

## COLLABORATION OF ANALYTIC HIERARCHY PROCESS AND SIMPLE ADDITIVE WEIGHTING METHODS TO DETERMINE EMPLOYEE SALARY BONUS

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**Abstract**— Improving the quality of employee performance, a company needs motivation in the form of giving employee bonuses. Bonuses are additional wages given to employees for achieving the best work that has been done in a period. The environmental service of Sragen has implemented a bonus for its employees, however, the bonus has not been assessed based on supporting criteria so that it is not considered objective. This research was made to be able to help determine employee bonuses more objectively by using several criteria that became the basis for giving bonuses. The criteria used are cooperation, behavior, attendance, performance, service and adaptation. The Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods are used in this study so that the bonus calculation can be more objective. The results of the weights from the AHP will be used as a reference for the calculation of SAW. The decision support system is developed using Java programming. The system created can produce recommendations for the amount of bonuses received by each employee. So the resulting bonus value is adjusted to the weight given by AHP. The bonus received by each employee according to the previously inputted data is : Cahyo Winarto received Rp. 1.753.772, Mugi Margo : Rp. 1.156.010, Jarwo : Rp. 1.649.858, Suprandi : Rp. 1.175.984 and Anggoro received Rp. 1.322.826.

**Keywords:** AHP method, SAW method, employee salary bonus

**Intisari**— Dalam meningkatkan kualitas kinerja karyawan suatu perusahaan atau instansi perlu adanya motivasi berupa pemberian bonus karyawan. Bonus upah atau gaji merupakan uang tambahan yang diberikan kepada karyawan atas pencapaian pekerjaan terbaik yang telah dilakukan dalam suatu periode. Dinas Lingkungan Hidup

Sragen sudah menerapkan pemberian bonus bagi karyawannya, hanya saja pemberian bonus belum menggunakan penilaian berdasarkan kriteria-kriteria penunjang sehingga dirasa belum obyektif. Kriteria yang digunakan dalam penelitian ini antara lain kerjasama, perilaku, absensi, kinerja, pelayanan dan adaptasi. Penelitian ini dibuat dengan tujuan untuk dapat membantu menentukan bonus karyawan dengan lebih obyektif yaitu menggunakan beberapa kriteria yang menjadi dasar pemberian bonus. Metode *Analytic Hierarchy Process* (AHP) dan *Simple Additive Weighting* (SAW) digunakan dalam penelitian ini agar perhitungan bonus dapat lebih obyektif. Hasil bobot dari AHP akan dijadikan acuan untuk perhitungan SAW. Sistem pendukung keputusan dibuat menggunakan pemrograman Java. Sistem yang dibuat dapat menghasilkan rekomendasi besaran bonus gaji yang diterima masing-masing karyawan. Jadi nilai bonus yang dihasilkan disesuaikan dengan bobot yang diberikan oleh AHP. Bonus yang diterima oleh masing-masing pegawai sesuai dengan data yang telah diinput sebelumnya adalah Cahyo Winarto menerima Rp. 1.753.772, Mugi Margo: Rp. 1.156.010, Jarwo : Rp. 1.649.858, Suprandi : Rp. 1.175.984 dan Anggoro menerima Rp. 1.322.826.

**Kata Kunci:** metode AHP, metode SAW, bonus karyawan.

### INTRODUCTION

In an effort to realize the environmental condition of Sragen city as a city that is comfortable to live in, productive and sustainable, it is time to pay sufficient attention to the existence of green open spaces. Based on the data of field employees who are tasked with maintaining and caring for the

Sragen city environment, there are 65 field employees whose duties include the fleet, cleaning the highway (Patrol Crew), waste processing, garden cleaning (Park Crew), city sweepers.

