in Distributed System

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### ABSTRACT

This literature review study discusses data replication methods in distributed systems, which is an important requirement in modern data processing. The purpose of this study is to explore effective replication methods in distributed systems, such as synchronous, asynchronous, multimaster, database replication, partial replication, two-way replication, replication with load balancing, replication with auto-promote, and web service-based replication, as well as the challenges faced in maintaining data consistency. The method used is Systematic Literature Review (SLR) by analyzing 15 related scientific journals on best practices in data replication methods in distributed systems. The results show that there are three replication methods that are considered best practices. First, multimaster replication applied in the payroll system at CV Rejeki Jaya Makmur Abadi has successfully increased data availability and reliability, this application also reduces salary calculation errors and significantly speeds up data processing in complex payroll systems. Second, synchronous replication in online KRS application at Jabal Ghafur University showed high data synchronization results in testing, the study recorded a synchronization success rate of 100 percent in a limited scenario. Third, asynchronous replication applied to the financial systems of Graha Manunggal Property and Dealand Property provides high flexibility against network disruptions, allowing data to still be processed and synchronized incrementally without loss of information. This literature study is expected to provide important insights for distributed system developers to choose the replication method that best suits the needs of the application. To choose the right method, it is important to consider factors such as the level of consistency required, potential network disruptions, and the type of transactions performed, whether they are predominantly read-only or updates.

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## 1. INTRODUCTION

In today's digital era, distributed systems have become an essential requirement for various applications and services that we use daily. From cloud services to large database systems. "A distributed system is a computing environment in which numerous components are located across multiple computing devices on a network. These devices segregate the work, communicating and coordinating their efforts to appear to be a single cohesive system to the end-user." [1]. The increasing use of distributed systems in various applications and services is due to the need to process increasingly complex data and ever-increasing data formats. Distributed systems allow for efficient data processing and processing of data across multiple locations. However, one of the main challenges faced is maintaining data consistency and availability, especially when

data is to be copied to multiple locations. Data replication is an important solution to maintain data consistency and availability.

Royan Chadzami's research, in 2019 on the Implementation of a Sporting Goods Sales System Using a Distributed Database with the Asynchronous Replication Method (Case Study of Yos Sport Yogyakarta Store). This research discusses the development of a sports equipment sales system at Toko Yos Sport Yogyakarta using a distributed database and the asynchronous replication method. Previously, this store used a manual system that caused difficulties in data access between branches and inventory management. The purpose of the research is to improve efficiency and accuracy in the sales and purchasing process, as well as provide suggestions for the development of a more complex and secure system in the future.[2]

Research by Abdurrahman, Muhammad Alham Nushair and Kurnia Yahya. In May 2022, regarding the Implementation of Distributed Database Replication Using the Synchronous Method at Favehotel Makassar. This journal explores the implementation of distributed database replication using the synchronous method at Favehotel Makassar. This method is designed to improve service quality by ensuring data consistency between central and branch servers in real-time. The research shows that the implementation of synchronous method can overcome the problem of high network traffic and speed up the data access process, and suggests collaboration with cloud computing technology for future service improvement.[3]

Sawali Wahyu's research in 2024, regarding the Design and Implementation of Data Replication Concepts Based on Distributed Database Systems in E-Library Applications. This research focuses on the design and implementation of e-library applications that apply the concept of data replication in distributed database systems in several university branches. Using the synchronous replication method, this research aims to maintain system performance even in the event of a failure at one location. The Rapid Application Development (RAD) approach was used to accelerate the development of the application, and the results showed a System Usability Scale (SUS) score of 83.7, signifying a good level of acceptance from users.[4]

Research by Amal Setiawan in 2020. Regarding Distributed Database Replication for Financial Section Applications (Case Study: Graha Manunggal Property and Dealand Property Yogyakarta). This journal discusses the application of distributed database replication to improve efficiency and accuracy in managing financial data in two property companies, Graha Manunggal and Dealand Property in Yogyakarta. By using the asynchronous replication method, the system enables fast data synchronization between databases, so that company owners can monitor profits and property stocks in real-time without dependency between processes.[5]

