



Business process modeling with cloud computing support: A case study



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ARTICLE INFO

Article history:

Received 17 May 2021

Received in rev. form 13 June 2021

Accepted 14 June May 2021

Keywords:

BPM, BPMN, Cloud Computing,
Higher Education

JEL Classification:

L86, H11

ABSTRACT

Precise and clear Business Process Modeling (BPM) can be used to implement the all of processes according to the user's needs. On the other hand, cloud computing has become a solution for data storage and more effective and efficient computing processes. State Polytechnic of Malang (Polinema) is one of the vocational higher education Institutions in Indonesia that requires business process modeling to facilitate an integrated understanding of process flow. This study aims to describe the business processes of the financial realization system and the structure of cloud computing that can be used. This research used Bizagi for designing Business Process Model and Notation (BPMN) in modeling business processes of financial system realization. This paper describes the business model of the financial realization system at Polinema. This study proposes the use of an Infrastructure as a Service IaaS-based cloud computing service model using a hybrid cloud approach to support the work of the system.

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Introduction

The application of BPM in higher education institutions is important because it can help create accountability, financial transparency, and a management decision-making tool. To realize the Three Pillars of Higher Education (*Tridharma*), comprising education, research, and community service, it is necessary to have an Accounting Information System (AIS) regarding the budgeting system and the realization and proper budget in its implementation accountability can be achieved. Hence, the improvement of excellent service to create an effective, efficient, targeted financial administration management contributed to the institution and provided benefits to the broader community.

Due to technological developments in the Industrial Revolution 4.0 era, the use information systems based on digital and electronic technology have increased in both the private and public sectors (government). Moreover, the Covid-19 pandemic has pushed all institutions, including Polinema, to implement the physical distancing policy by requiring faculty members to work from home.

Polinema is one of vocational higher education Institutions in Indonesia which has a Public Service Agency (PSA) status. It runs out financial management based on applicable laws and regulations. Polinema has made adjustments to run an electronic-based financial management system. It means that moving from manual to digital form can help staff work from home. SIMKeu (Financial Information System) is a financial management system that implements an Electronic Government System in Polinema. Nowadays, the content of SIMKeu is still in the development process and is still used in budget planning activities for all unit in Polinema. Meanwhile, financial management includes not only planning, but also some stages from the realization of finance to the accountability reports.

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In relation to this, cloud computing can also help SIMKeu in carrying out its programs. Several studies have described the advantages of cloud computing/ cloud computing-based systems, including active and convenient accessibility for clients, saved IT costs, and security services handled by the provider. Other significant benefits of moving to the cloud are cloud computing vendors' IT scalability and flexibility, and increased mobility, i.e., clients can have access to software wherever they go, as long as internet access is available (Chou, 2015). Increased efficiency in modern applications, making the whole system integrated (Ren & Gu, 2014). Geographically unrestricted access increases performance through enhanced business agility and flexibility, unlimited data storage, no upgrade fees as the service is continuous, user-friendly, enabling companies to share their financial information with their clients in real-time (Dimitriu & Matei, 2014).

Several studies have shown the implementation of cloud computing and accounting in various sectors such as the public sector, private sector, government sector, MSMEs, and hospitality (Aman & Mohamed, 2017; Dimitriu & Matei, 2014; Ferreira et al., 2013; Lai & Hung, 2018; Ren & Gu, 2014). Furthermore, almost all studies mentioned the advantages and disadvantages of implementing cloud computing, and there are no weaknesses of the combination of cloud computing and AIS. Therefore, this research describes the business processes of the financial system used by Polinema and describes the structure of cloud computing that can be used.

The remainder of this paper is structured in the following manner—first, a review of the Business Process Model and Notation (BPMN); second, the discussion about cloud computing; third, the financial realization system in Polinema; fourth, the research methodology used in this paper. The next part presents the results and discussion. Finally, conclusions are presented at the end of the paper.