The system for determining the award of bonuses to environmental service employees of Sragen is still done manually, namely the process of evaluating employee performance carried out by the administration and managers by checking one by one the criteria that are used as basic guidelines and the process starts from selecting, weighing until determine and decide which employees deserve to be given a bonus in one year of work. The assessment process takes a long time, not to mention entering the wrong criteria value (Yulisman and Wahyuni 2021).

Bonuses are additional payments in addition to salaries or wages that are intended to stimulate incentives so that workers can carry out their duties better and more responsibly, with the hope of higher profits. The higher the profit earned by the company, the greater the bonus given to workers. Not all companies or agencies in Indonesia provide bonuses to employees. This bonus salary is usually issued at the initiative of the company leader (Brata and Whidyanto 2017). Giving a bonus is a form of appreciation from the company for employee performance, the amount of appreciation from the company can be seen by the amount of value given to employees who have worked for a long time. Currently, there are still many companies that do not appreciate the performance of their employees on the grounds that it can interfere with company income and can damage company finances. On the other hand, giving bonuses can actually increase employee performance and can be a separate motivation for each employee, giving bonuses has become a company obligation that must be paid to employees (Subagio, Sokibi and Hartoyo 2019). Besides that, there are many companies that have given awards to employees by giving bonus wages or salaries based on employee performance which is considered satisfactory by the company with the aim of motivating employees to work even harder (Stevanus, Handayani and Kristiyanti 2018).

The purpose of this research is to present a system to help determine the bonuses for field employees of environmental service Sragen. The method used is AHP and SAW. By combining the two methods of AHP and SAW, the system that will be created can produce recommendations for bonuses that will be accepted. By using the criteria that have been determined in this study, it is expected to produce more objective wage bonus information.

Analytical Hierarchy Process (AHP) is a method solve a complex problem structured into a hierarchical arrangement, by assigning which is subjective to each variable relatively. Process

Decision making is basically choosing a best alternative (Saputra & Bachtiar, 2021). This decision support model will describe a complex multi-factor or multi-criteria problem into a hierarchy. What is the role of the matrix in determining priorities and how to establish consistency. AHP is widely used to express a very effective decision making from a complex problem (Alif, Arlingga, Suciati and Priambodo 2021).

The Simple Additive Weighting (SAW) method is based on the average. The SAW method is often used as an assessment method related to decisions in various ways attribute. The evaluation score is calculated for each alternative by multiplying the scale value given to the attribute alternatives by the relative importance of the weight given directly by the decision maker followed by adding up the products for all criteria (Fathoni, Darmansah and Januarita 2021). The SAW method requires a matrix normalization process decision (X) to a comparable scale with all available alternative ratings. SAW method often Also known as the weighted addition method. Draft The basis of the SAW method is to find the weighted sum of performance rating on each alternative on all attributes (Yulianingsih and Ependi, 2020).

In the research entitled *Sistem Pendukung Keputusan Menentukan Pemberian Bonus Tahunan Pada Karyawan Menggunakan Metode Analytical Hierarchy Process (AHP)*, the criteria used include: work results in a year, length of work, number of consumers and warning letters. The number of alternatives or employees used for the calculation is only five people. Of the five people obtained the order: Rudi : 0.31, Agus : 0.19, Rahmat : 0.14, Bima : 0.22 and Ujang : 0.15. So it is recommended to get an annual bonus is Rudi because Rudi has the highest rank or value compared to other prospective employees. The results of the AHP calculation are only limited to who is entitled to a bonus (Saefudin and Farhan, 2019).

The study entitled *Penerapan Metode Analytical Hierarchy Process Dalam menentukan Gaji Bonus Karyawan Pada PTPN III Sei Putih*, performed calculations using the AHP method to determine the priority order of employee bonus salaries. The criteria used are only three: length of working, position and class. there are five alternatives used, they are : presence, work discipline, responsibility, confidence, team work. The order of priority on the resulting bonus salary is: confidence (0.336), work discipline (0.221), team work (0.214), presence (0.176) and responsibility (0.109) (Fadillah, Dur and Cipta 2021).

