Jurnal ICT : Information and Communication Technologies, 15 (2) (2024) 62-68

Published by: Marq & Cha Institute

Jurnal ICT : Information and Communication Technologies

Journal homepage: www.ejournal.marqchainstitute.or.id/index.php/JICT

Application of Analytic Network Method for Employee Bonus Determination Process

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Article Info

Article history :

Received : Oct 5, 2024
Revised : Oct 23, 2024
Accepted : Oct 31, 2024

Keywords :

Analytic Network Process (ANP);
Credit Risk;
Employee Bonus System;
Evaluation Criteria;
HR Management;
Reward System.

Abstract

Employee bonus system is one of the important strategies in human resource management (HRM) to improve employee motivation, performance, and loyalty. However, many companies face challenges in creating a fair, transparent, and effective bonus system, mainly due to reliance on traditional assessment methods that are subjective. This research aims to develop an employee bonus model based on the Analytic Network Process (ANP) method that is able to capture the relationship between criteria holistically. The research method involves data collection through observation, interviews, and literature study, and data analysis using ANP to evaluate criteria such as target achievement, productivity, work quality, initiative, teamwork, and attendance. The results showed that ANP was effectively able to produce objective and transparent prioritization calculations, with employee A03 (Dermawan) identified as the highest bonus recipient with a final score of 0.1632 (32.64%). The implications of this research suggest that the application of ANP can help companies design a more fair and strategic reward system, thereby increasing employee confidence in the bonus system. However, this research is limited to one case study and has not evaluated the long-term impact of the developed model. Future research is recommended to expand the coverage to various industry contexts and integrate advanced analytic technologies to improve the accuracy of the model.

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1. Introduction

Effective human resource (HR) management is one of the keys to organizational success in facing the challenges of increasingly complex global competition (Ahmed et al., 2020; Ferraris et al., 2019). Among the various HR management strategies, reward systems, such as employee bonuses, play an important role in improving employee motivation, performance, and loyalty to the company. Bonuses not only serve as a form of appreciation for individual or team achievements, but also as a strategic tool to align employee performance with organizational goals (Hameed et al., 2014; Ngwa et al., 2019). However, implementing a fair, transparent and objective bonus system remains a significant challenge for many companies (Venkatesh et al., 2020). Complexity in this process often arises due to various interrelated and influencing criteria, such as individual performance achievement, contribution to the team, level

of discipline and employee loyalty. In practice, traditional approaches based on subjective assessments tend to result in employee dissatisfaction and a perception of unfairness. Therefore, a methodological approach is needed that is able to capture the complexity of relationships between criteria and support more systematic and data-driven decision-making. Analytic-based approaches, such as the Analytic Network Process (ANP), offer the potential to address these issues by integrating the relationships between influencing criteria into a decision model (Dabab & Fountain, 2020). In the context of HR management, the application of ANP has great potential to create a bonus system that not only reflects fairness, but is also aligned with the company's long-term business strategy (Asadabadi et al., 2019; Taherdoost & Madanchian, 2023).

The process of determining employee bonus awards is often a source of significant challenges for companies, especially in creating a fair, transparent and effective system (Master et al., 2019; Wenzel et al., 2019). One of the main problems is the reliance on traditional, subjective approaches, such as direct assessments from managers or simple hierarchy-based systems. These approaches often fail to consider the complex relationships between various relevant criteria, such as individual performance achievement, contribution to the team, absenteeism, and compliance with company regulations. As a result, there is dissatisfaction among employees who feel that the reward system does not accurately reflect their contributions, which in turn can negatively impact their motivation and loyalty. In addition, traditional appraisal methods often ignore the interplay between criteria, resulting in less comprehensive and strategic decisions. The inability to integrate these complex relationships not only risks lowering the effectiveness of the bonus awarding system, but can also hinder the company's efforts in aligning employee goals with the organization's strategic vision. Therefore, more sophisticated methodological approaches are needed to deal with this complexity and support a more objective and structured decision-making process (Kelechi Chidiebere Ihemereze et al., 2023; Kornelakis, 2018).