Research by Aditya Nugraha and Ruhul Amin on September 1, 2022. menegnai Analysis of Database System Replication Methods at Pusintek Ministry of Finance. Data Replication Methods Used In this study, the three database replication methods analyzed were: Backup-Restore, Mirroring and AlwaysOn Availability Group. This journal discusses the importance of using Information Technology (IT) systems in business processes, especially in the pandemic era, as well as the risks associated with database availability, downtime, and potential data loss. This research aims to evaluate how efficient and effective the implementation of database replication methods is at the Ministry of Finance's Pusintek, focusing on the concept of High Availability Disaster Recovery on the SQL Server database platform.[6]

Data replication in distributed systems is the process of duplicating data and distributing the data to various locations to increase availability and reliability. With data replication, if one copy cannot be accessed, another copy is still available, reducing the risk of data loss. One of the data replication methods in distributed systems is asynchronous where this duplication method ensures that all suggestions can be updated simultaneously so that data consistency is maintained but can slow down performance because it requires confirmation from all locations before continuing. There is also synchronous where this replication method allows data to be written to the main location first then copied to other locations without waiting for confirmation which improves performance and but risks losing data if a failure occurs before replication is complete.[7]

This literature study aims to further identify the most effective data replication methods in distributed systems by comparing the advantages, disadvantages and application context of each method. By reviewing 15 reference journals on suitable and efficient data replication in distributed systems to explain the challenges and solutions related to data replication and consistency in distributed systems. This study focuses on how these methods maintain data consistency and availability under different network conditions and varying transaction loads. The various data replication methods that will be reviewed in this journal include synchronous, asynchronous, multimaster, database replication, partial replication, two-way replication, replication with load balancing, replication with auto-promote, and web service-based replication. Through this literature review, we hope to offer relevant and practical solutions for distributed database developers.

Through a deep understanding of data replication, it is hoped that this literature review journal can make a real contribution in understanding various data replication methods in distributed systems. By knowing various data replication methods, it is hoped that it can make data replication in distributed systems more suitable and efficient with implementation in its own field.

## 2. METODE

In this article, the object to be analyzed is the literature related to data replication methods in distributed systems. The main focus of this study is 15 scientific journals selected according to the criteria for reference in this journal. This selection aims to obtain an overview of data replication in distributed systems. The selected journals will provide information about the methods and data used in the journals, as well as the results of the reference journals. So that a conclusion can be drawn about suitable data replication methods in distributed systems.

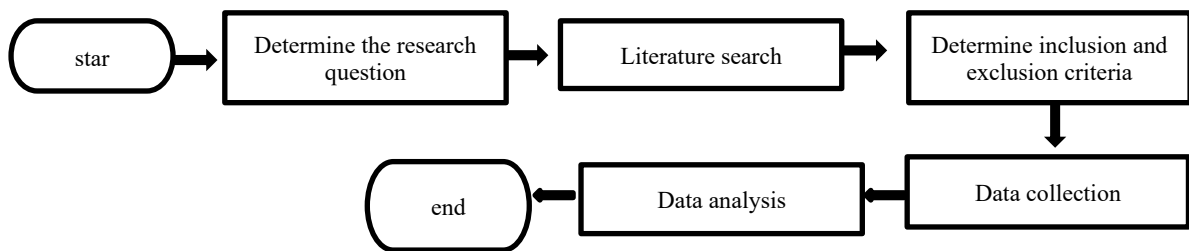


Figure 1. Research steps

In this journal, the research method used is Systematic Literature Review (SLR), which is a structured approach to identify, evaluate, and analyze literature related to the journal title. This literature review study is expected to provide insight into data replication methods in distributed systems.