Research conducted by Nababan & Rahim with the title *Sistem Pendukung Keputusan Reward Bonus Karyawan Dengan Metode TOPSIS*, only performs calculations using the TOPSIS method.

The criteria used include absenteeism, behavior, achievement and teamwork. From the twenty employees who became alternatives, a ranking was made and five peoples were taken who were entitled to get a bonus. The five employees are Niko (0.800981), Rikanto (0.69051), Hermansyah (0.69051), Rasyid (0.577268) and Syakeh (0.537239) (Nababan and Rahim 2018).

Research entitled *Metode Weighted Product Pada Sistem Pendukung Keputusan Pemberian Bonus Pegawai Pada CV Bejo Perkasa*, only performs calculations using the WP method. The criteria used include creativity, attendance, professionalism, cleanliness, cooperation, responsibility, manners and appearance. The number of alternatives used is ten employees. The result of the calculation of WP is a ranking of ten employees and determined three employees who get a bonus. The three employees are ridwan (0.1077), Andi (0.1056) and Pitri (0.1051) (Sugiarto, Rizky, Susilowati, Yunita and Hakim 2020).

From previous research, all only use one method in the decision support system. By using 2 methods will be able to produce recommendations that are more objective. The combination of the 2 methods can complete the shortcomings of the methods used previously. Several studies that have been conducted have not created a system so they only perform calculations using tools.

## MATERIALS AND METHODS

### 1. Collecting Data Method

#### a. Observation

This research is motivated by a lack of objective in giving bonuses because no definite criteria have been determined. Preliminary observations were carried out by obtaining information from environmental service officers and functionary of Sragen environmental service. This step is taken to get a real description of the problems that exist in the awarding of bonuses that have occurred so far.

#### b. Interview

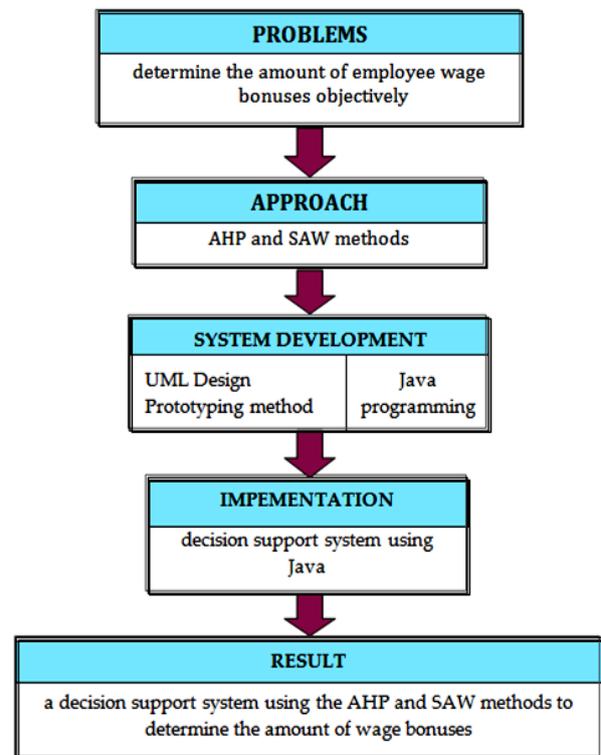
This interview activity is included in the observation stage. Interviews were conducted to obtain additional information about the policy for awarding bonuses. Information on policies that have been in effect so far is obtained from functionary of Sragen environmental service.

#### c. Literature Study

This stage is carried out to collect various information related to this research. The literature used in this study relates to decision support systems, methods in DSS, wages, bonuses and java programming. Previous research is used to compare with this study. Scientific research journals are the

dominant form of literature used in this research (Fridayanthie, et al., 2020).