Literature Review

Business Process Modeling Notation

Business Process Model and Notation (BPMN) is a de-facto standard notation that graphically represents every business process in an organization (Chinosi & Trombetta, 2012). BPMN includes several aspects which show decision paths, recurring events, timing events, tasks of various types (e.g., user tasks and script tasks), data objects, databases, and processes in progress (sub processes)(Pullonen et al., 2019). BPMN is a method of aligning an organization with the wants and needs of the organization to increase effectiveness and efficiency in line with efforts to achieve innovation, business flexibility, and integration with technology (Sari & Sukma, 2019).

The application of BPMN can be done with Bizagi software as a tool for drawing business process diagrams according to the needs of the entity. BPMN begins with an overview of workflows and business processes to better understand the need for a new modeling notation, which will be easy for everyone to read and understand but is semantically powerful enough to allow graphical diagrams that support the meaning, properties, and execution information of a process (Chinosi & Trombetta, 2012). The use of BPMN aims to solve a problem in the business process of a system along with the actors who do it and what to do in running the system from start to stop or finish. Thus, the desired system can be read easily and clearly, and can be implemented.

Cloud Computing

Cloud computing is a newly developed information technology (IT) parallel and distributed system of several dynamic interconnected and virtualized computer networks provided and presented as an integrated computing/computing resource based on an agreement at the IT service level through internet technology and on-demand mode (Chou, 2015). Cloud computing is much more than unlimited IT capacity (processing, hosting, etc.), and it is an opportunity to achieve new business models (Ferreira et al., 2013). Cloud computing generally refers to business conducted over the internet, without the use of computer hardware or a Licensed software (Christauskas & Miseviciene, 2012; Dimitriu & Matei, 2014). Cloud computing has four deployment models (Bumpus, 2013):

Private cloud: The cloud infrastructure is provided for exclusive use by a single organization consisting of multiple consumers (e.g., business units).

Community cloud: The cloud infrastructure is provided to exclusive users by specific consumer communities of organizations/ entities that have a common problem.

Public cloud: The infrastructure cloud is provided for open use by the general public.

Hybrid cloud: Cloud infrastructure is a composition of two or more different cloud infrastructures (private, community, and public).

Essential Characteristics

The National Institute of Standards and Technology (NIST) described the essential characteristics of cloud computing (Mell & Grance, 2011), namely:

On-demand self-service

A customer can unilaterally provide computing capabilities, such as network storage and time servers, as required in an automated manner without requiring face-to-face interaction with multiple service providers.

Broad network access

Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous client platforms (e.g., mobile phones, tablets, laptops, and workstations).

Resource pooling

Multiple provider resources pooled to serve consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and moved according to customer demand.

Rapid elasticity

Capabilities can be elastically provisioned and released, in some cases automatically, to scale quickly outward and inward commensurate with demand.

Measured service

Cloud systems can automatically control and optimize resource utilization by leveraging measurement capabilities at an abstraction level appropriate to the type of service (e.g., storage, bandwidth, and active user accounts).

Service Model on Cloud Computing

- i. The National Institute of Standards and Technology (NIST) suggests several service models on cloud computing (Bumpus, 2013), including the following:
- ii. Software as a Service (SaaS). The capability provided to the customer is to use the provider's applications running on the cloud infrastructure. Applications can be accessed from various client devices through a thin client interface, such as a web browser (e.g., web-based e-mail) or a program interface. Consumers do not manage or control cloud infrastructure, including networks, servers, systems, storage, or even individuals, by managing limited user-specific applications.
- iii. Platform as a Service (PaaS). The ability provided to customers to deploy to the cloud infrastructure consumer-generated or purchased applications built using the programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the cloud infrastructure that includes the network, servers, operating system, or storage but controls the applications used and may configure the hosting environment for the hosting environment.
- iv. Infrastructure as a Service (IaaS). The ability granted is to provide storage, network, and other fundamental computing resources on which consumers can use and run arbitrary software, including operating systems and applications. Consumers do not manage or control the cloud infrastructure on which they operate but control shared systems, storage, applications, and possibly limited control over specific network components (e.g., firewall hosts).

