Implementing Cloud Computing Technology on Restaurant’s Expenses Monitoring System

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Abstract. Cloud computing offers the advantage to increase business productivity because it combines computer technology and internet-based development that is currently needed in various fields, including the restaurant industry. The application of cloud computing in the restaurant industry that has been carried out includes building payment transaction systems, restaurant reservation systems, and customer satisfaction systems. Although there have been many studies on cloud computing applications in the restaurant industry, there is still minimal research that discusses the consolidation of many restaurant branches’ expenses. Business activities in the restaurant industry require payments that need to be monitored appropriately to avoid waste, providing information on the cost-efficiency of costs quickly and accurately, allowing easy observation of expenditure data movement. The method used is by collecting expenditure data from all restaurant branches then processing it by comparing the income data obtained to produce output in the form of the level of efficiency achieved by each store. For three months, the sample data were obtained from the Cekeran Midun restaurant, which has seven branches in Bandung and Cimahi, Indonesia. The user acceptance test results show that all functions work well and have an overall acceptance rate of 83.33%, with most comments on the improvement being on the convenience of use and the system’s layout. Further research combines the calculation of costs in a restaurant. It allows the development of a platform that provides cloud computing-based online services that can be used collectively by various restaurants (software as a service).

1. Introduction

Information technology has been widely applied in various fields, one of which is the restaurant industry. The restaurant industry’s application of information technology started more than two decades ago [1]. Different kinds of information technology are used, including point-of-sale systems to assist payment transactions. They also used employee management systems, stock monitoring or inventory systems, production-support systems to support production functions, and profit and loss calculations in the accounting system [1]. Information technology can provide easier access to penetrate new or existing markets, provide cost-effectiveness, and present goods and services more effectively [2]. This condition proves that restaurant industry owners need to adapt to ever-evolving technology.
Business activities in the restaurant industry certainly require operational costs. They have an essential role in achieving its success, namely obtaining profits or operating profits [3]. The restaurant industry’s operating activities’ expenses need to be monitored to avoid waste [4]. This condition also applies to restaurants that have many branches. Monitoring activities are carried out to obtain information continuously from a specific action to become a positive result following the objectives set [5]. Monitoring will provide information about the status carried out repeatedly from time to time, up to an ongoing process check [6]. The application of monitoring information systems has been carried out in many research fields, including textile companies for monitoring production [5] [6]. Post offices need an information system for monitoring transactions between agents [7]. In small and micro enterprises (SME) newspaper agents, the monitoring model improves management functions [8].

Meanwhile, for monitoring activities or activities, research has been carried out in student affairs to monitor student activities [9] and monitor humanitarian activities carried out in Zimbabwe [10]. Monitoring information systems are also needed in the banking sector [11]. The monitoring process can also be related to inventory activities in the procurement and logistics department [12]. Another study created a monitoring information system in the Public Works Office by applying the yield value concept approach [13]. In Small and Medium Industries (SMI), research is carried out to build a system capable of accelerating the monitoring process. The system can be accessed in real-time, making it easier for policymakers to obtain the required data [14]. The latest technology is applied to other restaurant industry research to build an integrated system that can monitor all revenue from restaurant sales in real-time. The system design is made by implementing the RESTFul API architecture with Token security access and Web Services’ use for data integration and processing in each information system [15]. The technology that is well known today is Cloud Computing, which can help create an application that regulates a restaurant system’s management or management well [16]. Also, the application of Cloud Computing is needed by Small and Medium Enterprises to carry out global marketing [17].

In contrast to previous studies, this study aims to monitor expenditure cost data spread across many restaurant branches so that data management can be carried out centrally. Restaurant business activities are carried out every day and result in increasing expenditure data. If it is not well organized, reporting expenditure data to the top management level will experience difficulties. Therefore, it is crucial to conduct current research to help the company’s progress and overcome problems in disseminating data and information in many places with information technology. This study’s cost data were obtained from the Cekeron Midun restaurant, which has seven branches spread across Bandung and Cimahi cities. Issues arose when the management tried to monitor waste in each branch due to data spread in many places. This situation resulted in slow reporting so that the company suffered losses due to the absence of early handling of the waste. Based on the background description, it is deemed necessary to research the information system for monitoring expenditures on the Cekeron Midun.