The conceptual framework of the research can be seen in Figure 1 :



Source : (Setyadi, Fauzi and Nurohim 2021)  
 Figure 1. Conceptual Framework

The initial stage of this research is to identify problems in determining employee bonuses for environmental service employees of Sragen. The identification results are formulated to be completed in this study. This identification stage consists of preliminary observations and identification of problems and research purposes. Identification of the problems involved in determining the amount of the bonus based on preliminary observations. This step is useful so that the problems discussed can be more focused so as to facilitate the implementation of the research and there are no deviations from the main objectives of this research.

### 2. System Development Method

At this stage, the system design is carried out so that it can become an application that can function as expected. Some of the stages carried out in this activity are:

a. Data Collection And Processing: At this stage the collection and processing of the data used to design the DSS for determining the amount of the bonus is carried out. The data used is six criteria; cooperation, behavior, absenteeism, performance, service and adaptation as well as data related to the

six criteria.

b. System Analysis and Design: This stage analyzes the weaknesses of the current system, analyzes the needs of the system to be built and defines the needs that must be met by the system to be built. After analyzing the next phase is system design. In the design stage, a design is made that can describe the workflow of the system to be built, the design of the parts that will be worked on in making the system (Agustina and Sutinah 2021).

c. System Implementation: At this stage, data processing will be carried out for the ratio of the importance of the criteria to be selected to the matrix creation according to the method used which is written in a programming language. The development of a decision support system is also carried out at this stage which includes the input of the interest ratio as well as making calculations according to the stages in AHP and SAW. The AHP method is commonly used to solve multi-criteria problems because it uses a hierarchical structure consisting of goals or objectives, criteria, sub-criteria, and alternatives. The SAW method is used to calculate the final alternative value, namely to calculate the bonus according to the weight generated from the AHP method (Fadilah, Nabilah, Juanita and Larasati 2021). The database management system is used to accommodate and manage the data required by the system developed in this research.

d. Evaluation: In this stage, testing is carried out on the level of success and effectiveness of the system built and an analysis of the results of the evaluation is carried out.

## RESULTS AND DISCUSSION

Based on the system design in the previous research methodology, this research produces a decision support system using the AHP and SAW methods to determine the bonus amount using the Java programming language. The weight value used in the SAW method is obtained from the calculation of the AHP method so that the process in this system uses two mutually supportive methods.

Before calculating using 2 methods, first fill in the criteria that will be used. The criteria used can be changed according to the wishes or existing provisions. The display of input criteria data can be seen in figure 2.

ID Kriteria	Nama Kriteria	Argumen Penilaian
1	Kerjasama	Minus
2	Perilaku	Plus
3	Absensi	Plus
4	Kinerja	Plus
5	Pelayanan	Plus
6	Adaptasi	Plus

Source : (Setyadi, Fauzi and Nurohim 2021)  
 Figure 2. Criteria Input Form

The alternative used in this case is that environmental service Sragen employees must also be included first. The form for inputting employee data is shown in figure 3.

ID	Nama Karyawan	Tempat Tugas	Alamat	Tempat Lahir	Tgl lahir	Telp
1	Jarwo Sukadimejo	Armada	Suruh wangan Rt...	Gawok	12-05-1970	085633251478
2	Mugi Margo Utomo	KRU Patroli	Mbayun Rt 15 Rw...	Jelis	08-01-1965	08212324001
3	Cahyo Winarto	KRU Taman	Sogan Tanggan...	Mondokan	18-09-1976	087866223293
4	Suprandi	Tossa Rute Ahm...	Srawung Rt 4 Gesi	Jambayan	03-12-1967	083365639112
5	dirga bayu	armada	sragen	bandung	12-11-1994	887899
6	fauzi	taman	mojo muljo	sragen	12-06-1994	229811

Source : (Setyadi, Fauzi and Nurohim 2021)  
 Figure 3. Employee Input Form

After the criteria and alternatives are entered, then input the weight values for all employees on each criterion. Weight or value input form is shown in figure 4.

