Decision Support System for Selection of the Best Member at Junjung Biru Waste Bank Using the Composite Performance Index (CPI)

Fitri Purwaningtias*, Maria Ulfa, Febi Franata
Information Systems Study Program
Universitas Bina Darma
Palembang, Indonesia
*Correspondence: fitri.purwaningtias@binadarma.ac.id

Abstract-Junjung Biru Waste Bank conducts a selection of the best member biennially. The process is crucial, but it does not have a supporting system, which poses problems emerging from data redundancies and data loss. Among the problem is the difficulty for administrators in summarizing data of members who have transactions. To solve the problem, we devised and implemented a decision support system using the CPI (Composite Performance Index) method. The criteria are the amount of balance and active saving during a six-month interval. The results of this research is a web-based decision support system that produces a ranking order of members, which helps in selecting the best member.

Keywords: decision support system, member, composite performance index

1. Introduction

Decision Support System (Decision Support System) has been developed since 1970. Decision Support System (DSS) supported by a computer-based information system can help someone improve their performance in decision making by choosing various alternative decisions by means of processing information available using a decision-making model. Decision Support System is defined as an information system that provides information, modeling and data manipulation [1].

Waste management is an activity carried out to handle waste from its generation to final disposal. In general, waste management activities include waste generation control, garbage collection, transportation, processing and final disposal. Community-based waste management is a waste management approach based on active community participation [2]. Junjung Birru garbage bank is a kindergarten school that has been established since 2003 only only recently used the garbage payment method in 2013. According to the results of interviews conducted with the director of the Junjung Biru waste bank, the school has a focus on increasing environmental awareness and promoteing a school payment method using trash collected by the students' parents. The main reasons of such initiative is due to the Junjung Birru garbage bank is located around low-income communities

such that the use of garbage as a payment method instead of money will reduce the burden of the parents. The Junjung Biru waste bank also received assistance from one of the national companies i.e. PERTAMINA through its CSR Development Partners Program as to improve the community's economy. The trash collected by the parents are organic waste and non-organic waste. Organic waste will be managed into compost and non-organic waste will be recycled into various accessories. In fact, everyone can be a member of the garbage bank not only the guardians of the students at the Junjung Biru school but also the general public around the Junjung Biru school.

Currently, Junjung Biru Waste Bank has 100 members consisting of kindergarten children who attend school in Junjung Biru and adolescents as well as the elderly living in the area Junjung Biru. To encourage the participant of Junjung Biru Waste Bank, it wants to give appreciation to the surrounding community in the form of reward as the best member. Rewards are given as gratitude for the good response of the community members who have made for this positive activity. Presently, Junjung Biru does not have a system to manage its members and how to determine the best members in the community. Therefore, the administration staff finds it difficult to select the best member. In addition, manually selecting it may cause an error due to there might be incorrect data input and miss calculation. The situation becoming more difficult since

the selection of the best members is conducted twice a year or once every 6 months.

To solve the problems, a decision support system is needed by the administrator of Junjung Biru waste banks to determine the best members who will be rewarded. In this research we proposed a web-based application as a decision support system (DSS) to tackle the problems of the community.

Decision support systems have several methods in determining decisions such as the Exponential Comparison (MPE) method, the Bayes method and the Composite Performance Index (CPI) method. These methods are often used in criteria-based decision making. The Bayes method has the advantage of being easy to understand, it only requires simple coding and is faster in calculations, but there is a weakness namely the less accurate results obtained, in other words, less evidence to prove the correctness of the answers generated from this method [8]. In addition, Bayes is also used when the alternative value is the real, measurable value [9]. Furthermore, the exponential comparison method (MPE) is used for uniform assessment similar to the Bayes method [10]. The Exponential Comparison method is used to determine the priority order of decision alternatives with multiple criteria and is very suitable for ordinal scale assessments, for example very good, good, poor and very poor) [11].

Several previous studies have also implemented decision support systems, in which one of the DSS methods used is the Composite Performance Index (CPI). One of the studies applied the CPI to provide teacher performance assessments, so that the use of information technology can be of maximum benefit to every level of society [3]. Another study also stated that DSS can minimize errors and subjectivity in choosing the best teacher and can provide more effective results regarding the selection of exemplary teachers as well as make it easier to select it [4].

