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PREFACE

Editor of JITK (Jurnal Ilmu Pengetahuan dan Teknologi Komputer), said praise and gratitude to the presence of Allah S.W.T, creator of the universe who mastered knowledge as wide as heaven and earth, for the abundance of grace and gifts that have been given to JITK editors to publish JITK Vol. 5, No. 2 February 2020, which is used by lecturers, researching, and professionals as a medium or media to publish publications on the findings of research conducted in each semester.

JITK is published 1 (one) year for 2 (two) times at the end of each semester, JITK editors receive scientific articles from the results of research, reports / case studies, information technology studies, and information systems, which are oriented to the latest in science and information technology in order to be a source of scientific information that is able to contribute to the increasingly complex development of information technology.

The editor invited fellow researchers, scientists from various tertiary institutions to make scientific contributions, both in the form of research results and scientific studies in the fields of management, education, and information technology. The editors really expect input from readers, information technology professionals, or those related to publishing, for the sake of increasing the quality of journals as we all hope.

The editor hopes that the scientific articles contained in the JITK scientific journal will be useful for academics and professionals working in the world of management, education, and information technology

Chief Editor

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IMPLEMENTATION OF CONCOLIC UNIT TESTING IN TESTING BINARY SEARCH ALGORITHM USING JCUTE

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Abstract— Testing is the process of implementing a program to find an error. A good test case is one of the tests that have the possibility of finding an undisclosed error. One of the existing types of testing is the Concolic Unit Testing Engine. In this research, testing is applied using the JCute tool, which is a tool to systematically and automatically test sequential C programs (including instructions) and Java programs together. This test is carried out on the search function of an element of data in the Binary Search Search Algorithm. However, to check whether concolic testing can detect bugs in the software practically through case studies. This research describes a case study of the application of a test tool to a Java application. Through this research, we tested the path coverage and Branches Covered. We can also find out the details of total branches covered; total functions invoked, percentage of branches covered, and the number of iterations. JCute can also find an interleaving of two sequences or circuits that results in an infinite loop.

***Keywords**: Testing, Concolic Unit Testing Engine, JCute, Binary Search.*

Abstrak— *Pengujian adalah suatu proses pelaksanaan suatu program dengan tujuan menemukan suatu kesalahan. Suatu kasus test yang baik adalah apabila test tersebut mempunyai kemungkinan menemukan sebuah kesalahan yang tidak terungkap. Salah satu dari jenis pengujian yang ada adalah Concolic Unit Testing Engine. Pada penelitian ini diterapkan pengujian dengan menggunakan tools JCute yang merupakan alat untuk secara sistematis dan otomatis menguji program C berurutan (termasuk petunjuk) dan program Java bersamaan. Pengujian ini dilakukan pada fungsi pencarian suatu elemen atau data pada Algoritma Pencarian Binary Search. Namun untuk memeriksa apakah pengujian concolic dapat mendeteksi bug pada perangkat lunak secara praktis melalui studi kasus. Penelitian ini menjelaskan studi kasus penerapan alat uji coba ke aplikasi Java. Melalui penelitian ini, kami melakukan pengujian terhadap path coverage dan Branches Covered. Kita juga dapat mengetahui detail total branches covered, total functions invoked, percentantage of branches covered dan number of iterations. JCute juga dapat menemukan sebuah interleaving dari dua urutan/rangkaian yang menghasilkan loop tak terbatas.*

***Kata Kunci**: Pengujian, Concolic Unit Testing Engine, JCute, Binary Search.*

INTRODUCTION

Testing is a series of activities that can be planned and carried out systematically. Activities related to testing include analyzing items and programs and features of software items. [1]. Software testing is an essential part of determining software quality, every software that has been built needs to be tested so that there are no logical process errors and to ensure the software is 100% correct according to needs, errors in the software built not because a programmer does not pay attention to the processes that occur or do not pay attention to the quality of the software he creates, errors can occur because of the complexity of the software logic and the broad scope of the software can be the reason for these errors.

The purpose of software testing is to detect differences between the output of the software and the expected conditions and find errors. By testing, the quality and trust in the functioning of the software will increase. Bortolino, in his research "Software Testing Research: Achievements, Challenges, Dreams", mentions several approaches that can be used in software testing, including model approaches, engineering approaches, search-based approaches for the generation of test inputs and attribute performance assessment approaches [2].

Binary Search Algorithm is implemented to assist software testing. This algorithm is a method of searching for data or elements in an array with data conditions in an ordered state. The binary search process can only be done on a set of data that has been sorted beforehand. The researcher implements the Binary Search Algorithm into the JCute software to perform computerized software testing. JCute (Java Concolic Unit Testing Engine) for C and Java is a tool for systematically and automatically testing sequential C programs (including hints) and concurrent Java programs.

According to Sen. K and Agh. G [3], during execution, the algorithm collects a constraint on the symbolic value at each branch point (that is, a symbolic constraint). At the end of implementation, the algorithm has calculated the sequence of symbolic constraints corresponding to each branch point. We call this constraint conjunction a path constraint. Note that all input values that satisfy a given path constraint will explore the same execution path, provided we follow the same thread schedule. In addition to collecting symbolic constraints, the algorithm also calculates race conditions (data race and lock race) between various events in program execution, where informally, an event represents the execution of a statement in the program by a thread.

According to Kim. M, and Jang. Y [4]". Concolic Testing (concrete and symbolic) is a hybrid software verification technique that performs symbolic execution, a classical technique that treats program variables as symbolic variables, along a concrete execution path (testing on specific inputs).

Concrete testing explores possible paths in the same way as symbolic execution. [5][6]. Unit tests are built to map symbolic input to function parameters. This technique then aggregates the symbolic input value constraint and a set of path constraints and problem solvers. In addition, this technique collects input values with a constraint solver that produces test input values that can make high path coverage. When this technique resolves all constraints, it uses the tangible value of execution for the algorithm to continue. Moreover, since the algorithm performs a concrete implementation, all errors inferred by the technique are real.

The concolic test tool can also identify input and output variables used to generate test cases to determine input/output dependencies on the application [7]. And it can also get a high execution scope and is widely used in the industry for program testing [8].

JCute combines concrete and symbolic execution in a way that avoids overtesting as well as false warnings. The tool also introduces a race-flipping technique to efficiently test and check programs along with data input. Related to testing, the JCute Binary Search Algorithm can automatically search for possible input data for the test case design.

Based on the background of the problem as described previously, this research designs and builds software using a binary search algorithm and JCute as tools used to test software. And analyze software testing using the Concolic Unit Testing Engine approach, which can find undiscovered errors using JCute.

MATERIALS AND METHODS

The research methods applied in obtaining data and information that support this research are as follows :

Study of literature

Literature research is used as the basis for theoretical discussion by using data obtained from observations and evaluating the results of journal research, theories and views from books, internet searches and other sources in this study.

Software Testing Method

The basis of any software testing life cycle is first of all the knowledge about the specified system to be developed and all influencing factors. From the point of view of a model-centric approach to the problem, this knowledge base was created by first developing a concept that enables a lightweight integration of model information from all modeling domains (influencing factors) [9].

The method in writing this research consists of several steps, which we can see in Figure 1 below.

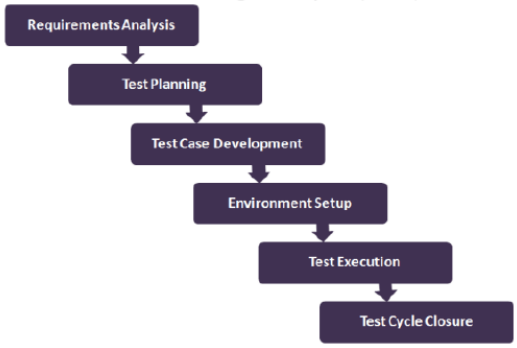

Figure 1. Software Testing Life Cycle [10] (STLC)

Requirements Analysis

In this first stage of the software testing cycle, the test team reviews each document and design requirements to determine what can be tested. By studying the needs, the test team understands the scope of the test. This phase may involve conversations with developers, designers, and stakeholders [11].

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Test Planning

What to test, how the test needs to be done, and who will try it. These are things that are determined during the testing planning stage. Once the requirements have been reviewed, it's time to plan a test project. A test plan document is created during this phase. This phase keeps everyone on the same page about how the test project will be approached.

Test Case Development

This stage aims to determine in detail the "how" to test. Test cases should be written to guide the tester through each test. If old test cases are used, make sure they are up to date. Many tests may require test data. Prepare the test data needed to run the test during this phase, so you don't have to spend time doing this during the trial.

Environment Setup

Ensure that the required test data is entered into the system and is ready for use. The test environment is the software and/or hardware configuration in which the test team performs testing. Without a ready-to-use test environment, you will run into a bottleneck.

Test Execution

Now that the tests are ready to run and the environment is set up, it's time to run the tests. Using test cases, the tester executes each test, compares the expected result with the actual outcome of each test and marks it as pass or fail or skip. If the test fails, the examiner must document what actually happened during the trial. This phase also involves bugs in the designated bug tracking system (defined in the planning phase)[12].

Test Cycle Closure

After all test cases have been run, the test manager must ensure that all required testing has been completed. This involves analyzing the defects found and other metrics such as how many test cases were passed/failed. This final stage in the software testing cycle may also include a project/testing process retrospective. This allows the team to learn from and improve future test projects.

RESULTS AND DISCUSSION

Requirements Analysis

The analysis is the first step in testing software. At this stage, the analysis process includes problem analysis software specification analysis. This analysis combines literature study data obtained from the data collection process and methods in testing. In this stage of testing, identify the requirements that can be tested. Activities that must be carried out in the needs analysis stage are as follows:

1. Analyze the system requirements specification from a testing point of view
2. Identify testing techniques and types of tests
3. Prioritize features that require focused testing
4. Analyze the feasibility of automation
5. Identify details about the test environment in which the actual testing will be carried out

Test Planning

The activities that will be carried out in the Test Planning stage are as follows :

1. Estimated testing effort
2. Selection of Testing Approach
3. Preparation of Test Plan, a Test Strategy document
4. Selection of Testing tools

Deliverables (Results) from the Test Planning stage are :

1. The most suitable Test Approach: Concolic Unit Testing
2. Test equipment to be used: JCute

Test Case Development

The activities that will be carried out in the Test Case Development stage are as follows :

1. Making test cases, namely binary search application cases
2. Test script creation if needed
3. Verify test cases and automation scripts
4. Test Data Creation in the test environment

Class BinarySearch.java

```
1.  public class BinarySearch {
2.      private int[] mData;
3.      private int mSize;
4.      public BinarySearch(int[] data) {
5.          this.mData = data;
6.          this.mSize = data.length;
7.      }
8.
9.      public int search(int key) {
10.         int low = 0;
11.         int high = this.mSize - 1;
12.         while(high >= low) {
13.             int middle = (low + high) / 2;
14.             if(this.mData[middle] == key) {
15.                 return middle;
16.             }
17.             if(this.mData[middle] < key) {
18.                 low = middle + 1;
19.             }
20.             if(this.mData[middle] > key) {
21.                 high = middle - 1;
22.             }
```

```
23.         }
24.
25.         return -1;
26.     }
27.}
```

Class MainConsole.java

```
public class MainConsole {
    public static void main(String[] args) {
        if(args.length == 0) {
            System.out.println("Parameternya
belom");
            return;
        }
        int[] data = {1,2,3,4,5,6,7,8,9,10};
        BinarySearch binarySearch = new
BinarySearch(data);

        int search = Integer.parseInt(args[1]);
        int result = binarySearch.search(search);
        if(result != -1) {
        System.out.println("Yang dicari: " + result +
" ada pada index ke: " + result);
        } else {
            System.out.println("Ndak ado");
        }
    }
}
```

Environment Setup

The activities that must be carried out in the Test Environment Setup stage are as follows :

1. According to the requirements and Architectural documents, prepared a list of software and hardware
2. Setting up the test environment
3. Generating test data
4. Install build and test execution

Potongan Sourcode yang akan di Uji

```
1.  public int search(int key) {
2.  int low = 0;
3.  int high = this.mSize - 1;
4.
5.  while(high >= low) {
6.      int middle = (low + high) / 2;
7.      if(this.mData[middle] == key) {
8.          return middle;
9.      }
10.     if(this.mData[middle] < key) {
11.         low = middle + 1;
12.     }
13.     if(this.mData[middle] > key) {
14.         high = middle - 1;
15.     }
16.}
17.
18.return -1;
19.}
```

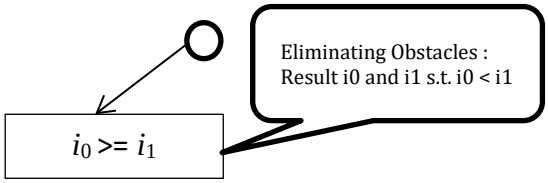
In the algorithm snippet above, the low variable value is inputted 0; then the high variable is calculated using the formula mSize – 1. Then we try to violate this statement: int middle = (low + high) / 2;. Then we assign a random value to the variable int low = 0; the value is 10 and the variable int high = this.mSize - 1; the value is 6. In Table 1 it is Randomly input concrete value Concolic Execution.

Table 1. Randomly input concrete value

	Concrete	Symbolic
low	10	i_0
high	6	i_1

Enter the concrete value, which is the new input:
Low = 10 which is a concrete value, and i0 is a symbolic value
High = 6 which is a concrete value, and i1 is a symbolic value.

Then we execute the Execution Tree based on the equation below:



Where variable int middle = (low + high) / 2; . Then we try again to make a new input, this time the variable int low = 0; the value is 8 and the variable int high = this.mSize – 1; its value is 20, and the following statement corresponds to the equation int middle = (low + high) / 2;. We input for the new concrete value of concolic execution after we got for the low variable the concrete value is 8, and the high concrete value is 20, which can be seen in Table 2 for the concrete value and its symbolic value.

Table 2. Enter the new concrete value

	Concrete	Symbolic
low	8	i_0
high	20	i_1

Enter the concrete value, which is the new input:
Low = 8 which is a concrete value, and i0 is a symbolic value
High = 20 which is a concrete value, and i1 is a symbolic value

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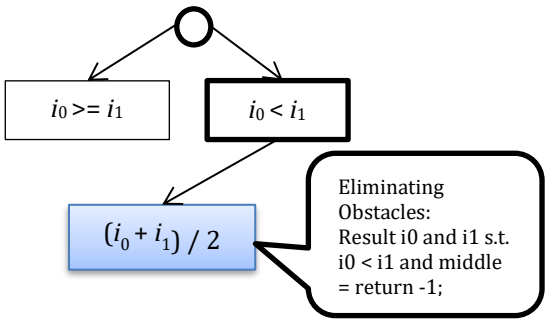
Then we can re-execute the Execution Tree based on the concrete and symbolic values in Table 2 to produce the following equation:



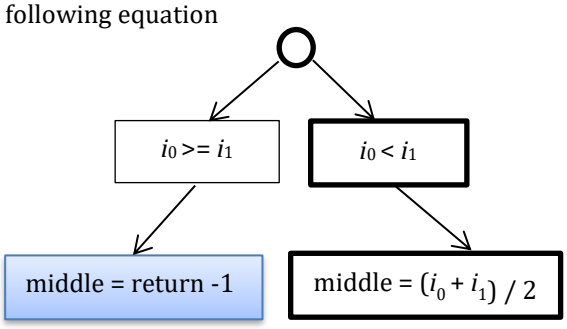
Then we try again to make a new input, but at this time, the variable int low = 0; has value 100 and variable int high = this.mSize - 1; the value is 4. The value of the two variables is obtained based on the following equation int middle = (low + high) / 2; In Table 3, we can see the low and high variable values that we got earlier, and we inputted them as new concrete values for the concolic execution.

Table 3. Enter the next new concrete value

	Concrete	Symbolic
low	100	i_0
high	4	i_1

Enter the concrete value, which is the new input:
Low = 100 which is a concrete value, and i0 is a symbolic value
High = 4 which is a concrete value, and i1 is a symbolic value

For the next experiment, we can execute the Execution Tree again based on the concrete and symbolic values in Table 3 so as to produce the following equation



Testing experiments carried outrun the program concretely and symbolically. Symbolic execution differs from traditional symbolic execution in that the algorithm follows a path that requires concrete execution. During execution, the algorithm collects a constraint on the symbolic value at each branch point (that is, a symbolic constraint). At the end of execution, the algorithm has calculated the sequence of symbolic conditions corresponding to each branch point. We can notice that all input values that satisfy a given path constraint will explore the same execution path, provided we follow the same thread schedule.

In addition to collecting symbolic constraints, concolic unit testing also calculates race conditions (data race and lock race) between various events in program execution, where informally, an event represents the execution of a statement in the program by a thread. The first algorithm generates random input and a schedule, which determines the execution order. Then the algorithm does the following in a loop: it executes the code with the information and the resulting program. At the same time, the algorithm calculates the race conditions between various events and the symbolic constraints. It generates backtracks and generates a new schedule or new input, either by reordering the circumstances involved in the race or by breaking symbolic barriers, respectively, to explore all possible different execution paths using a deep first search strategy. Note that the algorithm performs a concrete execution, i.e., all the bugs it finds are actual.

Test Execution

After executing several test cases on the binary search algorithm by automatically generating inputs and schedules so that each program execution path is performed at once, we can see in Figure 2 that JCute develops a testing path of 16 paths. Incorrect paths are indicated by an asterisk (*) to view appropriate inputs and traces. The asterisk symbol (*) on path 10 will also cause program error, while on path 7, it is not wrong because there is no sign (*).

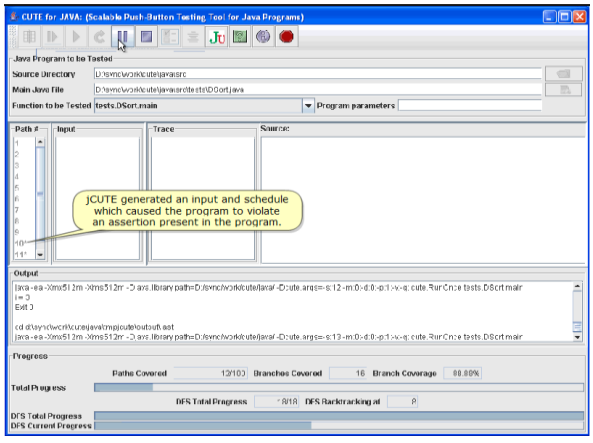


Figure 2. Incorrect traced program

Tests carried out on all existing paths when searching for paths manually will take a long time, but using JCute can be found automatically and thoroughly. It can determine error paths for certain data cases.

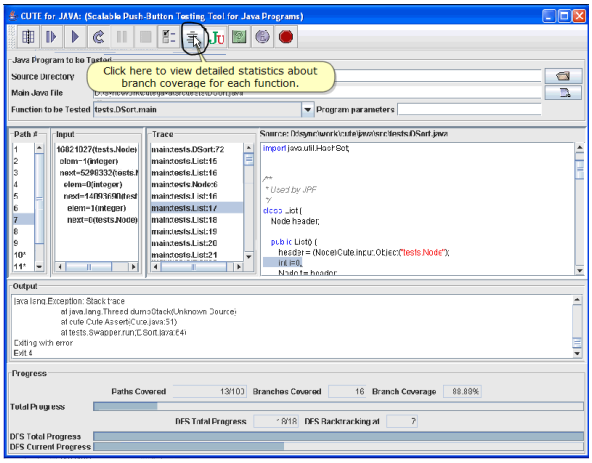


Figure 3. Branch coverage for each function

In Figure 3, it can be seen that JCute generates different inputs for each path and is also visualized in Figure 3 to the right of the code to be executed. It can be seen that the input variable is the branch we want to run. Trace performed as many as 72 TraceList.

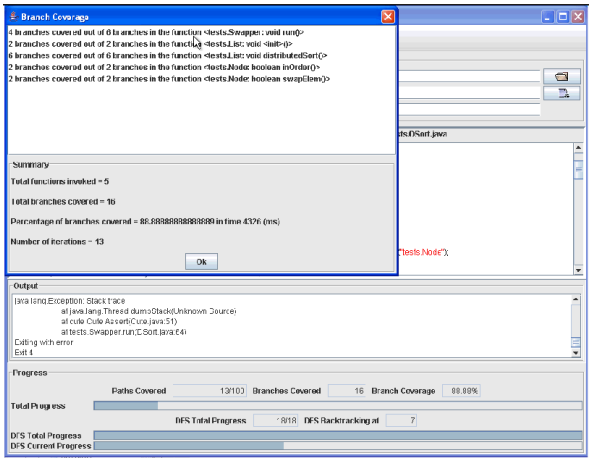


Figure 4. Details of branch coverage

Java programming with the input data provided, the results are shown in Figure 4 and more details are shown in Table 4 include 5 total functions invoked, 16 total branches coverage, 88.88 percentage of branches coverage, and 13 number of iterations.

Table 4. Evaluation results of binary search testing using JCute.

Number Of Iterations	Total Functions Invoked	Total Branches Coverage	Percentage Of Brances Coverage
13	5	16	88.88
8	4	11	79.56
2	3	9	70.03

If the number of iterations is 2, the Percentage Of Branches Coverage only reaches 70.03. If the number Of Iterations is 8, the Percentage Of Branches Coverage reaches 79.56. If the number of iterations is 13, the Percentage Of Branches Coverage reaches 88.88.

CONCLUSION

In this study, the results obtained from analyzing the program source code for software testing using the Concolic Unit Testing Engine approach that the JCute application has been successfully used in testing the binary search algorithm. The binary search algorithm built in the Java programming language with the input data resulted in 5 total invoked functions, 16 total branches coverage, 88.88 percentage of branches coverage, and 13 iterations. The obtained percentage of branches coverage is above 70 percent. And the total function invoked is more than 0. The test driver also calls the algorithm by entering the concrete value and the number of iterations generated according to the function and concrete value entered. Testing the binary search algorithm in the Java programming language has been successfully carried out using JCute automatically.

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DESIGN AND IMPLEMENTATION OF INVENTORY INFORMATION SYSTEM IN PUTRA MARIYO TRADING BUSINESS

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Abstract—Technological advancement in information technology applications allows the data recording process to become easier. Putra Mariyo Trading Business is a business institution that sells wood as a building material in various types and sizes. Data processing of incoming and outgoing goods in this business is performed only by writing goods data into a specific book. Consequently, some problems such as the loss of data and miss calculation in processing transactions usually occur. Therefore, in this research, we design a system to address the problems. The system is developed by following the Waterfall software development method. To build the system, we opt to use PHP programming language, CodeIgniter framework, and MySQL as the database server. To determine system reliability, this information system testing uses black box testing which focuses on the functional requirements of the system. To evaluate the performance of the system two testing steps i.e., black-box testing and System Usability Scales (SUS) are adopted. Black-box testing results show that the error percentage of our system is 0%. The SUS testing is conducted to obtain responses from users and the SUS score obtained is 70.1 indicating that the system is at the "good" level and reliable to use.

Keywords: inventory, website, information system.

Abstrak—*Kemajuan teknologi seperti saat ini memungkinkan pencatatan data barang dapat dilakukan dengan menggunakan sebuah sistem agar proses pengelolaannya lebih mudah. Usaha Dagang Putra Mariyo merupakan sebuah usaha yang menjual kayu sebagai bahan bangunan dengan berbagai jenis dan ukuran. Pengolahan data barang masuk dan keluar pada usaha tersebut hanya dengan menyalin data barang kedalam buku sehingga sering terjadi permasalahan seperti hilangnya data dalam proses pengolahannya. Oleh karena itu, dibutuhkan sebuah sistem untuk mengatasi permasalahan tersebut. Sistem ini dikembangkan menggunakan metode pengembangan perangkat lunak Waterfall. Selanjutnya sistem akan dibangun menggunakan bahasa pemrograman PHP, framework CodeIgniter serta MySQL sebagai database server. Untuk mengetahui kehandalan sistem, pengujian sistem informasi menggunakan black box testing yang mana memfokuskan pada keperluan fungsional dari sistem. Hasil black box testing menunjukkan persentase eror sebesar 0%. System Usability Scale (SUS) dilakukan untuk mendapatkan respon dari pengguna yang melakukan percobaan terhadap sistem yang telah dikembangkan . Skor akhir SUS yang diperoleh adalah 70,1 yang berarti sistem berada pada tingkatan "good".*

***Kata Kunci**: inventori, website, sistem informasi.*

INTRODUCTION

The rapid development of technology brings various benefits because it can help people in completing their work [1]. Information technology allows access to information and data faster, more effective, and more efficient. The use of the technology has proven to be very helpful in one's work specifically in processing data, such as inventory data such that the data can be better organized [2].

Putra Mariyo Trading Business is a business that sells wood as a building material of various types and sizes. To explore the problem, several interviews with the owner of the Putra Mariyo trading business have been conducted. Interesting information is obtained that the data processing of incoming and outgoing goods rely on a simple way i.e., by simply copying reports from notes into notebooks. This activity is very risky since the notes in the book are prone to get damaged and even lost. Accordingly, trading business owners need more time when they want to know the product inventory.

Inventory is a list of goods as a whole from an institution including companies in the form of inventory of goods or stock accompanied by types,

conditions, and prices [3]. The inventory information system is an information system that is used to find out the number of certain items in the warehouse [4]. The information system is usually developed using web technology such as HTML, PHP, and MySQL. The development of HTML and PHP versions adapting to technological developments where the latest developments are that a website can be developed with various development facilities including PHP, HTML5, Cascading Style Sheet (CSS), and Javascript [5]. CodeIgniter is a popular framework that can speed up the development of web applications, therefore, in the development of inventory information systems, we adopt the framework [6].

The processing of products' information at the Putra Mariyo Trading Business is conducted in a simple way in which it is manually written into certain books. Therefore, we are motivated to develop a website-based information system that makes it easy for business owners to process products' data, transactions, and reports of incoming and outgoing goods. In addition, the web-based application allows the data processing becomes much faster and lowers data inaccuracy. To make the application becomes more useful we add it with several features, including the printing reports. incoming and outgoing goods transactions reports, and filtering transactions that occurred within a certain period.

MATERIALS AND METHODS

The software development method that is used to develop the inventory information system at the Putra Mariyo Trading Business is the waterfall method. The waterfall method is a design process in developing sequential and systematic software that looks like a waterfall flow which consists of stages namely requirements analysis, system design, implementation, testing, and system maintenance. [7]. The adoption of the waterfall method is it provides a clear software development flow so that the work on the system will be more detailed and the tasks to be carried out become more detailed [8]. In addition, the method is simple to understand and implement.

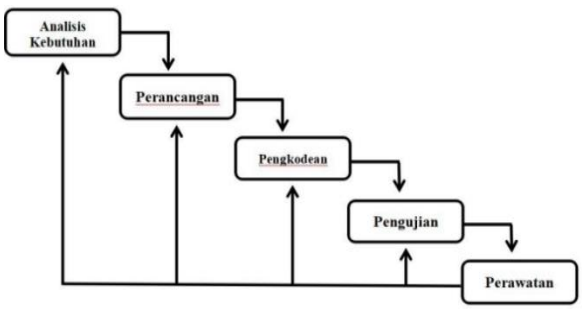

Figure 1. Illustration of the Waterfall Model

A. Requirement Analysis

The initial stage is performing requirement analysis by collecting data from the business owners through interviews, the data in the form of data on goods, suppliers, consumers, wood, and species. From the results of the interview, information was obtained that the owner of the Putra Mariyo Trading Business needed an information system that could be used to store data (goods, suppliers, and consumers) and transactions that had occurred to prevent data/transaction records from being lost if one day they would be needed again.

In addition, there is an analysis of system requirements consisting of functional and non-functional requirements. The functional requirements of this system are by the function of the system to be able to insert, update, and delete data managed by the admin. Then non-functional requirements related to the software and hardware needed to develop this system.

B. Design

After all the requirements have been collected, the following step is designing a Unified Modeling Language (UML) diagram which includes use case diagrams, activity diagrams, and Entity Relation Diagrams. This stage is carried out to describe what the actor will do and the design of the display system [9]. Figure 2 is a use case diagram design that displays the activities carried out by actors from the information system. Figure 3 is a diagram of admin activity, the administrator of the system is required to log in to the inventory information system. Figure 4 shows admin activity when viewing a short report on the dashboard page.