ID Alternatif Kriteria	ID Alternatif	ID Kriteria	Nilai	Nama Alternatif	Nama Kriteria
1	1	1	8.2	Jarwo Sukadimejo	Kerjasama
2	1	2	9.4	Jarwo Sukadimejo	Perilaku
3	1	3	8.4	Jarwo Sukadimejo	Absensi
4	1	4	9.3	Jarwo Sukadimejo	Kinerja
5	1	5	8.2	Jarwo Sukadimejo	Pelayanan
6	1	6	7.4	Jarwo Sukadimejo	Adaptasi
7	2	1	7.3	Mugi Margo Utomo	Kerjasama
8	2	2	8.1	Mugi Margo Utomo	Perilaku
9	2	3	10	Mugi Margo Utomo	Absensi
10	2	4	10	Mugi Margo Utomo	Kinerja
11	2	5	6.3	Mugi Margo Utomo	Pelayanan
12	2	6	8.4	Mugi Margo Utomo	Adaptasi
13	3	1	6.4	Cahyo Winarto	Kerjasama
14	3	2	9.3	Cahyo Winarto	Perilaku
15	3	3	7.3	Cahyo Winarto	Absensi
16	3	4	7.8	Cahyo Winarto	Kinerja
17	3	5	9.8	Cahyo Winarto	Pelayanan

Source : (Setyadi, Fauzi and Nurohim 2021)  
 Figure 4. Value Input Form (Weight)

For the calculation of the AHP and SAW methods, it is presented in 1 form consisting of pairwise comparison ratio, the matrix in AHP and the matrix in SAW. A cut of the pairwise comparison ratio is shown in figure 5.

Kerjasama - Perilaku  
 Kerjasama Lebih Penting Perilaku (Nilai=5)

Kerjasama - Absensi  
 Kerjasama Lebih Penting Absensi (Nilai=5)

Kerjasama - Kinerja  
 Kerjasama Lebih Penting Kinerja (Nilai=5)

Kerjasama - Pelayanan  
 Kerjasama Sedikit Lebih Penting Pelayanan (N...

Kerjasama - Adaptasi

	A1	A2	A3	A4	A5	A6
A1	1	1	2	3	4	5
A2	1	1	1	2	3	4
A3	0,5	1	1	1	2	3
A4	0,333	0,5	1	1	1	2
A5	0,25	0,333	0,5	1	1	1
A6	0,2	0,25	0,333	0,5	1	1
Jml	3,283	4,083	5,833	8,5	12	16

Source : (Setyadi, Fauzi and Nurohim 2021)

Divide each element in the column by the appropriate number of columns. From the matrix element values and the number of each column above, the normalization matrix can be calculated by dividing each element in the column by the appropriate number of columns.

Table 2. Normalization Matrix

	A1	A2	A3	A4	A5	A6	weight
A1	0,305	0,245	0,343	0,353	0,333	0,313	0,315
A2	0,305	0,245	0,171	0,235	0,250	0,250	0,243
A3	0,152	0,245	0,171	0,118	0,167	0,188	0,173
A4	0,102	0,122	0,171	0,118	0,083	0,125	0,120
A5	0,076	0,082	0,086	0,118	0,083	0,063	0,084
A6	0,061	0,061	0,057	0,059	0,083	0,063	0,064

Source : (Setyadi, Fauzi and Nurohim 2021)

In table 2, the last column is the number of each row that will be used as the basis for calculating the consistency matrix. The next step is to create a consistency matrix by multiplying the elements in the matrix column with the appropriate criteria weights. The matrix column element referred to here is the initial matrix, namely the comparison matrix table 3.