2. Research Method

This study uses several techniques for data collection consisting of interviews with relevant parties and company observations. We conduct the interview processes at the three Cekeron Midun Outlet located in Cimahi and Padjajaran, Indonesia. The first visit was made on the 5th of October 2020 to meet with the head outlet and ask permission to conduct interviews to determine the workflow on Cekeron Midun. More meetings were held on the 6th of October 2020 to meet with the financial staff in head office and began speaking about the business process, the actors involved, and thoroughly explaining the company’s activities. In addition to the interview, the observation process also took place from 23rd to the 24th of October 2020. During the observation, the activities carried out were to look at the company’s events, see who the actors were there, and record the observations’ results.
2.1. Business Process Identification and System Objective

The first stage in software development identifies the business flow to create the system’s objective [18]. The business process related to expense consolidation expenses that run on Cekeran Midun starts with ordering raw material made by each branch. After the production receives a list of orders for raw materials from each branch, the production staff prepares the raw materials to be sent by the driver and writes a list of orders in a road letter. The road letter is useful for processing by the financial staff in calculating the expenses of each branch. Every day, there is daily closing to calculate the revenue earned by each branch. Expense cost consolidation is complete after obtaining efficiency level results. The efficiency level is obtained from calculating the percentage of costs, which divides the income and expenses.

We identify the gap or problems within the business process identification, as depicted in Table 1.

Table 1. Problems Found during Business Process Identification

| No | Problems Found | Description |
|----|----------------|-------------|
| 1  | Expenses data spread across many branches | The company is growing rapidly but not followed by technological advances. Ultimately resulting in the spread of data that cannot be appropriately consolidated. |
| 2  | It took a long time to collect expense data | Due to the spread of expenses data in many places, as a result, it takes a long time to collect expenses data for processing and monitoring. |
| 3  | Monitoring branches experiencing waste is difficult | It is difficult for stakeholders to know which branches are experiencing waste in managing their expenses. |
| 4  | Data on expenses consolidation are not mutually integrated | Data that is not integrated makes it less efficient the time needed to check. |
| 5  | Efficiency level information is not accurately recorded | Information regarding efficiency level is challenging to monitor by the CEO |
| 6  | Unstandardized report | Reports that have been done were known to have no standards. |

From this problem found during business process identification, we set up objectives using the SMART approach [19]. It is a framework of objectives used to help guide goal setting. SMART is an acronym that stands for Specific, Measurable, Achievable, Realistic, and Time-Bound. Therefore, a SMART goal incorporates all these criteria to help focus on making a sound system and increasing the chances of achieving that goal. SMART objectives are well known in the education sector [20] [21], although we also can find the framework being implemented in health [22] and even national defense [23]. Our interpretation of objectives based on the SMART approach can be seen in Table 2.
Table 2. SMART Objectives of the Restaurant’s Expenses Monitoring System

| No | Objective Type | Objective Description                                                                 | Solving Problem No- |
|----|----------------|----------------------------------------------------------------------------------------|---------------------|
| 1  | Specific       | The purpose of this system is to create clear and transparent information on the consolidated expense data of various branches | 1, 3, 4, 5          |
| 2  | Measurable     | To collect and process expense data in one cloud-based platform and can be accessed from many places | 1, 2, 3, 5          |
| 3  | Achievable     | To manage and monitor the company’s operational activities in the expense consolidation process | 1, 4, 5, 6          |
| 4  | Realistic      | All stakeholders can access the web-based system at the middle management and top management levels for monitoring purposes | 1, 2, 3, 4, 5, 6    |
| 5  | Time-Bound     | To be used in the 1st semester of 2021 and measured after 60-days of use               |                     |

2.2. System Design

System design deals with planning information systems development by understanding and specifying what a system should do and how its components should be implemented and work together [24]. System analysts solve business problems by analyzing information systems’ requirements and designing such systems by applying analysis and design techniques. The design emphasizes a conceptual solution that fulfills the conditions rather than its implementation [25]. For example, in this study, a description of a table structure of order and road letter (2 of our most important table in the system) is presented in Table 3 and Table 4.