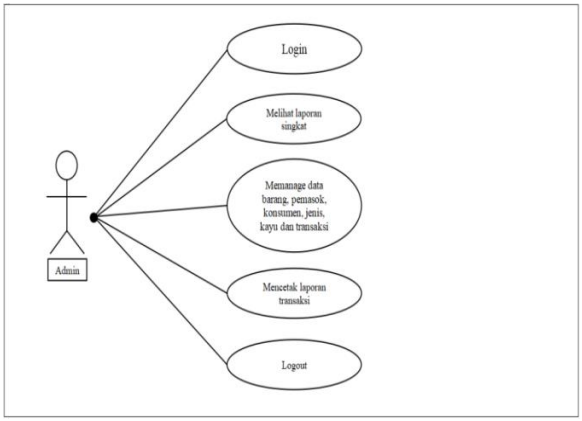

Figure 2. Use Case Diagram

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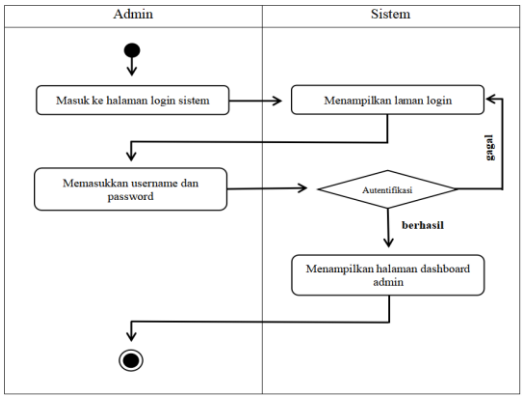

Figure 3. Admin Activity Diagram Login

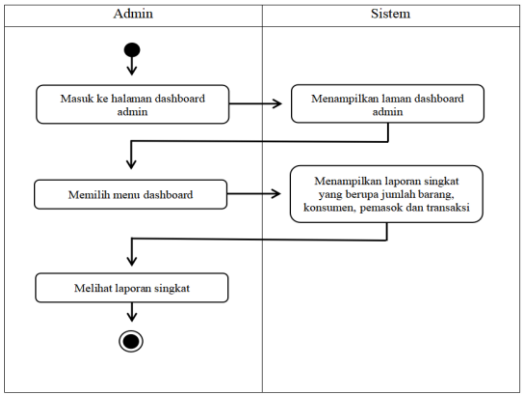

Figure 4. Admin Activity Diagram Viewing a Brief Report

After logging in and viewing a short report on the inventory information system on the dashboard page, the admin can manage the product data for the transactions process, including data on goods, suppliers, consumers, wood, and types. The admin activity diagram managing data can be seen in Figure 5. After the admin manages the data above, the admin can fill in the fields contained in the transaction menu. Figure 6 describes a diagram of the admin activity in filling the transaction data.

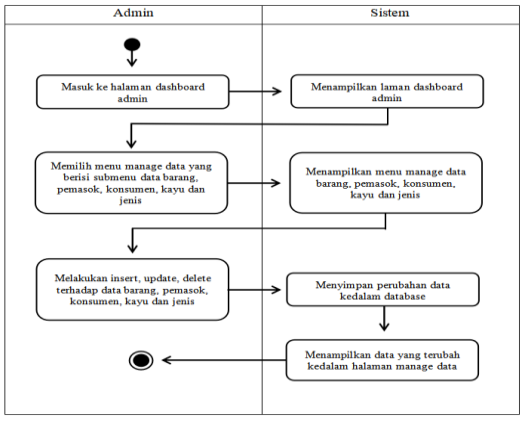

Figure 5. Admin Activity Diagram Managing Data

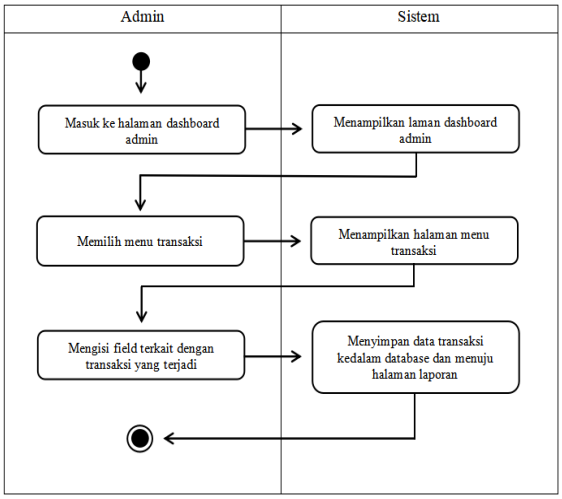

Figure 6. Admin Activity Diagram Filling Transaction Data

In this inventory information system, the admin can print out transaction reports that have been recorded, both incoming and outgoing transactions. The activity diagram of printing transaction reports can be seen in Figure 7. Once the admin is finished these activities, the admin can log out from the system and log in at a later time. Figure 8 below shows a diagram of the admin activity logging out of the inventory information system.

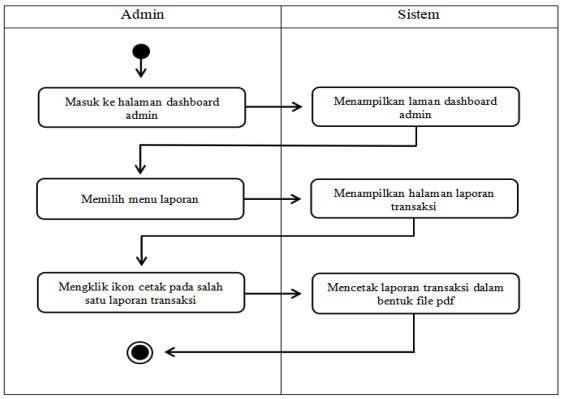

Figure 7. Admin Activity Diagram Printing Transaction Reports

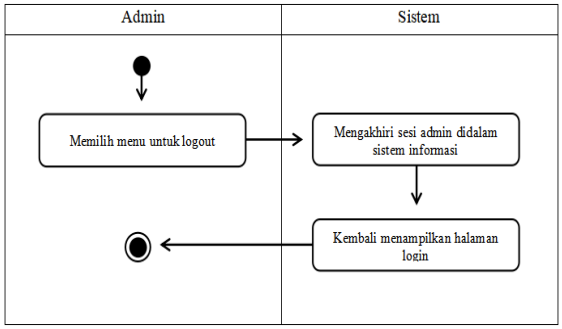

Figure 8. Admin Logout Activity Diagram from the System

To successfully manage the inventory data in a proper manner, a database should be designed carefully. The database design for the inventory information system is depicted in Figure 9 where it consists of 11 tables that have a relation among them.

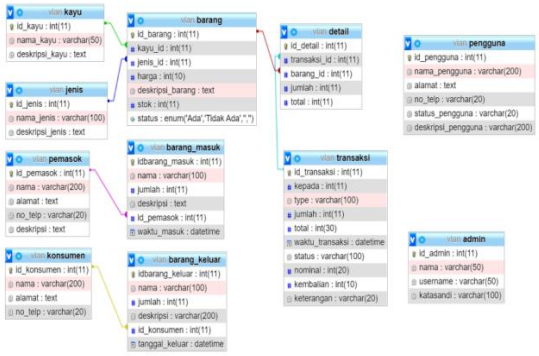

Figure 9. Database Design

C. Coding

This stage is writing program code or translating the system design into a computer language that has been designed in the previous stage into an application program [10]. The coding of this information system uses web application programming like PHP, HTML, CSS, and JavaScript programming languages.

D. Testing

Ensuring free error code using proper testing is crucial in the development phase. The testing process is taken after the completion of writing the code. This test is carried out to determine whether the system that has been designed can run properly and to find errors in the system [11]. Several tests are carried out on this information system such as Black Box Testing and System Usability Scale. Black box testing is conducted by entering input to the system according to certain conditions and then the system will do the tasks of its entire function [4]. System Usability Scale (SUS) is a testing method developed that has a function to measure the usability of a system according to the user's subjective.

E. Maintenance

The last stage in the waterfall method is maintenance. After the information system has been completely developed, the next step is running the system and carrying out maintenance. At this stage, the Putra Mariyo Trading Business admin is trained so that he can understand the system that has been developed specifically regarding the features in the inventory information system. This maintenance stage includes fixing errors that were not found in the previous stage [12].

RESULTS AND DISCUSSION

As the system development is completed, we proceed with the implementation of the design into the system. The first page of this system is the admin login page because the actor of this system is only an admin. Figure 10 shows the login page for the admin to enter the dashboard of this inventory information system.

Figure 10. Login Page Display

As the admin is successfully logging in, the admin will be directed to the dashboard page that contains several menus as shown in Figure 11.

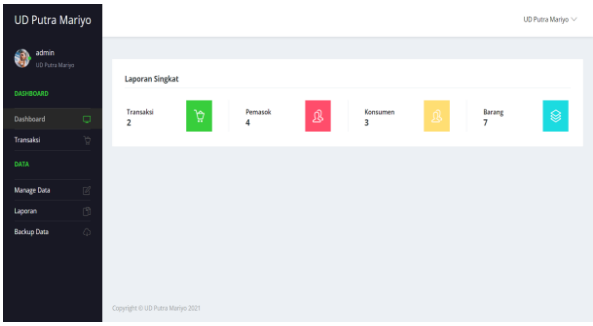

Figure 11. Dashboard Page Display

On the dashboard page, there is some information such as the number of transactions, suppliers, consumers, and goods that have been stored in the system. Then in the sidebar, there are menus such as dashboards, transactions, manage data, reports, and data backups. In the transaction menu, several fields must be filled in by the admin, including the date of the transaction, supplier or consumer, type of transaction, goods and their amount, and nominal money. The transaction menu page can be seen in Figure 12.

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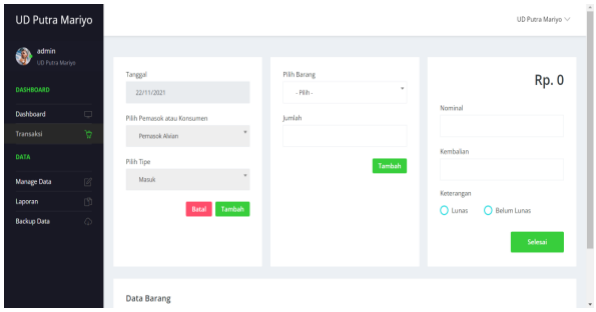

Figure 12. Transaction Page Display

Then the manage data menu is used by the admin to manage data such as data on goods, suppliers, consumers, wood and wood types which will later be used to complete the data on the transaction menu. Figure 13 below shows the display of the goods data manage page.

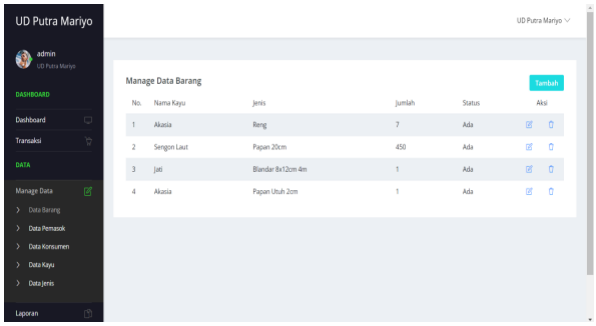

Figure 13. Display of the Manage Item Data page

After the transaction is completed by the admin, the transaction data will be entered into the report menu. In the report menu, there are 3 submenus, namely transaction reports, incoming goods reports, and outgoing goods reports. By the type of transaction carried out previously, later the transaction data will be entered into the incoming goods report or outgoing goods report. Then in the transaction report submenu, there are 2 features, namely the print and delete features, this print feature allows the admin to print transaction reports that have occurred into a pdf format file. The report page display and transaction printout can be seen in Figures 14 and Figure 15.

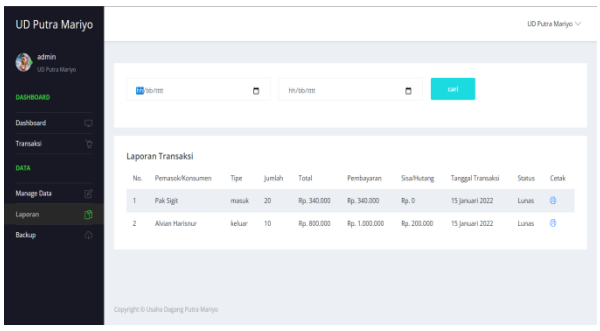

Figure 14. Report Page Display

Figure 15. Display of Report Print Results

The last feature is data backup. The feature serves to download the system database and can later be used as a data backup if the system experiences damage or some error functions. The result of the download is a zip format file in which there is a database file from this information system. Figure 16 below is the result of downloading backup data.

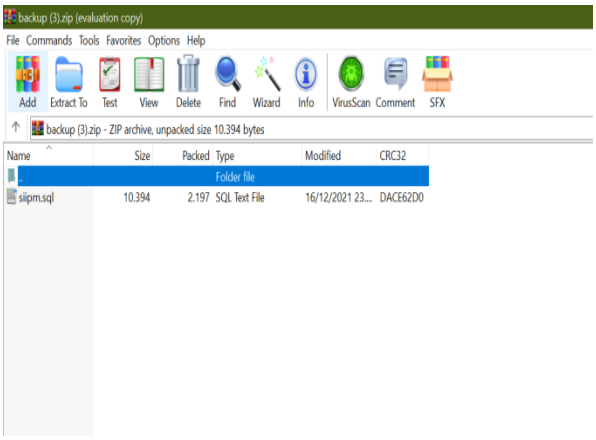

Figure 16. Data Backup Download Results

After the implementation of the design into the system has been completed, the next step is to test the system. In its development, this system was tested using 2 methods, namely Black Box Testing and System Usability Scale. Black Box Testing focuses on system input and output, not code for the implementation of the system, in other words, this test focuses on the output results of the input values that have been inputted. Below is a table of Black Box Testing :

Table 1. Black Box Testing

No	Testing	Test Case	Hope	Description
		Admin		
1	Login	The username and password are correct	Go to the dashboard page	Success
		The username and password are incorrect	Stay on the login page	Success
2	Logout	Admin presses the logout option	Back to log in page	Success
3	Master Data	Admin presses the master data sidebar	Master data appears with a dropdown	Success
4	Data on Goods, Suppliers, Consumers, Timber, and Species	The admin presses the item data menu, suppliers, consumers, wood, and types	Data of goods, suppliers, consumers, wood, and types appear	Success
5	Transaction	Admin presses the add button	Show form to add data	Success
		Admin presses edit action	Show form to edit data	Success
		Admin presses delete action	Selected data deleted	Success
		Admin presses the transaction menu sidebar	A form appears to add a transaction	Success
		Admin presses the "Selesai" button	Item data stored in the table	Success
		Admin delete transaction	Deleted transaction data	Success
6	Report	Admin presses the report menu sidebar	The transaction report menu, incoming goods, and outgoing goods appear with a dropdown	Success
		The admin presses the transaction report menu, incoming goods, and outgoing goods	Transaction report data, incoming goods, and outgoing goods appear	Success
		Admin prints transaction reports	Report output in the form of a pdf file	Success
		Admin delete transaction report	The selected transaction is deleted	Success
7	Backup data	Admin presses the sidebar menu backup data	Downloaded and backed up system data	Success

To ensure that the system is useful for the user, testing called System Usability Scale is conducted. The System Usability Scale focuses on users' evaluation of the system that has been developed. In the application, the testing method uses a questionnaire consisting of 10 questions that should be answered by the respondents [13]. The assessment is carried out using a Likert scale point from 1-5 where it indicates "strongly disagree" to "strongly agree", then the usability aspects that will be assessed by respondents including effectiveness, efficiency, and user satisfaction to the system that has been developed [14]. Tabel 2 contains a set of questions in the questionnaire:

Table 2. Table of System Usability Scale Questions

No	Pertanyaan
1	I think will use this system again.
2	I find this system difficult to use.
3	I think this system is easy to use.
4	I think that I need the help of someone else or a technician to use this system.
5	I think there are too many inconsistent things in this system.
6	I think there are too many inconsistent things in this system.
7	I feel that most people will understand how to use this system quickly.
8	I find this system very confusing.
9	I feel confident in using this system.
10	I need to learn many things before I can use this system.

Table 3. System Usability Scale Test Results

Rsp	System Usability Scale Score Results										Total	FS
	1	2	3	4	5	6	7	8	9	10		
1	3	3	4	2	3	2	4	2	4	1	28	70
2	4	2	4	3	4	1	3	3	3	3	30	75
3	3	4	3	4	2	1	3	2	4	2	28	70
4	2	2	3	2	3	2	2	3	3	3	25	62,5
5	4	3	4	3	2	3	3	3	3	2	30	75
6	3	2	3	2	3	1	3	3	2	3	25	62,5
7	4	4	3	3	3	2	4	4	3	3	33	82,5
8	1	2	2	0	2	2	2	1	2	2	16	40
9	3	3	3	2	2	2	3	3	3	3	27	67,5
10	3	3	3	3	3	2	4	2	3	3	29	72,5
11	3	3	3	3	3	3	4	3	2	2	29	72,5

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Rsp	System Usability Scale Score Results										Total	FS
	1	2	3	4	5	6	7	8	9	10		
12	4	4	3	3	2	2	3	3	3	3	30	75
13	3	3	4	4	3	2	4	3	3	3	32	80
14	4	3	4	3	3	3	2	2	3	2	29	72,5
15	3	2	3	2	2	1	3	2	2	2	22	55
16	3	3	3	3	3	3	4	3	3	3	31	77,5
17	3	4	4	2	3	1	3	2	4	4	30	75
18	4	3	3	3	2	2	3	3	3	3	29	72,5
19	3	4	3	4	2	1	3	2	4	2	28	70
20	3	3	3	2	3	2	3	3	3	4	29	72,5
21	3	3	4	3	2	2	4	3	3	3	30	75
22	2	3	3	3	2	1	3	3	2	3	28	70
23	3	3	3	3	3	2	3	3	2	2	28	77
24	4	3	3	3	3	3	2	2	3	3	28	70
25	3	3	4	3	2	1	3	3	2	3	27	67,5
											Total	1752,5
											Final Score	70,1

The collected assessment data from the respondents is calculated to determine whether the system is categorized as good or not [13]. Accroding to the System Usability Scale calculation, the scale value for odd numbers is reduced by 1 and for even numbers the score position is 5 which is then reduced by the scale value, after getting the total value from questions 1-10, the total value is multiplied by 2.5 and the value of the System Usability Scale is the average value. The average of the total value that has been multiplied in advance [15]. There are several assessment categories in the System Usability Scale test, including acceptability (not acceptable, marginal and acceptable), grade scale (A, B, C, D and F) and adjective rating (worst imaginable, poor, acceptable, good, excellent and imaginable) [16].

Referring to the test results in Table 3, it can be concluded that the inventory information system in Putra Mariyo's trading business obtains an average value of 70.1. Thus, the system is classified as acceptable for the acceptability category, then the grade scale gets a C value and based on the adjective rating it is at the good level.

CONCLUSION

The development of an inventory information system in Putra Mariyo's trading business is based on the objectives and needs, namely so that trading business owners can improve data accuracy in processing data on goods, transactions, reports of incoming goods and reports of goods going out compared to the previous method, namely copying into books which will be potentially damaged or even lost. In the development process, the information system is tested using Black Box Testing and System Usability Scale. In the Black Box Testing, it can be concluded that the features available in the system can run well and with an error percentage of 0%, while the System Usability Scale testing gets 70.1. In terms of acceptability this system is classified as acceptable, then in terms of the grade scale it gets a C value and for the adjective rating system, it is classified as good. So it can be concluded that the developed information system is feasible to use.

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TOTAL DISRUPTION OF PERFORMANCE FOR SOFTWARE PROGRAMMER TEAM SELECTION

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Abstract—In 2020, there were 50% of software development projects failed. Lack of development team skills is one of the failure factors of software development projects. On the other hand, the method of selecting a team based on the interdependence of team members which is considered to increase the chances of team success does not consider the skills in forming a development team. Therefore, in this study, the formula for calculating the total disruption of the performance of the development team was improved on the interdependence-based development team selection method, by adding a skill variable to increase the chances of team success. The results of improvement the calculation formula for the total disruption to the performance of the development team by adding a skill variable, shows that it can reduce the risk of project failure, in terms of the number of late requirements and bugs/errors.

Keywords: Total Disruption Of Performance, Interdependence, Team Selection, Skill

Abstrak—*Pada tahun 2020, terdapat 50% proyek pengembangan perangkat lunak mengalami kegagalan. Kurangnya keterampilan tim pengembang merupakan salah satu faktor kegagalan proyek pengembangan perangkat lunak. Dilain sisi metode pemilihan tim berbasis interdepensi anggota tim yang dianggap dapat meningkatkan peluang keberhasilan tim, tidak mempertimbangkan keterampilan dalam pembentukan tim pengembang. Oleh sebab itu, pada penelitian ini dilakukan peningkatan formula perhitungan total disruspi kinerja tim pengembang pada metode pemilihan tim pengembang berbasis interdependensi, dengan menambahkan variabel keterampilan untuk meningkatkan peluang keberhasilan tim. Dari hasil perbaikan formula perhitungan total disrupsi kinerja tim pengembang dengan menambahkan variabel keterampilan menunjukkan dapat mengurasi risiko kegagalan proyek, dari sisi jumlah requirement yang terlambat dan bugs/errors.*

Kata Kunci*: Total Disrupsi Kinerja, Interdepensi, Pemilihan Tim, Keterampilan*

INTRODUCTION

In 2020, there were 50% of software development projects failed [1]. One of the reasons was the lack of skills of members of the development team [1]. Skill is one of the factors that affect the success of software development projects [1], [2]. Based on the results of research done by the Standish group, skills are ranked fifth as a factor that affects the success of software development projects [1]. Therefore, the project manager needs to form a team that has skills that are suitable to the project's needs [3], [4]. Informing a team of software developers, there are several team orientations used to form a team, such as homogenous, heterogeneous, and interdependency team member selection [5]. The method that is frequently used and considered to be able to form the best team in developing software is an interdependency-oriented team between team members [5], [6]. This method selects team members based on the social element connection and calculates the total disruption of performance of team members' candidates which formed into several teams [5]. The team with the smallest total disruption of performance value will be selected as a team of software developers. Social elements are assessed based on the relationship between team members in completing work according to the project leader [5], [6], [7].

Calculation of the total value of disruption of performance is calculated based on the sum of disruption values multiplied by the value of the performance of each team member [5], [6]. The value of disruption is obtained from how many dependent partners are gone while the value of performance is assessed from the direct supervisor of the team members from previous software

development projects [5], [6]. The calculation of the total disruption of performance will impact the opportunity for the formation of teams that do not have the skills to meet the needs of software development projects.

In 2018, Baskara conducted the research by determining dependent partners based on skills using the bee colony method [6], [8]. In this research, we only make improvements to the stages of determining the dependent partner, which is by determining the dependent partner candidate team members based on the results of skill measurement [6]. But the formula for calculating the total value of disruption of performance used is still similar, which causes the skills of the formed team to be not optimal and can affect the success of the project [6].

Therefore in this research, we will make improvements to the method of determining the dependent partner of each team member by paying attention to the relationship of candidate team members based on social elements and skills and formulating the formula for calculating the total disruption of performance by adding skill variables as dividers into calculation formulas. Skill distribution in formulas is to prevent the high value of disruption from social elements and to optimize the value of social element disruption to expertise.

The purpose of this study in improving the team selection method is to produce a method of determining the contributing partner of a dependent partner objectively by adding skill variables of team members. So that each dependent partner can depend on a contributing partner who has more skills than him in completing project tasks and can increase the chances of team success

MATERIALS AND METHODS

The research is divided into several activities, starting with conducting preliminary observations, problem identification & formulation, solution analysis, solution design, testing & evaluation of methods, results, and discussion and conclusions. In general, it can be seen in Figure 1.

Preliminary observations. The first step is to conduct preliminary observations related to the project failure risk analysis from resource factors, team-building methods, comparisons of related previous studies, research attributes, research problems based on literature studies, and previous research observations.

Identification and formulation of research problems. At this stage, the variables that will be used in the research are determined and the research problem is formulated into a research problem formulation. Solution analysis. Solution analysis is done by analyzing the appropriate parameters to determine interdependency between candidates and analyzing the method of determining team members in the previous method.

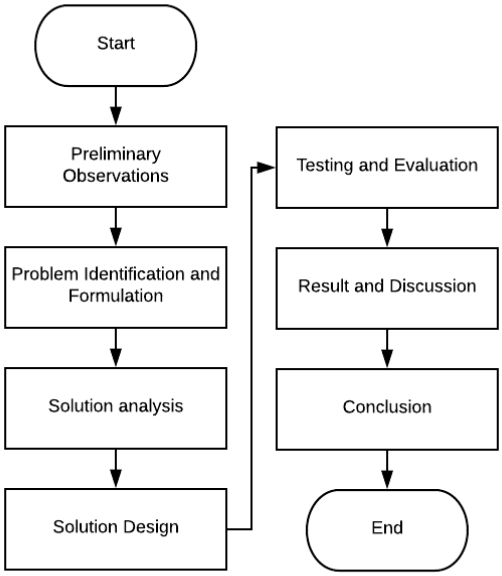

Figure 1. Research Methodology

Solution design. Designing a team formation method that has interdependence in terms of skills and obtains team results that have the minimum total value of disrupted performance. The design carried out includes the design of the method for determining the contributing partner of each candidate based on the skill level and risk analysis of each candidate

Testing and evaluation. Testing the accuracy of the method in determining the team that has the minimum total value of disrupted performance, comparing the teams generated by the proposed method with the previous method.

Results and Discussion. This stage contains the results of testing the developed method and also a discussion of the results of the tests that have been carried out. And Conclusions from research activities.

The formation of interdependency-oriented teams is formed by calculating the total value of the team's disruption of performance [4], [5]. The team with the lowest total disruption of performance value will then be selected as a team of software developers. Calculation of the total value of disruption of performance is calculated by summing the results of the multiplication of performance and disruption of each candidate member of the team [5]. The performance value is assessed by the candidate team members obtained from the candidate's superior team members in the previous project [4]. While the value of disruption is obtained by calculating the number of dependent partner

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candidates for the team that is not placed with one team with him [5]. Dependent partners are people who can be relied on by someone to complete their work [5], [6]. The stages of team formation using interdependency-oriented methods are called the determination of interdependency and team formation [5].

Determination of interdependency is a step to determine the dependent partner of each candidate member of the team [5]. Dependent partners are people who can be relied upon to complete work or contribute [5]. The determination of interdependency between candidates for team members with dependent partners is assessed from the proximity or social elements assessed by superiors [5]. Furthermore, after getting the dependent partner of each candidate member of the team, sorting the candidate team data is based on the contribution of team members [5]. Then the data of the team members that have been sorted are divided into two parts or two teams [5]. If the number of team members needed is smaller, then delete the team members who are low contributors. If after eliminating the number of team members formed still exceeds what is needed, then delete the team members who have the least support [5]. Perform calculation of the value of Total Disruption Performance (TDP) of each team using formula 1. The selected team is the team that has the lowest total disruption performance value [5].

$$TDP = d_1p_1 + d_2p_2 + ... + d_np_n \quad ..... (1)$$

d = disruption
p = performance
n = quantity of employee.

The development team data was obtained from the developer team data at the BubatDev software house in Bandung and Jakarta. Testing the team formation method is carried out by evaluating the risk analysis of the team formed on the number of late issues in the last project and the number of issues with bug categories in the last project (Table 1).

Table 1. Risk Evaluation Method

Probability (P=T*V)		Impact (I = P*Cost (Assets)
Treat Catalog (T)	**Vulnerability (V)**	**Assets(Cost)**
Delay in delivery (PT1) Bug/ Error (PT2)	Skill	Salary

Delay in delivery is the number of late issues in the last project, Bug/error is the number of issues with bug categories in the last project and Issue is the list of project task features, bugs, and project management for bitbucket to be tracked

RESULTS AND DISCUSSION

A. Determination of Interdependency

Determination of interdependency is done by measuring the skills of each candidate member of the team and proximity from the social element side. Candidates for team members will have a dependent partner who has higher skills than him and has a relationship from the social element side. The skills of candidates for team members are assessed in terms of hard skills and soft skills.

Hard skill measurement is done using a programming quiz. The programming quiz is taken from online certification (https://www.brainbench.com/) with the category of java programming language (J2EE). While the soft skill measurement is done using the 360-degree measurement method. The measurement instrument used is the competency dictionary in Spencer's work that has been mapped into the soft skill category that must be owned by the programmer (Table 2) [9]–[11].

Table 2. Softskill Programmer [7] [8]

Softskill Category	Competency	Indicator	Measure
Team Player	Teamwork -kesungguhan-(TW1)	Spencer scale	Competency level
	Teamwork - inisiatif-(TW2)	Spencer scale	Competency level
Group work	Developing others, (DEV)	Spencer scale	Competency level
	Concern for Order (CO)	Spencer scale	Competency level
	Achievement Orientation – Motivated Action (ACH1)	Spencer scale	Competency level
Time Management	Fleksibelitas (FLX2)	Spencer scale	Competency level
Listening Skills	Interpersonal understanding - Kedalaman pemahaman terhadap orang lain - (IU1)	Spencer scale	Competency level
	Interpersonal understanding - Mendengar Dan Merespon Orang Lain - (IU2)	Spencer scale	Competency level
Problem Solving	Analitical Thingking - Ukuran Permasalahan Yang dihadapi - (AT2)	Spencer scale	Competency level

Softskill Category	Competency	Indicator	Measure
Critical thinking	Analitical thinking - Kompleksitas Analisis- (AT1)	Spencer scale	Competency level
	Conceptual thinking, (CT)	Spencer scale	Competency level
Trustworthiness	self-confidence (SCF)	Spencer scale	Competency level
Ability to work under pressure	Self-control, (SCT)	Spencer scale	Competency level
Personal Integrity	Expertise -Penguasaan keilmuan- (EXP3)	Spencer scale	Competency level
	Achievement Orientation – Degree of Innovation (ACH2)	Spencer scale	Competency level
	Inisiatif (INT)	Spencer scale	Competency level
	Berorientasi pada pelanggan (CSO)	Spencer scale	Competency level

Table 3. Dependent partner based on the social element

Person Id	Dependent Partner based on Social Element		Performance	Vulnerability	Skill
	SE1	SE2			
A1	A2	A12	0,8	35	65
A2	A9	A11	0,66	30	70
A3	A12	A4	7	55	45
A4	A12	A1	0,5	45	55
A5	A12	A1	0,7	45	55
A6	A7	A14	0,85	35	65
A7	A16	A2	0,6	20	80
A8	A1	A12	0,78	65	35
A9	A2	A12	0,8	35	65
A10	A5	A12	0,7	25	75
A11	A2	A9	0,45	55	45
A12	A14	A1	0,8	30	70
A13	A12	A2	0,7	45	55
A14	A15	A12	0,67	75	25
A15	A14	A12	0,6	45	55

In this study, the team formation simulation was conducted by forming a team of software development programmers. For comparison to the results of the team formed, a dependent partner was determined based on interdependency social elements based on previous research (Table 2). The assessment of dependent partners based on interdependency social elements is assessed by the project manager who has collaborated with each of the candidates for the project team before.