Another study implemented DSS for selecting the best hotel in certain city. The study stated that the creation of decision support systems results an information of hotel ratings which can be used as a reference for the people under several criteria [5]. A study that specifically implemented CPI method also stated that it can help users to make decisions in determining promotion strategy with an outstanding performance [6]. Additionally, another research explained that the use of the CPI method makes it easier to determine decisions on multi-criteria problems such as selecting student council officers with multi criteria and alternative choices that are arranged into a hierarchy [7].

The Composite Performance Index (CPI) method is usually applied for assessment with non-uniform criteria [12]. The CPI has the advantage of determining ratings or ratings of various alternatives based on several criteria [13]. From some of the studies above, we conclude that this decision support system needed in uphold blue waste banks is a system using the CPI (Composite Performance

Index) method. The CPI (Composite Performance Index) method is a method of calculating decision-making based on a combined performance index that can be used to determine ratings or ratings of various alternatives *i* based on several criteria *j*. With the decision support system for selecting the best member, it can help Junjung Biru waste banks understand the best members and the process of calculating member data becoming more accurate and efficient so that it can motivate the surrounding community to participate the program as well as encourage them to protect the surrounding environment by collecting garbage. This decision support system is made in the form of a website application and the results of the calculation of the best members can be displayed in graphical form, making it easier for the admin to see the results and the printing process can be done immediately.

2. Method

a. Data Collection Method

In this research, the data collection is carried out through primary data in the form of observation and interviews. Observations are conducted directly at the Junjung Biru waste bank. At that place we are directly involved in the activities and observed it, the results of such activities become the data source. Observations are also carried out flexibly such that research data can be directly written into notes and using a voice recording device. Furthermore, we also conduct additional interviews with the director and teachers of the Junjung Biru school to explore the critical problem of how to determine the best member in the community to be awarded. In addition, we also use questionnaire as an instrument to measure the usability of the application system is made for the user. In addition to primary data, researchers also use secondary data in the form of data obtained indirectly from the object to help this research in the form of document studies, namely books and journals related to research.

b. CPI (Composite Performance Index) method

The Composite Performance Index (CPI) is a composite index that can be used to determine the assessment or rank of various alternatives *i* based on several criteria *j* [14]. The CPI method is formulated as follows:

a. Matrix Normalization

Matrix normalization is done by adjusting the Criteria Value with a predetermined weight value.

b. Menentukan nilai kriteria:

$$A_{ij} = x_{ij} / x_{ij}(\min) \times 100; \tag{1}$$
$$i = 1,2,\ldots\ldots\ldots, \text{n and } j = 1,2,\ldots\ldots\ldots, \text{m}$$

c. Determining CPI Value:

$$I_i = 1 A_{ij} B_j; \tag{2}$$
$$i = 1,2\ldots\ldots\ldots, \text{n dan } j = 1,2\ldots\ldots\ldots, \text{m}$$

Information:

A_{ij} = The alternative value to *i* in the criteria *j*

X_{ij} = The initial value of the alternative *i* in the criteria

j

X_{ij} (min) = The alternative value to i on the minimum criterion to j

B_j = Weighted criterion importance to j

I_i = Criteria combined index on alternate keys i

c. Systems Development Method

The system development method used in this research is the Prototype method. The prototype method consists of 3 stages [15] as can be seen in Figure 1.
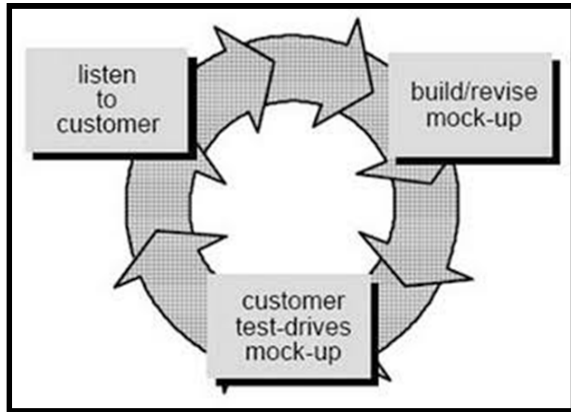

Figure 1. Prototype Model

From the Figure 1, the stages of the prototype are described as follows:

a. Listen-to-Customer Stage

This stage is to identify the needs of potential users by designing business processes, identifying documents, main menus and user interface structures.

b. Build / Revise-Mock-Up Stage

This stage begins with designing a database based on the menu and user interface design. The next process is translation into programming languages and determining the supporting software and hardware.

c. Customer Test-Drive-Mock-Up Stage

At this stage, the simulation is carried out in coordination with potential users to find out to what extent the system can accommodate their needs. When there is a need for improvement, it returns to the Listen-to-Customer Stage and beyond until all user needs are properly accommodated.