In this journal, the research steps taken are:

1. Determine the research question. The first step used is to determine the research question, by formulating a clear research statement. To be used as the main guide in finding literature and references such as, [8] .What data replication method is most effective in ensuring data consistency and availability in a distributed system?
2. Literature search, the search will be carried out on a trusted academic database, namely Google scholar. the keywords used are data replication in distributed systems. The search will be limited to the publication time span of the last 5 years, this is done to ensure that the information obtained is the latest and relevant to the journal title.[9]
3. Inclusion and exclusion criteria, the inclusion criteria used include. Journals that discuss data replication methods in the context of distributed systems in the form of case studies, implementations or experiments. Exclusion criteria used include. Journals that are not relevant to the topic in the form of reviews or comments without research contributions. By using these criteria, it is expected that the 15 selected journal references are of high quality for further analysis.
4. Data collection, data collected by reading and collecting important information from each reference journal. Which includes data and methods used in the journal, as well as the results of the journal. The data obtained from 15 reference journals will be made into a table for further analysis.
5. Data analysis, this analysis approach aims to provide insight into data replication in distributed systems. The analysis is done by reading and comparing each result from the 15 reference journals, to draw general conclusions regarding best practices in data replication in distributed systems.

## 3. RESULTS AND DISCUSSION

### 3.1. Reference result Table

From 15 existing reference journals, data can be collected in the form of: data and methods used in each reference journal, as well as the results of these reference journals which are made in the table below.

No	Title	Replication Type	year of publication and publisher	Data	Methods	Results
1	Implementation of Distributed Database System Payroll System of CV. Rejeki Jaya Makmur Abadi with	Multimaster replication	Richeldo M. Pitna Lamidja & Th Dwiati Wismarini ( february 2024)	The data used in this journal includes academic and financial information related to the payroll system at CV Rejeki Jaya Makmur Abadi.	This journal uses descriptive methods to identify and explain problems by collecting data from the object of research. Then proceed with the system analysis stage which begins with prototyping, system design starts from the login	The research shows that implementing a distributed database with MySQL replication and horizontal fragmentation improves the efficiency of the payroll system at

No	Title	Replication Type	year of publication and publisher	Data	Methods	Results
	Multimaster Replication and Fragmentation Methods Horizontal [10]			Data taken in the form of employee payroll records, attendance data and other information used.	page, dashboard, transaction data, reports and results.	CV Rejeki Jaya Makmur Abadi. The system effectively integrates academic and financial data, reduces salary calculation errors, and speeds up data processing.
2	Implementation of Sports Equipment Sales System Using Distributed Database with Asynchronous Replication [2]	Asynchronous replication	Royan Chadzami (2019)	The data used in the journal includes information related to the sales system at Toko Yos Sport, including data on purchases, sales, inventory, and financial reports.	The method in this journal starts with data collection through direct observation at Yos Sport Shop and interviews with owners and employees. Next, a system analysis was conducted to identify problems. The system is implemented using Delphi and SQL programming languages with the asynchronous data replication method, where data from the central database (master) is replicated to the branch database (slave) without requiring a permanent connection.	The results of this journal with a distributed database system, make it easier for the central store to know all the data that is in each branch store. So that the data processing distribution process between branch stores and the central store can be well integrated and the central database can be replicated to store all data on other storage media.
3	Implementation of Distributed Database Replication Using the Synchronous Method At Favehotel Makassar [3]	Database replication	Abdurrahman, M.Alham Nushair, & Kurnia Yahya (may 2022)	The data used in this journal comes from the database replication process carried out at favehotel, by recording server activity and the number of records replicated between the central and branch databases.	The research method used in this journal is the analysis and design of a distributed database replication system using the synchronous database replication method. With this method, data transferred between the central database and branches can be done in real-time.	The results of the journal with the application of database replication using the synchronous method succeeded in overcoming the problem of high network traffic which caused the slow transaction process at the favehotel hotel. so that the data access process becomes faster and more efficient.
4	Design and Implementation of Data Replication Concept Based Distributed Database System on E-Library Applications [4]	Synchronous Replication	Sawali Wahyu (2024)	The data used in the journal was obtained from observations at the library at University X. Data was taken from the process of recording members, borrowing transactions, and returning books in the library.	The research method used in this journal starts from problem identification, then continues with the data collection stage and system creation with Rapid Application Development (RAD), which is designed to accelerate the process of designing and developing e-library applications.	The results of this journal show that the e-library application that was built was successful with a System Usability Scale (SUS) score of 83.7, which is categorized as Excellent or Acceptable. In addition, the User Acceptance Testing (UAT) test obtained a percentage of 86%, indicating that the application was well received by users..
5	Implementation of Distributed Database System With Partial Replication Method [11]	Partial replication	Mashuri (december 2020)	The data in this journal comes from physical and financial realizations managed by the Regional Work Unit (SKPD) in the Meranti Islands Regency. Which is input by the SKPD	The method in this journal is the development of a distributed database system with a partial replication approach. The process begins with a needs analysis. The system is designed using web technology with PHP and MySQL programming, allowing online data input by SKPD admins into a	The results of the study indicate that the implementation of this system has succeeded in increasing efficiency in managing physical and financial realization data and information. Testing the query duration between a centralized