Financial Realization System

The financial system in institution, especially at the level of Higher Education, has applicable regulations. Financial realization is a system where the expenditure treasurer issues/realizes money and submits it to the Person in Charges (PIC) at the Polinema. This realization is divided into several work units according to the amount budgeted at the time of planning through activity proposals. In this paper, several actors or actors carry out the financial realization system, which will be discussed in business modeling in Figure 1, including:

- i. Vice Director II (VD II), an official in charge of Administration, Finance, and Personnel affairs.
- ii. Commitment Making Officer (PPK), an official appointed by the Director as an Authorized Budget User, who is authorized as the owner who is responsible for implementing the plans set out in the DIPA (budget implementation check list), issuing decisions relating to third parties related to assignments and other letters related to the implementation of activities.
- iii. The Head of the Treasury, an official who is authorized to take actions that result in expenditures being incurred;
- iv. Expenditure Treasurer (BP), a person appointed to receive, store, administer and account for the money for state expenditure purposes in implementing state expenditures at institutions.
- v. Assistant Expenditure Treasurer (BPP), a person assigned to assist the Expenditure Treasurer in carrying out treasury duties;
- vi. PIC, a person who submits funding through a proposal and uses the funds for an activity based on the institution's work plan.

Methodology

This research employs a case study design with qualitative method. This method is used to explore in-depth the existing business processes in Polinema, especially in the financial realization system. Using this method will help to achieve the research objectives. The research was conducted at a vocational Higher Education institution, namely the State Polytechnic of Malang, especially in the financial sector. The finance sector in the Polinema was chosen because of the complexity of financial activities that must be assisted by a system that facilitates employees' work. The research period was three months.

Data were collected through observation, literature study, and interviews. Observations were made directly in the office with related parties. The needs of the current system were determined based on the results of observations and interviews. The literature study used in this study includes materials for BPMN and cloud computing. In addition, there are secondary data, including RAB, financial submission proposals, and financial reports. BPMN material is used to model the realization of financial systems, and cloud computing is used to describe cloud computing projects used for advanced system development. This research was conducted by analyzing problems regarding the financial realization system. The next step was analyzing the improvement of business processes. The last is the design of the structure of cloud computing as a supporter of this system.

Analysis of the Problem

The financial realization system is the most crucial part of the implementation of activities that require funding. The implementation of this system at Polinema is not in real-time due to process overload. The PICs want to immediately disburse money to the Treasurer to carry out activities following the proposals that have been submitted. So there needs to be speed for payments to the PIC. The bureaucracy of submitting activities through temporary proposals still uses a dual system, which means that even though it has been carried out online/systemically, it is still done manually or offline. The process of making proof of disbursement is still manual and not yet automated. The activities that must be funded are numerous and timely so that the funded activities can proceed as planned. In addition to the approved proposals, problems also occurred with employees in the evidence of financial reporting on disbursed funds. So, we need a system that makes this process easier.

Funds from this financial realization cannot be separated from taxation by applicable taxation regulations in Indonesia, especially at state universities that involve tax elements in all financial transactions. So far, Tax calculations are still performed manually, resulting in human errors in tax calculations. Tax calculations must be carried out systematically based on the applicable tax rates for transactions. In addition, the number of disbursement transaction activities systematically in several units causes limited data storage, servers, and databases.

In addition, the Covid-19 pandemic has resulted in several employees doing almost all works from home (work from home). Therefore, it is necessary to build a system that facilitates online work with any media (mobile and PC), anytime, and anywhere.

Business Process Improvement Analysis

Based on these problems, it is necessary to make several business process improvements:

- i. There is a notification of proposal submission to the Treasurer to be immediately approved according to the planned schedule.
- ii. The proposal bureaucracy is carried out systematically and focuses on the online system to make the process paperless.
- iii. It is necessary to design a financial disbursement system that has an automatic printout feature of disbursement evidence.
- iv. A system for bureaucratic processes in financial reporting evidence for easy disbursement of funds must be designed.
- v. It is necessary to design a systematic tax calculation based on the tax object rate by the expenditure transaction.
- vi. Cloud computing should be used to facilitate online work.

