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Determination Of Marketing Area Priority Scale To Enhance Financial Transactions Through Pln Mobile Using Ahp-Topsis Method At Pln Up3 Palembang

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AHP, geo-segmentation marketing priority, PLN Mobile marketing strategy, TOPSIS

Abstract
Adoption disparities are influenced by technological infrastructure quality, financial resource availability, and socio-economic readiness (facilitating conditions). To address these challenges, a multi-criteria decision-making approach is required to identify marketing areas with the highest potential for increasing financial transactions through PLN Mobile. This study aims to determine the priority scale of marketing areas that are most effective in improving PLN Mobile's financial transaction performance by applying the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. The AHP method is employed to determine the relative importance weights among criteria, while TOPSIS is used to rank alternative areas based on their proximity to the ideal solution. The criteria applied include market potential, technological factors, human resource-related aspects, economic conditions, and quality of services. The results are expected to produce an objective and quantifiable model for determining marketing area priorities. Through this approach, PLN UP3 Palembang can optimize marketing resource allocation and expand digital service adoption among customers across South Sumatra.

INTRODUCTION

Digital transformation has fundamentally reshaped service delivery across various sectors, including the energy industry, compelling utilities worldwide to adopt digital platforms for enhanced customer accessibility (Attah et al., 2024; Erhueh et al., 2024; Grievson et al., 2022; Maroufkhani et al., 2022; Nazari & Musilek, 2023). According to the World Bank's Digital Progress and Trends Report 2023 (2024), global digital adoption accelerated significantly following the COVID-19 pandemic, with the percentage of adults in middle-income countries holding formal financial accounts rising from 63% in 2017 to 71% in 2021. However, some developing countries continue to face challenges in technology adoption, including digital divides, literacy and trust gaps, and innovation disparities compared to developed countries (Antonio & Tuffley, 2014; Rice, 2003; Shirazi & Hajli, 2021; Sindakis & Showkat, 2024; Vimalkumar et al., 2021).

The digitalization of Indonesia's public service sector continues to progress rapidly, including in the energy sector managed by PLN. To improve service quality for customers, PLN introduced an innovation in the form of the PLN Mobile application. This application offers customers convenience in performing various financial transactions, such as monthly

electricity bill payments and the purchase of prepaid electricity tokens. Through this application, PLN aims to enhance service efficiency and accessibility across all segments of society (Engka et al., 2022; Kusuma & Damiri, 2021; Kusuma & Rahim, 2021; Yulistiar & Kriswibowo, 2024).

Although the PLN Mobile application provides various conveniences, its national utilization rate remains relatively low. As of December 2024, the number of PLN Mobile users was recorded at 52,480,387 out of a total of 92,877,292 PLN customers, indicating that most customers have not yet maximized its use. This condition highlights a gap between the high potential of PLN Mobile and its actual adoption rate, revealing the need for strategic efforts to overcome barriers that hinder broader and more sustainable usage.

At the regional level, PLN UP3 Palembang has shown comparatively better performance in terms of application downloads. As of June 2025, PLN Mobile downloaders reached 1,037,102 users, or approximately 95.8% of the total 1,081,804 subscribers. However, the high number of downloads has not been matched by active financial transaction activity through the application. During the 2024–2025 period, the average monthly financial transaction rate ranged from only 2%–4% of total PLN Mobile downloaders, despite a slight increase in 2025 compared to the previous year. This indicates that the primary challenge lies not only in increasing the number of users but also in optimizing application utilization to drive a substantial rise in financial transactions.

The uneven use of digital applications such as PLN Mobile reflects the broader challenge of determining appropriate regional priorities for implementing technology-based public service innovations. This issue is closely related to the importance of data-driven strategies for deploying digital technologies effectively across regions. According to Purnamasari et al. (2025), the success of digital transformation in public services is greatly influenced by the quality of technological infrastructure, the availability of financial resources, and the socio-economic readiness of communities (facilitating conditions). Therefore, technology deployment strategies must consider demographic factors, digital literacy levels, and local needs to ensure optimal impact on public service quality.