B. Team Formation

The next step in forming an interdependency-oriented team after determining the dependent partner is to sort the dependent partner data based on their contribution and break the candidate team members into several teams based on the level of contribution.

In Table 4 can be seen the distribution matrix of the initial data of the programmer (Table 4). Table 5 is the result of sequencing the candidate members of the team formed based on contributions in terms of social elements (Table 5), while Table 6 is the result of sequencing the candidate members of the team formed in terms of social elements and skills (Table 6).

Table 4. Dependent partner based on a social element by the project manager

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
A1	*	*										*			
A2		*							*		*				
A3			*	*								*			
A4	*			*								*			
A5	*				*							*			
A6						*	*							*	
A7		*				*	*								
A8	*							*				*			
A9		*							*			*			
A10					*				*	*		*			
A11		*							*		*			*	
A12	*											*			
A13		*										*	*		
A14												*		*	*
A15												*		*	*

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Table 5. Shorted matrix dependent partner based on a social element by the project manager

	A10	A5	A8	A1	A3	A4	A13	A12	A6	A14	A15	A7	A2	A9	A11
A10	*	*						*							
A5		*		*				*							
A8			*	*				*							
A1				*				*					*		
A3					*	*		*							
A4				*		*		*							
A13							*	*					*		
A12				*				*		*					
A6									*	*		*			
A14								*		*	*				
A15								*		*	*				
A7									*			*	*		
A2													*	*	*
A9								*					*	*	
A11													*	*	*

Table 6. Shorted matrix dependent partner based on social element and skill

	A5	A1	A3	A4	A8	A10	A13	A12	A6	A14	A15	A7	A2	A11	A9
A5	*	*						*							
A1		*						*					*		
A3			*	*				*							
A4		*		*				*							
A8		*			*			*							
A10	*					*		*							
A13							*	*					*		
A12		*						*		*					
A6									*	*		*			
A14								*		*	*				
A15								*		*	*				
A7									*			*	*		
A2													*	*	*
A11													*	*	*
A9								*					*		*

Furthermore, from the data that has been sorted, TDP is calculated. The formula for calculating TDP in the previous study (formula 1) was improved by adding skill variables (formula 2) to prevent the high value of disruption from social elements and optimize the value of social element disruption to expertise.

$$TDP = \frac{d_1 p_1}{s_1} + \frac{d_2 p_2}{s_2} + ... + \frac{d_n p_n}{s_n} \quad \text{..... (2)}$$

d = disruption
p = performance
n = total number of employees
s = skill

Based on the results of the calculation of the total disruption of performance, teams formed based on interdependency social elements are teams consisting of A10, A5, and A8 (Table 7). While the team formed using the TDP improvement calculation method produced a team consisting of A2, A11, and A9 as the development team (Table 8).

Table 7. Total disruption of performance team based on the social element

Team			TDP
A10	A5	A8	2.1
A1	A3	A4	4.28
A13	A12	A6	9.15
A14	A15	A7	4.48
A2	A9	A11	3

Table 8. Total disruption of performance team based on social element and skill

Team			TDP
A5	A1	A3	2.58
A4	A8	A10	1.55
A13	A12	A6	4.59
A14	A15	A7	1.92
A2	A11	A9	1.54

The results of the team formed to develop software development projects using the total disruption of performance calculation formula from

previous research and improvement have different teams produced. The method of forming teams that only use social elements in their TDP calculations produces a team consisting of A10, A5, and A8. While the formation of a team that calculates TDP uses social elements and skills produce team consists of A2, A11, and A9.

The two teams selected with different methods tested with a risk assessment to see a comparison of the chances of possible team failures in developing software [12]. Risk assessment is carried out by considering two types of threats, the number of late requirements (T1) and the number of requirements that are bug/error (T2). Risk assessment is assessed based on possible threats from skills possessed by each team member [12], [13], [14], [15]. The number of late requirements seen from the number of unfinished issues does not match the schedule of the previous project, while the number of requirements that are bugs/errors is seen from the number of issues that have a category of bugs/errors in the previous project of each candidate team. In Table 9, it can be seen the results of the risk assessment carried out on the team formed using the social element calculation method only, the chance of late requirement risk is 18.19 and the requirement risk is a bug / error of 19.66. Whereas the team formed using the calculation of TDP social elements and skills has a risk of late requirements of 13.06 and the requirement risk that is a bug/error of 13.97 (Table 10). This shows that the team formed by using TDP and social element calculations has a lower chance of software development project failure in terms of delays and bug / error requirements.

Table 9. Opportunities for team threats to be formed based on the social element

	A10	A5	A8	Risk
T1	4.5	10.73	39.34	18.19
T2	8.15	7.84	42.98	19.66

Table 10. Opportunities for team threats to be formed based on social element and skill

	A2	A11	A9	Risk
T1	16.43	11.99	10.77	13.06
T2	14.46	23.31	4.15	13.97

CONCLUSION

The calculation of total disruption of performance using social element and skill variables can reduce the chance of the risk of the threat of late and bugs/errors. This is caused by the team members depending on the dependent partner who has proximity in terms of social elements with it and has more skills than him. In addition, the improvement of formula total disruption of performance by adding with skill variables can prevent the high value of disruption from social elements and optimize the value of disruption of social elements on the expertise of each member of the development team.

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MULTIVARIATE ANALYSIS OF COMMODITY AVAILABILITY OF STAPLE FOODS USING COMPLETE LINKAGE HIERARCHICAL CLUSTERING METHOD

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Abstract— The government directly supervises 11 basic food commodities. The system of interplay between the price of goods and the availability of staple food directly has an impact on the high price of food at certain times. It is necessary to classify the food that is most needed by the community on big holidays in Indonesia so that it can be a reference for the government in preparing market needs in the coming year. In this study, the grouping of staple food availability was based on hierarchical cluster analysis with complete linkage method. The availability of food commodities in the discussion of this research is sourced from production materials and daily prices for meat, eggs, cooking oil and rice commodities. Cluster interpretation results in cluster 1 indicating Fulfilled Availability of 88-89%, Cluster 2 showing Sufficient Commodity Availability of 90-93% and Cluster 3 showing Availability of Rare Commodities of 87%. The three clusters formed are depicted in the form of a dendogram as a visualization of the relationship between food availability groupings.

Keywords: Multivariate Analysis, Complete Linkage, Hierarchical Clustering, Food Commodities

Abstrak — Pemerintah secara langsung melakukan pengawasan terhadap 11 komoditas bahan pokok pangan. Sistem saling mempengaruhi antara harga barang dengan ketersediaan pokok pangan secara langsung berdampak bagi tingginya harga pangan pada waktu-waktu tertentu. Perlu pengelompokan pangan yang paling dibutuhkan masyarakat pada hari-hari besar di Indonesia sehingga dapat menjadi acuan pemerintah dalam mempersiapkan kebutuhan pasar pada tahun yang akan datang. Dalam penelitian ini pengelompokan ketersediaan pokok pangan berdasarkan analisa cluster hierarki metode complete linkage. Ketersediaan komoditi pangan dalam pembahasan penelitian ini bersumber dari bahan produksi dan harga harian komoditi daging, telur, minyak goreng dan beras. Interpretasi cluster menghasilkan cluster 1 menunjukkan Ketersediaan Terpenuhi sebesar 88-89%, Cluster 2 menunjukkan Ketersediaan Komoditi Cukup sebesar 90-93% dan Cluster 3 menunjukkan Ketersediaan Komoditi Langka sebesar 87%. Tiga cluster yang terbentuk digambarkan dalam bentuk dendogram sebagai visualisasi hubungan antara pengelompokan ketersediaan pangan.

Kata Kunci: Analisis Multivariat, Complete Linkage, Hirarki Clustering, Komoditi Pangan

INTRODUCTION

The current average price of local food is not competitive compared to other food sources such as rice, flour, and corn. The government directly supervises 11 basic food commodities at certain times [1]. The means for distributing food are limited, resulting in a lack of food production. In addition, with changing people's lifestyles, automatically the demand for food as consumers of food also changes [2]. This can result in changes in the prices of food products, especially before religious holidays. The government, through the Ministry of Trade, can control the prices of basic commodities and other important goods through the distribution of basic goods. The government is expected to improve the distribution of basic and other important goods. so that every time there is a price increase, the public can also monitor it [3]. This situation can be circumvented by a strategy of changing the habit of consuming foods from processed animal foods into foods that are low in fat, low in fiber but high in calories. In this study, the availability of 11 types of staple food was grouped based on hierarchical cluster analysis using the complete linkage method [4]. Logically, a good

cluster is a cluster that has high homogeneity (similarity) between members in one cluster and high heterogeneity (difference) between one cluster and another [5]. The grouping of food types using the Hierarchy method works by determining two or more objects that have the closest similarities, forwarded to other objects, and so on until the cluster will form a tree, there is a clear level (hierarchy) between objects, from the most similar to the least similar [6]. In the complete linkage method, clustering is based on the furthest distance between one object and another [7] [8].

Grouping of food availability based on data on prices of basic commodities, data on food supply originating from production, trade (exports and imports), stock changes. Cluster analysis begins with the standardization process, if there are data (variables) that have a large difference in unit size, measuring the similarity between objects (similarity) with 3 ways of measuring correlation, distance, and size [9] [10].

After the cluster is formed, the next step is to interpret and validate the results of the cluster analysis. The purpose of the study was to map the relationship between selling prices and the availability of staple food commodities and to find clusters of food commodities that were sufficiently available according to consumer demand [11] [12].

Research on Cluster Analysis of People with Mental Disabilities in the Province of the Special Region of Yogyakarta describes in determining cluster categories, low, medium, and high categories seen from the average calculation value of the highest and lowest variables overall. The cluster results use the average linkage, complete linkage, single linkage, ward, and centroid methods [13]. Comparative Research of Single Linkage, Complete Linkage, and Average Linkage Methods in Grouping Districts Based on Variable Types of Livestock, Sidoarjo Regency explained that in the formation of clusters a matrix of distances between districts was formed against the data consisting of 18 districts with 11 types of livestock. The distance between districts is calculated by the Euclidean distance [14] [15].

Research on Poverty Analysis in the Agricultural Sector (Case Study of Rice Commodities in Malang Regency) describes clusters that will form a kind of tree, there is a clear level (hierarchy) between objects, from the most similar to the least similar. A tool that helps to clarify this hierarchical process is called a “dendrogram”. Research Using Matlab and Python in Data Clustering, Matlab and Python have enough libraries and toolboxes to help users cluster data, present graphs. The test results show that both programming languages can carry out the clustering process [16].

MATERIALS AND METHODS

The data inputted by the CSV file will enter the distance measurement process using the Euclidean Distance technique which will produce a distance matrix and then apply the Hierarchical Clustering Complete Linkage method.
Research implementation method:

a. Data collection

The availability of food commodities in the discussion of this study is animal food consisting of commodities with the availability of:

Food production materials source https://www.bps.go.id/ :

1) Beef Production per Province (Tons), 2018-2020.
2) Broiler Meat Production per Province (Tons), 2018-2020.
3) Laying hens Egg Production per Province (Tons), 2018-2020.
4) Cooking Oil Production per Province (Tons), 2018-2020.
5) Provincial Rice Production (Tons), 2018-2020.

Food price material source https://hargapangan.id/ :

1) Rice Food Prices for the period (daily) January 2020 – January 2021.
2) Chicken Meat Food Prices (daily) January 2020 – January 2021.
3) Beef Food Prices (daily) January 2020 – January 2021.
4) Egg Food Prices for the period (daily) January 2020 – January 2021.
5) Cooking Oil Food Prices (daily) January 2020 – January 2021.

b. Cleansing Data

The data set collected is not ready for use, so it is necessary to clean the data as data preparation. Data preparation consists of several processes such as data cleaning, data transformation, and data reduction. The data cleaning process includes identifying and removing outliers and correcting missing values.

c. Euclidean Distance Technique

Each data will undergo a distance measurement process to determine the cluster. The distance calculation is determined using the Euclidean distance technique which produces a distance matrix. After getting the distance matrix from the calculation of the distance between the data, the data will be processed using Hierarchical Clustering Complete Linkage.

d. Clustering

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Hierarchical Clustering groups data that works by grouping two or more data that have similarities or similarities, then the process is continued to other objects that have proximity to two, this process continues until the cluster forms a tree, there is a clear hierarchy or level between objects from the most similar to least similar. Merging two clusters can still be continued if there are still other closest points that are possible to be combined. Next, as in the previous step, look for the two closest clusters to combine. The clusters that are combined are in the form of a single point in the first step or clusters which are a combination of two points/clusters. The process will end when all clusters have been merged into one large cluster. The Complete Linkage method groups the two objects that have the furthest distance first. Based on the distance matrix, then the data is grouped with complete linkage (farthest distance). By treating the data as a group, then determine the distance of the two smallest groups.

e. Multivariate Analysis

Analyzing the effect of several variables on other variables at the same time. A statistical method that allows researchers to research more than two variables simultaneously. Multivariate analysis techniques are classified into two, dependency analysis and interdependence analysis. Dependency analysis serves to explain or predict the dependent variable by using two or more independent variables. Multivariate analysis techniques are classified into two, namely dependency analysis and interdependence analysis. Dependency analysis serves to explain or predict the dependent variable by using two or more independent variables.

f. Interpretation of Cluster Analysis

Cluster interpretation is carried out to determine the profile of each group by using the average on each variable. Naming clusters or concluding is very subjective and depends on the research objectives.

g. Food Commodity Group

The results of grouping food commodities using the complete linkage method consisting of 3 clusters.

RESULTS AND DISCUSSION

Grouping using the complete linkage method is the process of merging two or more objects that have the furthest distance.

Step 1: Standardize the data on the complete linkage method. Standardization of data is needed if the data used in a study has various units.

Step 2: Determine the size of the similarity or dissimilarity between two objects in the complete linkage method. Pairs of objects that are closer together will be more 'similar' in characteristics compared to pairs of objects that are farther away. One method to measure the distance between objects is to use Euclidian Distance.

Step 3: Complete Linkage Cluster Analysis Process. Cluster analysis with the complete linkage method is the process of merging two or more objects that have a maximum distance or the farthest neighbor, the distance between one cluster and another cluster is measured based on the furthest distance of the members.

Step 4: Repair the Distance Matrix Using the Complete Linkage Method. Clusters are formed based on cluster pairs with the farthest distance.

Step 5: Determine the number of cluster members and their members in the complete linkage method. In determining cluster members, group objects into 3 clusters.

Step 6: Interpretation of the cluster on the complete linkage method. After the cluster is formed, the next step is to give specific characteristics to describe the contents of the cluster.

The types of food commodities discussed in this study consist of five commodities, namely beef, chicken, rice, eggs, and cooking oil. Dataset variables:

X1 = Beef Production by Province
X2 = Broiler Meat Production by Province
X3 = Egg Production of Layers by Province
X4 = Provincial Cooking Oil Production
X5 = Provincial Rice Production
X6 = Beef Prices for the Period Jan 2020 – Jan 2021.
X7 = Price of Broilers for Jan 2020 – Jan 2021.
X8 = Price of Laying Chicken Eggs Jan 2020 – Jan 2021.
X9 = Cooking Oil Price Jan 2020 – Jan 2021.
X10 = Rice Price Period Jan 2020 – Jan 2021.

The large percentage of imports on the one hand will benefit consumers with relatively affordable prices, but on the other hand it can reduce producer prices. Research involving multiple variables, data analysis techniques are often used multivariate analysis. All statistical methods that analyze several measurements (variables) that exist in each object in one or many samples simultaneously. Based on this definition, any analytical technique that involves more than two variables simultaneously can be considered as multivariate analysis.

A variation of a number of n weighted variables (X1 to Xn) can be expressed mathematically as follows variate value = w1X1+ w2X2+ w3X3+…+wnXn.

Daily commodity prices can be shown in the graph, shown in the Figure 1.

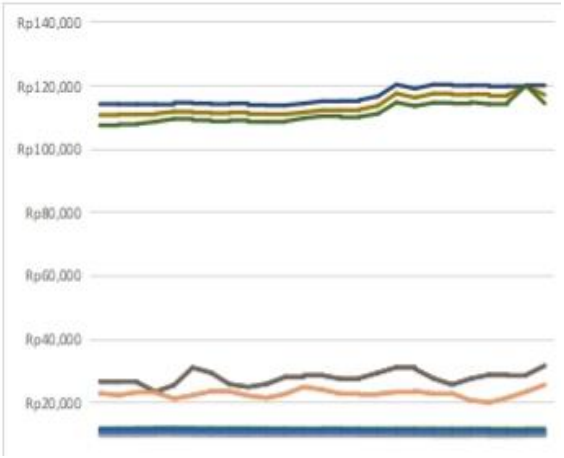

Figure 1. Graph of the average daily price

Computational linkage (y) representation of the vector from the distance matrix. Linkage checks if y is a Euclidean distance. Avoid this time-consuming check by entering X - y. The 'centroid' and 'median' methods can produce non-monotonic cluster trees. This result occurs when the distance from the combined two clusters, r, and s, to the third cluster is less than the distance between r and s. The path from the leaf to the root node takes several steps downward. In this case, cluster 1 and cluster 3 merge into a new cluster, and the distance between this new cluster and cluster 2 is smaller than the distance between cluster 1 and cluster 3.

The full dendrogram displays the progressive clustering of objects. If truncation has been requested, a broken line marks the level the truncation has been carried out. The truncated dendrogram shows the classes after truncation, shown in the Figure 2.

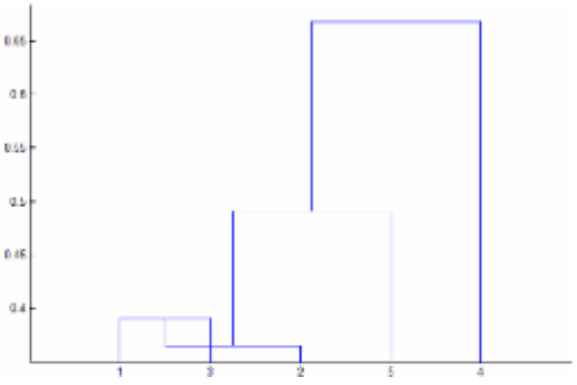

Figure 2. Non Monotonous Cluster Tree

Cluster interpretation is carried out to determine the profile of each group by using the average on each variable as follows:

1. The cluster with the lowest average is categorized as Rare Availability.
2. Clusters with an average higher than the lowest cluster mean are categorized as Sufficient Availability.
3. The cluster with the highest average is categorized as Fulfilled Availability.

The purpose of cluster interpretation for determine the number of clusters. Result of clustering of food commodities cluster interpretation consist of Rare Cluster, Fulfilled Cluster and Enough Cluster shown in the Table 1.

Table 1. Clustering of Food Commodities

Commodity	Total	%	Cluster
Beef Quality 1	308990	87	Rare
Beef Quality 2	220331	86	Fulfilled
Chicken meat	259300	86	Fulfilled
Chicken eggs	569392	89	Enough
Bulk Cooking Oil	359201	90	Fulfilled
Cooking Oil 1 kg	319313	92	Fulfilled
Cooking Oil 2 kg	422498	95	Enough
Super Quality Rice 1	108990	78	Fulfilled
Medium Rice 1	120331	86	Fulfilled
Bottom Rice 1	259300	92	Enough

Complete Linkage also known as furthest neighbor or maximum method, this method defines the distance between two groups as the distance between their two farthest-apart members. This method usually yields clusters that are well separated and compact.

The steps of the complete method linkage is as follows:

1. Calculate the distance matrix between data with using Euclidean distance calculations. An example of calculating the distance matrix between cluster 1 and cluster 2.
   By using the calculation that the same, the distance matrix of cluster 1 and cluster 3, cluster 1 and cluster 4, and so on
2. Determine the smallest or closest distance from distance matrix. Calculate the combined cluster distance with other clusters.
3. Calculate the combined cluster distance with other clusters.
4. Create a new distance matrix based on previous calculations.
5. Repeat step (2) through step (4) to form four clusters.
6. Based on the distance matrix, four clusters have been obtained, so the grouping process stops. The clusters in this study are three clusters. The three clusters formed can be depicted in the form of a dendrogram, Figure 3.

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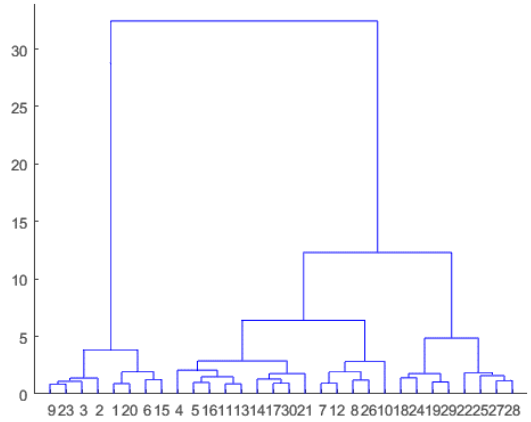

Figure 3. Complete Linkage

This allows us to find certain hierarchical clustering methods that can identify stronger clustering structures. These techniques do not let you explicitly set the number of clusters. Instead, you pick a distance value that will yield an appropriate number of clusters. This will be discussed further when we discuss the Dendrogram and the Linkage report.

Multivariate regression analysis is a statistical method that allows examining the relationship of more than two variables simultaneously. The continuous (real) value of the output t aims to predict the output accurately for new data. Regression analysis studies the form of the relationship between one or more independent variables (X) and one dependent variable (Y). In research, the independent variable (X) is usually the variable determined by the researcher independently. predictions that are often used on quantitative scale data (intervals or ratios) are Linear Regression. Linear regression technique can analyze the effect of several variables on other variables at the same time, Figure 4.

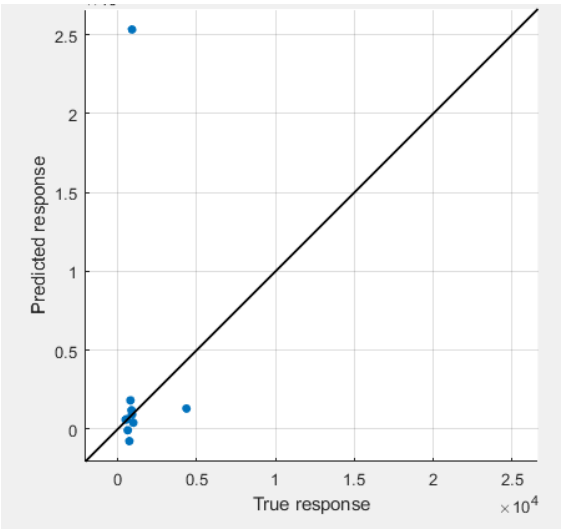

Figure 4. Prediction of Linear Regression

CONCLUSION

The availability of food commodities tends to fluctuate and demand continues to increase, especially on religious holidays in Indonesia, the application of complete linkage clustering can map the types of food needs from the distance between data set variants. The grouping results are displayed in the form of a dendrogram diagram. The dendrogram is used to clarify the grouping in the hierarchical method obtained 3 clusters of food availability. The application of linear regression in analyzing multivariate data results in precise data cluster modeling that can predict the output accurately. From the results of grouping food availability, it is found that there are types of food commodities that experience high prices due to high demand while the availability of food ingredients is not sufficient for consumer needs with the percentage of 85%-88%.

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APPLICATION OF MACHINE LEARNING FOR BITCOIN EXCHANGE RATE PREDICTION AGAINST US DOLLAR

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Abstract—Predicting a currency Exchange rate and performing analysis is an action to try to determine the price valuation of a currency or other financial instrument traded on an exchange platform. Bitcoin is a consensus network that enables new payment systems and fully digital money. Bitcoin is the first decentralized peer to peer payment network that is fully controlled by its users without any central authority or intermediary. From the user's point of view, Bitcoin is like cash in the internet world. Bitcoin can also be viewed as the most prominent triple bookkeeping system in existence today. The change in Bitcoin's behavior against the US dollar is influenced by many factors. Basic or economic factors that may be affected include inflation rates and money supply. In this study, data was collected by obtaining all data through the API provided by binance.com and labeled with the specified attribute. The modeling is done by using the rapidminer application. The process begins by taking training data that has been provided previously. The next stage is the data testing process, all operators that have been previously determined are connected and tested using the Linear Regression operator. The purpose of testing this data is to predict stock prices from the testing data that has been made by the Split Data operator, which is 19% of the total data that has been prepared.

Keywords: Prediction, Training, Testing, Bitcoin

Abstrak—*Memprediksi sebuah nilai tukar suatu mata uang dan melakukan analisa adalah sebuah aksi untuk mencoba menentukan valuasi harga dari suatu mata uang tersebut atau instrument finansial lain yang diperdagangkan disebuah platform exchanger. Bitcoin adalah jaringan consensus yang memungkinkan sistem pembayaran baru dan uang yang sepenuhnya berbentuk digital. Bitcoin merupakan jaringan pembayaran peer to peer desentralisasi pertama yang dikontrol sepenuhnya oleh penggunanya tanpa ada otoritas sentral ataupun perantara. Dari sudut pandang pengguna, Bitcoin seperti uang tunai di dunia internet. Bitcoin juga dapat dipandang sebagai sistem pembukuan tiga pencatatan paling menonjol yang ada saat ini. Perubahan perilaku Bitcoin terhadap dolar AS dipengaruhi oleh banyak factor. Faktor faktor dasar atau ekonomi yang mungkin terpengaruh termasuk nilai inflasi dan peredaran uang. Pada penelitian ini, data dikumpulkan dengan cara mendapatkan seluruh data melalui API yang disediakan oleh binance.com dan diberi label atribut yang ditentukan. Pemodelan dilakukan dengan memanfaatkan aplikasi rapidminer. Proses diawali dengan mengambil data training yang telah disediakan sebelumnya. Tahap selanjutnya adalah prises pengujian data, semua metode yang sudah ditentukan sebelumnya, disambungkan dan di uji dengan menggunakan metode Linier Regresion. Tujuan dari pengujian data ini adalah untuk memprediksi harga saham dari data testing yang sudah dibuat oleh operator Split Data, yaitu 19% dari total data yang sudah disiapkan.*

Kata Kunci *: Prediksi, Training, Testing Bitcoin*

INTRODUCTION

The exchange rate is the exchange rate of a country's domestic currency against other foreign currencies. Foreign exchange rates are determined in the foreign exchange market, which is the market for trading different currencies[1]. Currency exchange rate is one of the important macroeconomic variables, because changes in exchange rates affect stability and economic activity. Exchange rate volatility can affect the flow of capital and trade, because more than one currency will be involved in international economic

transactions, namely the domestic currency and foreign currency[2].

Predicting a currency exchange rate and performing Analysis is an action to try to determine the price valuation of a currency or other financial instrument traded on an exchanger platform[3].

Crypto assets are digital assets that use cryptography, peer-to-peer networks and public ledgers to manage new unit generation, verify transactions and secure transactions without intermediary intervention[4]. The definition of crypto assets has the same elements as the definition of cryptocurrency by Merriam Webster

This happens because crypto assets started as cryptocurrencies when Bitcoin was launched in 2009, but there have been many developments in crypto technology so that cryptocurrencies are not able to cover all existing crypto products[2]. Crypto assets have many functions and uses, depending on the purpose of the owner of the crypto asset and the type of crypto asset itself. Crypto assets can be used as a means of payment and can also be used as an investment instrument because their value is highly volatile.

Bitcoin is a consensus network enabling new payment systems and fully digital money. Bitcoin is the first decentralized peer to peer payment network that is fully controlled by its users without any central authority or intermediary[5]. From a user's perspective, Bitcoin is like cash in the internet world. Bitcoin can also be viewed as the most prominent triple record opening system currently available.

The change in Bitcoin's behavior against the US dollar is influenced by many factors. Basic or economic factors that may be affected include the inflation rate, money supply, capital inflows and outflows[6].

Linear regression will generally make predictions based on pre-existing values. This method constructs a function of linear equations, which are formed by constants and which represent straight lines, when converted into graphical form. After obtaining a linear equation, predictions can be made by replacing the test variable in the linear equation. After that the predicted value of the expected variable will be obtained. The linear regression method is often used in research related to prediction or forecasting, because many libraries in various programming languages and applications have implemented the method, one of which is the RapidMiner application.

Neural Network or Artificial Neural Network (ANN), which is one of the methods of machine learning commonly used for discrete, real, and vector problems[7]. Neural Network is also a model of the human nervous system in carrying out certain tasks

Artificial Neural Network (ANN) often referred to as Neural Network (NN) is a mathematical model or a computational model inspired by the structure and function of the biological aspects of human neural networks. Neural Network consists of a group of interconnected artificial nerves that process information[8].

MATERIALS AND METHODS

In this study, data was collected by obtaining all data through the API provided by Binance.com via https://api.binance.com/api/v3/ticker/price/symbol=BTCUSDT. Some of the attributes contained in the data to be used are shown in Table 1.