Business Process Modeling

Based on the analysis of the problems encountered and the analysis of business process improvements mentioned above, the primary business process model is designed using the notation of business process management (BPMN). BPMN is designed to visualize the analysis of business process improvements so that an overview of business processes can be obtained. This can make it easier for users to implement the realization of the financial system carried out by Polinema. The business modeling is presented by the figure below

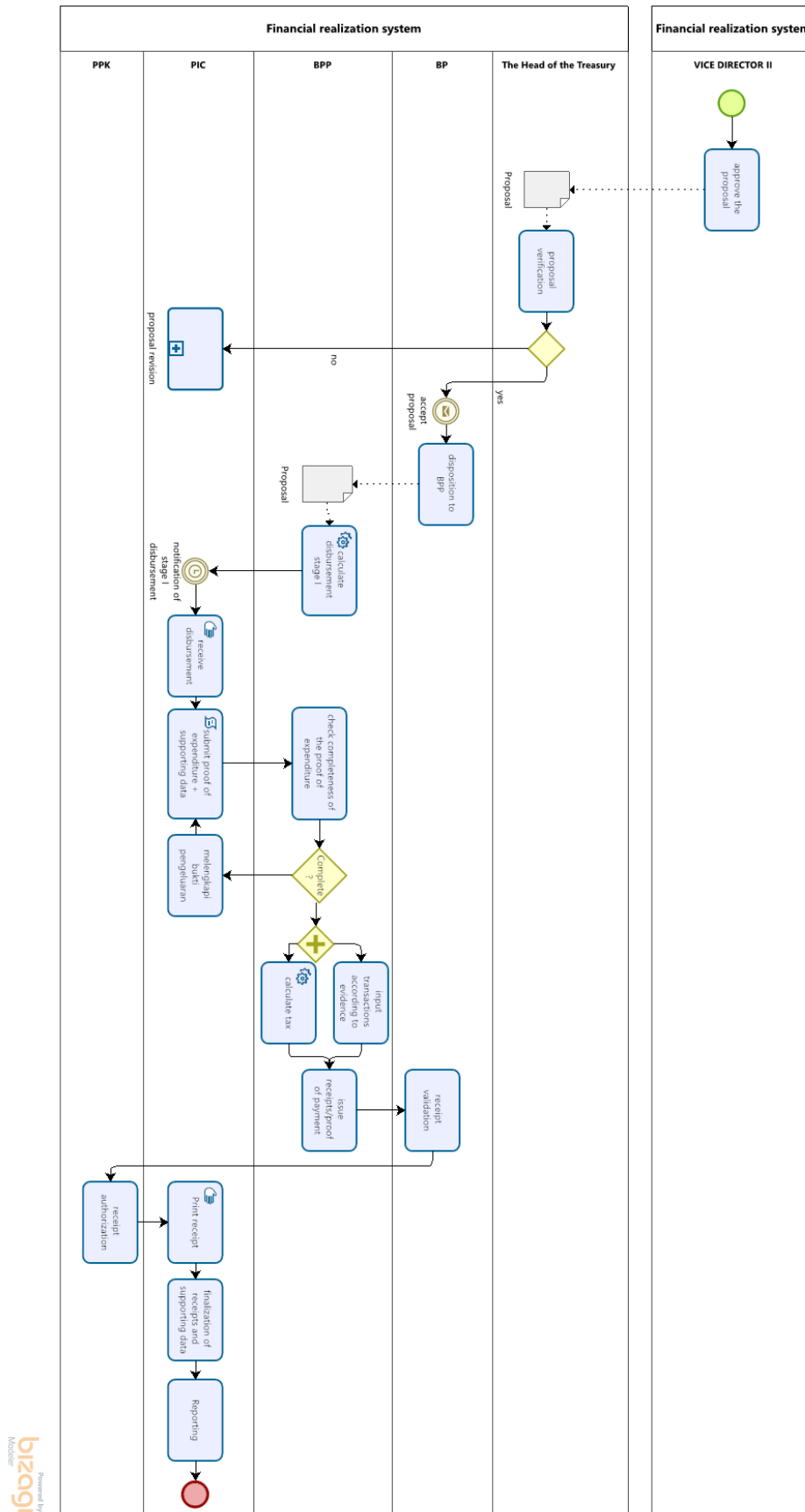


Figure 1: BPMN financial realization system

BPMN shows that several actors who play a role in the financial system include Vice Director II, Head of Treasury, Expenditure Treasurer (BP), Assistant Expenditure Treasurer (BPP), PIC, and PPK. The system starts from a budget proposal approved by Vice

Director II. The Head of the Treasury will accept the approved proposal, and the correctness and completeness (verification) of the documents will be announced. If the proposal has been verified, it will be sent to the expenditure treasurer for disposition to the Assistant Expenditure Treasurer (BPP). However, if revision is needed, it must be revised according to the direction. For proposals that have been assigned to BPP, the system will automatically calculate the amount of disbursement stage I that the PIC will receive and also send notifications to the PIC for the realization schedule.