One of the main factors contributing to the low usage of the PLN Mobile application is the limited penetration of effective communication and promotional efforts in certain service areas, alongside insufficient information about its benefits. This leads some customers to remain unaware of the convenience offered, prompting them to continue using conventional service methods. According to Turahza et al. (2024), PLN's communication strategy has not fully addressed the psychological and technical barriers experienced by users, such as perceptions of unclear usefulness (perceived usefulness), resistance to change (social influence), and limited technological competence among users (ecosystem). Therefore, a more adaptive, educational communication and promotional approach is required to expand PLN Mobile adoption across diverse customer segments.

Meanwhile, research by Mahadewi et al. (2025) demonstrates that data-driven marketing strategies can greatly improve the effectiveness of digital campaigns by targeting specific customer segments and high-potential regions. Through the analysis of customer behavior across digital channels, such strategies have been shown to increase new customer acquisition by up to 40% and sales conversion rates by 15–22%. This data-centric approach

enables companies to better understand customer preferences within each service area, allowing marketing messages to be tailored more effectively to specific audiences.

Similarly, Uddin et al. (2024) explain that the application of geo-segmentation—or location-based marketing—enhances both digital transaction rates and customer loyalty. This approach enables digital service providers to identify regional differences in consumer behavior and customize communication, distribution, and promotional strategies according to local characteristics. Consequently, a marketing strategy focused on high-potential regions not only strengthens market penetration but also improves the efficiency of marketing resource allocation.

By implementing a similar strategy, PLN could increase both adoption and financial transactions through the PLN Mobile application—especially if such a data-driven approach is coupled with educational campaigns in regions with low digital literacy. This strategy would help PLN strengthen customer awareness of digital service benefits and encourage a transition from conventional methods to more efficient, technology-based systems.

The Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are multi-criteria decision-making approaches commonly used to determine strategic priorities across various fields, including marketing. AHP is employed to establish the relative importance of each criterion based on expert judgment, while TOPSIS evaluates and ranks alternatives by calculating their relative distance to the positive (best) and negative (worst) ideal solutions.

In a marketing context, the integration of AHP–TOPSIS has proven effective in helping organizations identify the most impactful strategies. For example, applying the AHP–TOPSIS method in evaluating online marketing strategies within the hospitality industry revealed that search engine marketing had the most significant impact on business performance compared to alternatives such as social media, websites, blogs, email marketing, online communities, online news, and pay-per-click advertising (Ocampo et al., 2021).

Research by Sylvia et al. (2021) further confirms that combining AHP and TOPSIS is effective in determining distribution and marketing strategy priorities for basic consumer goods companies. In a case study of a drinking water distribution company in the Special Region of Yogyakarta, results showed that geographically based strategies had the highest relative proximity values compared to product-based, customer-based, and hybrid strategies. This finding demonstrates that the integration of AHP–TOPSIS enables companies to identify the most profitable marketing area priorities by considering multiple criteria, including customer profiles, corporate capabilities, and customers' financial conditions.

The determination of the priority scale of marketing areas to improve financial transactions through PLN Mobile at PLN UP3 Palembang using the AHP-TOPSIS method is very important to understand how data-based marketing optimization can support the achievement of financial transaction targets. In the midst of the increasing need for digital services in the service sector, PLN faces challenges in determining areas with high transaction potential, considering the demographic, socio-economic, and digital infrastructure variations between regions. With the AHP-TOPSIS approach, this research is expected to be able to provide optimal solutions in identifying marketing priority areas, which can significantly improve the effectiveness of service distribution and financial transactions. The

results of this study have the potential to support a more targeted marketing strategy, have a positive impact on the performance of PLN UP3 Palembang, and meet the needs of the wider community for access to digital services.