Table 3. Consistency Matrix

	A1	A2	A3	A4	A5	A6	Sum
A1	0,315	0,243	0,347	0,361	0,338	0,320	1,923
A2	0,315	0,243	0,173	0,240	0,253	0,256	1,481
A3	0,158	0,243	0,173	0,120	0,169	0,192	1,055
A4	0,105	0,121	0,173	0,120	0,084	0,128	0,733
A5	0,079	0,081	0,087	0,120	0,084	0,064	0,515
A6	0,063	0,061	0,058	0,060	0,084	0,064	0,390

Source : (Setyadi, Fauzi and Nurohim 2021)

The number of each row above is divided by the corresponding priority, so the calculation is as follows :

Priority quotient 1 = 1,923/0,315 = 6,1022

Priority quotient 2 = 1,481/0,243 = 6,1030

Priority quotient 3 = 1,055/0,173 = 6,0834

Priority quotient 4 = 0,733/0,120 = 6,0926

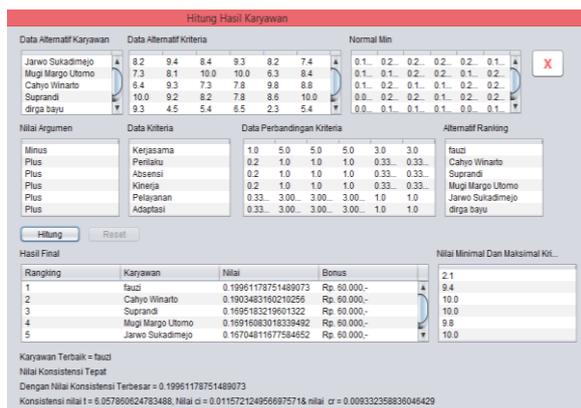
Priority quotient 5 = 0,515/0,084 = 6,0964

Priority quotient 6 = 0,390/0,064 = 6,0965

The next step is to calculate max by adding up the results of the division in step 6 above and then

Source : (Setyadi, Fauzi and Nurohim 2021)  
 Figure 5. Pairwise Comparison Ratio Form

In the calculation form, the admin will carry out the calculation process with the system using the AHP and SAW methods with input from criteria data and alternative criteria data that are already compatible. Then after that press calculate, the calculation process will automatically run and will display the results of the decision support system for determining employee wage bonuses.



Source : (Setyadi, Fauzi and Nurohim 2021)  
 Figure 6. AHP and SAW Calculation Form

The calculation process is presented in the form of a table or matrix starting from the calculation of the interest ratio, calculating the normalization matrix, making a consistency matrix, calculating the weights in the SAW method to calculating the normalization matrix of the SAW method can be explained as follows :

Table 1. Ratio Of Interest

dividing by the number of elements (n = 8). With the above rules, max can be calculated as follows :  
 $(6,1022+6,1030+6,0834+6,0926+6,0964+6,0965)/6=6,096$ . Calculate the consistency index with a formula  $(\lambda_{max}-n)/(n-1)$ .  $IK=(6,096-6)/5 = 0,019$ .

Calculating the consistency ratio with the  $IK/KR$  formula, where  $KR$  is random consistency worth 1.24 because in this case it has a matrix of size 6.  $RK$  value can be calculated =  $0.019/1.24 = 0.015$ . From the  $RK$  value obtained, the previously obtained sub-criteria weight value can be used because the  $RK$  value is less than 0.1. After the calculation of the AHP method is complete and the results are consistent, the next step is the calculation of the SAW method. The preference weight is the main value that represents the absolute preference of the decision maker (values 1-5), where 1 is very low and 5 is very high based on the level of importance).

Table 4. Weight Criteria SAW

	C1	C2	C3	C4	C5	C6
A1	82	94	84	93	82	74
A2	73	81	10	10	63	84
A3	64	93	73	78	98	88
A4	10	92	82	78	86	10
A5	93	45	54	65	23	54

Source : (Setyadi, Fauzi and Nurohim 2021)

The following steps calculate the SAW normalization table. To determine the value in row 1, column 2 (1,2) and 2,3 the normalization table can be calculated as follows:

$$r_{1,2} = \frac{94}{\max(94,81,93,92,45)} = 1$$

$$r_{2,3} = \frac{10}{\max(84,10,73,82,54)} = 0,119$$

The calculation as above is continued until the last row and column. The results of the normalization matrix are shown in table 5.