No	Title	Replication Type	year of publication and publisher	Data	Methods	Results
				admin managed by ADPEM.	centralized database managed by ADPEM.	database and a database with partial replication shows a significant difference in duration, with an average time reduction of 41%.
6	MySQL Cluster Implementation to Build Two-Way Replication of Distributed Database with Implementation of Fail Over and Load Balancing Methods [12]	Two way replication	Fajar Siddiq, Candra Asus Umbar Wahono & Septian Heri Alfiansyah ( 2020 )	The data used in this journal comes from the database scheme of the Gorontalo City District. In addition, this journal also refers to the results of a previous journal review from a journal entitled "Distribution of Population Data in Gorontalo City Using the Database Replication Method with the Single Master Replicated Technique".	The research method used in this journal is the implementation of two-way database replication using the Fail Over and Load Balancing techniques. The research began by identifying the problem, then analyzing the existing methods and found that the previous method was still less effective. Furthermore, designing and implementing a MySQL Cluster scheme involving a Management Node and two Node servers to run two-way replication,	The results of this journal show that the implementation of two-way database replication with the Fail Over and Load Balancing methods successfully increases the availability of server data. Testing shows that when one of the Node servers experiences a disruption, the other server can take over the role and continue the data query process without losing information.
7	Implementation of Synchronous Replication in Online Krs Data Application at Jabal Ghafur University Using Postgresql [13]	Synchronous Replication	Dedi Muliawan & Dedy Iskandar (December 2023)	In this journal, the data used focuses on the management of KRS (Study Plan Card) at the Faculty of Engineering, Jabal Ghafur University.	In this journal using synchronous replication method. The research begins with the collection of accurate data on the KRS management process. then design using synchronous replication with one-master one-slave model on PostgreSQL ODBMS.	The results of this journal show that the implementation of synchronous replication in the online KRS application at Jabal Ghafur University has succeeded in increasing efficiency, reliability, security, and data availability. Testing with the one-master one-slave model on ODBMS PostgreSQL, the data synchronization process achieved 100% success,
8	Distributed Database Replication for Finance Application (Case Study: Graha Manunggal Property and Dealand Property Yogyakarta) [5]	Asynchronous replication	Amal Setiawan (2020 )	The data used in this journal relates to the system implemented at the Graha Manunggal Property and Dealand Property company offices.	The method in this journal uses the asynchronous replication method. Researchers began by conducting direct observations and interviews at the company office, continued with the analysis and design stages of database and interface designs, then the process of creating programs with PHP and MYSQL programming languages, with a focus on distributed database replication.	The result of the research is to produce a Distributed Database Replication System for Financial Applications that can facilitate the financial transaction process, especially the ordering and payment process. and the system is able to distribute data from the center to the branches so that it is easier for the owner to know the profits obtained from the two companies.
9	Distributed System Implementation Haproxy Load Balancing and	replication with load balancing	Galang Pandu Sajati & Bambang Tri Handoko (2019)	The data used comes from distributed system testing involving two web servers and one load	The method used in this research begins with the design of a distributed system involving load balancer configuration and database replication settings	The results of the study show that by implementing the load balancing and database replication methods, data availability on