This study examines the determination of marketing area priority scales to increase financial transactions through PLN Mobile at PLN UP3 Palembang using the Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. The problem formulation focuses on identifying the most effective marketing area priorities based on various relevant criteria and alternatives. The purpose of this study is to identify the criteria and subcriteria influencing the determination of marketing area priorities; to design an AHP–TOPSIS-based decision-making system for selecting the best alternatives; to establish the priority scale of alternatives according to the defined criteria; and to identify supporting and inhibiting factors along with recommendations to enhance the marketing effectiveness of PLN Mobile. This study is limited to analyzing the prioritization of several criteria and alternatives to improve financial transactions, excluding the creative design aspects of marketing campaigns. The data used in this research refer to business data from June 2025, analyzed through a Multi-Criteria Decision-Making (MCDM) approach utilizing the AHP and TOPSIS methods. The research covers the operational area of PLN UP3 Palembang, which includes Palembang City, Banyuasin Regency, and Musi Banyuasin Regency, with a total customer base of 1,081,804 across various tariff groups. The results of this study are expected to provide a clear, systematic, and measurable foundation for decision-making in determining marketing area priorities. This will enable PLN UP3 Palembang to develop more effective and efficient strategies and resource allocation plans aimed at increasing financial transactions through PLN Mobile.

RESEARCH METHODS

This chapter outlines the stages of research implementation using a combined approach of the Analytic Hierarchy Process (AHP) method and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The research process began with the AHP method to determine the weights of criteria and sub-criteria based on their relative importance, followed by the TOPSIS method to identify and rank the best alternatives.

Data collection was conducted through two sources: primary and secondary data. Primary data were obtained directly from resource persons or experts through discussions and interviews with middle management officials of PT PLN (Persero), such as Senior Managers and Vice Presidents, who possess knowledge and experience relevant to the research focus. Meanwhile, secondary data comprised demographic data of PLN customers, employee data, customer economic conditions from June 2024 to June 2025, as well as literature and academic articles pertinent to marketing analysis and the application of the AHP and TOPSIS methods, serving as additional support to strengthen the research analysis.

Data processing began with the application of the AHP method through the development of a decision hierarchy structure that included objectives, criteria, sub-criteria, and alternatives. This was followed by the construction of a pairwise comparison matrix to assess the relative importance of each criterion and sub-criterion. The comparison results were then normalized to obtain the weights of each criterion, and a consistency test was

performed to ensure the methodological validity of the assessments. Once the weights of the criteria and sub-criteria were established, the TOPSIS method was applied to determine the best alternative. This involved constructing a decision matrix, normalizing the values, and multiplying them by the weights derived from the AHP results.

Subsequently, the ideal and anti-ideal solutions were identified based on the nature of the criteria—whether as benefits or costs—and the distance of each alternative from these solutions was calculated. The resulting relative proximity values served as the basis for determining alternative rankings, with the alternative having the highest value designated as the top priority for enhancing financial transactions through PLN Mobile.

RESULTS AND DISCUSSION

A. Data Collection

1. Determination of PLN Resource Persons in Research

Primary data in this study was obtained directly from the resource persons (experts) through discussion. The experts determined in this study are middle management officials at PT PLN (Persero) who know and understand and have experience about PLN Mobile transactions. This level of middle management positions includes Senior Manager in the Main Unit and Vice President in the Head Office. The researcher selected 2 (two) experts to be involved in this study, namely Vice President of Digital Services PLN Head Office (1 person) and Senior Manager of Commerce and Customer Management of PLN UID South Sumatra, Jambi and Bengkulu (1 person). Table 1 presents information on research sources.

Table 1 Profile of Resource Persons (Expert)

Resource Persons	Experience	Field	Units	Departments
Expert 1	15 years	Digital Services in the Retail Customer Service Division	PLN Head Office	*Vice President*
Expert 2	20 years	Commerce and Customer Management	PLN UID South Sumatra, Jambi and Bengkulu	*Senior Manager*

2. Identify Alternatives in Marketing Area Prioritization

There are 7 (seven) Customer Service Units (ULP) under PLN UP3 Palembang which are used as alternatives in research to determine the priority scale of marketing areas. The seven ULPs are: ULP Rivai, ULP Kenten, ULP Sukarami, ULP Ampera, ULP Mariana, ULP Pangkalan Balai, and ULP Sekayu.

Of the 7 ULPs, 4 ULPs serve the city of Palembang, namely ULP Rivai, ULP Sukarami, ULP Ampera and ULP Kenten. 2 ULPs serve Banyuasin Regency, namely ULP Mariana and ULP Pangkalan Balai. And 1 ULP serves Musi Banyuasin Regency, namely ULP Sekayu. Table 4.2 shows the name ULP as an alternative.

