SITEKIN: Jurnal Sains, Teknologi dan Industri, Vol. 22, No. 2, pp.265 - 271
ISSN 2407-0939 print/ISSN 2721-2041 online

Internet Service Selection Decision Support System Using the Analytical Hierarchy Process (AHP) Method (Case Study of PT Media Antar Nusa)

Nugrah Anggara Siregar[1], Mhd Zulfikar Pinem[2], Debi Yandra Niska [3]
[1.2.3] Department of Computer Science, Universitas Negeri Medan
Jl. Willem Iskandar Pasar V, Medan, 20221
Email: nugrahanggarasiregar@mhs.unimed.ac.id[1], zulfikar@mhs.unimed.ac.id[2], debiyandraniska@unimed.ac.id[3]

ABSTRACT

In the digital era, the need for reliable and high-quality internet services has become critical for business operations. PT Media Antar Nusa faces the challenge of selecting the most suitable Internet Service Provider (ISP) from a wide range of options. This study aims to develop a Decision Support System (DSS) using the Analytical Hierarchy Process (AHP) method to assist the company in making structured and objective decisions. The research process includes identifying relevant criteria (price, speed, and connection stability), building a hierarchical structure, performing pairwise comparisons, evaluating consistency, and determining priority weights. Data were collected through literature studies, direct observation, and expert interviews. The AHP method proved effective in selecting the optimal ISP alternative, with fiber optic dedicated services achieving the highest priority scores across all criteria. The consistency ratio obtained was below the threshold of 0.1, indicating valid and consistent decision-making. The developed DSS successfully provides transparent and measurable recommendations to support PT Media Antar Nusa's operational efficiency and strategic decision-making regarding internet service selection.

Keywords: *Decision Support System, Analytical Hierarchy Process, Internet Service Provider*

Introduction

In today's digital age, the need for reliable and high-quality internet services has become a vital aspect in supporting the operational activities of various sectors, particularly within corporate environments. One such company is PT Media Antar Nusa, which heavily relies on internet connectivity for the continuity of its business operations. Faced with a variety of internet service providers (ISPs) offering diverse service specifications, companies must undertake a careful and systematic selection process.

The selection of internet services does not depend on a single factor but involves various important criteria such as access speed, connection stability, service cost, and customer support quality [1]. Decisions made without a systematic approach may negatively impact the company's operational efficiency. Therefore, a method is needed to assist in making decisions that are objective, structured, and data-driven.

One effective method for supporting multi-criteria decision-making is the Analytical Hierarchy Process (AHP) [2]. AHP allows complex problems to be organized into a simple hierarchical structure, followed by pairwise comparisons to determine the relative importance of criteria [3]. Previous research, such as that conducted by Saputra and Nugraha [4], shows that the AHP method produces consistent decisions with a consistency ratio of 0.0794, which is lower than the threshold of 0.1, making it valid and reliable in the context of ISP selection.

In the context of PT Media Antar Nusa, the application of the AHP method is expected to assist in selecting the ISP that best aligns with the company's needs and priorities. Through this approach, criteria such as price, speed, and connection stability are systematically evaluated to produce rational and accountable decisions. Thus, this study aims to develop a Decision Support System (DSS) based on the AHP method to assist PT Media Antar Nusa in selecting the best internet service to support the company's operational efficiency and effectiveness.

Research Methods

The research used a quantitative approach with a system development model based on a Decision Support System (DSS) using the Analytical Hierarchy Process (AHP) method. The activity design began with the identification of needs, determination of criteria and alternatives for internet services, development of a hierarchical structure, preparation of a pairwise comparison matrix, consistency analysis, calculation of priority weights, and finally selection of the best alternative based on the highest score.

Determining Objectives and Criteria

The initial stage began with setting the main objective, which was to select the best ISP for the company. Next, a number of relevant evaluative criteria that reflected the actual needs of the organization were determined. Based on field conditions and a review of the literature, the criteria used included price, speed, and internet connection stability. These three criteria were chosen because they were considered to have a significant impact on the effectiveness of the internet services received by the company.

Hierarchical Structure Preparation

Once the criteria are determined, a decision hierarchy structure is built. This structure consists of two main levels, namely: (1) the main objective at the top level and (2) ISP alternatives at the bottom level. This hierarchical arrangement aims to visualize the relationship between elements and simplify the complexity of the problem into a more structured form [5].