Table 1. Atribut Data Nilai Curs

Column	Type	Notes
Date	Date	Date
Open	Numeric	BTC-USD exchange rate
High	Numeric	BTC-USD exchange rate
Low	Numeric	BTC-USD exchange rate
Close	Numeric	BTC-USD exchange rate
Volume	Numeric	BTC-USD exchange rate

The data obtained will be divided into 2 parts, namely as training data and testing data. The Training data consists of more than 100 data on daily exchange rate changes which are from July 1, 2021 to November 30, 2021. The training data will be used in the linear regression method to obtain equations or predictive models. The second part is data testing which consists of 31 daily crucible change data which is in the range of July 1, 2021 to November 30, 2021. The processing of training data and data testing will use the Rapid Miner application[9].

In this study, the attributes used to obtain predictive models using linear regression methods and artificial neural networks are the values of Open, High, Low, and Close[10]. The date attribute is not used in the prediction model because it does not have a large influence on the prediction results. However, it is helpful to use as the ID of the value that appears later. In addition, the date attribute cannot be included in the calculation of linear regression and neural network methods because the value of the date is not a numeric.

The modelling is done by utilizing the RapidMiner application[11]. The process starts by taking the training data that has been provided previously by pressing right on the main process screen, selecting New Operator, then Import, then Data, and finally Read Excel, because the training data collected is in the form of an excel file. This process can also be seen in Figure 3.

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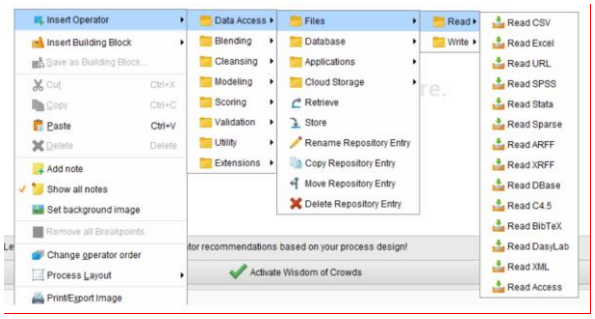

Figure 3. How to add Read Excel operator

After the Read Excel operator is added, the next step is to select the training data excel file that will be used. Click the Import Configuration Wizard button, as shown in Figure 4, then select the excel file to use. There are several steps after selecting a file, namely selecting data, annotations, and data attributes. Because the data used is as needed, there is no need for additional settings[12].

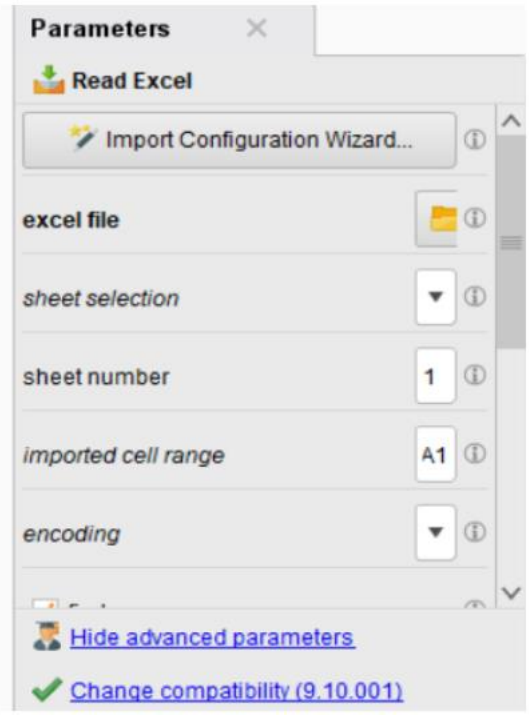

Figure 4. Selection of Training Data FIles

The next step after adding the Read Excel operator is to add the Linear Regression operator. The operator belongs to the Function category and is in the Modelling Folder then Predictive then to Function, as shown in Figure 5[13]. After adding the Linear Regression operator, the next step is to add the Split Data operator and then set the Enumeration that is in the operator as shown in Figure 6 Then add the ratio in the operator with a ratio of 0.81 and 0.19 to create training data and testing data.

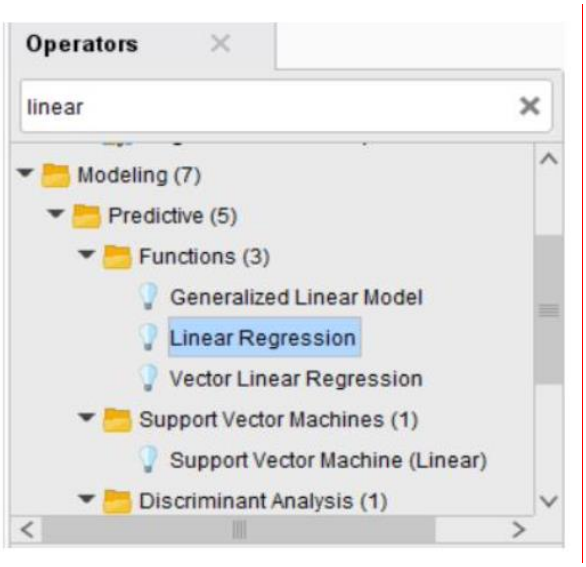

Figure 5. Liner Regression Operation Location

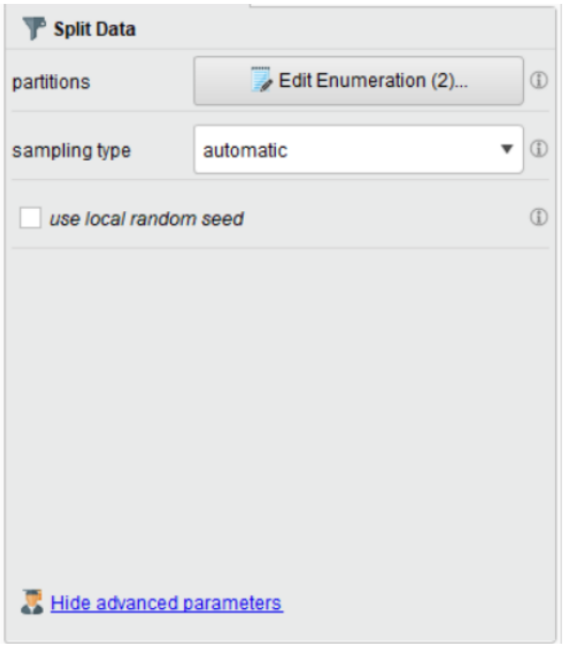

Figure 6. The Edit Enumeration Button

Then, add the Apply Model operator to apply the previously trained model using the training data on the unlabelled data (data testing). The goal is to get predictions on unlabelled data (testing data) that do not yet have a label. What needs to be considered is that the testing data must have the same order, type, and attribute roles as the training data[14].
And add the Performance operator. Because what we will predict is numerical data, the Performance operator used is the Performance (Regression) operator. The Performance (Regression) operator is used only for regression tasks. On the other hand, the Performance operator automatically determines the type of learning task and calculates

the most common criteria for that type. The attribute display is shown in Figure 7.

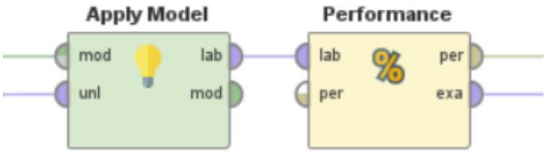

Figure 7. Apply Model and Performance (Regression) Attributes

In addition to using Liner Regression, we also tested the data using the Neural Network operator (Neural Net). Neural Net is an operator that can be applied to an invisible data set to predict label attributes. Basically, the attributes used in this test are the same. It's just that in this test, the Linear Regression operator is replaced with the Neural Net operator as shown in Figure 8.

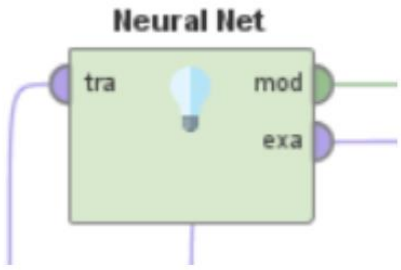

Figure 8. Neural Network Operator

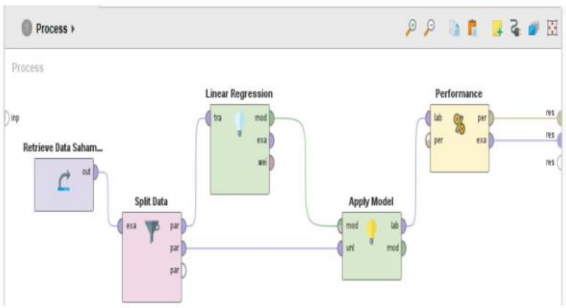

Figure 9. Linier Regression Testing

The next stage is the data testing process in RapidMiner. All operators that have been described previously, are connected as shown in Figure 9 above. The data will be tested using the Linear Regression operator. The purpose of testing this data is to predict stock prices from the testing data that has been made by the Split Data operator, which is 19% of the total data that we have prepared.

RESULTS AND DISCUSSION

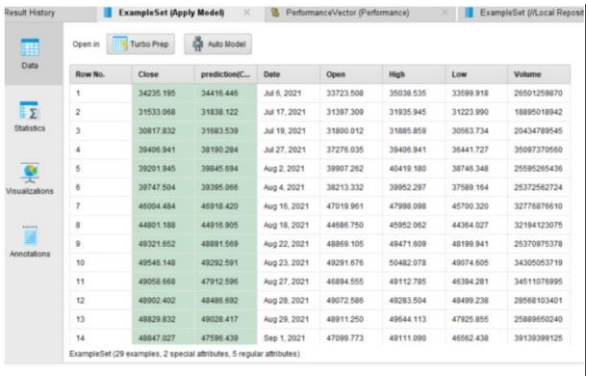

Figure10. The results of running data using Linear Regression

From this process, 29 examples prediction data were produced as shown in Figure 10. The data was then converted into Microsoft Excel Worksheet (.xlsx).

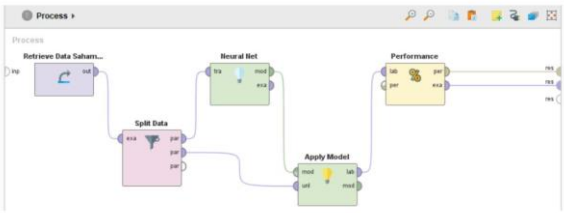

Figure 11. Neural Net Testing

The data testing process is carried out again using the Neural Net operator. All operators are connected as shown in Figure 11. The purpose of testing this data is the same as before, namely to predict stock prices from the testing data that has been made by the Split Data operator, which is 19% of the total data that we have prepared.

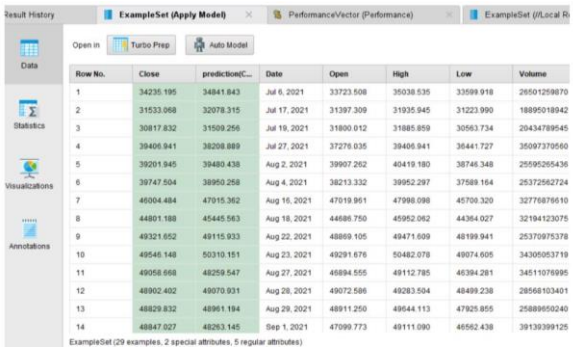

Figure 11. Results of running data using Neural Net

And from this process, 29 examples prediction data were generated as shown in Figure 10. As before, the data was then converted into Microsoft Excel Worksheet (.xlsx).

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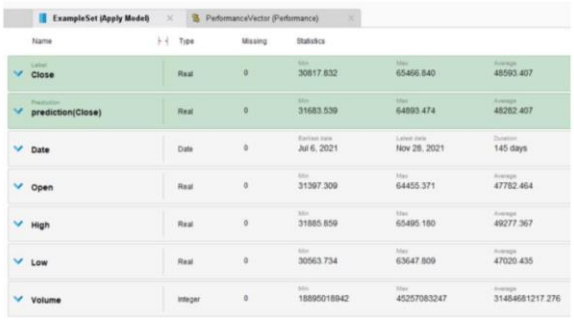

Name	Type	Missing	Statistics		
Close	Real	0	Min 30817.832	Max 65466.840	Average 48593.407
prediction(Close)	Real	0	Min 31683.539	Max 64893.474	Average 48282.407
Date	Date	0	Earliest date Jul 6, 2021	Latest date Nov 28, 2021	Duration 145 days
Open	Real	0	Min 31397.309	Max 64455.371	Average 47782.464
High	Real	0	Min 31885.859	Max 65495.180	Average 49277.367
Low	Real	0	Min 30563.734	Max 63647.809	Average 47020.435
Volume	Integer	0	Min 18895018942	Max 45257083247	Average 31484681217.276

Figure 12. The results of statistical data using Linear Regression

From Figure 12 above, it is known that the prediction (Close) results obtained using the Linear Regression operator are at a minimum price of 31683,539 to a maximum of 64893,474 with an average price prediction of 48282,402. We can see the statistical development of the prediction data through the "Visualization" feature in the RapidMiner application as shown in Figure 13 below.

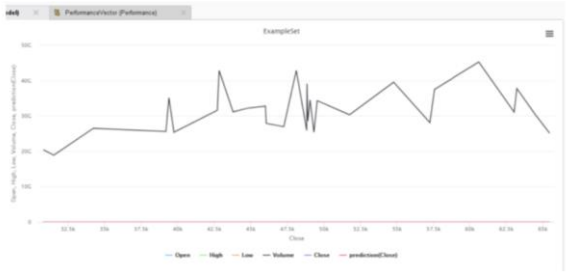

Figure 13. Results of data visualization using Liner Regression

Name	Type	Missing	Statistics		
Close	Real	0	Min 30817.832	Max 65466.840	Average 48593.407
prediction(Close)	Real	0	Min 31509.256	Max 64029.358	Average 48271.341
Date	Date	0	Earliest date Jul 6, 2021	Latest date Nov 28, 2021	Duration 145 days
Open	Real	0	Min 31397.309	Max 64455.371	Average 47782.464
High	Real	0	Min 31885.859	Max 65495.180	Average 49277.367
Low	Real	0	Min 30563.734	Max 63647.809	Average 47020.435
Volume	Integer	0	Min 18895018942	Max 45257083247	Average 31484681217.276

Figure 14. The results of statistical data using Neural Net

From Figure 14 above, it is known that the prediction (Close) results obtained using the Neural Net operator are at a minimum price of 31509,256 to a maximum of 64029,358 with an average price prediction of 48271,341. We can see the statistical development of the prediction data through the "Visualization" feature in the RapidMiner application as shown in Figure 15 below.

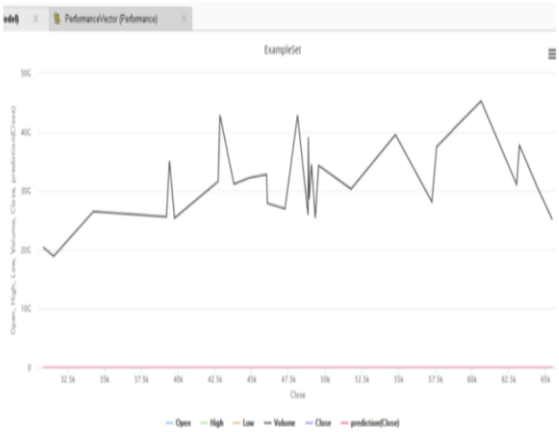

Figure 15. Results of data visualization using Neural Network

Due to the limitations of the visualization modeling in the RapidMiner application, we created our own script using the Python programming language (.py). Here is the content of the script that we made.

Algorithm: data-to-graph.py

```
import pandas as pd
import numpy as np
import plotly.graph_objects as go

data = pd.read_excel('./test-btc-usd.xlsx', parse_dates=True)

data.info()
print(data.head())

fig = go.Figure(data=[go.Candlestick(x=data['Date'],
open=data['Open'], high=data['High'], low=data['Low'],
close=data['Close'])])

fig.update_layout(yaxis_title="BTC-USDT", title="Normal
Data Chart")

fig.show()
```

Figure 16. Content of script

```
data2 = pd.read_excel('./btc-usdt-linear-regression.xlsx',
parse_dates=True)
fig2 = go.Figure(data=[go.Candlestick(x=data2['Date'],
open=data2['Open'], high=data2['High'], low=data2['Low'],
close=data2['Close'])])

fig2.update_layout(yaxis_title="BTC-USDT", title="Linear
Regression Prediction Data Chart")
fig2.show()

data3 = pd.read_excel('./btc-usdt-neural-network.xlsx',
parse_dates=True)
fig3 = go.Figure(data=[go.Candlestick(x=data3['Date'],
open=data3['Open'], high=data3['High'], low=data3['Low'],
close=data3['Close'])])
fig3.update_layout(yaxis_title="BTC-USDT", title="Neural
Network Prediction Data Chart")
fig3.show()
```

Figure 17. Content of script

From the script, it will produce 3 images obtained from the data that has been made by the RapidMiner application. Here are 3 image visualizations made from the script we created and used.

Figure 16. Normal Data Visualization

Figure 17. Data Visualization Using Linear Regression

Figure 18. Data Visualization Using Neural Network

Table 2. Comparison of Prediction (Close) Results

Operator	Minimum	Maximum	Average
Linier Regresion	31683,539	64893,474	48282,402
Neural Network	31509,256	64029,358	48271,341

From table 2 it can be seen that the prediction results of the Linear Regression operator and the Neural Net operator are not much different. However, the prediction result from Neural Network is smaller than Linear Regression.
Through the practicum that has been done, it can be said that The application of Neural Networks in making predictions takes a lot of time because they need to do a lot of experiments in determining the number of input data, the number of neurons and layers, the possibility of learning levels, testing with functions, and applying learning techniques to the formed network. So, compared to the use of Linear Regression, the use of Neural Network operators can be said to be the best result. Because with maximum Neural Network operator performance, a higher level of accuracy is obtained.

CONCLUSION

From the practical explanation above, it can be concluded that to predict stock prices, you can use the Forecasting method with the operators used are Linear Regression and Neural Network. To predict stock prices, you can use the Forecasting method with the operators used are Linear Regression and Neural Network. Prediction (Close) results obtained using the Linear Regression operator is at a minimum price of 31683,539 to a maximum of 64893,474 with an average price prediction of 48282,402. Prediction(Close) results obtained using the Neural Net operator are at a minimum price of 31509,256 to a maximum of 64029,358 with an average price prediction of 48271,341. The application of Neural networks is considered more effective than Linear Regression because, with a maximum performance from Neural Network operators, a higher level of accuracy is obtained.

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WHAT MADE IMPLEMENTING EFFECTIVE ELEARNING HARD?: A SYSTEMATIC LITERATURE REVIEW

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Abstract— Covid-19 pandemic change a lot of industries in the world, including education. Education industries have become the third most affected by the pandemic and force educational institutions to change how they deliver their education services. eLearning became one of the solutions to these problems. But the implementation of eLearning proved to be hard and faced many obstacles or barriers. This paper is a Systematic Literature Review paper using Kitchenham. The systematic review results show four categories of barriers in eLearning: human factors, technological factors, financial factors, and organizational factors. To tackle this problem, educational institutions need to change the way they deliver the material; gamification is one way to change it. The organization also has a vital contribution to tackle these barriers as the policymakers and supporters, both financially and as training providers.

Keywords: Covid-19, eLearning, Barrier

Abstrak—Pandemi covid 19 mengubah banyak sekali industri di dunia, termasuk dalam sektor Pendidikan. Dengan adanya pandemic ini, banyak institusi pendidikan yang terpaksa mengubah cara mereka dalam memberikan layanan Pendidikan bagi masyarakat. Salah satu cara yang berubah adalah berubahnya penyampaian dari luring menjadi daring menggunakan berbagai platform. Dengan diterapkannya eLearning ini, muncul masalah-masalah baru yang mengakibatkan kegiatan eLearning ini menjadi tidak efektif. Paper ini adalah paper Systematic Literature Review menggunakan pendekatan kitchenham sebagai protokol review. Dari hasil review yang dilakukan, ditemukan empat kategori pengahalang yang ditemukan, yaitu; Faktor Manusia, Faktor Teknologi, Faktor Finansial dan Faktor Organisasi. Untuk menghadapi hal ini, institusi Pendidikan perlu mengubah cara dalam menyajikan materi daring. Salah satu cara yang bisa digunakan adalah dengan menggunakan gamifikasi. Organisasi disini juga mempunya peran penting terutama dalam pembuatan kebijakan paying dan dukungan dakam pelaksanaan pembelajaran daring.

Kata Kunci: *Covid-19, eLearning, Penghalang.*

INTRODUCTION

The covid-19 pandemic changed a lot of ways people worked and disrupted a lot of sectors. Statista in 2020 [1] published some data which show that in 2020, education and health industries were significantly affected by the pandemic. Figure 1 Sectors Affected by pandemics show the affected sectors.

We know from Figure 1 that the most affected sectors are Leisure and hospitality, wholesale and retail, and education, respectively. The education sector became one of the most affected sectors because almost all activities were conducted offline in class. In their paper, Ghulam et al. [2]explained that this covid 19 pandemic pushed many educational institutions to change their way of delivering education to ensure the continuity of learning activity. This change of methodology caused by this condition made some universities, schools, and other educational institutions can't run their activities. This condition became harsher because we don't know when this pandemic will end, as mentioned by Roman et al. in their paper [3]. Many academic institutions changed their learning methods into online platforms such as LMS, social media, or other platforms to tackle this obstacle. This kind of method is usually called eLearning. eLearning itself can be described as delivering educational materials through the internet [3]. eLearning itself is not a new thing on the internet. In the early stage of the internet, the internet is mainly used for exchanging information. The first documented formal eLearning media is CBT. CBT was born in the late eighties [4] and used as a training platform.

eLearning implementations faced many challenges, which hindered the effectiveness of the learning activities, as mentioned in [5]. This research tried to summarize and analyze how academic institutions

such as universities could implement eLearning more effectively and what features can be added to the eLearning platforms to aid this goal.

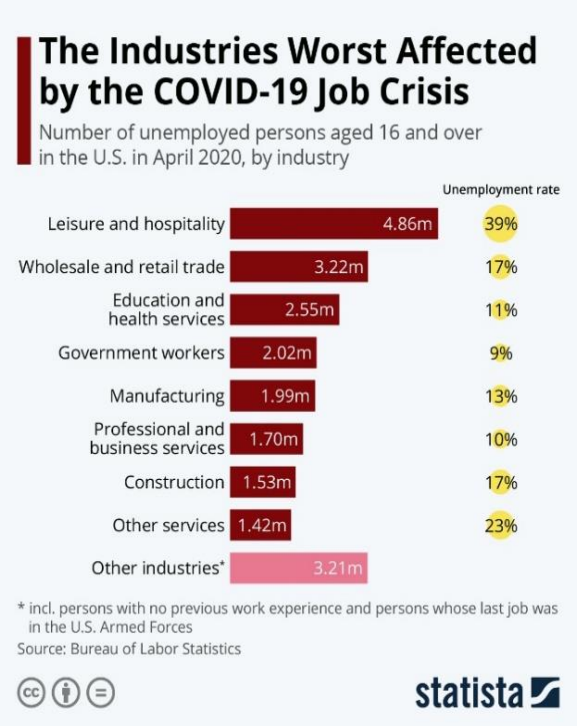

Figure 1 Sectors affected by pandemic [1]

MATERIALS AND METHODS

This paper is a systematic literature review paper. To gain the barrier of eLearning, we used Kitchenham's systematic literature methodology [6][7]. Kitchenham's Systematic Literature Review procedure can be seen in Figure 2 Search Protocols. The first step of the review is deciding the research questions. The research questions used in this research is:

1. Q1: What hinders or the barrier of eLearning?
2. Q2: how to improve the effectiveness of the eLearning activity?

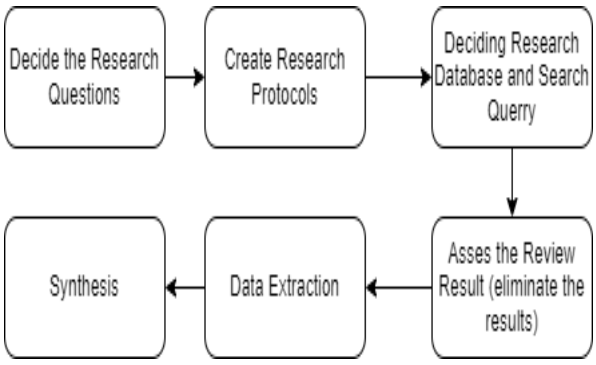

Figure 2. Search Protocols.

The next step is creating the protocols. The goal of creating a search protocol is to ensure that the excellent quality of the review can be achieved. As mentioned, the Protocols we used are using Kitchenham's Systematic Literature Review Protocols. After deciding the research protocols, we determine the search query and the research database we will use. In this research, we use four research databases: Science Direct, IEEExplore, Emerald, and Proquest. The search query implemented is: (eLearning OR e-Learning OR Distance Learning OR Asynchronous Learning) And (Barrier OR Hindrance OR Obstacles). This search query was then implemented and modified accordingly based on the research database requirements. After deciding the database and search query, the next step is determining the elimination criteria. The elimination criteria are:

1. The research paper wrote in a non-English language.
2. The Research paper does not mention eLearning, Distance Learning, or Asynchronous learning in the search query results.
3. The paper stated the research clearly in the abstract

After deciding the elimination criteria, the next step is conducting the data extraction. In this step, we read the papers, find the eLearning implementation barriers, and write it into the synthesis tables.

RESULTS AND DISCUSSION

Table 1 Search and Elimination Results

No	Research Databases	Search Result	Eligible papers
1	Science Direct	12	3
2	IEEExplore	14	6
3	Proquest	2	-
4	Emerald	3	1
5	Total	31	10

Table 1 search and elimination results show that the search results were not that big. Because of the search results in the research, many research papers were not mentioned the search query clearly, so we eliminated it. From thirty papers we collected and read, only ten papers wrote the barriers of eLearning in their paper.

Table 2 Synthesis Results show the result of the Synthesis Process. The synthesis results are classified based on the HOT models [8] developed by Yusof et. Al. We added financial factors into the classification model because finances became one of the main factors we found and can be seen from organizational and Personal factors.

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Table 2 Human Factor

Barrier of eLearning	Source
Human Factor	
Lack of Interaction	[9], [10]
Harder to Assimilate Material	[9]
Resistance	[9], [11], [12], [13]
Lack of ICT Skill	[13], [14], [10], [15]
Lack of Digital Literacy	[14], [15]
Lack of English Proficiency	[14], [11], [12], [13]
Weak Motivation	[12]–[14], [16]
Lack of Pedagogical Skill	[13], [15][10][3]
Education Method	[10], [12]
Lack of Compensation and Time	[12], [13], [15]
Distrust	[12], [16]
Boredom	[12]
Frustration	[3], [12]
Exhaustion	[16]
lack of student preparation	[10]
Inability to meet student's need	[10]

From Table 2 till Table 4, we can see that the most mentioned factors mentioned in these papers were human factors. Many psychological factors come when we fully implement eLearning, such as exhaustion, frustration, and boredom. Humans as a social entity need social interaction and partners either in teaching or studying. Human factors also became the most identified by researchers because the nature of people is the same even though they come from a different geographic area.

The lack of English skills, Pedagogical skills, and ICT Skills also became the highlight of the results. Students and teachers lack this skill, which hinders the effectiveness of the learning process. Many LMS used, such as Teams, google classroom, and Moodle using English as the user interface language. On the other hand, the English of the researcher's research subject has low English literacy. For example, based on EF research data, Indonesia has low English proficiency and got position eighty from one hundred and twelve countries in Asia [17]. This lack of ability made many learning features unused and can be utilized by the user.

The other problem that occurred when institutions changed their learning method from offline to online learning is the lack of online pedagogical or online teaching proficiency from the teacher or the lecturer. Naveed et al. mentioned that the inability of the teacher to create online teaching materials became a roadblock to eLearning success. Therefore universities or any educational institutions need to give their teachers training to develop effective learning materials, as mentioned in Montazer's research [12], which also became the main barrier factors in the organization side.

Another weakness from the educator side is the teaching methods. Many educators use educational practices that aren't suitable for eLearning methods, resulting in boredom and exhaustion for both the educator and the students [12]. This factor also has a close relationship with the lack of training from the organization. Therefore, educators, in this case, teachers, lecturers, and the ministry of education, need to find new ways to teach.

Teachers and lecturers can implement gamification to tackle this boredom and lack of motivation in learning. Gamification can be described as implementing gaming mechanics into other forms of activity, such as in education. Medal's functionality is one form of gamification usually used in forums and other communities [18].

Many learning websites use this kind of gamification to keep the learner's attention during the learning session. For example, Duolingo, an English learning platform, uses this kind of gamification to achieve learning. This achievement can be seen by other users who made the competitive situation between learners to continue their study.

This competitive nature itself can enhance the students learning phase. Another factor from Duolingo which can be adapted into formal eLearning is the concept of self-learning and "do it your own-phase." Many online learning websites such as Duolingo, Udemy, and other learning websites use this concept to less the learning burden of the students. Hypothetically Using students' own-phase in learning could enhance their learning curve.