Table 2 Alternatives

Alternatif
ULP Rivai (A1)

ULP Kenten (A2)
ULP Sukarami (A3)
ULP Ampera (A4)
ULP Mariana (A5)
ULP Pangkalan Balai (A6)
ULP Sekayu (A7)

Source: Results of the researcher's own processing

3. Identify Criteria in Prioritizing Marketing Areas

In an effort to improve financial transactions through PLN Mobile, the identification of influencing criteria and sub-criteria is a crucial first step. The criteria that affect the success of digital wallet penetration in Indonesia based on previous research have been partially presented in Chapter II of the Literature Review in Figure 2.3. Furthermore, a study was carried out to complete the necessary criteria and sub-criteria, from several previous studies that were successfully collected, including the research of Wu, et al. (2024), Alora, et al. (2024), Nguyen (2023) and Ren (2025).

A study by Wu, et al. (2024) that aims to use a multicriteria decision-making method to analyze the operation of the electricity market in China, proposes its selection criteria at two levels, namely index and sub-index. These criteria are grouped into three perspectives, namely: market design, market efficiency and development coordination. The criteria and their complete grouping are presented in Table 3.

Table 3 Index and Sub-index by Wu, et al. (2024)

Index	***Sub-index***
Market design	*Medium and long-term contract ratio, Proportion of renewable energy unit capacity, Load peak to valley ratio*
Market efficiency	*Openness of trading market, kWh revenue cost index, Performance rate of power purchase contract*
Development coordination	*Reserve capacity rate, Lender index, Electricity price charge rate/coal price change rate*

Alora, et al. (2024) in their research on the challenges of digital currency adoption in developing countries, grouped the selected criteria and sub-criteria into two levels, namely broad criteria for level 1 and sub-criteria for level 2. The criteria are categorized into five perspectives, namely: technological factors, financial, economic, human resources related, country specific factors. and the Criteria and sub-criteria are presented in Table 3.

Nguyen (2023) in his research analyzing the selection of e-wallets, grouped the selected criteria and sub-criteria into two levels, namely major criteria and sub-criteria. The selected criteria are categorized into three perspectives: perceived usefulness, perceived ease of use and perceived risk, as presented in Table 4.

Table 4 Broad Criteria and Subcriteria based on Alora, et al. (2024)

Broad criteria	Subcriteria
Technological factors	Data security and privacy protection, Comprehensive data and Oracle ecosystem, Digital literacy, Minimal digital divide, Programmable digital currency

Financial	Low-cost access networks, Financial inclusion, Financial integrity and privacy, Peer-to-peer (P2P) payments system, Growth of cryptocurrencies
Economic	Cross-border payments, Dwindling use of cash, Digital economy Cost of cash-based transaction, Adoption of a robust anti-money laundering framework, Coexistence
Human Resources related	Availability of skilled workforce, Identity management system Trust, Collaboration, Convenience and ease of use
Country specific factors	Increased responsibility for benefit transfer schemes/subsidies, CBDC-friendly policy development and regulations, Innovation capability, Scalability, Consumer protection, Public-private partnerships

Table 5 Major Criteria and Sub-criteria by Nguyen (2023)

Major criteria	*Sub-criteria*
Perceiced usefulness	*Social influence, System quality*
Perceived ease of use	*Self-efficacy, Facilitating conditions, Familiarity*
Perceived risk	*Privacy risk, Performance risk, Security risk*

Research by Ren (2025), which analyzes the demand for EV public charging stations in China. In the study, the criteria were grouped into five categories, namely: population distribution, traffic organization, infrastructure, land use and regional economy, as presented in Table 4.6.