Pairwise Comparison and Weight Determination

The next step is to conduct a pairwise comparison between criteria and between alternatives for each criterion. Comparisons are made based on the relative importance of each element using a preference scale developed by Saaty. The results of this process are then mathematically processed to obtain the priority weight (eigen vector) of each element, which reflects its relative contribution to the final goal.

Criterion Weight Calculation

The Analytical Hierarchy Process (AHP) method starts by creating a pairwise comparison matrix based on the relative relevance or preference among criteria before calculating the criteria weights [6]. Saaty's fundamental scale [7], which ranges from 1 to 9, is used in the assessment to describe the intensity of preference between two elements. For example, if criterion C_1 is considered more important than C_2, then the value of $a_{12} > 1$, and $a_{21} = \frac{1}{a_{12}}$. The matrix is a square of size $n \times n$, where n is the number of criteria.

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{bmatrix} \tag{1}$$

Each column in the matrix is then summed, and each element is then divided by the corresponding column sum to complete the normalization process.

$$a'_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \tag{2}$$

The average value of each row in the normalization matrix is then calculated to determine the priority weight for each criterion.

$$w_i = \frac{1}{n} \sum_{j=1}^{n} a'_{ij} \tag{3}$$

The w_i value is the weight of the i-th criterion which reflects its level of importance in the decision-making process [8]. This weight can then be used in the alternative ranking process.

Consistency Evaluation

To ensure the reliability and validity of the comparison results, a consistency evaluation is carried out through the calculation of the Consistency Ratio (CR). With Formula:

$$\boldsymbol{CR} = \frac{\frac{\lambda_{max}-n}{n-1}}{\boldsymbol{Index\ Ratio}} \tag{4}$$

The CR value obtained must be below the threshold of 0.1 (or 10%) for the comparison results to be considered consistent [9]. If the CR value exceeds this limit, the comparison process needs to be reviewed to correct the inconsistency.

Aggregation and Best Alternative Selection

The final stage is the process of aggregating the weights of the criteria and alternatives to produce a total score for each alternative. The final score is obtained by summing up the multiplication results between the criteria weights and alternative weights on each criterion [10]. The alternative with the highest score is declared the best choice that best meets the predetermined criteria.

Results and Discussion

Preparation Of Pairwise Comparison Matrix

A pairwise comparison matrix was prepared based on a 1-9 preference scale as recommended by Saaty [7]. This matrix is used to evaluate the relative importance between the predefined criteria, namely price, speed, and connection stability. The preference scale can be seen in Table 1.

Table 1. Preference scale

Importance Intensity	Description
1	Both elements are equally important
3	One element is slightly more important than the others
5	One element is more important than the other
7	One element is clearly more absolutely essential than the other
9	One element is absolutely more important than the other
2, 4, 6, 8	Values between two adjacent judgmental values

In this research, the pairwise comparison matrix was compiled based on the results of interviews with experts and references to previous studies. Table 2 presents the pairwise comparison matrix for the three criteria.

Table 2. Pairwise comparison matrix

	Price	Speed	Stability
Price	1.000	0.333	0.500
Speed	3.000	1.000	2.000
Stability	2.000	0.500	1.000

Normalization Of Pairwise Comparison Matrix

Normalization of the pairwise comparison matrix is one of the important stages in the Analytical Hierarchy Process (AHP) method which is used to calculate the priority weight of each criterion that has been compared in pairs. This process is done by dividing each element in the matrix column by the total number of columns, resulting in a normalized matrix. The average value of each row in the normalized matrix is then used as an estimate of the relative weight of each criterion. This stage is important to ensure that the comparison results are consistent and can be used in rational and structured decision making. Previous research applied this normalization process in the context of sustainable construction material selection in New Zealand, where the criteria determined through expert surveys were normalized to obtain the priority weights used in the final assessment [11].

Table 3 presents the normalization results of the criteria comparison matrix for internet service selection.