Figure 2 Example of Gamification in eLearning, Duolingo

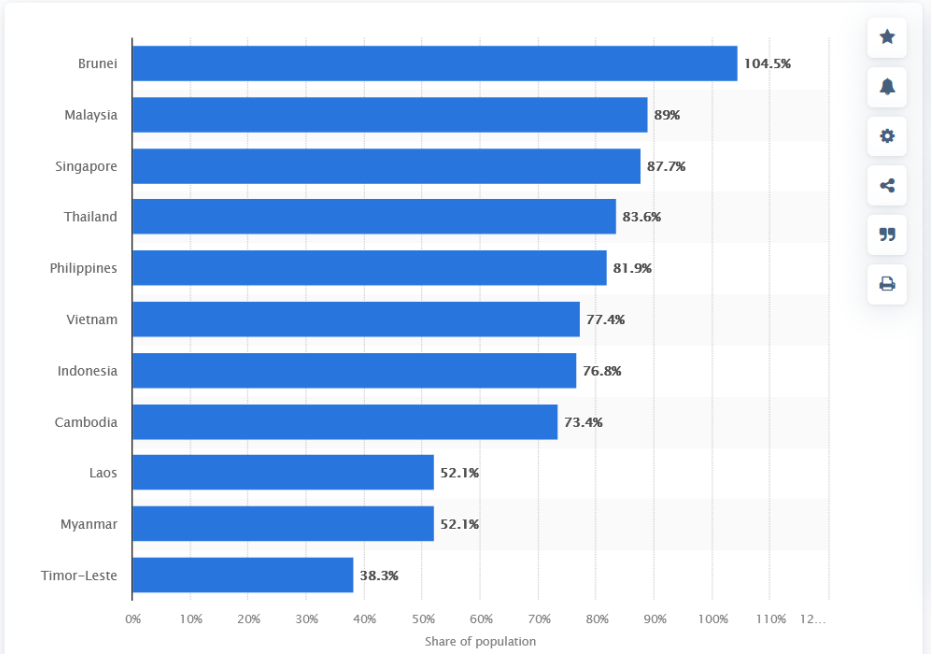

Figure 3 Internet Penetration Data [19]

For example, in the Udemy business process, the students learn the skill they want at their own phase with a predetermined time to clear the course. The educators with good enrollment numbers could get bonuses, which made the ecosystem live [20]. Moodle also has the same kind of gamification that educators can utilize. The gamification comes in the form of a badge that the educators can give to the learner as a learning achievement.

But, to ensure this learning method can be implemented, the technology factors became the next problem because this kind of education method needs good technological infrastructure and devices [21].

Table 3 Technological Factor

Barrier of eLearning	Source
Accessibility	[9], [12]
Difficulty in Online Exam	[9]
Inappropriate Infrastructure	[3], [13], [14], [22]
Technical Problems	[10], [11], [16]
Lack of Technological devices like computer	[12], [22]
Internet problems	[12], [3], [16], [22], [10]
Power Problems	[12], [22]

From the technological factor, the main issue is the internet, which started from accessibility, reliability, and availability. Lack of technology such as the device and infrastructure became the main factors that made the internet inaccessible. Figure 3 Internet Penetration shows that Indonesian are still left behind in the availability of internet connection in Southeast Asia. Indonesia ranked seventh among eleven countries in Southeast Asia. This data shows that Indonesia does not have good internet to support eLearning.

For example, in Indonesia, as reported by Kompas. Many students need to climb mountains and risk their lives to get internet access [23]. This news is supported by the data gained by the World Bank in 2021 [24]. This lack of internet access made the students can not study effectively. Lack of internet access not only became the problem these students need to face. The lack of digital devices also made the learning process ineffective because they needed to use the devices together and alternately.

Another problem faced by both students and educators is the power problem. Many places do not have adequate electricity to ensure the learning process can be run effectively. Aminu et al. found in their research in Nigeria that one of the problems educators and students alike face is the power problem [22]. Without adequate electrical power, the device used in eLearning can not operate well. Indonesia also met this problem amidst the covid-19, As written by Okezone.com [25]. In this news article, Bogor, one of Indonesia's big cities, has problems in conducting online learning assessments because of unreliable electrical power. As mentioned before, the lack of devices also became the main problem in eLearning effectiveness. Many students do not have adequate eLearning devices or use the devices alternately between siblings or friends [23]. This problem is connected to the next category of issues which are financial problems.

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Table 4. Financial Factor

Barrier of eLearning	Source
Financial Condition	[12], [22]
Lack of Investment	[10]
Expensive device	[10], [22]
Expensive internet	[10]

Figure 1 shows that many industries are affected by covid-19, and table 3 shows what would happen when such sectors closed. Many parents of the students depend on these industries to fund their child's education, but many people lose their job and can not afford the devices or technologies needed for eLearning. Lack of Financial Investment or budget made the students can not afford to buy the devices. Therefore they can not attend the class.

Table 5 Organizational Factor

Barrier of eLearning	Source
Lack of Technical Support	[14][13]
Lack of Financial Support	[14]
Lack of Inadequate Policy	[14]
Lack of Training in eLearning	[14], [11], [12], [22]
Lack of Instructional Design	[14]
Privacy and Security	[11]
Shortage of Technical Staff	[10]
Cultural	[12]
lack government support	[12]
Lack of quantity and quality Content	[12]

The last category we identified is the Organization factors as shown is Table 5. In this category, we also include government as the regulator. The main problem of the organization is the lack of preparation due to sudden changes situation amidst the pandemic. Therefore a lot of organizations employed the hit and run strategy. Lack of policies from organizations made some educators and students lose motivation [14]. As mentioned before, organizations need to give adequate training to the educator, and the organization as the education provider also needs to ensure the eLearning participants' privacy and security. Therefore, organizations need to create policies as the umbrella for said activity. Another factors organization need to focus at is the availability of the ICT staff. Without adequate ICT Staff as the eLearning support center, the eLearning activity does not have enough support.

CONCLUSION

Covid-19 pandemics change many things in the world, including education. Education became the third most affected industry amidst the pandemic situation. This pandemic forces many educational institutions to change their way of teaching from direct learning in classrooms into eLearning. But, in this shifting process, many problems occur, which makes the learning process ineffective. The issues found can be categorized into four factors: human, Technological, financial, and Organizational factors. Human factors became the most studied and observed factors that hindered learning. Educators and organizations need to find other ways to serve the learning activities to change this condition. One of the ways is using gamification, which proved to be effective in enhancing learning effectiveness. Government and organizations also need to make policies to support eLearning.

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IMPROVING MARKETING PERFORMANCE OF THE INFORMATION TECHNOLOGY INDUSTRY

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Abstract—The marketing performance of the information technology industry in DKI Jakarta was still low, allegedly due to customer focus, cross-functional coordination, and relatively low organizational capability. The purpose of this research was to determine and analyze the effect of customer focus, cross-functional coordination, and organizational capability partially or simultaneously on marketing performance. Descriptive and explanatory survey methods, the method used in this research with a sample size of 200 respondents, while the data analysis method used a structural equation model. The results showed that customer focus, cross-functional coordination, and organizational capability partially or simultaneously had a positive and significant effect on marketing performance with a contribution of 76%. Cross-functional coordination was partially the most dominant variable influencing marketing performance. The results of other studies show that the most dominant dimension in measuring customer focus was the service process dimension. While product development and marketing program preparation are the dominant dimensions in measuring cross-functional coordination, interpersonal skills are the dominant dimensions in measuring organizational capability, and profitability is the most dominant dimension in measuring marketing performance..

Keywords: customer focus, cross-functional coordination, organizational capability, marketing performance.

Abstrak—*Kinerja pemasaran industri teknologi informasi di DKI Jakarta masih rendah disinyalir disebabkan oleh fokus pelanggan, koordinasi lintas fungsi, dan kapabilitas organisasi yang masih relatif masih rendah. Tujuan penelitian ini adalah untuk mengetahui dan menganalisis pengaruh fokus pelanggan, koordinasi lintas fungsi, dan kapabilitas organisasi secara parsial maupun simultan terhadap kinerja pemasaran. Metode survey deskriptif dan eksplanatori, metode yang digunakan dalam penelitian ini dengan ukuran sampel sebesar 200 responden, sementara metode analisis data menggunakan model persamaan struktural. Hasil penelitian menunjukkan bahwa fokus pelanggan, koordinasi lintas fungsi, dan kapabilitas organisasi secara parsial maupun simultan berpengaruh positif dan signifikan terhadap kinerja pemasaran dengan kontribusi sebesar 76%. Koordinasi lintas fungsi secara parsial merupakan variabel paling dominan pengaruhnya terhadap kinerja pemasaran. Hasil penelitian lain menunjukkan bahwa dimensi paling dominan dalam mengukur fokus pelanggan adalah dimensi pelayanan proces. Sementara dimensi pengembangan produk dan penyusunan program pemasaran merupakan dimensi dominan dalam mengukur koordinasi lintas fungsi, interpersonal skill merupakan dimensi dominan dalam mengukur kapabilitas otganisasi, dan profitabilitas adalah merupakan dimensi yang paling dominan dalam mengukur kinerja pemasaran.*

Kata Kunci*: fokus pelanggan, koordinasi lintas fungsi, kapabilitas organisasi, kinerja pemasaran.*

INTRODUCTION

Indonesia as a member of the World Trade Organization has participated in the Information Technology Agreement (ITA) since 1996. Although Indonesia commits to the ITA agreement, the national information technology (IT) industry complains that the ITA agreement brings consequences for the liberalization of information technology products. considered to have hurt the performance and development of the national information technology industry. While referring to marketing performance which is a measure of the overall marketing process activities of a company or organization. In addition, marketing performance can also be viewed as a concept used to measure the extent to which market achievements have been achieved by a product produced by the company. Marketing performance is a factor that is often used to measure the impact of the strategies

implemented by the company [1]. The company's strategy is always directed to produce marketing performance such as sales volume and good sales growth rate as well as good financial performance. Furthermore [1] states that good marketing performance is expressed in three main values, namely sales value, sales growth, and market share. So based on the statement, the ITA agreement which brought consequences for the liberalization of information technology products which were considered to have hurt the performance and development of the national information technology industry tended to be caused by the relatively low development of the information technology industry and the low marketing performance of information technology products.

The low marketing performance of information technology products is indicated based on BPS data (2019), the total value of trade in Indonesia's information technology products nationally has grown from 2003 to 2018. In 2003, exports of information technology products were recorded at USD 1.39 billion, while imports were valued at USD 1.39 billion. USD 1.64 billion. The trade balance for information technology products in 2003 experienced a deficit of US$ 254 million. Overall in 2003, the total trade value of Indonesian IT products was USD 3.03 billion. In 2018 exports of IT products increased to USD 3.80 billion, as well as imports which were much more increased to USD 8.65 billion. The trade balance for information technology products in 2018 also experienced an increase in the deficit to USD 4.85 billion. Overall in 2018, the total trade value of Indonesia's information technology products increased to USD 12.45 billion.

The pattern of trade in Indonesian information technology products from 2003 to 2018 continues to change, if you pay attention to the development of trade data for information technology products during the period 2013 - 2018 it shows that in 2003 Indonesia's information technology product trade experienced a deficit of US$ 254 million. However, in 2008 and 2013, Indonesia's trade in information technology products experienced a surplus of USD 2.65 billion and USD 2.20 billion, respectively. Export developments from 2003 to 2018 increased by 35.42% while imports increased by 73.67%. Overall, during the 2003 - 2018 period, the trade balance of Indonesia's information technology products experienced a fairly large deficit in 2018 which was valued at USD 4.85 billion (BPS, 2019).

Then the low marketing performance of Indonesia's information technology products is also shown by the information and communication technologies (ICT) Service export Indonesia until 2019, which is still relatively low, where since 2013-2017 Indonesia's ICT Services exports have only reached the range of US$6-8 billion. under the Philippines, Malaysia, and Thailand. In 2019, ICT Services exports increased to reach the range of US$ 8-10 billion above Thailand, but ICT Services exports decreased to below US$ 8 billion below the Philippines, Malaysia, and Thailand [2].

The relatively low marketing performance of Indonesian information technology products can also be seen in the performance of information technology companies at the regional level in DKI Jakarta. This is based on the performance of several information technology companies in Jakarta which shows that the profitability of information technology companies from the funds invested by the company, return on assets for the last five years (2015-2019) has decreased by an average of -19.06%. While the profit after tax from the company's equity until 2017 experienced a sharp decline, from 15.97% in 2013 to 1.81% in 2017, then increased in the following period which achieved a return on equity gain of 6, 18 in 2019 but still below the achievement in 2015 (15.97%). Then the Net Margin from sales over a period of five years (2015-2019) also decreased, with a quite drastic decrease obtained in 2017 which only reached 4.13% compared to 2015 which reached 13.05% (Financial Report Six Information Technology Company (processed), 2019).

Many factors cause low marketing performance of information technology products. Customer focus makes a positive contribution to organizational performance by providing innovation differentiation and market differentiation [3]. Another finding of this study is that the impact of innovation differentiation on organizational performance is greater than market differentiation. So it is suspected that the low marketing performance of information technology products in Indonesia tends to be caused by the relatively low customer focus carried out by information technology companies in Indonesia. This is indicated in the data from the results of a preliminary survey by researchers (2018) on thirty information technology companies in Jakarta. The survey results show that customer focus carried out by information technology companies in total shows results that are relatively low or below the standard score, which only reaches an average of 103 (on a scale of 1-5). Then if further observed, it is seen that customer focus with a focus on frequency in providing after-sales service, regularly measuring customer satisfaction, improving marketing performance, and prioritizing product completeness still has a score below the average compared to other customer focus indicators such as frequency of serving customers. until the contract runs out of 107, always commits to customers of

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110, creates value for customers of 106, and the importance of product benefits for customers is 103. The low customer focus carried out by information technology companies in Jakarta can also be seen from information technology users, In general, IT application users stated that the released product was designed to be used in the long term and no upgrading programs were prepared for the product. On the other hand, companies engaged in information technology also cannot know how satisfied customers are with the applications used. This is due to the absence of continued communication between application developers and users. The process of developing and implementing the product is not by the agreed time, even in general there is a prolonged implementation.

Cross-functional coordination improves a company's customer and financial performance [4]. The low marketing performance of information technology companies also tends to be due to the inaccuracy of carrying out internal improvements in coordination across managerial functions. This is reinforced by the statement [5] which states that the sources of company excellence, namely a company's strengths in the form of superior skills, superior resources, and superior control which are the basis for innovation (internal sources of innovation) by managing main activities include: production, finance, human resources, marketing, and research and development (cross-functional coordination).

Lack of precise internal improvements in coordination across managerial functions of information technology companies is indicated in the results of the researcher's preliminary survey (2018) of thirty Information Technology Companies. The survey results show that the cross-functional coordination carried out by information technology companies is still relatively low, where only 57% of companies have collaborated between managerial functions. Then the company cooperates between functions only 28%, 16% cooperation in production/development, another 16.7% cooperation with all management functions. Meanwhile, 63% of information technology companies prefer to work with private research institutions or universities.

The effect of MDCs (marketing dynamic capabilities) on IJV (international joint ventures) competitive advantage and performance [6]. In addition, MDCs were found to be influenced by the magnitude of IJV resources, complementary resources, organizational culture, and organizational structure [6]. This statement indicates the low marketing performance of information technology companies tends to be caused by relatively weak organizational capabilities. This is reinforced by the statement that resources are information, knowledge, company attributes, organizational processes, assets, and capabilities that can strengthen companies in formulating and implementing strategies effectively and efficiently [7].

Organizational capabilities are still relatively weak in information technology companies, this is indicated based on the results of the researcher's preliminary survey (2018) of thirty Information Technology companies in DKI Jakarta. The survey results show that the total organizational capability of information technology companies shows relatively low results, which only reaches an average of 104 (on a scale of 1-5). Then if it is observed further, it can be seen that, on the higher education dimension, it still has the lowest score and is below the average compared to the other three dimensions, such as interpersonal skills, professional field, and job attitude, which is 98. Meanwhile, other organizational capability indicators are still low. below the standard, the organizational capability indicator score is interpersonal skills in terms of the level of respect and building good relationships with customers with a score of 101 and the ability to resolve complaints in meeting customer needs with a score of 104. Job Attitude in terms of persistence and proactiveness at work with a score of 100.

Based on the description of the research background, the formulation of the problem can be formulated as follows:

1. Does customer focus affect the marketing performance of information technology companies in DKI Jakarta?
2. Does cross-functional coordination affect the marketing performance of information technology companies in DKI Jakarta?
3. Does organizational capability affect the marketing performance of information technology companies in DKI Jakarta?
4. Do customer focus, cross-functional coordination, and organizational capability simultaneously affect the marketing performance of information technology companies in DKI Jakarta?

This research aims to identify and analyze:

1. The effect of customer focus affects the marketing performance of information technology companies in DKI Jakarta.
2. The effect of cross-functional coordination on the marketing performance of information technology companies in DKI Jakarta.
3. The effect of organizational capability on the marketing performance of information technology companies in DKI Jakarta.
4. The effect of customer focus, cross-functional coordination, and organizational capability

simultaneously affect the marketing performance of information technology companies in DKI Jakarta.

MATERIALS AND METHODS

The object of research that becomes the independent variable in this research is customer focus, cross-functional coordination, and organizational capability.

Customer Focus

Customer focus a product and/or product attributes that can be measured based on the provisions of the customer as a requirement to obtain satisfaction by customer expectations and desires [8]. By knowing these specific behaviors and actions, the company will determine standards for product delivery to its customers. A series of customer perceptions, tastes and expectations of product needs based on product attributes and benefits that are taken into consideration for the company. Meanwhile, according to [9], states that of the various factors that influence a person's expectations of a particular product or product, changes will occur from time to time as a result of increasing information received and studied. The company cannot meet the expectations of its customers, it can cause changes in consumers to take the next purchase decision, meaning that there will be a process of re-election by customers to other products that are better able to meet customer needs, so that customer preferences will emerge. to decide on your next purchase [10].

Cross Function Coordination

A market-oriented company will be effective in moving business functions to work together and add superior value to its customers [11]. Business process perspective, function coordination is a management process that includes aspects of quality results, time, cost, the accuracy of the information, the breadth of other functions that receive information and share information, and the variety of decisions made to deliver superior value to customers [12].

Organizational Capability

Organizational capabilities are not specific “inputs” such as tangible or intangible assets but are skills and ways to combine assets, labor, and processes used by companies to convert inputs into outputs. For example, the use of the internet to automate and provide specialized services creates a new level of organizational capability that combines assets, people, and processes inside and outside the organization so that it becomes a source of sustainable competitive advantage (John A Pearce II, 2013). Organizational capability from the strategic management point of view, organizational capability to integrate, reconfigure, acquire, and release internal resources to adapt or even create market changes and lead to organizational competitive advantage [13]. Organizational capability is divided into four dimensions, namely interpersonal skills, professional field, job attitude, and higher education [14].

Marketing Performance

Marketing performance measurement needs to be done because the business goal is not only to create customers, but the business must be able to make a profit [15]. Marketing performance measurement can be done using the marketing profitability approach [16] and shareholder value [17]. The study of marketing performance is a study of the relationship between marketing activities and business performance [18]. Proposes four indicators to measure marketing performance, namely sales volume, sales growth, market share, and profitability [19].

Framework

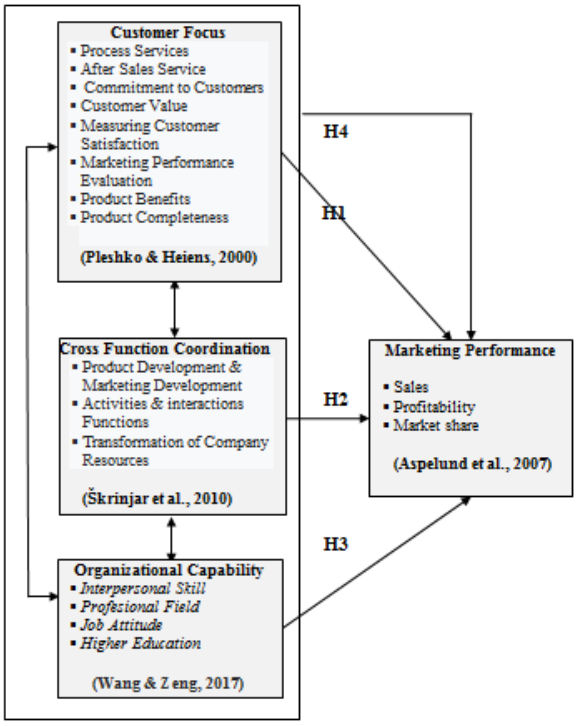

Figure 1. The framework of The Research

Meanwhile, the dependent variable is marketing performance. The nature of this research is descriptive and verification. Considering the nature of this research is descriptive and verification carried out through data collection in the field, the research method used is descriptive survey method and explanatory survey method. Given the nature of this research is descriptive and

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verification carried out through data collection in the field, the research methods used are descriptive survey methods and explanatory survey methods. The unit of analysis in this study is a company or information technology industry located in Jakarta, with the unit of observation being the directors. The perception data of respondents' responses are related to research variables, then each variable is arranged dimensions, which are then operationalized on the indicators. The operational research variables are as follows:

1. Customer focus is measured using eight dimensions with 8 indicators.
2. Cross-functional coordination is measured using three dimensions with 10 indicators.
3. Organizational capability is measured using four dimensions with 8 indicators.
4. Marketing performance is measured using three dimensions with 5 indicators.

The population is the Directors or Managers appointed from Information Technology (Software) Companies in DKI Jakarta as many as 288 companies (MIKTI, 2013). Joreskog and Sorbom in [20] state that the sample size required for the analysis of the structural equation model is at least 200 observations. So the minimum size of the sample in this research is 200 respondents with the sampling method used in this research is to use probability sampling.

The method of analysis and hypothesis testing in this research is by the research objective, namely measuring the effect of the independent variable (customer focus, cross-functional coordination, and organizational capability) on the dependent variable (marketing performance). The approach in modeling and the solution technique used is using the Structural Equation Model (SEM) method and with data processing, analysis tools using the Lisrel 8.80 application program.

RESULTS AND DISCUSSION

Table 1. Model Fit Index Size

GOF Indicators	Expected size	Estimation results	Conclusion
Absolute Fit Size			
GFI	GFI > 0,90	0,89	Marginal Fit
RMSEA	RMSEA < 0,08	0,072	Good Fit
Incremental Fit Size			
NNFI	NNFI > 0,90	0,95	Good Fit
RFI	RFI > 0,90	0,92	Good Fit
AGFI	AGFI > 0,90	0,85	Marginal Fit
RFI	RFI > 0,90	0,92	Good Fit
IFI	IFI > 0,90	0,96	Good Fit
CFI	CFI > 0,90	0,96	Good Fit

Based on Table 1 above, the six conformity measures obtained have a good fit index, namely RMSEA, NNFI, NFI, RFI, IFI, and CFI. Meanwhile, the two model suitability indices are below the good fit measure but are still within the scope of marginal fit, namely GFI and AGFI. So that it has met the requirements of analysis and data analysis can be continued in the next analysis [21].

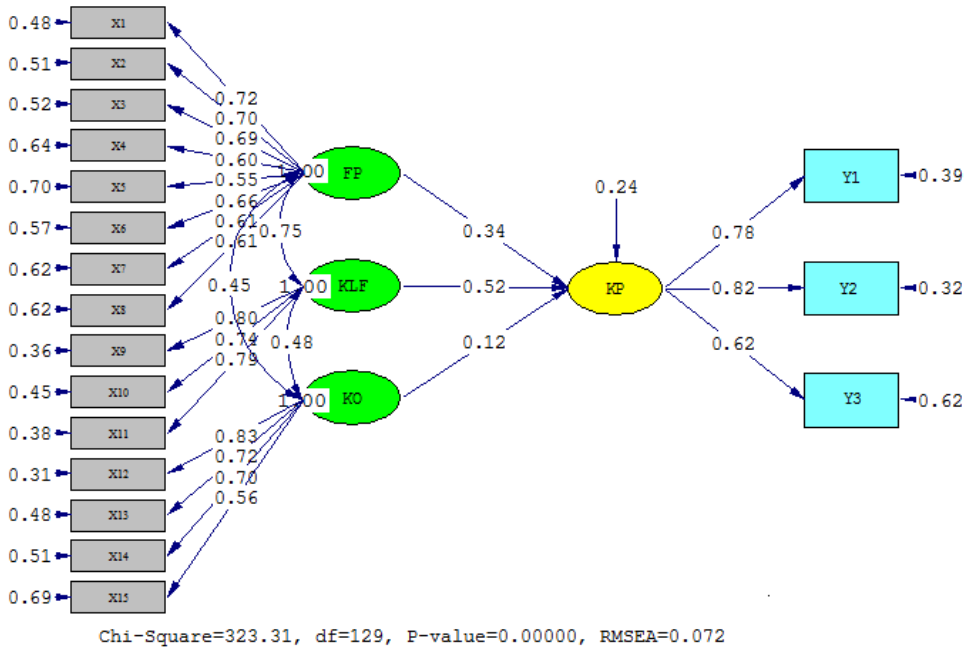

Figure 2. Full Model SEM (Standardized)

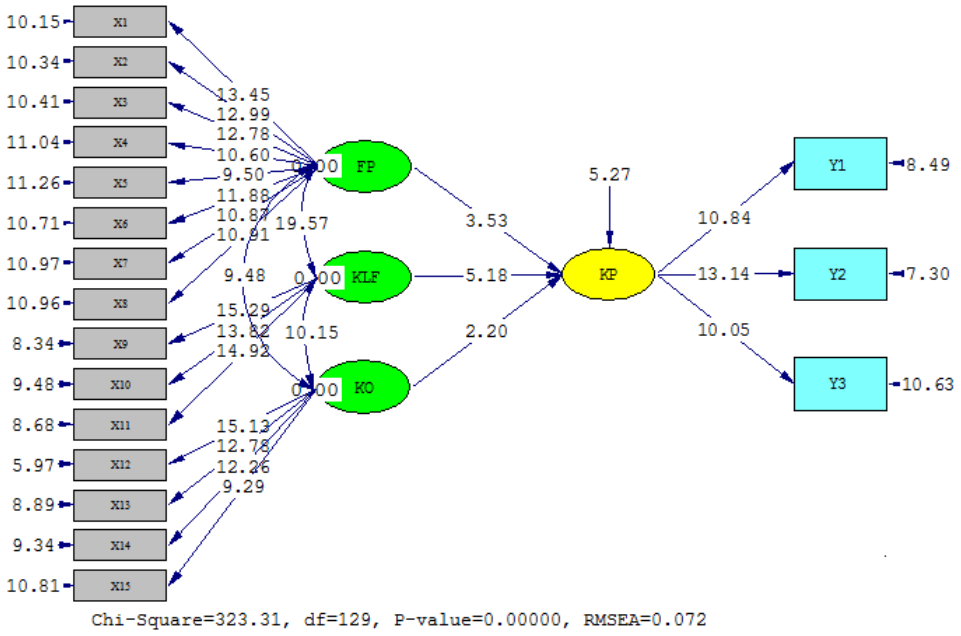

Figure 3. Full Model SEM (t-value)

Structural Equation:

$KP = 0.34FA + 0.52KLF + 0.12KO, Errorvar. = 0.24,\ R^2 = 0.76$ ..... (1)

(0.097) (0.10) (0.054) (0.045) (0.0045)
3.53 5.18 2.20 5.27 209.43

Based on Figure 2, Figure 3, and the structural equation model (1) above, the hypothesis testing is as follows:

1. The results of testing the hypothesis of the customer focus variable partially show a positive and significant influence, this is evidenced by the significant test the t-value has a tcount of 3.53 > 1.96 and a path coefficient of 0.34 on marketing performance. The magnitude of the coefficient indicates the magnitude of the direct influence contribution of 11.56%, while the magnitude of the indirect influence is 15.10%. From this hypothesis, Ha is accepted and H0 is rejected. The service process dimension (X1=0.72) is the most dominant dimension that contributes value in shaping the customer focus variable. Meanwhile, marketing performance with the most dominant dimension is the Profitability dimension (Y2=0.82). The results of this test indicate that the customer focus reflected by the service process can improve marketing performance both directly and indirectly through cross-functional coordination and organizational capabilities, but the indirect effect is more dominant. So that the marketing performance of information technology companies will be further improved if the customer focus on information technology companies can be improved supported by good cross-functional coordination and high organizational capabilities of the company.
2. The results of testing the hypothesis of the cross-functional coordination variable partially show a positive and significant effect, this is evidenced by the significant test the t-value has a tcount of 5.18 > 1.96 and a path coefficient of 0.52 on marketing performance. The magnitude of the coefficient indicates the magnitude of the direct influence contribution of 27.04%, while the magnitude of the indirect influence is 16.25%. From this hypothesis, Ha is accepted and H0 is rejected. The dimensions of product development and preparation of marketing programs (X9=0.80) are the most dominant dimensions that contribute to the formation of cross-functional coordination variables. Meanwhile, marketing performance with the most dominant dimension is the Profitability dimension (Y2=0.82). The results of this test indicate that cross-functional coordination as reflected in product development and marketing program preparation can improve marketing performance which is reflected in high profitability both directly and indirectly through customer focus and organizational capability, but the direct influence is more dominant. So that the marketing performance of information technology companies will be further improved if cross-functional coordination in information technology companies can be improved.
3. The results of the hypothesis testing of the organizational capability variable partially show a positive and significant effect, this is evidenced by the significant test the t-value has a tcount of

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2.20 > 1.96 and a path coefficient of 0.12 on marketing performance. The magnitude of the coefficient indicates the magnitude of the contribution of the direct influence of 1.44%, while the magnitude of the indirect effect of 4.83%. From this hypothesis, Ha is accepted and H0 is rejected. The interpersonal skill dimension (X12=0.83) is the most dominant dimension that contributes value in shaping the organizational capability variable. Meanwhile, marketing performance with the most dominant dimension is the Profitability dimension (Y8=0.82). The results of this test indicate that organizational capability as reflected by interpersonal skills can improve marketing performance which is reflected in high profitability, either directly or indirectly through customer focus and cross-functional coordination, but the indirect effect is more dominant. So that the marketing performance of information technology companies will increase if the organizational capabilities of information technology companies can be improved supported by a high focus on customers and the company's organizational capabilities.