Various previous studies have explored the application of analytic methods, such as the Analytic Hierarchy Process (AHP), in supporting strategic decision-making, including in human resource management. These studies show that AHP is effective in identifying priorities based on hierarchical criteria. For example, research in the context of employee performance evaluation or organizational resource allocation shows that this approach can increase the objectivity and transparency of the decision process. However, the limitations of AHP become apparent when faced with situations where criteria have interdependent or non-hierarchical relationships. This condition is often found in the process of determining employee bonuses, where individual performance, loyalty, team contribution, and absenteeism are dynamically interrelated. As a solution to this limitation, some studies propose the use of Analytic Network Process (ANP), which is a development of AHP and is designed to handle the complexity of relationships between criteria that affect each other (Asadabadi et al., 2019; Reisi et al., 2018). Studies on ANP have been applied in various fields, such as project management, supplier selection, and other strategic decision-making. However, the implementation of ANP in the context of employee reward systems, particularly bonus awarding, is still very limited. Most of the literature only touches on the theoretical aspects without providing practical guidance or comprehensive case studies. Therefore, this research aims to bridge the gap by developing a model for ANP implementation in employee bonus awarding systems. This research also offers a new contribution to the literature by presenting a case study that illustrates how ANP can be used to systematically prioritize criteria and sub-criteria, while providing strategic recommendations to improve the fairness and effectiveness of the reward system.

This research aims to develop an employee bonus awarding model based on the Analytic Network Process (ANP) method to support more objective, transparent, and strategic decision-making (Jahandarlashaki et al., 2024; Salehzadeh & Ziaeian, 2024). Through this approach, this research aims to identify the key criteria and sub-criteria that influence bonus awarding decisions, such as individual performance achievement, contribution to the team, loyalty, and absenteeism. In addition, this research aims to analyze the relationships between these criteria in depth, so that companies can understand how each element contributes to the overall decision. By applying ANP, this research also

aims to provide practical guidance for companies in designing a fair reward system that is aligned with the organization's strategic goals. This research is expected to produce a model that can not only increase employees' trust in the bonus system, but also boost their motivation and performance in a sustainable manner. Ultimately, the results of this study aim to make a significant contribution to the scientific literature and practice of human resource management, particularly in the use of analytical methods for strategic decision-making.

While there are a number of studies that have used analytic approaches such as the Analytic Hierarchy Process (AHP) for decision-making in human resource management, there is a significant gap in the literature relating to the application of the Analytic Network Process (ANP) in the context of awarding employee bonuses. Existing research has largely focused on using the AHP for simpler reward systems, where the relationships between criteria are still hierarchical and clearly separated. However, in the context of awarding employee bonuses, the relationships between criteria such as individual performance, loyalty, team contribution and absenteeism are often more complex and mutually influencing, which requires a more holistic approach such as ANP. Furthermore, while there are some studies highlighting the application of ANP in decision-making in other areas, such as supplier selection or project planning, there is limited research integrating ANP with employee performance-based reward systems. This suggests that there has not been much research exploring the potential of ANP to handle interdependencies between criteria in employee bonus awarding systems. Thus, this study fills this gap by proposing the use of ANP as a method to improve fairness and transparency in employee reward systems, and suggesting practical applications that can be implemented by companies.

2. Research Methodolgy

This research methodology is a structured research flow design delivered through sequential images according to what stages will be carried out in conducting a research. This research framework can make it easier to work on the material to be discussed. The research framework used is as follows. The method used in this research is the Analytic Network Process (ANP) Model and describes the system scheme using Data Flow Diagram (DFD), with the following stages (Cheema et al., 2023; Chong & Diamantopoulos, 2020).

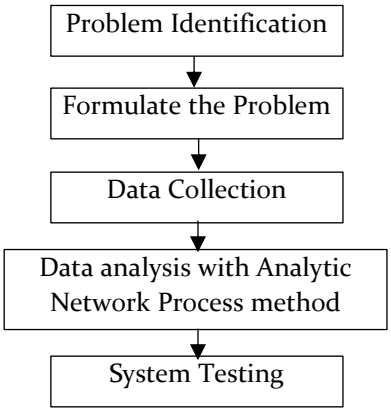

Figure 1. Research Framework

Based on the research framework above, each understanding can be described as follows:

1. Problem Identification

Problem identification is the initial stage in the research or problem solving process. Problem identification can be done by conducting surveys, data analysis, interviews, or field observations. The problem found is the number of proposals for renovation of houses of worship that exceed the budget for repairing houses of worship each year. The next problem is the lack of direct review to the location together so that this problem cannot see the level of damage that is almost similar to the difference in

damage value that is almost invisible to the naked eye. Renovation of houses of worship is determined directly without considering the values of each criteria that have been determined.