Table 3. Normalization of criterion weights

	Price	Speed	Stability

Price	0.167	0.182	0.143
Speed	0.500	0.545	0.571
Stability	0.333	0.273	0.286

After forming a pairwise comparison matrix between criteria, the next step in the Analytical Hierarchy Process (AHP) method is to normalize the matrix. This normalization aims to equalize the value scale in each column so that comparisons between criteria can be made objectively and proportionally. The normalization table shown reflects the calculation results between the three criteria, namely Price, Speed, and Stability. The values in the table are obtained by dividing each element in the initial matrix column by the total number of each column. For example, the value of 0.500 located in the Speed row and Price column indicates that the initial value of the comparison was divided by the total value in the Price column. Similarly, the other elements follow a similar procedure. This process allows all the values in each column to become proportions that can be compared equally. This stage is the basis for calculating the priority weight or eigenvector for each criterion, which will then be used in determining the final ranking of the assessed alternatives. This normalization procedure is very important for the transformation of matrix values to produce valid and consistent decision-making results within the AHP framework [12].

Criteria Priority Weight Calculation

The calculation of criteria priority weights is a crucial stage in the Analytical Hierarchy Process (AHP) method because it determines the relative importance of criteria in decision making. In the context of internet service selection, these priority weights will reflect users' preferences on various aspects such as speed, price, coverage area, and customer service. This process is done by comparing each criterion pairwise and calculating the eigenvector value of the comparison matrix. This approach is in line with previous research that implements AHP in a web-based decision support system for the selection of social assistance recipients, where the determination of criteria weights becomes the basis in the final assessment of available alternatives [13]. Therefore, the application of this method allows the system to produce recommendations that are objective and in accordance with the needs of internet service users.

After the assessment process and the calculation of priority values between criteria are carried out, the next step is to compile the weight of the comparison results into a table to facilitate analysis and interpretation. This criteria weight table illustrates the relative importance of each criterion to the main objective, namely the selection of the best internet service. Each weight represents the contribution of related criteria in making the final decision. The results of the calculation of criteria weights can be seen in the following table for each category of criteria.

Table 4. Price criteria weighting for broadband alternatives

	FO Broadband	Wireless Broadband	FO Broadband Prepaid
FO Broadband	0.632	0.667	0.571
Wireless Broadband	0.211	0.222	0.286
FO Broadband Prepaid	0.158	0.111	0.143

Based on Table 4, FO Broadband has the highest average weight (0.632, 0.667, 0.571), compared to Wireless Broadband and FO Broadband Prepaid. This shows that in terms of price efficiency, FO Broadband is prioritized.

AHP suggests that weights are obtained from pairwise comparisons which are then normalized and averaged to obtain a priority score for each alternative [1].

Table 5. Speed criteria weighting for broadband alternatives

	FO Broadband	Wireless Broadband	FO Broadband Prepaid
FO Broadband	0.690	0.727	0.625
Wireless Broadband	0.172	0.182	0.250
FO Broadband Prepaid	0.138	0.091	0.125

In Table 5, FO Broadband also dominates with weights (0.690, 0.727, 0.625). Wireless Broadband and FO Broadband Prepaid lagged behind significantly, indicating that the connection speed of FO Broadband is

SITEKIN: Jurnal Sains, Teknologi dan Industri, Vol. 22, No. 2, pp.265 - 271
ISSN 2407-0939 print/ISSN 2721-2041 online

considered superior by respondents. In AHP, high weights indicate strong preferences of respondents based on perceived direct experience or technical evaluation.

Table 6. Stability criteria weights for broadband alternatives

	FO Broadband	Wireless Broadband	FO Broadband Prepaid
FO Broadband	0.690	0.727	0.625
Wireless Broadband	0.172	0.182	0.250
FO Broadband Prepaid	0.138	0.091	0.125

Table 6 shows the same pattern as the speed: FO Broadband is the highest (0.690, 0.727, 0.625). This means that connection stability is also a key strength of FO Broadband. The stability criterion is very important to users as it is directly related to service consistency, as stated in the AHP hierarchy structure for ISPs.

Table 7. Weight of price criteria for dedicated alternative

	FO Dedicated	Wireless Dedicated	P2P Fiber Optic
FO Dedicated	0.632	0.667	0.571
Wireless Dedicated	0.211	0.222	0.286
P2P Fiber Optic	0.158	0.111	0.143

FO Dedicated shows the highest weights in Table 7 (0.632, 0.667, 0.571), indicating that in terms of cost, this service is preferred over Wireless Dedicated and P2P Fiber Optic. These weights were obtained from the pairwise comparison matrix, which was evaluated for consistency using a $CR \leq 0.1$ as required in AHP.