No	Title	Replication Type	year of publication and publisher	Data	Methods	Results
	MySQL Replication [14]			balancer using Haproxy, as well as a database managed with MySQL.	using MySQL and PHPMyAdmin.	each server is well maintained, and server performance increases significantly.
10	Implementation of Efficient Data Back Up and Replication with Synchronous Method: Case Study of FTI–UKSW Salatiga [15]	Synchronous Replication	Charys Satyarca & Prof. Dr. Ir. Eko Sedyono, M.Kom (2019)	The data used in this journal is taken from the laboratory of the Faculty of Information Engineering, Satya Wacana Christian University.	The method used in this study is waterfall, which consists of several stages. First, needs analysis, then continued with system design with network topology, after that implementation, unit and system testing with Synchronous replication	The results of this journal show that the backup and replication application has successfully performed backups well, although the potential for major disruptions can thwart the backup process.
11	Implementation of Database Replication and Discretionary Access Control Model for Database Security Case Study of SMK Plus Pratama Adi Banjaran. Scientia Regendi [16]	Database replication	Widi Linggih Jaelani (february 2022)	In the journal, the data used in the online examination system at SMK Plus Pratama Adi Banjaran includes several types of important information, namely question data, answer data, student data, and value data.	The method used in this journal begins with observation of the online exam system at SMK Plus Pratama Adi, Next, a database system design is carried out with replication techniques and DAC models, then the implementation and testing of the security system using Safe SQL Injection software.	The results of this journal show that the implementation of database replication and the discretionary access control model has successfully improved the security of the online exam system at SMK Plus Pratama Adi Banjaran.
12	Database Replication System Implementation Postgresql Master-Slave Repmgr With Auto Promote Masterdb [17]	replication with auto promote	Erwin Asriyar & Teten Sutendi (july 2019)	The results of this journal show that the backup and replication application has successfully performed backups well, although the potential for major disruptions can thwart the backup process.	The method used in the journal . begins with the planning and design of the replication system, including the selection of master-slave architecture and server specifications. Furthermore, PostgreSQL is installed and tools such as repmgr are configured to support replication.	The results of the study show that the implementation of the PostgreSQL database replication system with the master-slave method significantly increases the availability and reliability of data in a distributed database system. With this technique, data is copied and synchronized in real-time between the master and slave servers.
13	Implementation of Distributed Database in Inventory Information System with Multi Master Replication Method (Case Study of Tulip Living Home Decor).[3]	Multimaster replication	Kurniawan, A (2021).	The results of this journal show that the implementation of database replication and the discretionary access control model has successfully improved the security of the online exam system at SMK Plus Pratama Adi Banjaran.	The method in this journal begins with manual transaction data collection by Tulip Living Home Decor, followed by the creation of multi-master replication including analysis and redesign of the database system to support replication, as well as the configuration of connections between databases in the warehouse, center, and branch units	The results of this journal show that the implementation of multi-master replication has succeeded in increasing efficiency in data management and information access between warehouse and central units.
14	Implementation of Distributed Database System with Multi-Master Method Database Replication [18]	Multimaster replication	Ahmad Heryanto &Alber (january 2019)	The data used in this journal comes from observations and recordings made using conventional computer network simulator software.	The initial study was conducted through a literature study, where researchers analyzed reference sources from the literature. Then, observation was used to conduct observations and record data using network simulator	The results of this journal show that the database cluster system is able to overcome the lack of computing resources on the database engine.

No	Title	Replication Type	year of publication and publisher	Data	Methods	Results
					software. After that, system design was carried out to determine the right hardware and software. System testing was then carried out, followed by analysis of the results.	
15	Implementation of Distributed Systems Using Database Replication and Web Services [19]	replication with web service	Joko Triyono, Putri Nadira & Canu Ali Subkan (december 2021)	The data used in this journal comes from academic information system simulations involving database replication processes and the use of web services.	The method in this journal begins with the design of a distributed system that implements database replication and web services to support the academic process. The research focuses on testing the Master-Slave architecture, where the master database is the main source of data and the slave database receives replication.	The results of the journal show that replication combined with web services runs effectively, supporting academic transactions efficiently. Data from the master database (SIAK) can be replicated to the slave database (department and laboratory) smoothly.