2. Formulating the Problem
The research process where the identified problem is studied in general to understand its causes, impacts, and context. With the identification of the problem, the researcher formulates the problem to make the research focused and directed, including in determining the types of data needed according to the research conducted. As for the formulation of problems that have been made, namely how to apply the Analytic Network Process (ANP) method, design and create a Decision Support System in analyzing data for determining employee bonuses.

3. Data Collection
Data collection is collected to support research objectives or solve problems to be solved. Data collection from this study uses two techniques, namely:

a. Observation
   Observation at PT Resmar Hartana Kab. Deli Serdang can be done with a focus on the selection process for determining bonuses for employees. Direct observation of the various stages in the selection process, starting from data collection, data processing to the decision-making process.
b. Interview
   Interviews with PT Resmar Hartana Kab. Deli Serdang related to the determination of employee bonuses.
c. Literature Study
   Literature study to collect scientific articles that are in accordance with the research topic. The scientific articles collected are about the Analytic Network Process method and the provision of renovations to houses of worship.

4. Analisa Data Dengan Metode Analytic Network Process (ANP).
Analisa data dengan metode Analytic Network Process (ANP). membantu dalam penentuan kelayakan pemberian bonus. Data karyawan dievaluasi berdasarkan setiap kriteria yaitu dengan memperhitungkan bobotnya masing-masing. Dengan demikian, analisis data menggunakan metode Analytic Network Process (ANP) memungkinkan untuk mengidentifikasi dan mengevaluasi pemberian bonus karyawan secara lebih terstruktur.

5. Pengujian Sistem
Pengujian sistem dengan Black box merupakan pengujian kualitas perangkat lunak yang berfokus pada fungsionalitas perangkat lunak. Pengujian black box bertujuan untuk menemukan fungsi yang tidak benar, kesalahan antarmuka, kesalahan pada struktur data, kesalahan performansi, kesalahan inisialisasi dan terminasi

3. Results and Discussion

1. Data Analysis
Based on the analysis of the research methods that have been used, the data obtained for research needs after being analyzed are as follows:

Table 2 Employee Data

No.	Code	NIK	Employee Name	Position
1	AO1	2013224127	William	Staf
2	AO2	2013080853	Nadya Paulina	Staf
3	AO3	2013015539	Dermawan	Staf
4	AO4	2013173491	Pranata Dwi Putra	Staf
5	AO5	2013171930	Nonifili	Staf

2. Criteria Data

These criteria serve as indicators that describe certain characteristics of the object or subject being assessed. Here are some criteria for determining employee bonuses

No.	Code	Criteria
1	CO1	Target Achievement
2	CO2	Productivity
3	CO3	Quality of Work
4	CO4	Initiative
5	CO5	Teamwork
6	C06	Attendance

3. Supermatrix Calculation

Supermatrix is a matrix consisting of several matrices. Supermarches are used in ANP because of the interrelationship between elements in the network.

	A01	A02	A03	A04	A05	C01	C02	C03	C04	C05	C06
A01	1	0	0	0	0	0.5417	0.0986	0.082	0.2442	0.1951	0.1539
A02	0	1	0	0	0	0.1069	0.0624	0.2886	0.0794	0.381	0.0881
A03	0	0	1	0	0	0.1837	0.4162	0.1421	0.4017	0.0808	0.4129
A04	0	0	0	1	0	0.0608	0.2618	0.082	0.1373	0.1951	0.2571
A05	0	0	0	0	1	0.1069	0.1611	0.4053	0.1373	0.148	0.0881
C01	0.1646	0.0474	0.0499	0.0394	0.0477	1	0	0	0	0	0
C02	0.0676	0.057	0.1359	0.1409	0.1118	0	1	0	0	0	0
C03	0.0676	0.1251	0.0809	0.0639	0.1973	0	0	1	0	0	0
C04	0.2076	0.1825	0.2136	0.2023	0.1973	0	0	0	1	0	0
C05	0.1274	0.2562	0.0809	0.1199	0.1118	0	0	0	0	1	0
C06	0.3652	0.3318	0.4387	0.4336	0.3339	0	0	0	0	0	1
Total	2	2	2	2	2	2	2	2	2	2	2

Fig 2. Supermatrix Calculation

4. Calculation of Weighted Supermatrix

This supermatrix is formed from each weighted priority vector block based on the inter-cluster pairwise comparison matrix.