4. The results of the hypothesis testing of customer focus variables, cross-functional coordination, and organizational capability simultaneously show a positive and significant effect, as evidenced by the significant test of the F-value having a Fcount of 209.43 > 3.84 and a coefficient of determination (R^2) 76% of marketing performance. Meanwhile, 24% are other variables that affect marketing performance but were not examined in this study. The cross-functional coordination variable is the most dominant variable affecting the marketing performance variable (0.52) compared to the customer focus and organizational capability variables which are only 0.34 and 0.12. The results of this test indicate that customer focus reflected by service processes, cross-functional coordination reflected in product development and marketing program preparation, as well as organizational capability reflected by interpersonal skills will simultaneously improve marketing performance which is reflected in high profitability of 76%.

So based on testing the hypotheses above, the findings of this study are to improve the marketing performance of the information technology industry, especially in the profitability dimension, it will be able to be improved if the information technology industry is able to improve cross-functional coordination, especially in the dimensions of product development and marketing program preparation, and is supported with increased focus on customers, especially focus on service processes and organizational capabilities, especially on interpersonal skills.

CONCLUSION

Customer focus, cross-functional coordination, and organizational capability simultaneously or partially have a positive and significant impact on marketing performance, with a simultaneous contribution (R^2) reaching 76%. The cross-functional coordination variable as measured by the dimensions of product development and preparing marketing programs was the most dominant variable affecting marketing performance as measured by the profitability dimension of information technology companies in DKI Jakarta. This conclusion shows that information technology companies in DKI Jakarta will be able to improve marketing performance, especially in high profitability if the company is able to improve cross-functional coordination with product development dimensions and develop marketing programs, and is supported by increasing customer focus, especially in the high service process and also supported by increased customer service. the company's organizational capabilities, especially in improving interpersonal skills.

Managerial Implications

The results show that if the customer focus on service processes, cross-functional coordination in product development and compiling marketing programs and organizational capabilities in interpersonal skills can be synergized in carrying out Information Technology business then this will be able to have a positive and significant impact on the marketing performance of Information Technology Companies. in Jakarta, especially in terms of company profitability. Based on these findings, managerial implications that can be applied to improve marketing performance through increased cross-functional coordination by taking into account the most dominant dimensions, namely product development and developing marketing programs, so that Information Technology Companies in Jakarta must pay attention to and improve indicators such as product development capabilities. , accuracy of marketing information, and involvement of all functions in the preparation of marketing programs.

Suggestions For Managerial

Based on the results of research and discussion, suggestions for Managerial Information Technology Companies in DKI Jakarta can be put forward as follows:

1. Customer focus carried out by Information Technology Companies in DKI Jakarta has shown

a relatively high customer focus. The high level of customer focus carried out by information technology companies in the Jakarta area that must be maintained includes indicators such as the frequency of serving customers until the contract expires, always being committed to customers, creating value for customers, and regularly measuring customer satisfaction. However, there are still some indicators of customer focus that must be considered and improved by Information Technology Companies such as the frequency level indicator in providing after-sales service, the level in improving marketing performance, the level of importance of product benefits for customers, and the level of prioritizing product completeness.

2. Cross-functional coordination carried out by Information Technology Companies in DKI Jakarta has shown relatively good cross-functional coordination. Cross-functional coordination carried out by information technology companies in the Jakarta area that must be maintained includes indicators such as the level of involvement of all functions in the preparation of marketing programs, close interaction between functions, the accuracy of human resources, the strength of financial resources, and frequency of R&D activities. However, there are still several indicators of cross-functional coordination that must be considered and improved by Information Technology Companies in the Jakarta Area such as the level of ability in product development, the level of accuracy of marketing information, the level of integrating the activities of all functions, the level of accuracy of the company's direction, and the level of accuracy. technology used
3. The organizational capabilities of Information Technology Companies in DKI Jakarta in running their business have relatively high organizational capabilities. The organizational capabilities of information technology companies in the Jakarta area in running their business that must be maintained include indicators such as the level of troubleshooting ability, perseverance and proactiveness at work, and the ability to independently learn science and technology and new technologies. However, there are still some indicators of organizational capability owned by Information Technology Companies that must be considered and improved by companies such as indicators of the level of respect and building good relationships with customers, level of ability to resolve complaints in meeting customer needs, level of professional ability in providing good service according to competence. IT professionals, the level of ability to work hard and cooperatively with partners, and the level of ability to innovate on IT products.

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OPTIMIZING COURSE SCHEDULING FACULTY OF ENGINEERING UNSOED USING GENETIC ALGORITHMS

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Abstract— Creating an activity schedule is quite easy if the entities involved are not too many and if the entities are not bound to each other, but for larger cases, manually creating an activity schedule will take a considerable amount of time and may result in errors in the schedule or ineffectiveness in the resulting schedule. This is commonly experienced in the creation of course schedules in universities because the course data is very much and lecturers can teach several courses at once at the same time, therefore in the creation of course schedules can be done by applying genetic algorithms so that the time required in the creation of course schedules become shorter and the results obtained can be more optimal compared to the results of manually making course schedules. In this study, the optimal course schedule was obtained in the 31st generation using room data, courses, study time, lecturers, and majors so that one chromosome has 154 genes, then the length of the population is made as much as 9 individuals or chromosomes, the mutation rate is set at a value of 0.1, and the method performed in the individual selection stage is done by tournament selection method where the tournament size is set at 3. The value of fitness taken so that a schedule is said to be optimal is if the fitness value is equal to 1 because it thus indicates that there are no mistakes or problems (such as time, lecturers, conflicting rooms) that occur in the schedule.

***Keywords**: Genetic Algorithm, Optimization, Scheduling.*

Abstrak—*Pembuatan jadwal kegiatan cukup mudah dilakukan apabila entitas yang terlibat tidak terlalu banyak dan apabila entitas tidak saling terikat satu sama lain, tetapi untuk kasus yang lebih besar, pembuatan jadwal kegiatan secara manual akan memakan waktu yang cukup banyak serta dapat mengakibatkan kesalahan pada jadwal atau terjadi kekurang efektifan dalam jadwal yang dihasilkan. Hal ini biasa dialami dalam pembuatan jadwal mata kuliah pada perguruan tinggi karena data mata kuliah sangat banyak serta dosen dapat mengajar beberapa mata kuliah sekaligus dan pada waktu yang tidak bersamaan, oleh karena itu dalam pembuatan jadwal mata kuliah dapat dilakukan dengan menerapkan algoritma genetika sehingga waktu yang diperlukan dalam pembuatan jadwal mata kuliah menjadi lebih singkat serta hasil yang diperoleh dapat lebih optimal dibandingkan dengan hasil pembuatan jadwal mata kuliah secara manual. Dalam penelitian ini, jadwal mata kuliah yang optimal didapat pada generasi ke-31 dengan menggunakan data ruangan, mata kuliah, waktu belajar, dosen, dan jurusan sehingga satu kromosom memiliki 154 gen, lalu panjang populasi dibuat sebanyak 9 individu atau kromosom, mutation rate diatur pada nilai 0.1, serta metode yang dilakukan dalam tahap seleksi individu dilakukan dengan metode tournament selection dimana ukuran turnamennya diatur sebesar 3. Nilai fitness yang diambil sehingga sebuah jadwal dikatakan optimal yaitu apabila nilai fitness sama dengan 1, karena dengan begitu menunjukkan bahwa tidak adanya kesalahan atau masalah (seperti waktu, dosen, ruangan yang bentrok) yang terjadi dalam jadwal tersebut.*

***Kata Kunci**: Algoritma Genetika, Optimasi, Penjadwalan.*

INTRODUCTION

With the rapid development of science and technology, computers have become the backbone of various work applications with their powerful processing capabilities and fast calculation speed. They have also become the dominant force in the smart education and teacher work, especially in recent years[1]. Using computers to create sound plans and preparation for different courses can quickly adapt to different constraints and get real results[2]. (The purpose of the planning task is to

first add up all the courses offered and finally to rationalize each teaching task, i.e. the course according to the teaching structure of this semester, as well as school and teacher resources, so that they optimize school resources, teachers learn rationally and students learn effectively[1]. Colleges and universities should arrange the time and location of courses and lecturers according to the structure of the teaching plan and study plan each semester. There are many rules for the course arrangement, and factors such as the teaching time, location, and lecturer must be considered. The reasonable configuration of these factors forms a professional value optimization problem with multiple constraints. At present, most colleges and universities have arranged courses manually by faculty members. Due to a large number of courses and lecturers, the required teaching locations, and multiple restrictions, many difficulties have been encountered. In response to the general needs of colleges and universities, this work takes each factor in the course scheduling problem as the input of the genetic algorithm, which is a multi-objective constrained optimization problem[3]. Many constraints and combination factors are used in the curriculum, which increases its complexity. A genetic algorithm is a parallel random search optimization algorithm that simulates natural and biological genetics and biological evolution. The algorithm established a biological evolution model and carried out corresponding calculations. The genetic algorithm can perform global optimization and parallel processing to optimize the configuration of various resources[4].

Intelligence in technology is generally called artificial intelligence, which can solve a variety of complex problems that may not be solved correctly, especially when it comes to formulating curriculum schedules, some universities still use manual methods to organize courses.

Scheduling is a combinational issue that has the limitations of conditions that must be met, therefore it becomes a complicated work that must be completed quickly, precisely, and [5] The availability of rooms, the capacity of the room, the availability of lecturers, the number of courses, the selection of time, and the number of students are absolute limitations that must be met in arranging the schedule of courses. With these restrictions, the preparation of course schedules will require thoroughness for the resulting schedule to fit, but it will certainly take a long time in arranging it and sometimes several schedules clash with each other.

In artificial intelligence, scheduling problems can be solved using genetic algorithms. A genetic algorithm is an algorithm based on the concept of evolution and gene changes in living things. The genetic algorithm was created by John Holland of the University of Michigan in 1975. Genetic algorithms are stochastic techniques or random occurrences and are based on evolutionary ideas of natural selection and genetics. Genetic algorithms are very precisely used for a variety of complex problems and are difficult to solve by conventional methods [6]. This method is categorized as a heuristic global solution finder.

The process of genetic algorithms begins with the formation of an initial population consisting of a collection of chromosomes composed of genes and is a representation of prospective completions that will be examined the actual value or fitness level, where the greater the value of fitness, the greater the likelihood of being maintained into the next population because genetic algorithms work like the principle of genetics and natural selection darwin theory that depends on the value of fitness owned by each individual. The fitness value is a value that indicates the value of chromosome toughness in adapting to problems [7]. After the formation of the initial population, the next process is an evolutionary process consisting of individual selection, crossover, and mutation. The selection process of individuals is aimed at selecting individuals as parents who will later interbreed (crossbreed) to obtain better offspring. There are several ways to make your choice, including roulette slots and tournaments. The process of crossing or crossing is a mechanism that genetic algorithms have when combining two chromosomes to produce a daughter chromosome that inherits the basic characteristics of a parent cross, acting to awaken an offspring or new daughter chromosome by replacing some information from the parent or parent's chromosome[8]. A mutation is a process of altering the sequence or composition of genes in an individual or the chromosome itself to replace genes that have been lost through the selection and crossing process [9].

Here are some scientific articles that discuss genetic algorithms [10] that discuss the application of the ma genetic algorithm in the creation of lesson schedules in a junior high school. The length of the chromosome used in this study is 2N where N is the number of hours and the room that exists and each room will be allocated subjects and teachers so that in one chromosome there are 414 genes. The perfect subject schedule will have a fitness score of 1 because the schedule has a total penalty value of the rule violated which is 0. The rule used is that if the teacher's teaching hours clash it will be given a value of 1 in the penalty rate. The selection method used in this method is a roulette wheel. Another study in 2019 by Wicaksono [11] algorithms in the placement system of SMKN students in Malang. The parameter values used are the suitability of the

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majors with internship vacancies, the quota of internship vacancies, student competency test scores, and the salaries of parents. Some rules must be met for each parameter and if it does not meet there are various penalty values such as unsuitable courses will get a penalty of 7, an unsuitable internship worth 1, and others. The best fitness results with a value of 0.0014286 were obtained on the number of individuals 200, the number of generations 200, the crossover percentage of 50%, and mutation 10%. Research in 2019 by Oktarina and Hajjah [8] [12]algorithms in the scheduling system of proposal seminars and thesis sessions at STIKOM Pelita Indonesia, in determining the schedule there are several rules such as in one seminar session and a session consisting of 3 lecturers, the test schedule of examiner lecturers and supervisors should not be the same and others. The number of chromosomes used in this study is 24 with each chromosome consisting of 4 criteria and each criterion has 4 sub-criteria encoded as genes, so each chromosome has 16 genes. from the processing obtained the best chromosomes in the 14th generation.

Seeing the success of genetic algorithms in handling scheduling problems in previous research, then in solving the problem of scheduling courses in this study will apply genetic algorithms and in the selection process, individuals will be used with tournament selection methods. Applying genetic algorithms to scheduling problems is expected to produce output in the form of a more effective and accurate course schedule without any problems clashing between schedules of activities and to save time in the preparation of schedules.

MATERIALS AND METHODS

Data Collection

The research data used is the data of the classroom and its capacity, day and time of learning, lecturers, courses along with several lecturers who can have and the number of students who take the course, as well as the majors along with their respective courses.

Research Stages

Figure 1. Research Stages

Explanation of research stages:

a. Literature studies

At this stage, literature collection such as books or journals or scientific articles by the research issues raised.

b. Analysis and design

At this stage, analysis of research problems is raised such as what data needs to be used and the best algorithms or methods used to deal with research problems.

c. implementation

The results of the analysis that has been done are then converted into a program using the Python programming language. Here's the flow of genetic algorithms applied in the program:

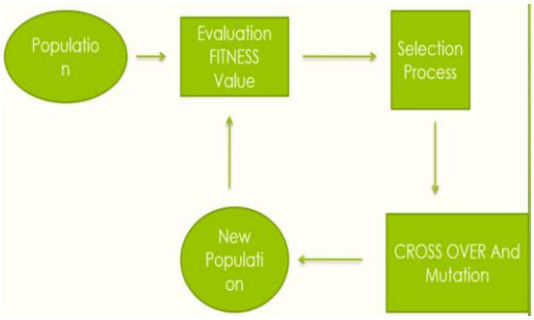

Figure 2 Genetic Algorithm Process

The process of evolution of the individual selection stage will be done using the *tournament selection* method where the tour value will be determined for the randomly selected chromosomes of a population. The best individuals in this tournament group will be selected as parents who will later be subject to the interbreeding process. The parameter used in the tournament *selection* method is the size of the tour is worth between 2 to N, where N is the sum of chromosomes in a population [13].

d. Testing and evaluation

The program results of the implementation stage are conducted testing to find out if the output results of the program are optimal and there are no problems or there are still some conflicting schedules.

RESULTS AND DISCUSSION

In the case of scheduling, the main problem that needs to be addressed is the time division of each lecturer who has more than one course and ensures that the place of learning and learning time do not collide with each other. Therefore the genetic model used consists of space as well as the day and time of learning. Courses will be arranged

sequentially in chromosomes followed by courses contained in those courses. The order is based on lecturers who can master the course, this is done to facilitate checking the rules related to lecturers. The length of the chromosome is the sum of all courses from each major, so the illustration of the chromosome is as follows:

Table 1 Chromosome Representation

J1						J2					
MK1			MK2			MK1			MK3		
R	D	in	R	D	in	R	D	in	R	D	in

information:

W: Learning time and day
R: Learning space
A: Courses
MK: Courses
D: Lecturer

The main thing to do in genetic algorithms is to initialize the initial population. In this process, defined the length of chromosomes used is as much as the number of all courses in each major (29 courses)multiplied by the number of existing majors (5 majors) so that the length of chromosomes is obtained as many as 154 genes and in this study a large population of 9 chromosomes in one population.

Table 2 Population Representation and Early Chromosomes

chromosome	Gen
0	TE,MKK01,E201,D2,MT13, TE,MKK02,E101,D3,MT15, TE,MKK03,C104,D4,MT14, ⋮
⋮	⋮
8	TE,MKK01,C101,D2,MT19, TE,MKK02,C103,D3,MT12, TE,MKK03,C101,D4,MT13, ⋮

After the combination of chromosomes is formed, then the calculation of errors such as courses that occupy a room that does not match its capacity, as well as errors in the time, room, and lecturers that collide schedules. Each error will be in the value of 1 and each error is accumulated in its entirety. After getting the total error in one chromosome, then done the calculation of fitness value. Here are the fitness functions used:

$$\frac{1}{(1\times totalKesalahan)+1} \quad \ldots\ldots (1)$$

From the above function can be concluded that the smaller the total value of the error, the smaller the fitness value, so that the optimal schedule will have a fitness value of 1 because the error that occurred does not exist or the total error is worth 0.

After calculating the fitness value of each chromosome, the next step is to check if the earliest chromosome has a fitness value equal to 1 or not, if the fitness value of the first chromosome is not equal to 1 then the program will run to the evolution stage and if the fitness value is equal to 1 then the processing has been completed and has produced an optimal schedule[14].

The first evolution stage that will be done if the fitness value is not equal to 1 is the selection stage, where the program will choose or select chromosomes to be used as parents. Parent selection is done by tournament selection method of determining the parent is done randomly from a collection of chromosomes that have been formed. The selection of chromosomes is done as much as the tournament value specified. In this study, the value of tournament used is 3, so that later obtained 3 random chromosomes that will be used as *parents.* The selected chromosomes are then sorted according to their fitness value from the smallest value to the largest value. Chromosomes with the largest fitness value are then used as parent 1 and for parent 2 is done again tournament selection process[15].

After obtaining 2 chromosomes as a parent, then the crossover process is done by swapping between selected genes on each parent chromosome. At the crossover stage, there is a crossover probability value to indicate the ratio of the resulting child in each generation to the population size. In this study, the crossover probability value used is 0.5 and because the population in this study has been initialized by 9, it is expected that 4 chromosomes out of 9 chromosomes in the population will experience crossover. Determining the point or gene to be exchanged for another parent gene is done randomly and repeatedly where if the random value is greater than 0.5 then the repeating gene to i will be exchanged for parent 1's iteration gene to i, and if the random value is less than 0.5 then the repeating gene to i will be exchanged for parent 2's iteration gene to i. This process continues until the value of i < large population.

The next stage is mutation. At this stage, the result of the crossover process will be done gene exchange with other composition genes. The mutation process is carried out as much as the number of all courses in each major and before the gene is exchanged, a random value check is performed with mutation rate. In this study mutation rate is set at 0.1, so if the random value is

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smaller than the mutation rate then the mutation process will not be done.

Here's a snippet of the code in the evolution section:

```
class GeneticAlgorithm:
   def evolve(self, population): return
self._mutate_population(self._crossover_population(populati
on))
   def _crossover_population(self, pop):
      crossover_pop = Population(0)
      for i in range(NUMB_OF_ELITE_SCHEDULES):
crossover_pop.get_schedules().append(pop.get_schedules()[i
])
      i = NUMB_OF_ELITE_SCHEDULES
      while i < POPULATION_SIZE:
         schedule1 =
self._select_tournament_population(pop).get_schedules()[0]
         schedule2 =
self._select_tournament_population(pop).get_schedules()[0]
crossover_pop.get_schedules().append(self._crossover_sched
ule(schedule1, schedule2))
         i +=1
      return crossover_pop
   def _mutate_population(self, population):
      for i in range(NUMB_OF_ELITE_SCHEDULES,
POPULATION_SIZE):
         self._mutate_schedule(population.get_schedules()[i])
      return population
   def _crossover_schedule(self, schedule1, schedule2):
      crossoverSchedule = Schedule().initialize()
      for i in range(0, len(crossoverSchedule.get_classes())):
         if (rnd.random() > 0.5):
crossoverSchedule.get_classes()[i]=schedule1.get_classes()[i
]
         else:
crossoverSchedule.get_classes()[i]=schedule2.get_classes()[i
]
      return crossoverSchedule
   def _mutate_schedule(self, mutateSchedule):
      schedule = Schedule().initialize()
      for i in range(0, len(mutateSchedule.get_classes())):
         if(MUTATION_RATE > rnd.random()):
mutateSchedule.get_classes()[i]=schedule.get_classes()[i]
      return mutateSchedule
   def _select_tournament_population(self, pop):
      tournament_pop = Population(0)
      i = 0
      while i < TOURNAMENT_SELECTION_SIZE:
tournament_pop.get_schedules().append(pop.get_schedules(
)[rnd.randrange(0, POPULATION_SIZE)])
         i += 1
      tournament_pop.get_schedules().sort(key=lambda x:
x.get_fitness(), reverse=True)
      return tournament_pop
```

Figure 3. Evaluation Process

The evolutionary process will continue if there are no chromosomes that have a fitness value equal to 1 in a population. In this study, the optimal course schedule was obtained in the 31st generation as follows:

Table 3 First Generation Evolution Results

schedule #	fitness	# of conflicts	Classes
0	1	0	TE,MKK01,C102,D25,MT14, TE,MKK02,C202,D3,MT4, TE,MKK03,C201,D4,MT11, TE,MKK05,C101,D4,MT7, TE,MKK06,C101,D6,MT1, TE,MKK07,C102,D8,MT8, TE,MKK08,E301,D7,MT6, IF,MKK05,E301,D6,MT4, IF,MKK06,C103,D6,MT8, IF,MKK07,C202,D8,MT14, IF,MKK08,C202,D7,MT20, IF ,MKK09,E101,D11,MT3, IF,MKK10,E201,D8,MT16, TS,MKK11,E301,D12,MT10, TS,MKK12,C202,D17,MT1, TS,MKK13,C201,D14,MT4, TS,MKK14,C103,D15,MT20, TS,MKK15,E301,D16,MT17, TI,MKK11,E301,D12,MT15, TI,MKK12,C202,D 13,MT16, TI,MKK16,C201,D19,MT12, TI,MKK17,C103,D20,MT1, TI,MKK18 ,E201,D21,MT10, TI,MKK19,C102,D17,MT15, TI,MKK20,C104,D18,MT14, TG,MKK21,E301,D22,MT13, TG,MKK22,C201,D23,MT16, TG,MKK23,C103,D24,MT13, TG,MKK24,C203,D25,MT8
⋮	⋮	⋮	⋮
8	0.2	4	TE,MKK01,C102,D25,MT14, TE,MKK02,C202,D3,MT4, TE,MKK03,C101,D4,MT15, TE,MKK05,C101,D4,MT7, TE,MKK06,C101,D6,MT1, TE,MKK07,C102,D8,MT8, TE,MKK08,C203,D10,MT16, IF,MKK05,C201,D4,MT2, IF,MKK06,C102,D6,MT10, IF,MKK07,C203,D9,MT13, IF,MKK08,C202,D7,MT20, IF ,MKK09,E101,D11,MT3, IF,MKK10,C201,D8,MT10, TS,MKK11,E301,D12,MT10, TS,MKK12,C202,D17,MT1, TS,MKK13,C202,D14,MT17, TS,MKK14,C102,D15,MT15, TS,MKK15,E301,D16,MT17, TI,MKK11,E301,D12,MT15, TI,MKK12,C101,D 13,MT4, TI,MKK16,E201,D19,MT18, TI,MKK17,C104,D20,MT15, TI,MKK18 ,E201,D21,MT10, TI,MKK19,C103,D17,MT7, TI,MKK20,C104,D18,MT14, TG,MKK21,E301,D22,MT13, TG,MKK22,C201,D23,MT16, TG,MKK23,C202,D24,MT20, TG,MKK24,C203,D25,MT8

Table 4 Course Schedule Program Output Results

Class #	Dept	Course (number, max # of students)	Room (Capacity)	Instructor (id)	Meeting Time (id)
0	too	Calculus (MKK01, 70)	C102 (70)	Umar (D25)	Thursday 08:50 - 10:40 (MT14)
1	too	Electrical Physics (MKK02, 20)	C202 (70)	The House (D3)	Monday 11:35am-1:55pm (MT4)
2	too	Basic Electrical Machinery (MKK03, 20)	C201 (30)	Fitria (D4)	Wednesday 09:45 - 11:35 (MT11)
3	too	Image Processing (MKK05, 40)	C101 (70)	Fitria (D4)	Tuesday 09:45 - 11:35 (MT7)

Class #	Dept	Course (number, max # of students)	Room (Capacity)	Instructor (id)	Meeting Time (id)
4	too	Pattern Recognition (MKK06, 23)	C101 (70)	Bambang (D6)	Monday 07:55 - 09:45 (MT1)
5	too	Artificial Intelligence (MKK07, 40)	C102 (70)	Danang (D8)	Tuesday 11:35am-1:55pm (MT8)
6	too	Software Engineering (MKK08, 40)	E301 (70)	Christiana (D7)	Tuesday 08:50 - 10:40 (MT6)
7	IF	Image Processing (MKK05, 40)	E301 (70)	Bambang (D6)	Monday 11:35am-1:55pm (MT4)
8	IF	Pattern Recognition (MKK06, 23)	C103 (30)	Bambang (D6)	Tuesday 11:35am-1:55pm (MT8)
9	IF	Artificial Intelligence (MKK07, 40)	C202 (70)	Danang (D8)	Thursday 08:50 - 10:40 (MT14)
10	IF	Software Engineering (MKK08, 40)	C202 (70)	Christiana (D7)	Friday 15:30 - 17:30 (MT20)
11	IF	Web Design (MKK09, 10)	E101 (20)	Guntur (D11)	Monday 09:45 - 11:35 (MT3)
12	IF	Data Warehouse (MKK10, 15)	E201 (30)	Danang (D8)	Thursday 11:35am-1:55pm (MT16)
13	TS	Chemical Engineering (MKK11, 40)	E301 (70)	Hamdani (D12)	Wednesday 08:50 - 10:40 (MT10)
14	TS	Technical Economics (MKK12, 40)	C202 (70)	Muhammad (D17)	Monday 07:55 - 09:45 (MT1)
15	TS	Foundation Engineering (MKK13, 20)	C201 (30)	Janoe (D14)	Monday 11:35am-1:55pm (MT4)
16	TS	Fluid Mechanics (MKK14, 20)	C103 (30)	Kartini (D15)	Friday 15:30 - 17:30 (MT20)
17	TS	SeaPort (MKK15, 5)	E301 (70)	Lukman (D16)	Friday 07:55 - 09:45 (MT17)
18	Ti	Chemical Engineering (MKK11, 40)	E301 (70)	Hamdani (D12)	Thursday 09:45 - 11:35 (MT15)
19	Ti	Technical Economics (MKK12, 40)	C202 (70)	Priest (D13)	Thursday 11:35am-1:55pm (MT16)
20	Ti	Introduction to Industrial Engineering (MKK16, 20)	C201 (30)	Reason (D19)	Wednesday 11:35am-1:55pm (MT12)
21	Ti	Ergonomics (MKK17, 20)	C103 (30)	Praise (D20)	Monday 07:55 - 09:45 (MT1)
22	Ti	Safety Systems (MKK18, 20)	E201 (30)	Qonita (D21)	Wednesday 08:50 - 10:40 (MT10)
23	Ti	Work Productivity (MKK19, 5)	C102 (70)	Muhammad (D17)	Thursday 09:45 - 11:35 (MT15)
24	Ti	Industrial Energy Management (MKK20, 20)	C104 (30)	Nike (D18)	Thursday 08:50 - 10:40 (MT14)
25	TG	Basic Geology (MKK21, 20)	E301 (70)	Robby (D22)	Thursday 07:55 - 09:45 (MT13)
26	TG	Indonesian Geology (MKK22, 15)	C201 (30)	Salman (D23)	Thursday 11:35am-1:55pm (MT16)
27	TG	Hydrogeology (MKK23, 10)	C103 (30)	Dance (D24)	Thursday 07:55 - 09:45 (MT13)
28	TG	Mineral Deposits (MKK24, 20)	C203 (30)	Umar (D25)	Tuesday 11:35am-1:55pm (MT8)

CONCLUSION

From the research conducted, it can be concluded that the first generation in this study has been able to produce an optimal lecture schedule, therefore genetic algorithms can be applied in handling the problem of optimization of course schedules so that a more optimal lecture schedule is produced without the problem of conflicting schedules, effective and accurate without takes a long time in the process of schedule making. However, to avoid getting caught up in the iteration of processing that can take a long time if the program continues to run because it has not found an optimal schedule or the best *fitness* value, it takes limitations or conditions that can stop the work of the program when facing the problem.

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DECISION SUPPORT AND MONITORING SYSTEMS FOR HUMANITARIAN PROGRAMS USING THE FORWARD CHAINING METHOD

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Abstract— One of the covid-19 pandemic impacts is the emergence of new social problems. Humanitarian agencies are helping the government's role to overcome various social issues that arise through its humanitarian programs. One of which is with the MSR program from Aksi Cepat Tanggap Purwokerto. With increasing social problems and the complexity of improving data collection due to the covid-19 pandemic, the methods' limitations previously using paper will be difficult, and the limits of people who have the expertise to make decisions related to the submission of prospective beneficiaries. A decision support system is needed to provide suggestions of results under the rules that have will determining and monitoring and filing systems to provide convenience in managing data collection.