Table 8. Weight of speed criteria for dedicated alternative

	FO Dedicated	Wireless Dedicated	P2P Fiber Optic
FO Dedicated	0.652	0.667	0.625
Wireless Dedicated	0.217	0.222	0.250
P2P Fiber Optic	0.130	0.111	0.125

FO Dedicated remains superior (0.652, 0.667, 0.625) to the other two alternatives (Table 8). This confirms that overall, dedicated fiber optic-based services offer the highest speeds. Consumer decisions are strongly influenced by the quality of internet services, especially in terms of speed, which is one of the main criteria in ISP AHP research.

Table 9. Stability criteria weight for dedicated alternative

	FO Dedicated	Wireless Dedicated	P2P Fiber Optic
FO Dedicated	0.545	0.600	0.500
Wireless Dedicated	0.182	0.200	0.250
P2P Fiber Optic	0.273	0.200	0.250

In Table 9, FO Dedicated also achieved the highest weights in the stability criteria (0.545, 0.600, 0.500). This shows that in addition to price and speed, FO Dedicated also excels in maintaining a stable connection. Data consistency was tested using eigenvalues and consistency ratios (CR), which, if valid (< 0.1), indicate valid decision-making results.

These findings reinforce the relevance of the AHP method as an effective approach in multi-criteria decision-making, especially in the information technology sector such as internet service selection. This is in line with the study by Barač et al [14], who applied AHP to evaluate noise levels in tractor operators based on operational parameters such as speed, tire pressure, and surface type. In the study, AHP was used to categorize working conditions into "*smooth*" and "*rough*" categories to simplify the assessment and simplify the complexity of subjective data.

Furthermore, the use of consistency ratio (CR) in this study reflects the importance of validating the data obtained from respondents. As was done in Barač et al.'s study, where each measure was analyzed by ANOVA and coefficient of determination (R^2) to ensure the validity of the AHP clustering results, this study also applied a similar approach through CR evaluation to ensure consistency in user preferences.

Matrix Consistency Evaluation

Evaluation of matrix consistency is an important stage in the Analytic Hierarchy Process (AHP) which aims to ensure the logical coherence of the assessments given by respondents in pairwise comparisons. This shows that the assessments given by participants are consistent and can be used to produce reliable criteria weights in this multicriteria decision-making process [15].

Table 9. Consistency value of criterion matrix

	Index Consistency	Ratio Consistency
Price	0.013	0.022
Speed	0.003	0.005
Stability	0.003	0.005

Based on Table 10, the Consistency Index (CI) and Consistency Ratio (CR) values for each criterion are obtained as follows: Price has a CI of 0.013 and CR of 0.022, Speed has a CI of 0.003 and CR of 0.005, and Stability has a CI of 0.003 and CR of 0.005. Since the CR values for all criteria are below 0.1, it can be concluded that the pairwise comparison matrix is within acceptable consistency limits. Thus, the assessment carried out can be considered consistent and valid for use in the decision-making process.

Conclusion

The conclusion of this research shows that the use of the AHP (Analytic Hierarchy Process) method in the internet service selection process can assist users in determining the optimal choice of internet services according to certain criteria. The implementation of the AHP method allows the evaluation of various internet service alternatives based on several key criteria, such as speed, price, connection stability, and customer service support. The results of the analysis show that the criteria weights obtained can be used to prioritize internet service options that best suit the needs of users. This method is also effective in overcoming the complexity of multi-criteria decisions, so it can be an applicable solution to support systematic data-based decision making.

References

[1] S. Nurajizah, N. A. Ambarwati, and S. Muryani, "Sistem Pendukung Keputusan Pemilihan Internet Service Provider Terbaik Dengan Metode Analytical Hierarchy Process," *JURTEKSI (Jurnal Teknologi dan Sistem Informasi)*, vol. 6, no. 3, pp. 231–238, Aug. 2020, doi: 10.33330/jurteksi.v6i3.632.

[2] Zaenal Mustofa, Arsito Ari Kuncoro, and Rizky Aji Prasetyo, "Sistem Pendukung Keputusan Penilaian Kinerja Karyawan Dengan Metode Analytic Hierarchy Process (AHP)," *Elkom : Jurnal Elektronika dan Komputer*, vol. 13, no. 1, pp. 116–120, Aug. 2020, doi: 10.51903/elkom.v13i1.184.