Table 6 Criterion Level and Index Level by Ren, et al. (2025)

Criterion level	Index level
Population distribution	Population vitalily intensity on weekday, Population vitalily intensity on rest day
Traffic organization	The closeness of road network, The betweenness of road network, Density of road network
Infrastructure	The scale of commercial centers, The scale of public service facility, The scale of park views, The scale of transportation stations, The scale of residential neighborhoods
Land use	Building coverage, Floor area ratio
Regional economy	Nighttime light distribution, House price level

Table 7 List of Criteria and Sub-criteria for Prioritization of PLN Mobile Marketing Area

Criteria	Sub-criteria	References
Market potential (C1)	Number of customers (C11)	Wu, et al. (2024); Ren, et al (2025)
	Number of PLN Mobile user (C12)	Wu, et al. (2024); Ren, et al. (2025)
	Number of PLN cash-based payment channel (C13)	Ren, et al. (2025)
Technological factor (C2)	Data security and privacy protection (C21)	Alora, et al. (2024)
	Digital literacy index (C22)	Nguyen (2023); Alora, et al. (2024)
	Access network (C23)	Alora, et al. (2024)
Human resources related (C3)	Number of billing management workforce (C31)	Nguyen (2023); Alora, et al (2024)
	Self-efficacy (C32)	Nguyen (2023); Nabila, et al. (2018)
	Social influence (C33)	Nguyen (2023)
Economic (C4)	Income per capita (C41)	Ren, et al. (2025)
	Cost of cash-based transaction (C42)	Alora, et al. (2024)
	Financial inclusion (C43)	

		Alora, et al. (2024)
Quality of services (C5)	Number of complaints (C51)	Wu, et al. (2024)
	Number of transactions (C52)	Wu, et al. (2024)
	Consumer protection (C53)	Alora, et al. (2024)

The results of the literature review produced 5 criteria and 15 relevant sub-criteria as presented in Table 7 Furthermore, the explanation of each criterion and sub-criterion is shown in Table 8.

Table 8 Description of Criteria and Sub-criteria

Criteria and sub-criteria	Description
Market potential (C1) - **Number of customers (C11)** - **Number of PLN Mobile user (C12)** - **Number of cash-based payment channel (C13)**	The market potential reflects the potential for extensification of the number of PLN Mobile application users from the existing PLN customer population. And the potential for intensification of the number of transactions from existing users of the PLN Mobile application. As well as see how many payment points are available as a barrier.
Technological factor (C2) - **Data security and privacy protection (C21)** - **Digital literacy index (C22)** - **Access network (C23)**	A more mature technological readiness will certainly increase the chances of PLN Mobile's marketing success. Indicators related to the readiness of this technology are data security, digital literacy index and the quality of telecommunication networks in the region.
Human resources related (C3) - **Number of billing management workforce (C31)** - **Self-efficacy (C32)** - **Social influence (C33)**	The human resource aspect is used in this study as a representation of the operational ability of a Customer Service Unit in carrying out socialization, education and customer assistance activities related to PLN Mobile services. As well as the ability of customers to use the application independently, and the influence of the surrounding environment.
Economy (C4) - **Income per capita (C41)** - **Cost of cash-based transaction (C42)** - **Financial inclusion (C43)**	The economic aspect in this case includes income per capita which reflects the average economic ability of the customer, as well as how high the cost is to make cash transactions, both direct and indirect costs, for example for transportation from home to payment counters/merchants.
Quality of services (C5) - **Number of complaints (C51)** - **Number of transactions (C52)** - **Consumer protection (C53)**	The quality of PLN Mobile service is a result criterion, which describes the extent to which customers are satisfied with the application. This can be explained by the number of complaints against the application and how many customers have used it to transact. In addition, the level of protection for customers in the event of transaction failures that result in potential retained balances is also an indicator to be considered

Furthermore, Figure 1 below shows a hierarchy model to determine the priority of PLN Mobile's marketing area at PLN UP3 Palembang.