***Keywords**: Decision support system, forward chaining, humanitarian programs, monitoring.*

Intisari— *Salah satu dampak pandemi covid-19 adalah munculnya masalah sosial baru. Lembaga-lembaga kemanusiaan membantu peran pemerintah untuk mengatasi berbagai persoalan sosial yang muncul melalui program-program kemanusiaannya. Salah satunya dengan program MSR dari Aksi Cepat Tanggap Purwokerto. Dengan semakin meningkatnya permasalahan sosial dan kompleksnya peningkatan pendataan akibat pandemi covid-19, keterbatasan metode yang sebelumnya menggunakan kertas akan menjadi sulit, dan keterbatasan orang yang memiliki keahlian untuk mengambil keputusan terkait pengajuan calon penerima manfaat. Sistem pendukung keputusan diperlukan untuk memberikan saran hasil berdasarkan aturan yang telah ditentukan dan sistem pemantauan dan pengarsipan untuk memberikan kemudahan dalam mengelola pengumpulan data.*

***Kata Kunci**: forward chaining, monitoring, program kemanusiaan, sistem pendukung keputusan.*

INTRODUCTION

Since March 2015, the change of national poverty rates has consistently decreased and shows progress at 9.82% in 2018 [1]. But this trend changed when there was an outbreak of coronavirus, better known as Covid-19, that has hit the world since the end of 2019 and is observed to enter and spread to Indonesia since March 2020, with the number of infected that continues to increase, the implementation of various policies to overcome the spread of the virus continues to be carried out. This resulted in the impact of the community's economic decline and increased the unemployment rate, decreased productivity levels of individuals and companies, and encouraged the emergence of new poor people who will increase the number of poor people [2].

Humanitarian institutions help overcome various social problems that arise through humanitarian programs. ACT (Aksi Cepat Tanggap) is an institution engaged in the field of humanity on a global scale that has reached more than 28 countries (data, March 2, 2020, until August 9, 2021) [3]. One of the ACT programs is a Mobile Social Rescue program, better known as the MSR program, that focuses on providing general assistance to the community with various sub-programs, including pre-prosperity, educational, and toilet facilities renovation assistance, assistance business capital, and contribution of Indonesian teacher friends. This sub-program is a local program that only covers the area that the work area of the ACT Purwokerto branch office.

With increasing social problems and with the complexity of data collection as a result of the covid-19 pandemic [4], the limitations of the methods used previously using paper will be difficult, as well as the limitations of people who have the expertise [5] to make decisions related to the submission of prospective beneficiaries then, a decision support system is needed to be able to

provide results advice by the rules that have been determined and the design—monitoring and submission to providing convenience in managing data collection. A decision support system (DSS) is a solution to solve a particular problem in a structured or unstructured manner [6]. The forward chaining method has been used in research [7] to determine the effect on the dressing skills of moderately mentally disabled children as a way of learning intervention. While research [8] used the forward chaining method in building an application for monitoring the nutritional status of children under five in the Puskesmas 1 Baturraden, Banyumas Regency.

The use of DSS in the social sector has been carried out in several previous studies, but the method used is different from that used in this study. Previous research used the Analytic Hierarchy Process method, which produces alternative criteria and determines priorities in more than one or some data on food recipients for low-income families [9]. Then the research on the decision supporting system of the recipient of the Program Keluarga Harapan (PKH) used the Simple Additive Weighting method that conducted an assessment of any input undertaken by the user based on the condition of the house, economic conditions, and condition of the occupants of the house [10]. Another research built a decision support system using the Weighted Product method to make it easier to determine recipients of assistance with Penyandang Masalah Kesejahteraan Sosial (PMKS) at the Ikatan Pekerja Sosial Masyarakat (IPSM) Kertajaya Village, Surabaya City [11].

MATERIALS AND METHODS

The research methods carried out are divided into several stages:

Identification of problems

Identify existing problems. The issue is to make decisions related to the submission of data received or not received and the management of data and monitoring of the results of the recommendation of the MSR humanitarian program to ACT Purwokerto.

Observation

Observation is a technique or approach that aims to obtain primary data by directly observing the objects [12]. This method is carried out by witnessing how the MSR humanitarian program runs from beginning to end with the Aksi Cepat Tanggap Purwokerto branch office problems.

Study of literature

Conduct research on various literature on forward-chaining methods and CodeIgniter (CI) frameworks. Based on several sources that have been collected, they can be used as a reference to make decisions on the decision support system expected to submit prospective beneficiaries of the ACT Purwokerto humanitarian program.

System Development

This research uses the waterfall model. The waterfall model is sequential software development. The progress is described by flowing down through various phases that must run to build computer software Figure 1 [13]:

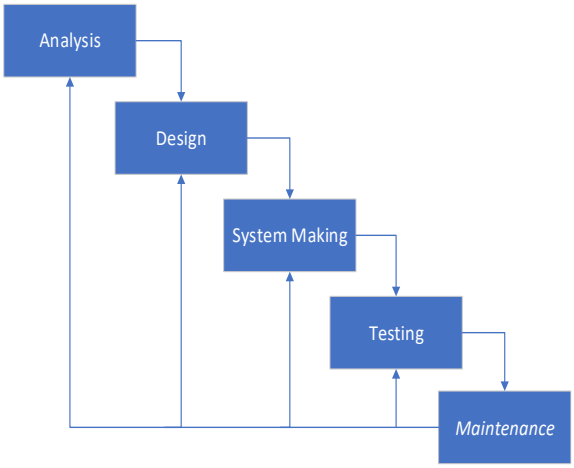

Figure 1. Waterfall Methods

Decision Support System Methods

Forward chaining is a method of searching or drawing a conclusion based on existing data or facts leading to a conclusion. The search starts from the existing facts and then moves forward through the premises to reach a conclusion or bottom-up reasoning [14][15]. The forward chaining method is a method that moves forward through the facts towards the existing conclusions [16]. Figure 2 described that fact 1 and fact 2 can result in a conclusion or decision 1, fact 3 or fact 4 can result in decision 2, and if conclusion 1 and conclusion 2 meet, it will result in conclusion 3:

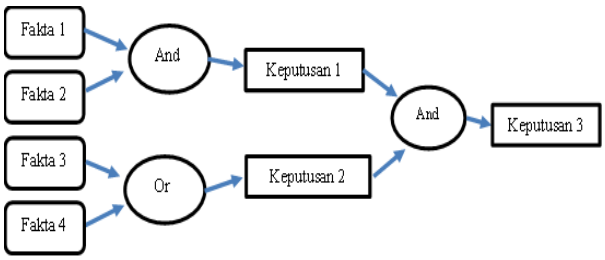

Figure 2. Forward chaining overview

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Data collection

The data used to make decisions on decision support systems is divided into two, namely conclusion or decision data and fact data, decision. data can be seen in table 1, while fact data can be seen in table 2.

Table 1. Decision data

Code	Description	Status
K1	Dikaji Ulang	Dikaji
K2	Ditolak	Ditolak
K3	Bantuan Pendidikan	Diterima
K4	Sahabat Guru Indonesia	Diterima
K5	Bantuan Modal Usaha	Diterima
K6	Renovasi Rumah	Diterima
K7	Renovasi MCK	Diterima
K8	Sumur Wakaf Keluarga	Diterima
K9	Bantuan Prasejahtera	Diterima

Table 2. Fact Data

No	Code	Description
1	F1	diajukan
2	F2	Jenis Pekerjaan : ASN, TNI, POLRI, Dosen, Pegawai BUMN/BUMD
3	F3	Jenis Pekerjaan : ASN, TNI, POLRI, Dosen, Pegawai BUMN/BUMD
4	F4	Jenis Pekerjaan : Pelajar
5	F5	Status Pernikahan : Belum menikah
6	F6	Status dalam keluarga : anak
7	F7	Jumlah anak : 0
8	F8	Biaya Pendidikan anak : >= 350000
9	F9	Jumlah tanggungan >= 200000
10	F10	Bantuan Pemerintah <= 500000
11	F11	Jenis Pekerjaan : Guru
12	F12	Jenis Pekerjaan : Pengajar
13	F13	Jumlah penghasilan : <= 1500000
14	F14	Jenis pekerjaan : Tidak bekerja
15	F15	Kondisi rumah : layak
16	F16	Kondisi MCK : layak
17	F17	Tidak memiliki penghasilan tetap
18	F18	Rata-rata penghasilan : <= 1500000
19	F19	Pemasukan tambahan <= 2000000
20	F20	Kondisi air : Sulit, jika kemarau kering
21	F21	Bantuan Pemerintah <= 500000
22	F22	Bantuan non pemerintah<= 400000
23	F23	Jenis pekerjaan : Wirausaha
24	F24	Memiliki MCK
25	F25	Kondisi rumah : tidak layak
26	F26	Jenis pekerjaan : buruh
27	F27	Tidak memiliki MCK
28	F28	Kondisi MCK tidak layak
29	F29	Jumlah penghasilan <= 100000
30	F30	Pemasukan tambahan <= 800000
31	F31	Bantuan pemerintah <= 300000
32	F32	Bantuan nonpemerintah <= 500000
33	F33	Kondisi rumah : layak
34	F34	Status tanah : pribadi, warisan, keluarga
35	F35	Jenis pekerjaan : swasta
36	F36	Status pernikahan : Menikah atau pernah menikah
37	F37	Status dalam keluarga sebagai suami
38	F38	Memiliki Pekerjaan
39	F39	Jumlah penghasilan <= 1500000
40	F40	Jumlah anak >= 2
41	F41	Jumlah keluarga >= 3
42	F42	Jumlah penghuni rumah >= 3
43	F43	Jumlah anak yang sedang menempuh pendidikan >= 1
44	F44	Biaya pendidikan anak >= 800000
45	F45	Status Tanah: sewa
46	F46	Jumlah kendaraan <= 1

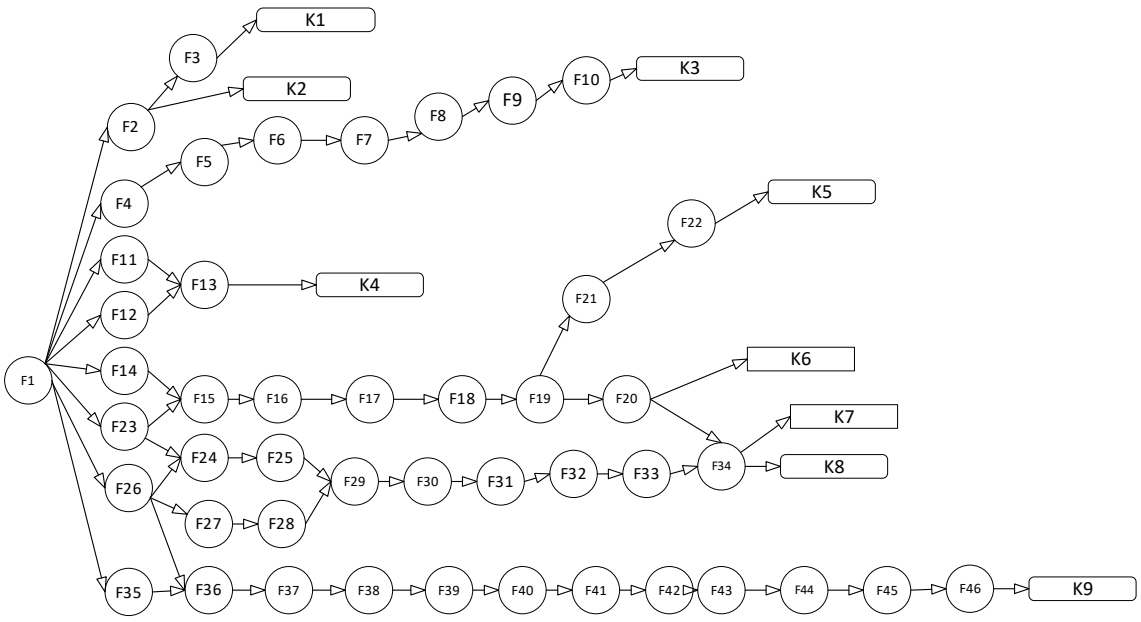

Figure 3. Decision support system rules

To get a conclusion, the existing facts must be accompanied by a rule, by which the data will go through the stages of checking whether the data is under the current rules; this fact will run until the facts can be verified. Conclude to be able to produce a decision that is used by the decision support system, as for the rules of the DSS can be seen in the following figure 3.

RESULTS AND DISCUSSION

Analysis

At this stage, researchers analyzed the problems at the ACT Purwokerto branch office and found several problems related to existing data collection specifically related to the MSR humanitarian program. At this time, manual data collection using the method of writing data into documents in the form of paper that with manual data collection can cause several problems, one of which is the difficulty of managing data when the existing data is more and more, and with documents in the form of paper it has a risk of being lost or damaged. In conducting data collection, there are assessment aspects that must be included in the results document, but only volunteers who have been equipped with the skills and knowledge of assessment can find out. In evaluating the results of the assessment as a parameter of whether or not prospective beneficiaries are accepted, people who have special expertise are needed. The number of beneficiaries of the MSR program is increasing day by day, so it will be a challenge to be able to monitor the pace or progress of each assistance received.

The solution to dealing with these problems is to use technology in the form of a website as a means to be able to manage the MSR humanitarian program at the ACT Purwokerto branch office.

Design

1. Use Case Diagram

A use case diagram for DSS application and monitoring consists of 2 actors, namely user, and admin with 14 use cases that actors can carry out. Each role or user access rights are different. User actors are restricted in accessing some of the website's existing features, and the admin actor can access all current features. The definition of actors can be seen in Table 3 below and the use case diagram in Figure 4:

Table 3. Actor Definition

Actor Definition		
No	**Actor**	**Description**
1	Admin	Actors that can interact with all monitoring and SPK application features
2	*User*	Actors can only interact with some features/access restricted to the app.

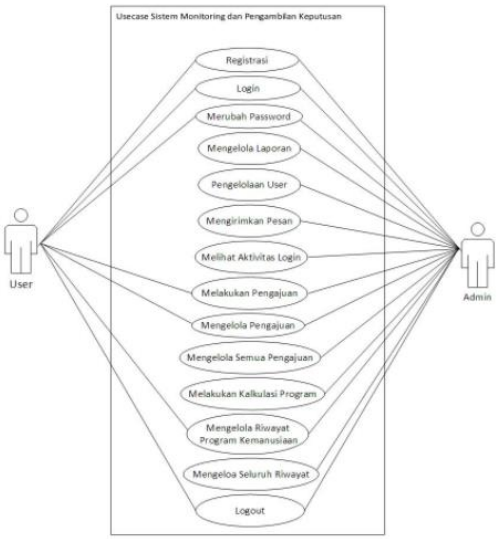

Figure 4. Use case diagram

2. Class Diagram

At this stage, describing the structure that shows classes and their relationship to each other in the website monitoring model and decision support system for the MSR humanitarian program at the ACT Purwokerto branch office, the class diagram can be seen in Figure 5.

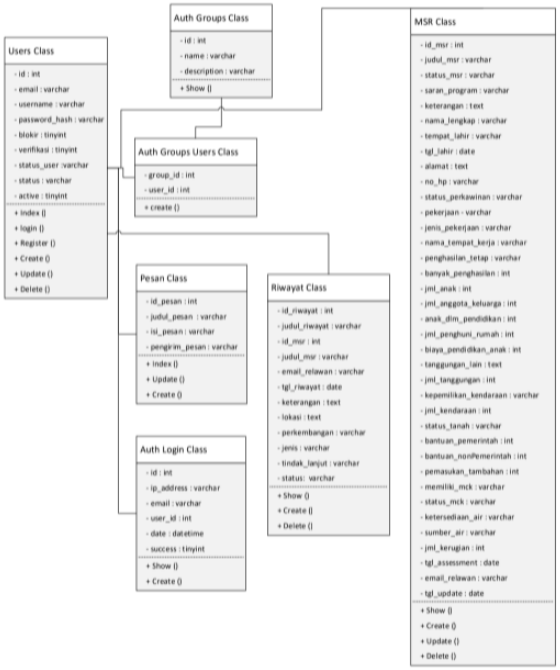

Figure 5. Class diagram

3. Design Concept

Design concepts are created to design software to be able to make it easier when the app will be continued in the implementation stage or application development and become a reference in the manufacturing stage. Making the design concept

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refers to the application requirements in terms of display or UI and becomes the initial part that bridges the user with the system; the design concept can be seen in Figure 6, Figure 7, Figure 8, and Figure 9.

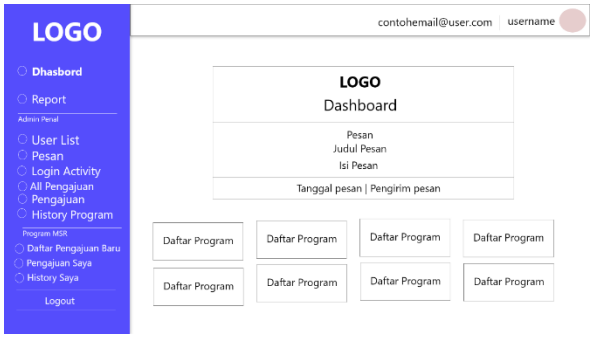

Figure 6. Dashboard Page

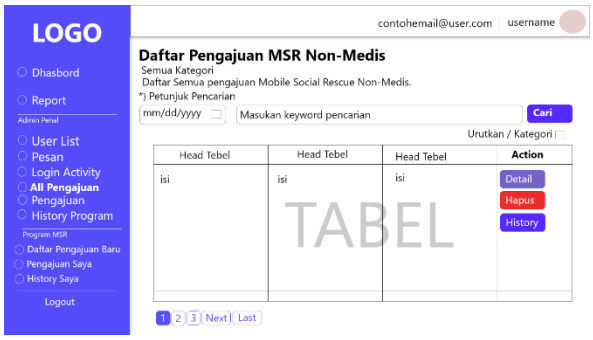

Figure 7. Submission List Page

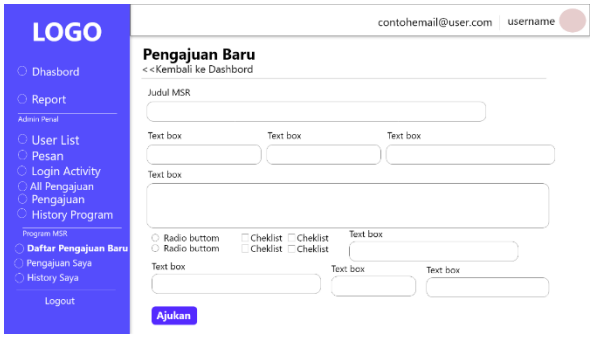

Figure 8. Add New Submission Page

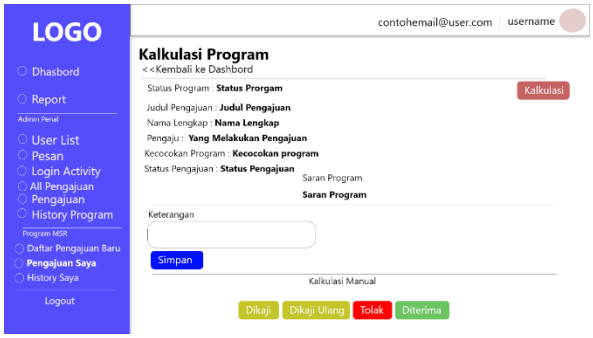

Figure 9. Calculation Page

System Making

System creation is the stage of writing lines of code from the results of previous analysis, to create a system in the form of a website, at this stage the creation of using PHP programming language with CodeIgniter framework.

Testing

1. System testing

System testing is carried out to evaluate the stages of system creation whether the system has been made under the analysis and design of the system. At this stage, researchers conducted testing on the software using the Blackbox Testing method. Software testing in terms of specific functions without passing the design and code testing of the program that can tell whether the process is running correctly, input to the output of software or software under the specifications and functions needed.

Blackbox test is the overall results of the website page if the result is valid, which means that all existing components work under the expected results. In contrast, invalid means some features do not run as expected. The black box test results can be seen in Table 4 as follows.

Table 4. Blackbox Test Results

No.	Page	Testing
1	Login	Valid
2	Dashboard	Valid
3	List of Submissions	Valid
4	Add New Submissions	Valid
5	Calculation	Valid

2. Decision Support System Testing

The results related to decisions obtained from the decision support system are as in Table 5:

Table 5. Decision Support System Testing Results

No	Calculation Results	Test Results
1	Status Ditolak	Valid
2	Bantuan Pendidikan	Valid
3	Bantuan Sahabat Guru Indonesia	Valid
4	Bantuan Modal Usaha	Valid
5	Bantuan Prasejahtera	Valid
6	Bantuan Renovasi Rumah	Valid
7	Bantuan Renovasi MCK	Valid
8	Bantuan Sumur Wakaf	Valid
9	Status Dikaji	Valid

Maintenance

At the maintenance stage, the finished software is operated by the user and will be maintained or maintained, at this stage also allows

the developer to make improvements to errors that occurred in the previous step.

The result of this study is a decision support and monitoring system of an MSR humanitarian program that will produce a conclusion to the data inputted by the user. The results of the test are as follows:

CONCLUSION

By using website-based technology to conduct data collection and monitoring of humanitarian programs, as well as the implementation of a decision support system to get results following the rules that have been determined, this can answer the problems that occur related to the limitations of people who can evaluate the results of a prospective beneficiary submission and replace data collection that uses documents in the form of paper that have a risk of loss and damage. From the test results, it can be known that the website can run following the expected results, and DSS can work by the rules that have been determined.

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WIRELESS COMPUTER NETWORK MANAGEMENT SECURITY ANALYSIS

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Abstract— The use of a wireless computer network in some institutions has become a very flexible option to connect all users of the existing computer network in the institution. This flexibility also has the disadvantage that anyone with a network password can take advantage of the wireless network. The possibility of threats to information security is very large, such as the presence of intruders on the network. Therefore, it is necessary to manage wireless networks that pay attention to information security issues on the network. The Directorate General of New, Renewable Energy and Energy Conservation at the Ministry of Energy and the Human Resources Republic of Indonesia was chosen as the research location given that computer network users in this institution are diverse and have also used The Dude MikroTik application to manage wireless computer networks, which are instruments to analyze information security. in this institution. The analysis was conducted to identify the activities and effectiveness of information security management in this institution. This study concludes that the use of The Dude MikroTik application is quite helpful in analyzing information security on wireless computer networks in this institution.

Keywords: Information Security, The Dude MikroTik, Wireless Network

Abstract— *Penggunaan jaringan komputer nirkabel pada sebuah institusi telah menjadi pilihan yang sangat fleksibel untuk menghubungkan semua pengguna jaringan komputer yang ada pada institusi tersebut. Fleksibilitas ini juga memiliki kelemahan di mana setiap orang yang memiliki password jaringan dapat memanfaatkan jaringan nirkabel tersebut. Kemungkingan terjadi ancaman terhadap keamanan informasi sangat besar, seperti adanya penyusup pada jaringan. Oleh sebab itu diperlukan pengelolan jaringan nirkabel yang memperhatikan masalah keamanan informasi pada jaringan tersebut. Direktorat Jendral Energi Baru, Terbarukan dan Konservasi Energi di Kementrian Energi dan Sumbar Daya Manusia Republik Indonesia menjadi pilihan lokus penelitian ini mengingat bahwa pengguna jaringan komputer di institusi ini beragam dan juga telah menggunakan aplikasi The Dude MikroTik untuk mengelola jaringan komputer nirkabel, yang menjadi instrumen untuk menganalisa keamanan informasi di institusi ini. Analisis dilakukan untuk mengidentifikasi aktivitas dan efektifitas pengelolaan keamanan informasi di institusi ini. Kesimpulan dari penelitian ini adalah penggunaan aplikasi The Dude MikroTik cukup membantu dalam menganalisis keamanan informasi pada jaringan komputer nirkabel di institusi ini.*

Kata Kunci*: keamanan informasi, aplikasi the Dude MikroTik, jaringan nirkabel*

INTRODUCTION

The development of computer networks today is very rapid and popular, so computer networks are often used to communicate in a building, office, home, internet cafe, and even between buildings. Computer networks are very supportive of the use of computers by many agencies and other businesses to facilitate users to exchange data and find the information needed quickly and accurately in carrying out activities as needed.

In the beginning, computer networks used cables to communicate with each other, but slowly this changed towards the use of wireless networks or often called Wireless Local Area Network (WLAN). Wireless Local Area Network (WLAN) devices serve to reach Local Area Network (LAN) areas that are difficult to reach by cable and also to reach mobile users. [1] One example of the application of wireless devices today is the use of

cellular phones. These wireless network applications provide a significant enough impact of change that allows people to expand their workspace because they are not tied to the use of cables. In wireless communication, some advantages are high mobility but also have disadvantages, namely the possibility of interference with fellow wireless connections on other computers, so it is necessary to do data security on the wireless network.

Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Human Resources (ESDM) has the task of carrying out the formulation and implementation of policies in the field of fostering, controlling, and supervising geothermal activities, bioenergy, various new and renewable energies, and energy conservation [2]. This institution which is located on Jalan Merdeka Selatan, Central Jakarta [3] has computer networks using from the 2nd floor up to the 7th floor. According to that so many network users on these 6 floors, it's conceivable that issues can happen connected with the progression of information correspondence through the organization (for example the bottleneck situation when a lot of users using the same channel) [4] and it is necessary to do an analysis related to network management, especially on the 4th floor where the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) is located

The purpose of this research is to observe and analyze the management of computer networks in this institution. In this research, observations were made on the implementation of wireless network management in the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Human Resources (ESDM). The results of this study are the results of an analysis of information security in wireless network management in the institution.

MATERIALS AND METHODS

Computer Network Management

Network management is the ability to apply a method to design, monitor, control a network, and plan (planning) resources (resources) as well as system components and computer networks to obtain good quality of service at all times a proportionate and optimal capacity [5].

Network management can be defined as the operational, administration, maintenance, and provisioning of networks and services. Types of operations related to day-to-day operations in providing services [6].

Method

This research was conducted using a qualitative approach that observations are made on the use/management of computer networks, especially on the 4th floor where the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) is located.

At this research, the author observed the current system, interviewed the IT Staff who maintain the network, and read some literature about computer network management and MikroTik. And then the author analyzed the computer network used, the use of The Dude MikroTik application to manage computer networks, which was performed in several stages: 1) Analysis of security hole sources, 2) Firewall device analysis, dan 4) Analysis by monitoring the system using The Dude MikroTik application

RESULTS AND DISCUSSION

Analysis of Security Hole Sources

An administrator often makes mistakes in analyzing the initial design of the network system. Sometimes they unwittingly have opened a gap that contains a security hole, either caused by a wrong design or a hole in the service operating system used. Security holes occur due to several things, namely [7]

1. Poor Implementation

Security holes caused by implementation errors are common. Many programs are implemented in a hurry, so they are less careful in coding. As a result, checks or testing that should have been carried out were not carried out. For example, The source of security holes caused by a poor implementation is strange characters that are entered as input from a program so that the program can access files or information that should not be accessed. The computer network system at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) has been tested, so that network security is quite safe.

2. Faulty design

Security holes created by faulty designs are rare. However, if it occurs it is very difficult to repair, even if the system is implemented properly, the weaknesses of the system will still exist.

For example, a security hole that can be categorized as a design error is the design sequence numbering (sequence numbering) of TCP/IP. This error can cause a problem known as "IP Spoofing" where a host pretends to be another host by creating fake packets after observing the sequence of packets from the host to be attacked. The network

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design at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) has been implemented quite well so that security holes can be properly covered.

2. Configuration Mistakes

Even if the program is implemented properly, security holes can still occur due to misconfiguration. Example: The problem caused by a misconfiguration is that a file that should not be able to be changed by the user accidentally becomes "writeable". If the file is an important file the effect will be a security hole. Network configuration the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) has been implemented properly so that important company data and files can be well protected.

Firewall Equipment Analysis

The network security system at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) is very wide because it is connected to a LAN network starting from the 2nd floor to the 7th floor with the central room being on the 2nd floor. Firewalls are network devices that enforce an organization's security policy [8]. The firewall device used is the CISCO ASA 5520 Firewall which has the following specifications: [9][10]

Table 1. Firewall CISCO ASA 5520 Specification

Feature	Description
Firewall Throughput	Up to 450 Mbps
Maximum Firewall and IPS Throughput	- Up to 225 Mbps with AIP SSM-10 - Up to 375 Mbps with AIP SSM-20 Up to 450 Mbps with AIP SSM-40
VPN Throughput	- Up to 225 Mbps
Concurrent Sessions	- 280,000
Psec VPN Peers	- 750
SL VPN Peer License Levels	- 2,10, 25, 50, 100, 250, 500, or 750
Security Contexts	- Up to 20
Interfaces	- 4 Gigabit Ethernet ports and 1 Fast Ethernet port
Virtual Interfaces (VLANs)	- 150
Scalability	- VPN clustering and load balancing
High Availability	- Active-Active, Active-Standby

The utilities of Firewall CISCO ASA 5520

1. Simplify security management, reporting, and reduce operational costs. Deploy security with a mix of security functions and enable to support existing systems.
2. Provides high performance for enterprises that require real-time network security services.

Security System Analysis using System Monitoring

According to Chopra [11] Network Security consists of provisions and policies adopted by a network administrator to preclude and monitor unauthorized access, alterations, perversion, declination of a computer network, and network-accessible resources

Monitoring of security systems is usually done with a special tool, this is applied so that holes or connections to the internet can be seen. In this way, it is hoped that we can find out the weaknesses and holes of the system made.

The system monitoring program used on the computer network of the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) is The Dude MikroTik. The Dude is a MikroTik application that is used for network management. Besides the application could be used as a regulator of Internet data bandwidth and filtering sites that can interfere with computer network connectivity [12], and used for network security [13]. The Dude can perform automatic scanning on all devices connected to a particular network subnet. The results of the scan can be in the form of a network configuration image that appears. The network configuration will describe whether the network condition is up/down [14].