After the PIC accepts the disbursement of funds stage I, the PIC must submit proof of the contest and supporting data by uploading it to the system. The BPP will check the uploaded evidence for completeness and correctness following the rules. If it is complete, the BPP will input the transaction based on the evidence that has been received and checked. If it is not complete, the PIC must complete the proof of the contest and re-upload it. Transactions entered by BPP are automatically calculated for tax in the system according to the current rates in tax regulations.

The result of the transaction input in this system is a standard printout of the receipt/proof of payment from Polinema. Printed receipts do not need to be complicated bureaucracy because BPP's issuance will be sent to the issued Treasurer for digital signature/e- sign. The expenditure treasurer will forward the bureaucratic process to the PPK for authorization. Authorized receipts can be printed by the PIC to be used as the basis for making reports. A report made by the PIC as a form of accountability for using the funds provided for use in activities following the proposals submitted.

Cloud Computing Topology Design

Based on the problem and analysis of the need for improvement, the analysis produces a solution, namely cloud computing. The cloud computing design is intended to make it easier for users, in this case Polinema, to carry out their work online with any media (mobile and PC), anytime, and anywhere. This model allows for convenient, on-demand network access to a shared pool of configurable computing resources (e.g., servers, networks, storage, applications, and services) that can be provided with minimal management effort or service provider interaction. In cloud computing, users must have internet access. All data are stored and located on the internet server, so there is no need to install it on a computer server. The following is a cloud computing network topology.

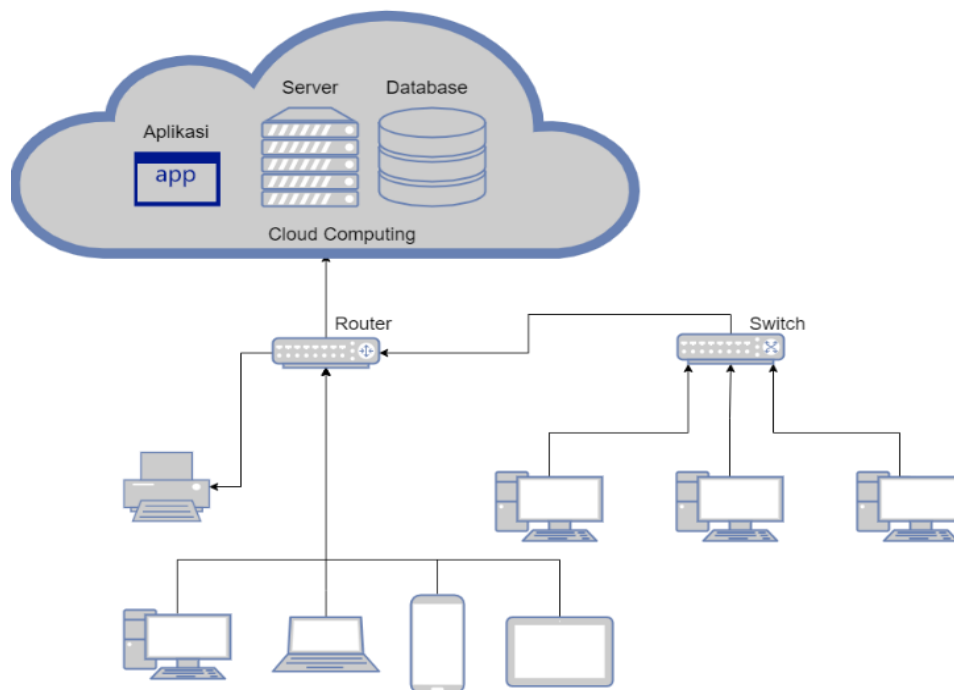


Figure 2: Cloud Computing Network Topology

The topology above shows the network design used by using cloud computing. Users can access this financial realization system from any media such as PC, Laptop, mobile, or tablet. Furthermore, access to this system is possible via a PC in the office that is linked to the switch. With cloud computing, we can also print documents through the printer hardware owned by the users. Users can perform data processing and send commands to the system with a separate account without installing it first. The command will then be stored virtually for follow-up.