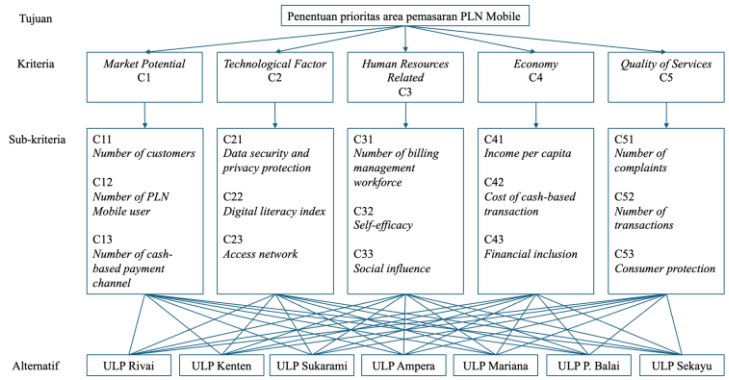

Figure 1 Hierarchy Model for Prioritizing PLN Mobile Marketing Area at PLN UP3 Palembang

B. Data Processing

In processing data in this study, the author uses the steps for implementing AHP TOPSIS in the study of Menon, et al. (2022), as follows:

a. Step 1 Compile a matrix of criteria and sub-criteria with pairwise comparison
b. Step 2 Normalize the matrix.
c. Step 3 Calculate the local weights of the criteria and sub-criteria, and perform a consistency test.
d. Step 4 Compile a matrix of normalization decisions.
e. Step 5 Compile a weighted normalization decision matrix.
f. Step 6 Determine the ideal solution and the anti-ideal solution of each sub-criterion.
g. Step 7 Calculates the distance of each alternative to the ideal solution and the anti-ideal solution.
h. Step 8 Calculate the relative distance of each alternative to the ideal solution.
i. Step 9 Compile alternative rankings based on relative distance.

1. Compile a matrix of criteria and sub-criteria

The pair-comparison assessment was carried out by two resource persons. To obtain the weight of the criteria representing the views of the two sources, an aggregation was carried out with a geometric mean (equation 1) on each element of the matrix (equation 2).

$$c_{ij}^{(\text{gabungan})} = \sqrt{c_{ij}^{(VP)} * c_{ij}^{(SM)}} \quad (1)$$

$$C = \begin{bmatrix} c_{11} & c_{12} & \cdots & \cdots & c_{1n} \\ c_{21} & c_{22} & \cdots & \cdots & c_{2n} \\ \cdots & \cdots & \cdots & \cdots & \vdots \\ \cdots & \cdots & \cdots & \cdots & \vdots \\ c_{n1} & c_{n2} & \cdots & \cdots & c_{nn} \end{bmatrix}, \text{ with } cji = 1 / cij \quad (2)$$

Table 9 below is a paired comparison matrix for the criteria.

Table 9 Criteria Matrix

Criteria	C1	C2	C3	C4	C5
C1	1	3,000	5,000	5,000	5,916
C2	0,333	1	3,000	3,000	3,872
C3	0,200	0,333	1	1,732	3,000
C4	0,200	0,333	0,577	1	3,000
C5	0,169	0,258	0,333	0,333	1

As for the sub-criteria matrix for the criteria of market potential, technological factors, human resources related, economy, and quality of service, respectively are presented in Table 10, Table 11, Table 12, Table 13 and Table 14 as follows.

Tabel 10 Matriks Subkriteria Market Potential

Criteria	C11	C12	C13
C11	1	0,333	3,000
C12	3,000	1	5,916
C13	0,333	0,169	1

Table 11 Matriks Subkriteria Technological Factor

Criteria	C21	C22	C23
C21	1	0,333	0,169
C22	3,000	1	0,258
C23	5,916	3,872	1

Tabel 12 Matriks Subkriteria Human Resources Related

Criteria	C31	C32	C33
C31	1	3,872	5,916
C32	0,258	1	1,154
C33	0,169	0,866	1

Table 13 Economy Subcriteria Matrix

Criteria	C41	C42	C43
C41	1	0,200	0,218
C42	5,000	1	2,449
C43	4,582	0,408	1

Table 14 Matriks Subkriteria Quality of Services

Criteria	C51	C52	C53
C51	1	0,258	0,333
C52	3,872	1	3,000
C53	3,000	0,333	1

2. Normalize the matrix

Next, the matrix is normalized by adding each column (equation 3) so that a normalization matrix is obtained.