Network Monitoring using The Dude MikroTik

Based on the analysis carried out at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) to monitor the security network located on the Fl. 4 using The Dude MikroTik application [15]

Figure 1. Network Access

Accessing the Network at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) and using the Wireless Network Connection of EBTKE Office which is on Floor 4 to monitor the security network on that floor.

Menu Display of Device Discovery The Dude

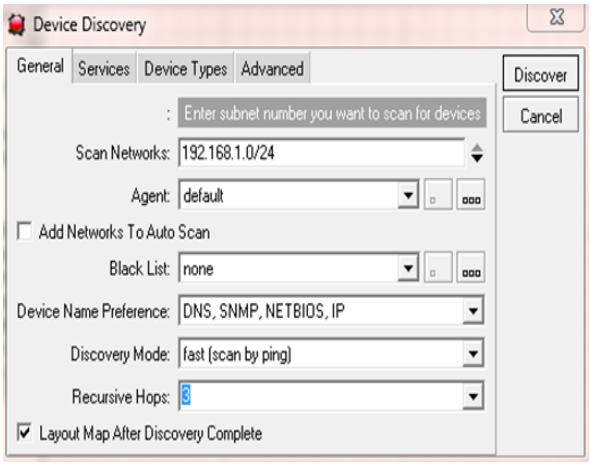

Figure 2. Menu Device Discovery

Figure 3 shown below displays a networking map by entering the subnet address at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) which is 192.168.1.0 and The Dude will automatically scan the network in that subnet.

The Display of Networking Map

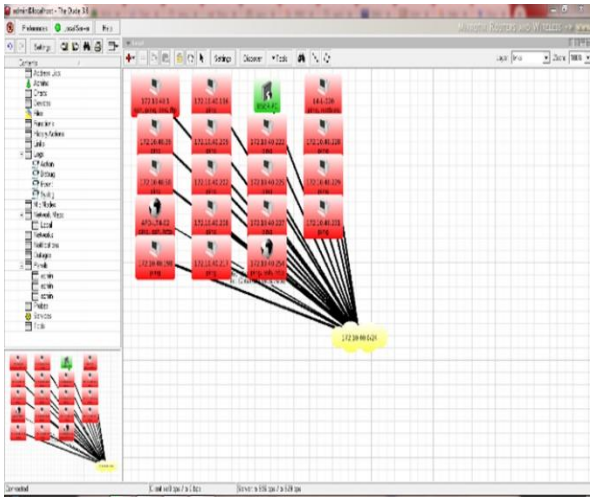

Figure 3. Networking Map

Figure 4 below displays the existing networking map at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM)

1. The Yellow one is a subnet located on the 4th floor of the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM).
2. The green color indicates network devices and equipment that have been detected are connected and can function properly (UP).
3. Red colors indicate network devices and equipment have encountered network problems (DOWN).

The display of the problem of the Network (DOWN)

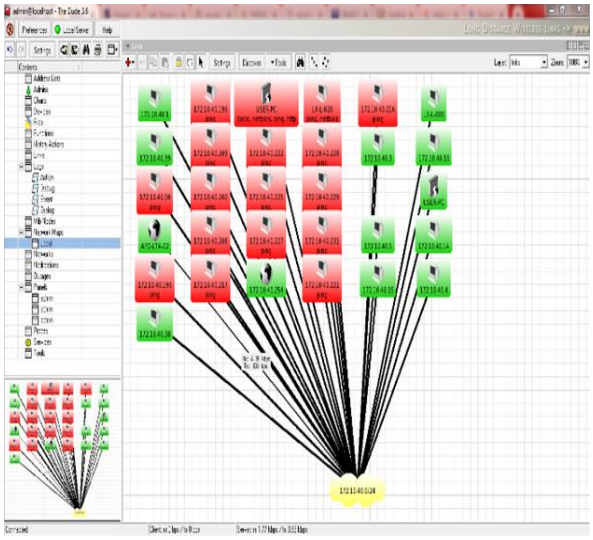

Figure 4. The network has Problems (DOWN)

Displays that the status of network devices that are on the Fl. 4 is experiencing a down or shutdown problem so that all computers that use the network cannot be used to access the internet. And it turns out that quite a lot of devices have connection problems at the time of the observation.

Network Traffic using Traffic Flow Analysis

Figure 5 show the direct network services traffic:

1. Green Traffic Incoming is information that incoming data from the connection used at EBTKE Office Fl.4.
2. Blue Outgoing Traffic is the outcoming information from the connection used at EBTKE Office Fl.4.
3. Traffic Red Broadcast is a service from server devices to client devices in sending data to several client computers.

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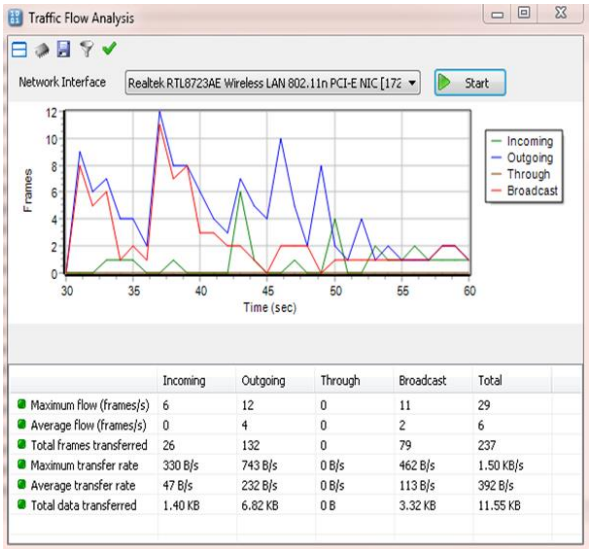
4. Maximum flow (frames/s) used are Incoming 6, Outgoing 12, and Broadcast 11. So the Total Maximum flow is 29.
5. The average flow (frames/s) used is Incoming 0, Outgoing 4, Broadcast 2. So the Total Average flow is 6.
6. The total Transferred frames used are Incoming 26, Outgoing 132, Broadcast 79. So the total of Transferred frames is 237.
7. Total Data Transferred used are 1.40KB Incoming, 6.82KB Outgoing, and 3.32KB Broadcast. So the total of Data Transferred is 11.55KB.



	Incoming	Outgoing	Through	Broadcast	Total
Maximum flow (frames/s)	6	12	0	11	29
Average flow (frames/s)	0	4	0	2	6
Total frames transferred	26	132	0	79	237
Maximum transfer rate	330 B/s	743 B/s	0 B/s	462 B/s	1.50 KB/s
Average transfer rate	47 B/s	232 B/s	0 B/s	113 B/s	392 B/s
Total data transferred	1.40 KB	6.82 KB	0 B	3.32 KB	11.55 KB

Figure 5. Network Traffic

The diagram above showed that the outgoing transfer rate is higher than the incoming transfer rate.

CONCLUSION

The computer network management security system at the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) is made with a fairly good design and configuration so that security holes can be covered to protect data from being read by people. unauthorized persons and insert data or delete the data. The Dude MikroTik application could be used by a wireless computer network management security system to monitor network activities so that data security can be guaranteed, and it can be known whether the network is having problems or is in good condition. Unfortunately, based on the observations in this study, it can be seen that there are quite a several problematic devices that need further handling on the computer network used.

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READINESS TECHNOLOGY AND SUCCESS MODEL INFORMATION TECHNOLOGY IN IMPLEMENTATION BETWEEN SMEs IN JAKARTA

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Abstract—*In general, information technology plays an essential role in organizational development. Similarly, if the advancement of information technology can be applied to the financial sector, small and medium enterprises, and so on, the sector's selling value will increase. This study was carried out to determine the level of readiness of the SMEs sector in carrying out information technology implementation projects in business management. In this case, the researcher is developing a research model by combining and adapting a technology readiness model and a successful model for developing information technology for SMEs in Jakarta. This quantitative study included 226 SMEs workers and managers. The data was processed and analyzed using the PLS-SEM method and SmartPLS 3.0 software, with descriptive data being entered into a spreadsheet application. The study also describes the findings of the readiness factor, which has a significant impact on the success of information technology development in Jakarta SMEs.*

Keywords*: SMEs, Readiness Technology, Succes Model, SEM.*

Intisari—Secara umum, pemanfaatan teknologi informasi memegang peranan penting dalam pengembangan organisasi. Demikian pula jika kemajuan teknologi informasi dapat diterapkan pada sektor keuangan, usaha kecil menengah, dan sebagainya, maka nilai jual sektor tersebut akan meningkat. Kajian ini dilakukan untuk mengetahui tingkat kesiapan sektor UMKM dalam menjalankan proyek implementasi teknologi informasi dalam manajemen bisnis. Dalam hal ini peneliti sedang mengembangkan model penelitian dengan menggabungkan dan mengadaptasi model kesiapan teknologi dan model keberhasilan pengembangan teknologi informasi terhadap perkembangan UKM di Jakarta. Studi kuantitatif ini melibatkan 226 pekerja dan manajer UKM. Data diolah dan dianalisis menggunakan metode PLS-SEM dan software SmartPLS 3.0, dengan data deskriptif dimasukkan ke dalam aplikasi spreadsheet. Kajian ini juga memaparkan temuan faktor kesiapan yang berpengaruh signifikan terhadap keberhasilan pengembangan teknologi informasi di UKM Jakarta.

Kata Kunci*:* SMEs, Readiness Technology, Succes Model, SEM.

INTRODUCTION

The modern Micro, Small, and Medium Enterprises (SMEs) economic environment dominated by globalization, intense competition, and the knowledge and information revolution have revolutionized how business is run. The age of technology is seen in the way of intensive investment in the process of using computers and data preparation tools in the manufacturing and service industries as well as telecommunications infrastructure, and the spread of their use in government agencies, educational organizations, and more recently, in households (Ali & Miller, 2017; Buchalcevova, 2015). Therefore technological advances, the implementation, and application of information technology (IT) is a significant driving force behind many socio-economic changes in the current state of the world (Antonelli & Fassio, 2014).

As IT utilization and commercialization become more widespread worldwide, the adoption of new IT can generate new business opportunities and various benefits. Currently, large organizations and SMEs are looking for ways to strengthen them to gain competitive and efficient positions and increase their productivity (F. M. Cesaroni, Consoli, & Sentuti, 2011). Correspondingly, there is an increasing awareness of the need to earn profits through investments in IT management.

The use of IT tools greatly helps SMEs by providing the necessary infrastructure to provide the correct information at the right time. IT can also give SMEs competitiveness through integration between supply chain partners and inter-organizational functions and by providing critical information (Burgess & Paguio, 2016).

However, previous IT literature has shown that only a few studies have focused on IT adoption and use in SMEs (Burgess & Paguio, 2016; F. Cesaroni, Consoli, & Demartini, 2010). Moreover, it has been found that although IT is growing exponentially in SMEs, the rate of IT adoption by these businesses remains relatively low (Barba-Sánchez, Martínez-Ruiz, & Jiménez-Zarco, 2007; Sani & Wiliani, 2019; Skoko, Buerki, & Ceric, 2007), and Large organizations have benefited over SMEs in IT-supported sales increase and cost savings (Sani, Rahman, Nawaningtyas, Budiyantara, & Wiliani, 2021).

Although it has a very strategic role in economic growth in Indonesia, the SMEs sector can be in a worrisome condition. The era of open free markets such as the ASEAN Free Trade Area (AFTA), which will threaten the existence of SMEs if their products cannot compete with foreign products, is another reason. To overcome this, SMEs need innovation in the entire network of activities or business processes to provide added value or excellence to the products/services offered. One way to innovate is to utilize technology, especially Communication and Information Technology (ICT) (Eze, Olatunji, Chinedu-Eze, & Bello, 2018; Ntwoku, Negash, & Meso, 2017); in other words, the use of information technology (IT) can facilitate SMEs in the innovation process. The application of the rapid use of IT provides tremendous potential and opportunities that can help solve SMEs problems due to various limitations (Napitupulu, Syafrullah, Rahim, Abdullah, & Setiawan, 2018; Sani, Wiliani, Budiyantara, & Nawaningtyas, 2020).

Several performance studies on the use of ICT in several organizations Almajed and Mayhew (2014); Hughes, Rana, and Simintiras (2017); (Jrad & Sundaram, 2015) show the failure of technology development, although technically successful, its implementation is not necessarily as profitable as initially planned. In practice, several researchers also found that efforts to implement ICT have not been implemented in several SMEs in the medium and small categories. On the other hand, technology will look more optimal for organizations such as Perusahaan Terbatas (PT), both in terms of operational support, management, and strategies to achieve a global vision. Therefore, this study is proposed to explore the readiness and success of the implementation of information technology, especially SMEs, and to determine the factors that influence its readiness and success. It is hoped that the findings of this research and contributing theoretically to integrating IS readiness and success models methodically can encourage methodological diversity in IS research; Practicality is expected to be one of the decision-making materials for SMEs stakeholders and similar companies. The research objectives are to find out the status of readiness and success of the implementation of ICT, especially for SMEs that are used as respondents and evaluate the factors that influence the readiness and success of the implementation of the use of ICT. In this study, the model applied is a combination of the technology readiness model (Colby, 2016; Parasuraman, 2000) with the information system success model (DeLone & McLean, 2003)

MATERIALS AND METHODS

Quantitative research methods are research methods based on the philosophy of positivism, used to examine specific populations or samples, data collection using research instruments, data analysis is quantitative or statistical, intending to test established hypotheses (Creswell, 2014; Sugiyono, 2018).

The research approach and strategy were chosen because they can accommodate aspects of

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complementarity, development, confirmation, compensation and diversity of research methods (Venkatesh, Brown, & Bala, 2013) to ensure the validity of the results. The population in this study were SMEs entrepreneurs who had been involved or had knowledge of the use of information technology.

Data collection techniques were carried out using data collection techniques simultaneously between questionnaires, interviews, and direct discussions in one data collection period. The questionnaire was conducted directly and indirectly using the google doc application for ease, efficiency, and effectiveness. Researchers will also conduct interviews (interviews) with several participants and conduct FDG (Forum Group Discussion) on several SMEs. Interviews and FGDs were conducted to dig deeper into data that were not touched when the questionnaire was conducted (Wilson, 2012).

The following is a picture of the research methodology that will be carried out:

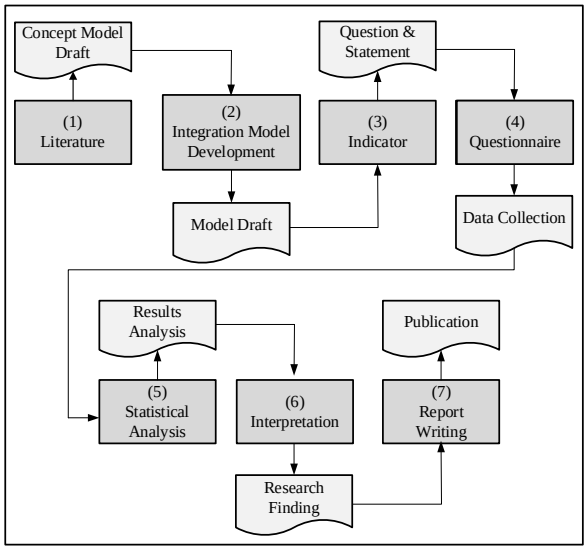

Figure 1. Research Procedure

The research instrument that will be carried out in this study is distributing questionnaires using 5 Linkert scales starting from "Strongly Disagree" to "Strongly Agree". The instrument displayed consists of a cover letter page for research, a research summary page, a research question page which will consist of 56 questions with details of 4 questions about the respondent's profile, 7 questions about IT usage profiles and 45 questions for testing the questionnaire. This questionnaire is a development of the previous research questionnaire.

After the data collection stage, the collected data will be processed into a computer, filtering and classifying the data using MS. Excel and IBM SPSS version 24. Quantitative data will then be analyzed using multivariate-based statistical methods (PLS-SEM) with SmartPLS version 3.0 software. In particular, the interpretation of the findings of the two methods will then be interpreted by confirming the quantitative findings following meta-inference from validation (Venkatesh et al., 2013).

RESULTS AND DISCUSSION

Referring to the indications of several previous students, the researchers combined the technology readiness index model (Parasuraman & Colby, 2015) and the IS success model in the context of the input-process-output (DeLone & McLean, 2003; Subiyakto & Ahlan, 2014) modelling process, as done by several previous researchers to develop a model of readiness and successful implementation of information technology adoption in SMEs. The results of previous studies were also considered in developing this research model. Figure 2 shows the model used, which consists of four system readiness variables, namely: optimism (OPT), innovativeness (INV), discomfort (DCF) and insecurity (ISC), and combines them with five variables of the IS success model, namely information quality (INQ), system quality (SYQ), service quality (SVQ), user satisfaction (USF), and IS success (ISS).

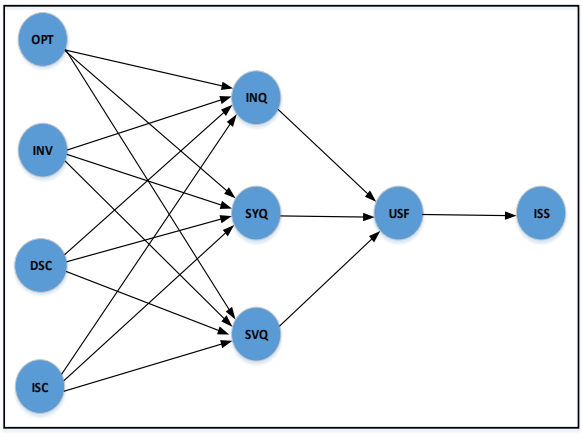

Figure 2. Research Model

This data analysis was carried out on respondents' answers, especially to the first eight questions in the questionnaire, to produce demographic information related to the characteristics of respondents and (Table 1) the status of successful implementation of information technology in SMEs that became the object of research (Table 2). The technique calculates the percentage of respondents' answers using Microsoft Excel 2013.

Based on Table 1. Regarding demographic information on respondents' profiles, we can see that most of the respondents (89.8%) have a bachelor's degree or above, with the highest

percentage (65.5%) of the total respondents being undergraduate graduates.

Meanwhile, the level of experience of respondents regarding their involvement in information technology development projects in their companies shows that the majority of respondents (85.9%) have experience under ten years, and most of them (45.3%) have experienced between 5-10 years in information technology development projects. Finally, for the type of position of the respondents in this project, the highest percentage of respondents (58.1%) are members of the development project team, the rest are top managers, business managers, staff and employees.

Table 1. Respondent Profile

Status	Responded	Percentage
Education	SLTA	10.2
	D3	15.7
	S1	65.5
	S2	8.6
Project Experience	< 2 years	16.8
	2 – 5 years	23.8
	5 - 10 years	45.3
	> 10 years	14.1
Position	Top Manager	13.0
	Business Manager	28.9
	Employees	58.1

Furthermore, the following are four main points related to the demographic information of the IT implementation profile at the SMEs that is the object of research. First, most of the respondents (69.1 %) indicated that the objective of developing an IT implementation project was to meet operational needs. Second, more than 66.8 % of the respondents said that the institution's internal development team carried out the IT development implementation strategy. Third, in the aspect of IT Implementation project funding, more than 87.9 % of the respondents stated that internal sources funded the IT project, and fourth, the majority of respondents (78.3 %) indicated the success rate of the IT Implementation was above 50%. 43.4 % of respondents stated above 75%.

Table 2. IT Implementation Profile

Measurement	Responded	Percentage
Development Goal	Operational Needs	59.1
	Managerial Needs	12.4
	Strategies Needs	21.2
	Operational & Managerial Needs	7.3
IT Implementation Strategy	Tools and Equipment 100% prepared	12.5
	Tools and Equipment 50% prepared	20.7
	Tools and Equipment 100% self-developed	66.8
Financial	100% self-financing	55.5
	50% self-financing	32.4
	100% external-financing	17.9
Level of Success	< 50%	23.7
	50 – 75%	32.9
	> 75%	43.4

Measurement Model Analysis Results

Evaluation of the outer model with reflective indicators can be assessed through convergent validity and discriminant validity. The loading factor value is said to be high if it is more than 0.7 and is usually done for confirmatory research. The loading factor value is 0.6 – 0.7 for exploratory analysis. And for the initial analysis, the value of 0.5 – 0.6 is still considered sufficient (Hair, Ringle, & Sarstedt, 2011; Hair Jr, Hult, Ringle, & Sarstedt, 2016). From the results of the analysis of the SmartPLS application, the convergent validity value is smaller than 0.6 in 10 of 45 indicators (Table 3)

Table 3. Outer Loading

Var	Ind	Cross Loading			
		OPT	INV	DSC	ISC
OPT	OPT1	Reject			
	OPT2	0,754			
	OPT3	Reject			
	OPT4	0,818			
	OPT5	Reject			
INV	INV1		0,791		
	INV2		0,792		
	INV3		0,864		
	INV4		0,861		
	INV5		0,839		
DSC	DSC1			0,908	
	DSC2			0,887	
	DSC3			0,828	
	DSC4			0,782	
	DSC5			0,838	
ISC	ISC1				0,813
	ISC2				0,908
	ISC3				0,912
	ISC4				0,850
	ISC5				0,839

Source: (Sani, Aisyah, Budiyantara, Doharma, & Hindardjo, 2022)

Table 4. Outer Loading

Var	Ind	Cross Loading				
		INQ	SYQ	SVQ	USF	ISS
INQ	INQ1	0,797				
	INQ2	0,852				
	INQ3	0,866				
	INQ4	0,858				
	INQ5	0,755				
SYQ	SYQ1		0,770			
	SYQ2		0,899			

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Var	Ind	Cross Loading				
		INQ	SYQ	SVQ	USF	ISS
	SYQ3		0,858			
	SYQ4		0,884			
	SYQ5			Reject		
	SVQ1			0,770		
	SVQ2			0,899		
SVQ	SVQ3			0,858		
	SVQ4			0,884		
	SVQ5			Reject		
	USF1				0,905	
	USF2				0,750	
USF	USF3				0,922	
	USF4				0,921	
	USF5			Reject		
	ISS1					0,929
	ISS2					0,925
ISS	ISS3					0,933
	ISS4					0,915
	ISS5					0,827

Source: (Sani et al., 2022)

Table 5. Construct Reliability & Validity

	Cronbach's Alpha (CA)	Composite Reliability (CR)	Average Variance Extracted (AVE)
OPT	0,726	0,822	0,586
INV	0,887	0,917	0,689
DSC	0,904	0,928	0,723
ISC	0,918	0,937	0,749
INQ	0,884	0,915	0,684
SYQ	0,781	0,862	0,589
SVQ	0,800	0,861	0,563
USF	0,857	0,898	0,652
ISS	0,946	0,959	0,823

Source: (Sani et al., 2022)

Based on the table above, it can be seen that on the outer loading, six indicators were rejected, namely OPT1, OPT3, OPT5, SYQ5, SVQ5 and USF5.

Internal consistency reliability was tested using the CR value with a threshold value above 0.7 (Afthanorhan, 2013; Hair et al., 2011; Hair Jr et al., 2016). Referring to several researchers above, we use the CR value instead of the Cronbach's alpha (CA) value because of the assumption of CA, which assumes that all indicators are the same in a variable. It is not for internal consistency reliability testing. The result is that the CR values of all variables have met the statistical requirements for use.

Convergent validity was tested using the average variance extracted (AVE) value with the accepted threshold above 0.5 (Hair, Sarstedt, Ringle, & Mena, 2012; Hair Jr et al., 2016; Urbach & Ahlemann, 2010; Wong, 2013). The result is by removing the OPT1, OPT3, and OPT5 indicators because their removal affects the AVE value of the OPT variable.

Discriminant validity was tested through a comparative analysis of cross-loading with the squared value of AVE (Afthanorhan, 2013; Hair et al., 2011; Hair et al., 2012; Urbach & Ahlemann, 2010; Wong, 2013). Table 5 shows the validity of all the variables used in the research model.

In summary, the measurement analysis of the model above shows that the proposed research model has good psychometric characteristics statistically even though the elimination of six indicators (IOPT1, OPT3, OPT5, SYQ5, SVQ5 and USF5). Furthermore, this can be interpreted that the model meets the requirements to be continued for testing the model structure.

Structural Model Analysis Results

This analysis was carried out through two stages of testing, including path coefficient testing (β) and a t-test using the bootstrapping method. Graphically, the results show in table 6 and figure 3.

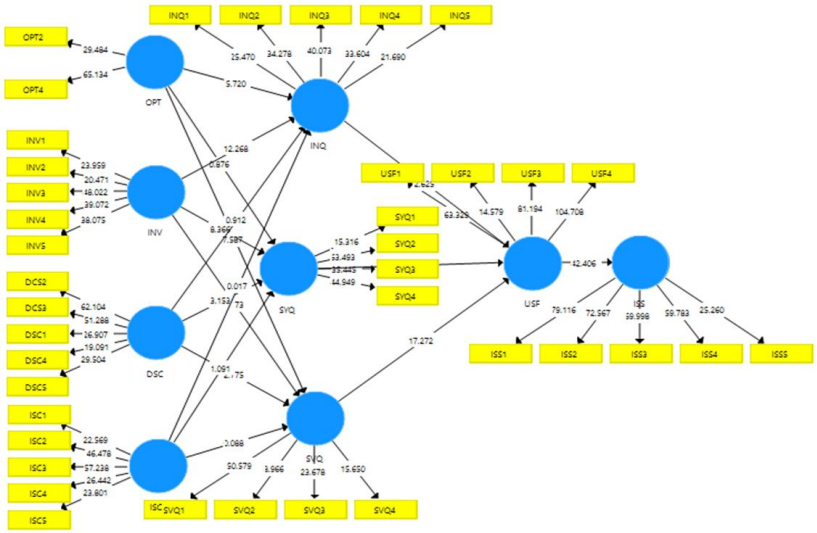

Figure 3. Structural Model Results

Table 6. Structural Model Analysis

Hypothesis		β	T-test	Analysis	
No	Path			β	T - test
H1	OPT -> INQ	0,292	5,720	Significant	Accept
H2	OPT -> SYQ	0,067	0,876	Unsignificant	Reject
H3	OPT -> SVQ	0,431	7,587	Significant	Accept
H4	INV -> INQ	0,542	12,26	Significant	Accept
H5	INV -> SYQ	0,508	8,366	Significant	Accept
H6	INV -> SVQ	0,018	0,273	Unsignificant	Reject
H7	DSC -> INQ	-0,08	0,912	Unsignificant	Reject
H8	DSC -> SYQ	-0,33	3,153	Unsignificant	Accept
H9	DSC -> SVQ	0,264	2,775	Significant	Accept
H10	ISC -> INQ	0,001	0,017	Unsignificant	Reject
H11	ISC -> SYQ	0,113	1,091	Significant	Reject
H12	ISC -> SVQ	0,007	0,088	Unsignificant	Reject
H13	INQ -> USF	0,217	2,625	Significant	Accept
H14	SYQ -> USF	-0,19	3,358	Unsignificant	Accept
H15	SVQ -> USF	0,754	17,27	Significant	Accept
H16	USF -> ISS	0,901	42,40	Significant	Accept

Source: (Sani et al., 2022)

β is tested with a threshold value above 0.1 to state that the path in question influences the model. The result is that 10 of the 30 paths show a statistically insignificant effect, as shown in Table 6.

The T-test was tested by a bootstrapping method using a two-tailed test with a significance level of 5% to test the research hypotheses. The hypothesis will be accepted if it has a t-test greater than 1.96 (Hair et al., 2012; Hair Jr et al., 2016; Subiyakto, Ahlan, Kartiwi, & Putra, 2016). Table 6 shows that only 10 of the 16 hypotheses were accepted.

There is no statistically significant effect of the ISC variable on INQ, SYQ and SVQ. It is indicated by the insignificance of the path between ISC to INQ and SVQ (ISC -> INQ and ISC -> SVQ). The two hypotheses are not accepted. The results of this analysis are inconsistent with several previous theories, including DeLone and McLean (2003), Petter, DeLone, and McLean (2008).

The researcher believes that this inconsistency is related to inaccuracy in using indicators and their operationalization to research instruments, as explained in the first paragraph. Similarly, even if the research model development and operationalization have been done as thoroughly as feasible, this may occur. Therefore, it is also recommended for further review and development related to using indicators from the ISC and their operationalization.

Another possibility is that this reflects the conditions of IT implementation projects in the research object's SMEs organizations. That ISC is not one of the factors influencing the project's success. On the other hand, INQ and SVQ are the main factors directly affecting the project's success. Furthermore, this can be related to the level of influence of INQ, SYQ and SVQ in the implementation of IT implementation projects, as shown by the significant path coefficient on other variables in the model, including also on USF (INQ -> USF, SYQ -> USF and, SVQ -> USF).

CONCLUSION

Procedurally, the analysis phase followed what was suggested by several previous related studies, including Hair et al. (2011) and Hair et al. (2012), specifically related to using the PLS-SEM method with SmartPLS software. In general, the implementation of the IT implementation project is indicated to have been successful based on the strategic plans made previously, as noted in the demographic information of the project profile. Furthermore, the analysis of the model structure has been carried out based on the results of model measurements that have good psychometrics and includes two types of analysis, starting from the analysis and T-test, the critical point from the results of the model structure analysis is related to technology readiness with variables OPT, INV, DSC and ISC and the success of IT implementation projects with INQ, SYQ, SVQ and USF variables. Interpretation of the results is also carried out by considering the limitations of statistical testing aspects, theoretical aspects based on support from several previous theories, and practical aspects related to the actual conditions of project implementation in the field. So based on the limitations of the research performance described, several suggestions can be underlined for the implementation of further research.

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