Table 3. Table of table_order

| No | Field Name         | Type Field | Size Field | Key        | Ref Table            | Remarks                              |
|----|--------------------|------------|------------|------------|----------------------|--------------------------------------|
| 1  | id_order           | Number     | -          | Primary Key| -                    | Not Null Integer [0-9]               |
| 2  | id_road_letter     | Number     | -          | Foreign Key| table_road_letter    | Not Null Integer [0-9]               |
| 3  | id_raw_material    | Number     | -          | Foreign Key| table_raw_material   | Not Null Integer [0-9]               |
| 4  | name_raw_material  | String     | 40         | -          | -                    | Not Null Varchar [Xx]                |
| 5  | price              | Number     | -          | -          | -                    | Not Null Integer [0-9]               |
| 6  | unit               | String     | 15         | -          | -                    | Not Null Varchar [Xx]                |
| 7  | category           | String     | 20         | -          | -                    | Not Null Varchar [Xx]                |
Table 3 explains the raw material ordering data used for the calculation of expenses. The actors who use this data are the head outlets from all branches and the production head. Table analysis produces two foreign keys, namely id_road_letter and id_raw_material, because later, the information is related to other tables.

**Table 4. Table of table_road_letter**

| No | Nama Field      | Type Field | Size Field | Key      | Ref Table     | Remarks           |
|----|-----------------|------------|------------|----------|---------------|-------------------|
| 1  | id_road_letter  | Number     | -          | Primary Key | -            | Not Null Integer [0-9] |
| 2  | id_outlet       | Number     | -          | Foreign Key | table_outlet | Not Null Integer [0-9] |
| 3  | letter_number   | Number     | -          | -        | -            | Not Null Integer [0-9] |
| 4  | date_actual     | Date       | -          | -        | -            | Not Null Date [ddmm-yyyy] |
| 5  | total_expenses  | Number     | -          | -        | -            | Not Null Integer [0-9] |
| 6  | total_sales     | Number     | -          | -        | -            | Not Null Integer [0-9] |
| 6  | status          | String     | 10         | -        | -            | Null Varchar[Xx]   |

Table 4 describes the road letter data that stores information about the id_outlet, the foreign key from table_outlet, letter_number, date_actual, total_expenses from the total of raw material orders total_sales of the total sales on that day. From these data, each branch’s amount of profit can be seen by reducing total_sales by total_expenses.

2.2.1. **Actor’s Identification.**

Identifying actors is one of the first steps in use case analysis [26]. An actor represents each type of external entities with which the system must interact. We define actors within our systems, and this can be seen in Table 5.

**Table 5. Actor Identification of Restaurant’s Expenses Monitoring System**

| No | Actors            | Descriptions                                                                 |
|----|-------------------|-----------------------------------------------------------------------------|
| 1  | Head Outlet       | access rights to adding raw material orders as the initial monitoring activities and adding sales data when restaurant operating hours are over. |
| 2  | Head of Production| access rights to view details of raw material orders, change raw material orders according to available stock and provide confirmation of raw material orders. |
| 3  | CEO               | access rights to view expenses monitoring reports in graphs and tables     |
2.2.2. Functional Analysis

Modules, functions, and features of a system are derived from the interpretation of objectives. We can find depicted in Table 6 the analysis and its correlation to the goals.

| No. | Module(s)               | Description of Functionalities                                           | Objective No. |
|-----|-------------------------|-------------------------------------------------------------------------|---------------|
| 1.  | Manage raw material orders | Manage activities: create activities, update activities, and delete actions. | 1, 2, 4, 5    |
| 2.  | Manage sales data       | To manage the sales data required in calculating the level of efficiency | 1, 2, 4, 5    |
| 3.  | Calculation of level efficiency | As a result of the percentage rate of expenses utilization. | 2, 3, 5       |
| 4.  | Manage reports          | Manage monthly expense reports from all branches, which can be presented in graphs or tables | 1, 3, 4, 5    |

2.3. System Development

In this study, we implemented the web-based software based on the PHP programming language with the editor is Visual Studio Code. It uses the MySQL database and Apache Web Server in the XAMPP application, Google Chrome / Mozilla Firefox as a Web Browser media, and Laravel Framework for PHP as a development restaurant’s expenses monitoring system.

2.4 Implementing Cloud Computing Technology

After the system development stage is complete, then apply cloud computing technology to the system. The hosting method is carried out so that the restaurant’s expenses monitoring system can be accessed via the link http://cekmid-monitoring.digital. This platform aims to provide easy access for users who want to use the system. Even though the design is made web-based, it is still compatible when accessed via a mobile screen.