	A01	A02	A03	A04	A05	C01	C02	C03	C04	C05	C06
A01	0.5	0	0	0	0	0.2709	0.0493	0.041	0.1221	0.0976	0.0769
A02	0	0.5	0	0	0	0.0534	0.0312	0.1443	0.0397	0.1905	0.044
A03	0	0	0.5	0	0	0.0918	0.2081	0.0711	0.2009	0.0404	0.2064
A04	0	0	0	0.5	0	0.0304	0.1309	0.041	0.0687	0.0976	0.1285
A05	0	0	0	0	0.5	0.0534	0.0805	0.2026	0.0687	0.074	0.044
C01	0.0823	0.0237	0.0249	0.0197	0.0239	0.5	0	0	0	0	0
C02	0.0338	0.0285	0.0679	0.0705	0.0559	0	0.5	0	0	0	0
C03	0.0338	0.0626	0.0405	0.032	0.0987	0	0	0.5	0	0	0
C04	0.1038	0.0912	0.1068	0.1011	0.0987	0	0	0	0.5	0	0
C05	0.0637	0.1281	0.0405	0.06	0.0559	0	0	0	0	0.5	0
C06	0.1826	0.1659	0.2194	0.2168	0.167	0	0	0	0	0	0.5
Total	1	1	1	1	1	1	1	1	1	1	1

Fig 3. Calculation of Weighted Supermatrix

5. Limit Supermatrix Calculation

Forming the limiting supermatrix is done by multiplying the weighted supermatrix repeatedly until the value in each column in one row becomes equal. This process is done by increasing the rank of the weighted supermatrix until it reaches k, where k is a consecutive integer, namely k = 1, 2, ... n.

	A01	A02	A03	A04	A05	C01	C02	C03	C04	C05	C06
A01	0.0956	0.0956	0.0956	0.0956	0.0956	0.0956	0.0956	0.0956	0.0956	0.0956	0.0956
A02	0.0708	0.0708	0.0708	0.0708	0.0708	0.0708	0.0708	0.0708	0.0708	0.0708	0.0708
A03	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632
A04	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973	0.0973
A05	0.0731	0.0731	0.0731	0.0731	0.0731	0.0731	0.0731	0.0731	0.0731	0.0731	0.0731
C01	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345
C02	0.0546	0.0546	0.0546	0.0546	0.0546	0.0546	0.0546	0.0546	0.0546	0.0546	0.0546
C03	0.0492	0.0492	0.0492	0.0492	0.0492	0.0492	0.0492	0.0492	0.0492	0.0492	0.0492
C04	0.1017	0.1017	0.1017	0.1017	0.1017	0.1017	0.1017	0.1017	0.1017	0.1017	0.1017
C05	0.0634	0.0634	0.0634	0.0634	0.0634	0.0634	0.0634	0.0634	0.0634	0.0634	0.0634
C06	0.1966	0.1966	0.1966	0.1966	0.1966	0.1966	0.1966	0.1966	0.1966	0.1966	0.1966
Total	1	1	1	1	1	1	1	1	1	1	1

Fig 4. Limit Supermatrix Calculation

6. Final Result

From the Matrix Calculation Results, the final value and percentage results are as follows:

Table 4. Final Result

No.	Code	Name	Final Score	Percentage
1	AO3	Dermawan	0.1632	32.64 %
2	A04	Pranata Dwi Putra	0.0973	19.46 %
3	A01	William	0.0956	19.12 %
4	A05	Nonifili	0.0731	14.62 %
5	A02	Nadya Paulina	0.0708	14.17 %

4. Conclusion

This study demonstrates that the application of the Analytic Network Process (ANP) method in determining employee bonuses provides a structured and objective approach, effectively integrating interdependent criteria such as performance achievement, team collaboration, and attendance. The findings highlight that ANP can significantly enhance fairness and transparency in bonus allocation, aligning employee rewards with organizational strategic goals and improving employee satisfaction and motivation. However, this research is limited by its reliance on a single case study and the absence of longitudinal data to evaluate the long-term impact of the proposed model. Future studies should consider expanding the sample size across diverse organizational contexts and industries to validate the generalizability of the model. Additionally, integrating advanced data analytics and machine learning techniques could further refine the model's predictive accuracy and adaptability to dynamic organizational needs.

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