3. Result

a. Listen to Customer stage

In this early stage, the researcher made direct observations to see the business process at the blue uphold waste bank. In addition, researchers also conducted interviews with the Directors and existing teachers to determine the assessment criteria and determine the best members. To get the best member, there are two criteria that are assessed. The first criterion, the amount of balance you have, then the second criterion is active savings, where this activity is taken from the number of deposit

transactions made, who is diligent in saving and making transactions. Of the two criteria, the best member will be obtained, but because there is no system for processing this decision support data, it is necessary to create a decision support system using the CPI (Composite Performance Index) method so that it can make it easier for admins to input data while helping uphold blue directors to be more fast in finding out the best members. This decision support system is website-based and the results of the best member data processing are displayed in graphical form.

b. Calculation analysis using the CPI method

The rank of criteria is determined based on several criteria. In the Junjung Biru waste bank, the criteria for the best member are determined based on the amount of balance and active deposit transactions of saving for 6 months. The criteria value is shown in table 1.

Table 1. Pairwise Comparison

Alternative	Criteria	
	C1 Total Balance	C2 Liveliness
A1	Rp 80.000	34
A2	Rp 30.000	16
A3	Rp 60.000	25

Furthermore, the degree of importance of each criterion in the Junjung Biru waste bank is also taken into account. Currently thre are two criteria and these two criteria are equally important to determine the best members, the value of the degree of importance is 0.5 for each criteria.

Table 2. Weight of Interest (P) and Trends

Criteria	C1 Total Balance	C2 Liveliness
Weight	0.5	0.5
Trends	Positive	Positive

1) Calculation of the value of the balance amount
The trend in the criteria for the amount of balance is (+) where the higher the value, the better.

Trends (+) = Value N/Min Value * 100

Table 3. Calculation of Total Balance Value

Numb	Alternative	Balance Amount	N/Min	N/Min*100
1	A1	80.000	2.67	267
2	A2	30.000	1	100
3	A3	60.000	2	200

2) Calculation of Activity Value
The trend in activeness criteria is (+) where the higher the value the better.
Trends (+)= Value N/Min Value *100

Table 4. Calculation of Activity Value

Numb	Alternative	Balance Amount	N/Min	N/Min*100
1	A1	34	2.125	212.5
2	A2	16	1	100
3	A3	25	1.56	156

3) CPI calculation
    CPI = value_criteria_number of balance * weight_count of balances + value_criteria_activity * weight_activity

Table 5. CPI Calculation Results

Numb	Alternative	CPI
1	A1	239,75
2	A3	178
3	A3	100

The final result after computing CPI, A1 gets the highest score and therefore, it becomes the best member at the Junjung Biru waste bank in this period. However, there are 2 people having the same value as the best member, we look again at the deposit transaction history from the second criterion and select the one who is the most active in saving and making deposit transactions each month.

c.   Mock Up Build / Revise Stage

After analyzing the running business processes and determining whether to make the DSS system, the researchers proceeded to make a system design. This study uses a system design in the form of DFD (Data Flow Diagram) in Figure 2 and also ERD (Entity Relationship) in Figure 3. DFD is a network that describes a computerized system, manually process or can be a combination of the two, whose depiction is arranged in the form of a collection of components connected to each other according to the rules of the game [16]. Whereas ERD is a technique to model the data requirements of an organization, usually carried out by system analysts in the requirements analysis stage of a system development project [17]. After the analysis process, the next step is to design the data flow diagram DFD of the system, details of the system DFD can be seen in Figure 2.
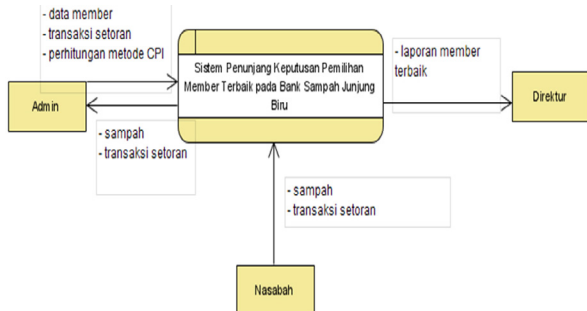