3. Result and Discussion

The design and manufacture of software available in this study were completed in four months. In the testing phase, there are two tactics, namely system testing and user testing. The test will determine the quality, success, testing stages, and conclusions of the study.

3.1 Restaurant’s Expenses Monitoring System

Implementation of the software interface results from the design concept or design created in the previous stage [27]. Interface design or mock-up helps developers make good designs to build monitoring systems for the restaurant’s expenses. To enter the system based on the user level, namely the head outlet, the head of the production, and the CEO. Each user must first fill in their username and password, as depicted in Figure 1.
Figure 1. The Implementation of the Restaurant’s Expenses Monitoring System

There is a raw material order management function in the system to input orders to fulfill the branch’s needs. After the order of raw materials is confirmed, the cost data is recorded in the system. Sales data are inputted to enter the day’s total revenue. Furthermore, the cost percentage is calculated by dividing the total income by the total expenses to produce a branch efficiency level. In Table 7, a test case of filling out the raw material order form.

Table 7. Use Case Test of filling out raw material order form scenario

| Use Case ID | UC-1 |
|-------------|------|
| Use Case Name | Manage Raw Material Order |
| Test Scenario | Filling out Raw Material Order |
| Test Case | The filling out field of order description, raw material, and quantity of raw material |
| Pre-Condition | Raw material order = empty |
| Test Steps | 1. Select the raw material ordering menu |
| | 2. Start filling out the data in all fields |
| | 3. Click “save.” |
| Test Data | 1. Fill out order description <entering the payday date; orders are reproduced> |
| | 2. Choose the raw material <Ceker, Mie, Bihun, Sosis> |
| | 3. Fill out quantity according to the selected raw material <30, 50, 25, 6> |
| Expected Result | Filling out raw material order succeeded without fail and show a message about details raw material order then the message “Data has been successfully saved.” |
| Post Condition Status | “Data has been successfully saved” |
| (Pass/Fail) | PASS |
The activity of ordering raw materials from each branch is essential in monitoring expenditure costs because containing raw materials produces data on each branch’s total raw materials. This natural material is processed in branches and has food sold to consumers and creates added value, which is its profit. Savings or wasteful of a branch in using expenses, seen from the level of efficiency obtained.

3.2. The Acceptance Test

To find out that the needs of users have been fulfilled, we conducted a user acceptance test. The test was made with 27 test scenarios for three types of users: (1) Head Outlet; (2) Head of Production; (3) CEO. User Acceptance Test results can be seen in Table 8.

Table 8. User Acceptance Test of Restaurant’s Expenses Monitoring System

| No  | User/Tester        | Acceptance Rate | Notable comments                                      | User Description                  |
|-----|--------------------|-----------------|-------------------------------------------------------|-----------------------------------|
| 1.  | Head Outlet        | (10 out of 12)  | “felt helpful because it made the work easier, the process of adding raw material orders was fast.” | - Seven user                      |
|     |                    | 83.3%           |                                                       | - Gender: man                     |
|     |                    |                 |                                                       | - High school and vocational school graduate |  
| 2.  | Head of Production | (8 out of 12)   | “a little trouble with the”                           | - One user                        |
| No | User/Tester | Acceptance Rate | Notable comments | User Description |
|----|-------------|-----------------|------------------|-----------------|
|    |             | 66.7%           | "layout of the buttons, but it’s a nice system.” | - Gender: man  
|    |             |                 |                  | - High school  
| 3. | CEO         | 100%            | "easy to use, data can be well visualized and accurate.” | - One user  
|    |             |                 |                  | - Gender: man  
|    |             |                 |                  | - Bachelor degree in economics |
|    |             |                 |                  | Average Acceptance |
|    |             |                 |                  | 83.33 %         |

4. Conclusions

This study is based on the spread of expense data in many restaurant branches, challenging to monitor. For these problems, the solutions presented with the help of technology make data scattered in many places that can be well organized and provide reports on each outlet’s efficiency level that are accurate and can be accessed easily. Taking advantage of the advantages presented by Cloud Computing in the form of the use of computer technology and internet-based development, the expense monitoring system can be built into a platform as a service. Further research combines the calculation of costs in a restaurant. It allows the development of a platform that provides Cloud Computing-based online services that can be used collectively by various restaurants (software as a service).

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