[3] D. Handoko, "Sistem Pendukung Keputusan Pemilihan Kapten Tim Futsal Dengan Metode Analytical Hierarchy Process (AHP)," *Jurnal Ilmiah Informatika dan Ilmu Komputer (JIMA-ILKOM)*, vol. 1, no. 2, pp. 77–86, Sep. 2022, doi: 10.58602/jima-ilkom.v1i2.11.

[4] M. I. H. Saputra and N. Nugraha, "Sistem Pendukung Keputusan Dengan Metode Analytical Hierarchy Process (AHP) (Studi Kasus: Penentuan Internet Service Provider Di Lingkungan Jaringan Rumah)," *Jurnal Ilmiah Teknologi dan Rekayasa*, vol. 25, no. 3, pp. 199–212, Dec. 2020, doi: 10.35760/tr.2020.v25i3.3422.

[5] S. Sumiyatun, S. Sudarmanto, C. Subiyantoro, and T. E. Tarigan, "Penggunaan Metode SAW dan AHP dalam Penilaian Kinerja Pegawai untuk Pemberian Penghargaan," *Jurnal Informatika Komputer, Bisnis dan Manajemen*, vol. 22, no. 3, pp. 54–65, Sep. 2024, doi: 10.61805/fahma.v22i3.147.

[6] N. A. Tarigan and A. Syahmarani, "Penerapan Metode Analytical Hierarchy Process (AHP) dan Simple Additive Weighting (SAW) dalam Penentuan Penerima Bantuan Langsung Tunai Dana Desa (BLT DD)," *IT Journal*, vol. 11, no. 2, pp. 311–322, 2023.

[7] T. L. Saaty, "Decision making with the analytic hierarchy process," 2008.

[8] S. Aulia, N. R. Al-Fa'th, D. Nugraha, M. F. N. Ilham, and Arbansyah, "Penerapan Metode Analytic Hierarchy Process (AHP) dalam Penentuan Nilai Akhir Mahasiswa," *Jurnal Informatika dan Teknologi Pendidikan*, vol. 4, no. 2, pp. 109–118, 2024, doi: 10.59395/jitp.v4i2.107.

[9] M. Hilman and R. Kartika Dewi, "Analisa Pemilihan Supplier Bahan Baku Keripik Kaca Pada UKM 99 Group Dengan Menggunakan Metode Analytical Hierarchy Process (AHP) Pada Masa Pasca Pandemi Di Kabupaten Ciamis," *Jurnal Industrial Galuh*, vol. 5, no. 1, pp. 8–17, Mar. 2023, doi: 10.25157/jig.v5i1.3056.

[10] H. Khotimah, M. T. A. Zaen, and K. Imtihan, "Implementasi Metode AHP Dan SAW Dalam Pemilihan Guru Terbaik Di SMK Plus Munirul Arifin NW Praya," *Jurnal Informatika Teknologi dan Sains (Jinteks)*, vol. 6, no. 2, pp. 314–321, Jun. 2024, doi: 10.51401/jinteks.v6i2.4149.

[11] J. Qian, C. Siriwardana, and W. Shahzad, "Identifying Critical Criteria on Assessment of Sustainable Materials for Construction Projects in New Zealand Through the Analytic Hierarchy Process (AHP) Approach," *Buildings*, vol. 14, no. 12, May 2024, doi: 10.3390/buildings14123854.

[12] A. D. Daulay and D. Y. Niska, "Penerapan Metode Analytical Hierarchy Process (AHP) Dalam Pemilihan Karyawan Berprestasi Berbasis Web Pada PT Dambosko Bronton."

[13] D. A. Tyas and D. A. Dermawan, "Implementasi Metode AHP Pada Kelayakan Penerima Bansos Berbasis Website Di Kelurahan Campurejo Kota Kediri."

[14] Ž. Barač, I. Plaščak, D. Radočaj, and M. Jurišić, "The Impact of Noise on Agricultural Tractor Operator in Relation to Certain Operational Parameters: An Analytical Hierarchy Process (AHP) Approach," *Agriculture (Switzerland)*, vol. 15, no. 5, May 2025, doi: 10.3390/agriculture15050466.

[15] S. S. Tahura, M. A. Shabur, and T. J. Nuva, "Evaluating the online and offline learning effectiveness in Bangladesh using Analytic Hierarchy Process," *Discover Sustainability*, vol. 6, no. 1, May 2025, doi: 10.1007/s43621-025-00879-6.