Figure 2. Data Flow Diagram

Figure 2 explains that there are 3 entities in the system, namely customers, admins and directors. In the Customer entity that provides waste to be inputted by the admin, the rupiah value is. then the customer can also provide a deposit for admin input. The admin who processes the best member data is taking member data and member deposit transaction data to find out the existing balance and also to be processed in the system using the CPI method, which then results in the best member being given to the Director Junjung Biru

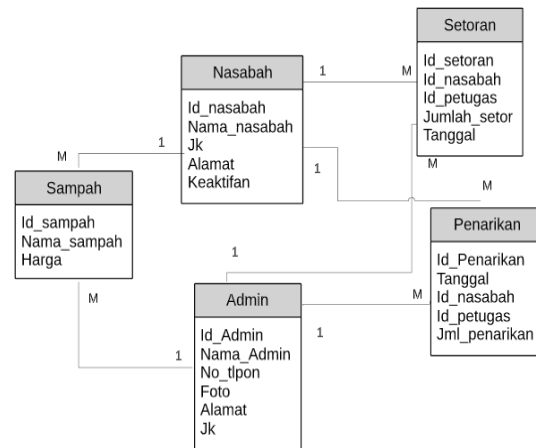Furthermore, in Figure 3, namely ERD (Entity Relationship Diagram) as follows:

Figure 3. Entity Relationship Diagram

4.   Discussion

The resulting discussion is the process of getting the best members at the website-based Junjung Biru waste bank using the CPI method with two criteria, namely by taking data on member deposit transactions that are carried out every month and from the number of balances owned by members and their activeness in saving garbage.
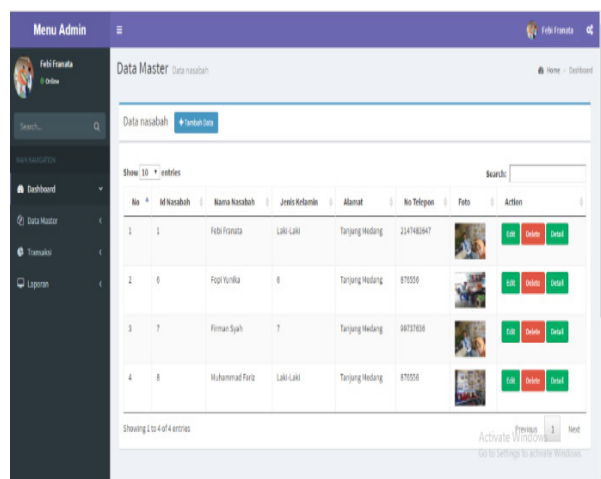

Figure 4. Member data

The member data in Figure 4 shows the data members of the Junjung Biru waste bank. The member

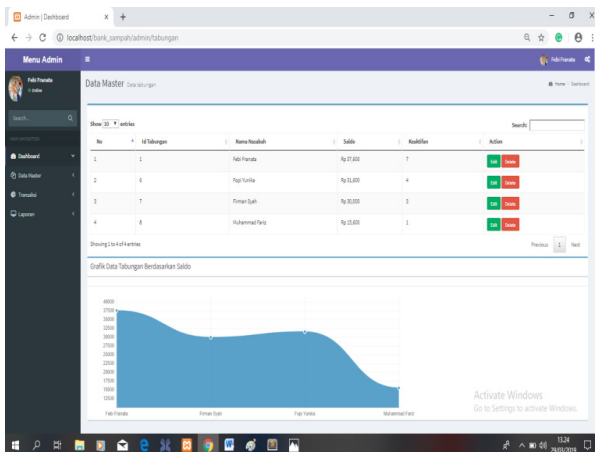d can make deposit transactions as shown in Figure 5 below:

Figure 5. Member Deposit Transaction Data Form

Figure 5 shows the members who have made deposit transactions every month and it shows the deposit as well balances and member activeness level. We can also see a graph depicting the member balance from the highest one to the lowest one. Furthermore, for the calculation of the best members using the CPI method is shown in Figure 6 as follows:
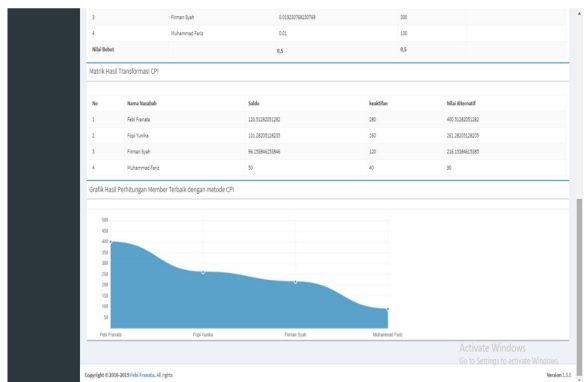

Figure 6. Best Member

Figure 6 explains how the CPI computes is like in the CPI calculation analysis which takes member data and also member deposit data then the CPI method is processed and the results are also illustrated with the best member charts according to the ranking order. Furthermore, the admin will perform the best member report to be given to the Director as shown in Figure 7.

After obtaining the best member, the admin prints the best member report and delivers it to the director.

To evaluate the functionality and usability of the web-based application system, we conduct several testing and analysis. The first testing of the application uses the black-box test. The black-box test is a method for testing software in terms of functional specifications without testing the design and program code [18]. The result of black-box is describe in Table 6.

Figure 7. Best Member Report

Table 6. Blackbox Testing

Test Class	Test Items	Type of Testing	Received
Login	Password Verification	Black Box	√
Customer data processing (Admin)	Add data	Black Box	√
	Data update		√
	See Data details		√
Savings data processing (Admin)	Data update	Black Box	√
Deposit Transaction Processing (Admin)	Add Transaction	Black Box	√
Best Member Report Processing (Admin)	The system performs automatic calculations based on balance and activeness criteria data	Black Box	√

In addition to the black-box testing, we conduct further evaluation for the developed system such as user acceptance and usability testing. The usability testing measures efficiency, ease of learning and the ability to remember how to interact without difficulty [19]. The attributes of usability testing include [20]:
a. Learning, the level of ease with which users learn the website to fulfill basic tasks when they first use the website.
b. Efficiency, the level of speed the user completes tasks after studying the website.
c. Memorability, the level of ease in using the website well, after not using it for a long time.
d. Errors, how many errors users have made and how users can easily fix errors.
e. Satisfaction, the level of user satisfaction in using the website

Usability testing is carried out by giving the user a number of pre-prepared tasks or tasks when interacting

with the system being tested. This task was given to 3 respondents, namely 2 as admin and 1 as a Director who will be directly related to this system. The task given is "means of interaction" in usability measurement [21]. Below is table 7 for the given usability testing tasks:

Table 7. Task Usability Testing

Numb	Question	Score
System Aspects:		
1	Is the appearance of the website easy to understand?	3,40
2	Is the website easy to operate?	3,45
3	Are the colors on the website easy on the eyes and not boring?	3,30
User Aspects (User)		
4	Is the menu display on the website easy to understand?	3,50
5	Is the website easy to read?	3,44
Interaction Aspects:		
6	Is it easy to access every process that will be carried out such as input and ranking?	3,42
7.	Can the website be accessed to be printed and sent to the director?	3,40
8.	Can you access to see the best member report results?	3,54

Table 7 shows the value of user satisfaction or acceptance (acceptance) for each attribute so that this website is suitable for use by users

5.   Conclusion

In this research we can conclude that the DSS for selecting the best member can be modeled using the CPI method. The CPI method is useful for solving problems in order of priority with multiple criteria. The results of this CPI method are output in the form of the best member ranking order which can help the admin to manage and determine the best members. In addition, the developed application can produce the best member reports accurately for the director. In the next research we plan to extend criteria of the best member selection and develop mobile application such that it can be easier and accessible for the administrators and director to support their work

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