Table 5. SAW Normalization Matrix

	C1	C2	C3	C4	C5	C6
A1	0,88	1	1	1	0,84	0,84
A2	0,78	0,862	0,119	0,11	0,64	0,95
A3	0,69	0,989	0,869	0,84	1	1
A4	0,11	0,979	0,976	0,84	0,88	0,11
A5	1	0,479	0,643	0,7	0,32	0,61

Source : (Setyadi, Fauzi and Nurohim 2021)

After the normalized matrix is complete, the next step is to determine the ranking so that the best alternative can be chosen with the following settlement algorithm with weights:

$$V_{A1} = (0,88*0,315) + (1*0,243) + (1*0,173) + (1*0,120) + (0,84*0,084) + (0,84*0,064) = 0,94$$

$$V_{A2} = (0,785*0,315)+(0,862*0,243)+(0,119*0,173) + (0,11*0,120)+(0,64*0,084)+(0,95*0,064) = 0,61$$

$$V_{A3} = (0,688*0,315)+(0,989*0,243)+(0,869*0,173) + (0,84*0,120)+(1*0,084)+(1*0,064) = 0,86$$

$$V_{A4} = (0,108*0,315)+(0,979*0,243)+(0,976*0,173) + (0,84*0,120)+(0,88*0,084)+(0,11*0,064) = 0,62$$

$$V_{A5} = (1*0,315)+(0,479*0,243)+(0,643*0,173) + (0,7*0,120)+(0,23*0,084)+(0,61*0,064) = 0,69$$

From the calculated value of  $V$ , it can be determined the amount of bonus wages received by using the basic salary formula (which has been inputted in employee data) multiplied by  $V$ .

$$A1 : 0,94 \times 1.870.000 = 1.753.772$$

$$A2 : 0,61 \times 1.910.000 = 1.156.010$$

$$A3 : 0,86 \times 1.927.000 = 1.649.858$$

$$A4 : 0,62 \times 1.890.000 = 1.175.984$$

$$A5 : 0,69 \times 1.930.000 = 1.322.826$$

The results of these calculations are presented in the form of a report as shown in figure 7.

Nama Karyawan & Hasil Bonus	Tanggal Penetapan
<b>Cahyo Winarto</b> Rp. 1.753.772	0.27844666777283783 11/19/15 7:40 AM
<b>Mugi Margo</b> Rp. 1.156.010	0.24824668639148673 11/19/15 7:40 AM
<b>Jarwo</b> Rp. 1.649.858	0.2392792575500342 11/19/15 7:40 AM
<b>Suprandi</b> Rp. 1.175.984	0.23402738828564124 11/19/15 7:40 AM

Source : (Setyadi, Fauzi and Nurohim 2021)

Figure 7. Bonus Report Form

## CONCLUSION

A Decision Support System has been designed and made which aims to provide recommendations in the decision-making process of employees who will receive salary bonuses from the service. By using the six criteria required by the agency to determine the wage bonus, it is hoped that the amount of the wage bonus will be more objective. In this decision support system there is an alternative value processing that is used as an input for employee value weights which will be processed through the AHP and SAW methods which are then processed to determine the wage bonus to be received. The result of the AHP method is the weight of the six predetermined criteria. The weight produced by the AHP method becomes a reference in the calculation of the SAW method.

The final result of the calculation of the SAW method in the form of the salary bonuses of five employees who have been previously inputted is as follows : Cahyo Winarto received Rp. 1.753.772, Mugi Margo : Rp. 1.156.010, Jarwo : Rp. 1.649.858, Suprandi : Rp. 1.175.984 and Anggoro received Rp. 1.322.826.

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