### 3.2. Analysis

In a literature review study of data replication methods in distributed systems, a wide variety of data replication methods used in distributed systems were found. Based on the results of 15 reference journals that have been collected, there are several replication methods that the authors consider to be best practices. In assessing the best practices of data replication methods in distributed systems, it is important to consider the results and context of each reference study. Although there are several journals with similar methods, not all implementations show equally effective results. In assessing the best practices of data replication methods, several important factors should be considered, including effectiveness, consistency of results, and impact on users. Although there are various replication methods such as synchronous, asynchronous, multimaster, database replicaton, partial replication, two-way replication, replication with load balancing, replication with auto-promote, and web service-based replication, not all of these methods show equally significant results in the context of the research that has been conducted.

In conducting this analysis, several steps were taken. First, case identification was conducted by collecting case studies of data replication method implementations from 15 reference journals. Next, data extraction was carried out to obtain information about the replication methods used, the context of implementation, the results reported, and the impact on users. After that, the results of each replication method implementation were evaluated based on criteria such as efficiency, data consistency, system availability, and user satisfaction level. Finally, findings from the various case studies are synthesized and compared to assess the effectiveness of each replication method in various contexts, in order to identify the best practices in implementing data replication methods in distributed systems.

One method that is considered a best practice is multimaster replication, which is implemented in the payroll system at CV Rejeki Jaya Makmur Abadi. This method allows multiple nodes to function as masters, thus improving data availability and reliability. The results of this study show that the implementation successfully reduces errors in salary calculation and speeds up data processing. Metrics such as a reduction in the salary calculation error rate from 10% to 2% show an 80% increase in accuracy. Processing time that previously took about 3 hours was reduced to 1 hour, showing an efficiency improvement of about 66%. With better data integration between various units, the company can operate in a more professional and responsive manner. In addition, user feedback indicates that the newly designed features are helpful in the management of tasks and responsibilities. Therefore, multimaster replication can be considered a best practice in distributed systems due to its ability to improve operational efficiency and user satisfaction.[10]

The synchronous replication method shows significant results in improving data reliability and security, such as in the online KRS application at Jabal Ghafur University. The research found that the one-master one-slave replication model on PostgreSQL ODBMS resulted in a 100% data synchronization success rate. This is important to maintain information consistency, especially in critical applications such as academic data management. With synchronous replication, any changes on the primary server are automatically updated on the backup server, reducing the risk of data loss due to damage or disruption. This success not only increases efficiency but also provides a sense of security for users. Therefore, synchronous replication is recommended for applications that require high levels of security and reliability, helping organizations maintain data integrity and ensure real-time availability of information.[13]

Another best practice is asynchronous replication, which is applied to the financial systems of Graha Manunggal Property and Dealand Property. This method allows the system to handle transactions efficiently despite connection disruptions. In the study, Prior to the implementation of the asynchronous replication system, the process of recording transactions and updating land stocks at Graha Manunggal Property and Dealand Property was done manually using Excel with no connection between branches, resulting in frequent recording errors and information delays of up to several days. With this system, data can be temporarily stored in the local database when the connection is lost and automatically updated to the master database once the connection is re-established. The results show that high efficiency in ordering and payment can be achieved without compromising data integrity. Metrics-wise, the error rate of recording transactions dropped dramatically from around 30-40% to below 5%, and the stock data update time that was previously done once a month can now be done in real-time. The advantage of asynchronous replication is its flexibility in managing non-committed transactions, making it perfect for dynamic business environments. In addition, the ability to distribute data from the center to the branches makes it easier for owners to monitor the company's profits in real-time. Therefore, asynchronous replication is the right choice for organizations that need a system that is responsive to changing network conditions.[5]

Overall, the application of various data replication methods such as multimaster, synchronous, and asynchronous shows that each has its own advantages in the context of distributed systems. The multimaster method provides high availability and operational efficiency, while synchronous ensures data consistency and security with maximum synchronization success rate. On the other hand, asynchronous offers flexibility in handling transactions despite connection disruptions. Results from various studies show that the implementation of these methods not only improves system performance but also provides significant benefits to end users. By understanding the characteristics of each data replication method, we can choose the replication strategy that best suits our needs. This will help in building a reliable and efficient information system. Therefore, choosing the right replication method is crucial to optimally achieve business and operational goals.