Discussion

The business modeling above shows several solutions to a problem in a system in the Polinema finance department. In BPMN, Figure 1 shows the solution from the analysis of improvements needed by the user in this case Polinema. Each actor plays an important role

in running the financial system. As the person in charge of Administration, Finance, and Personnel, Vice Director II can approve the PIC's submission. The head of the treasury, which acts as a supervisor in the treasury, monitors all expenditures based on the submission of funds through proposals. The expenditure treasurer (BPP) regulates all kinds of expenditures in the Polinema institution. The expenditure treasurer is assisted by an assistant expenditure treasurer (BPP) who focuses on spending in specific fields. PPK is responsible for everything done by the institution. PPK authorizes proof of expenditure from all transactions based on financial realization. The last actor in this system is the PIC who is the party that uses the funds for the realization through a proposal submitted to the leadership. Funds that have been realized will be accounted based on the expenditures made to carry out the activities contained in the proposals submitted. The accountability is in the form of a financial report containing the outputs of the proposed activities and absorption of funds accompanied by proof of uploaded transactions and proof of expenditures that have been authorized by the leadership, in this case the PPK.

All the processes in the BPMN in Figure 1 provide an overview of a system that runs efficiently and is accessible to all users. According to the explanation (Bazhenova et al., 2019) which states that BPMN can distinguish events based on their triggering behavior and position in the process. Executed events can provide data, and conditional events can influence how decisions are made.

Cloud computing topology design is presented as a solution to support the ease of running SIMKeu. The use of servers still has vulnerabilities to several conditions such as blackouts, ransomware incidents, and other disasters, so that when the server is down or dead, applications run by PCs or mobile clients cannot run. Not only that, damage and excess capacity on one of the hard drives on the server also causes the server to experience problems in the application and the occurrence of data loss at the institution. In terms of financing, the procurement of Server with a higher specification for a reasonable period includes three years plus costs and engineers to maintain the server. Procurement of servers also requires a particular room with a specific temperature to maintain the server's resilience, so it requires additional costs. Compared to server procurement with high capital expenditure, cloud procurement is considered effective and efficient and helps solve various problems in server institutions. Cloud computing has several benefits in practice, such as cost savings, ease of use, scalability, flexibility, and environmental sustainability (Chou, 2015).

Based on a review of cloud computing (Aman & Mohamed, 2017; Bumpus, 2013; Chou, 2015; Dimitriu & Matei, 2014), there are proposals for developing cloud computing that can be used using the service model IaaS (Infrastructure as a Service). The use of this service model aims to migrate several information system applications managed by conventional servers or cloud-based local services (Kurniawan, 2015). IaaS also has real-time online assurance and security within the 'scope' of one IaaS service unit (jurnal.id, 2021). However, if the transition period requires time to migrate all data on the server to cloud computing, Polinema can use a hybrid cloud approach. This approach is used where data is still stored on a local server but can still be connected to existing cloud services.

Conclusions

In this paper, we have presented business process solutions to realize the financial system in Polinema with the use of BPMN and the design of supporting the running of the system with cloud computing. BPMN is the financial realization system that provides a detailed and accessible description of each actor that must perform and the process that must be carried out. This model can be used as a primary system to implement based on users' needs. Cloud computing Can be proposed to support a working system that runs with all its service model's convenience, effectiveness, and efficiency. With the proposed Infrastructure as a Service (IaaS) cloud service model with a hybrid cloud approach, it is possible to help reduce the burden of server management and online assurance in real-time on Polinema.

In the future, whether the system that has been designed is effective and efficient needs to be examined. Otherwise, the financial realization system will not be effective and efficient. Furthermore, regarding the utilization of cloud computing, it is also necessary to develop a framework that can be used to implement cloud computing with specific service models and approaches.

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