#### 4. DISCUSSION

In this literature study, 15 scientific journals have been analyzed that discuss various data replication methods in distributed systems. The analysis shows that there are three data replication methods that are considered best practices: multimaster, synchronous, and asynchronous replication. Each method has different advantages and disadvantages, and the selection should be tailored to the application context and operational needs. Multimaster replication has proven to be very effective in improving operational efficiency. In a case study at CV Rejeki Jaya Makmur Abadi, the application of this method successfully reduced errors in salary calculations and accelerated data processing. This shows that by allowing multiple nodes to function as masters, organizations can significantly improve data availability and reliability. The implication of this finding is that companies that adopt multimaster replication can be more responsive to business needs and improve user experience through better data management.

The synchronous replication method also shows positive results, especially in maintaining data consistency and security. Research on the online KRS application at Jabal Ghafur University showed that the synchronization success rate reached 100%, which is very important for critical applications such as academic data management. The implication of these results is that organizations that require high levels of security should consider using synchronous methods to ensure data integrity. It also highlights the importance of choosing a replication method based on the nature of the data and applications being managed.

Meanwhile, the asynchronous replication method offers flexibility in handling transactions despite connection disruptions. In the study on Graha Manunggal Property and Dealand Property, the system was able to temporarily store data when the connection was lost and update the master database once the connection was re-established. This finding shows that asynchronous replication is well suited for dynamic and volatile business environments, where transaction speed is a priority. The implication is that companies need to evaluate their network conditions before choosing a replication method, in order to maximize operational efficiency.

Overall, the results of this analysis provide insight into how various replication methods can be applied in distributed systems. The selection of an appropriate method depends not only on the technical characteristics of each method but also on the specific application context and operational needs of the organization. By understanding the advantages and disadvantages of each method, developers can design more reliable and efficient information systems.

#### 5. CONCLUSION

This literature review study proves that data replication in distributed systems is an important element to ensure data consistency and availability. Through a systematic literature review involving 15 scientific journals, it was found that replication methods such as multimaster, synchronous, and asynchronous have their respective advantages in different application contexts.

The results of the study show that the multimaster method is very effective in improving operational efficiency and user satisfaction. For example, in his study on the implementation of a distributed database on the payroll system of CV. Rejeki Jaya Makmur Abadi, the multimaster replication method successfully reduced errors in salary calculations and accelerated the data processing process. In addition, synchronous replication offers a high level of security and data consistency. As seen in the online KRS application at Jabal Ghafur University, the use of the one-master one-slave replication model on the PostgreSQL ODBMS resulted in a data synchronization success rate of 100%. This is very important to maintain information consistency, especially in the context of critical applications such as academic data management. In addition, asynchronous replication provides flexibility in handling transactions even if there is a connection disruption. For example, in a study on the implementation of distributed database replication for financial applications at Graha Manunggal Property and Dealand Property, the asynchronous replication method allows the system to handle transactions efficiently even if there is a connection disruption. The ability to distribute data from the center to branches makes it easier for owners to monitor company profits in real time.

The conclusion of this study confirms that the selection of the most effective data replication method in a distributed system depends on the application context and operational needs. To select the right method, it is important to consider factors such as the level of consistency required, the potential for network disruption, and the type of transactions performed (whether more read-only or update). By understanding the characteristics of each method, developers can design information systems that are not only reliable but also efficient, thus optimally supporting business objectives. Further research is recommended to explore the combination of replication methods to find solutions that are more adaptive to changing needs in the future.

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