$$m_{ij} = \frac{c_{ij}}{\sqrt{\sum_i c_{ij}^2}} \quad (3)$$

3. Calculating the local weights of criteria and sub-criteria and consistency tests

Next, the calculation of the local weights of the criteria and sub-criteria (equation 4) is carried out.

$$W = [w_i]_{nx1} \quad (4)$$

With

$$w_i = \sum_{j=1} \frac{m_{ij}}{n} \quad (5)$$

Next, the consistency index (equation 7) and consistency ratio (equation 8) were calculated, by first calculating the maximum Eigen value (equation 4.6).

$$\lambda_{max} = \frac{\sum_{i=1}^{n} CV_i}{n} \quad (6)$$

$$CI = \frac{\lambda_{max} - n}{(n-1)} \quad (7)$$

$$CR = \frac{CI}{RI} \quad (8)$$

4. Compiling a normalization matrix

Based on the normalization calculation of the matrix and its weights for both the criterion and sub-criterion matrices, the normalization matrix for the criteria and their weights is presented in Table 15, and the sub-criteria normalization matrix and its weights are presented in Table 16, Table 17, Table 18, Table 19 and Table 20.

Table 15 Criteria Normalization Matrix and Criterion Weights

Criteria	C1	C2	C3	C4	C5	*Weight*
C1	0,526	0,609	0,505	0,452	0,352	0,489
C2	0,175	0,203	0,303	0,271	0,231	0,237
C3	0,105	0,068	0,101	0,157	0,179	0,122
C4	0,105	0,068	0,058	0,090	0,179	0,100
C5	0,089	0,052	0,034	0,030	0,060	0,053

The results of the criterion matrix consistency test in Table 15 above show a CR ≈ 0.047 where the value is within the tolerance (<0.10) so that it meets the consistency requirements.

Table 16 Normalization Matrix and Weighting of Market Potential Sub-criteria

Sub-criteria	C11	C12	C13	*Local Weight*
C11	0,231	0,222	0,303	0,252
C12	0,692	0,666	0,597	0,652
C13	0,077	0,113	0,101	0,097

The results of the consistency test of the Market Potential sub-criteria matrix in Table 16 above show a CR of ≈ 0.008 where the value is within the tolerance (<0.10) so that it meets the consistency requirements.

Table 17 Normalization Matrix and Weight of Technological Factor Sub-criteria

Sub-criteria	C21	C22	C23	*Local Weight*
C21	0,101	0,064	0,118	0,094
C22	0,303	0,192	0,181	0,225
C23	0,597	0,744	0,701	0,680

The results of the consistency test of the Technological Factor sub-criteria matrix in Table 17 above show a CR ≈ 0.044 where the value is within the tolerance (<0.10) so that it meets the consistency requirements.

Table 18 Normalization Matrix and Weighting of Human Resources Related Sub-criteria

Sub-criteria	C31	C32	C33	*Local Weight*
C31	0,701	0,675	0,733	0,703
C32	0,181	0,174	0,143	0,166
C33	0,118	0,151	0,124	0,131

The results of the consistency test of the Human Resources Related sub-criteria matrix in Table 18 above show a CR of ≈ 0.007 where the value is within tolerance (<0.10) so that it meets the consistency requirements.

Table 19 Normalization Matrix and Weight of Economy Sub-criteria

Sub-criteria	C41	C42	C43	*Local Weight*
C41	0,094	0,124	0,059	0,093
C42	0,472	0,622	0,668	0,587
C43	0,433	0,254	0,273	0,320

The results of the consistency test of the Economy sub-criteria matrix in Table 19 above show a CR ≈ 0.063 where the value is within the tolerance (<0.10) so that it meets the consistency requirements.

Table 20 Normalization Matrix and Weighting of Quality of Services Sub-criteria

Sub-criteria	C51	C52	C53	*Local Weight*
C51	0,127	0,162	0,077	0,122
C52	0,492	0,628	0,692	0,604
C53	0,381	0,209	0,231	0,274

The results of the consistency test of the Quality of Services sub-criteria matrix in Table 20 above show a CR of ≈ 0.069 where the value is within the tolerance (<0.10) so that it meets the consistency requirements.

Overall, the ranking order of the 15 sub-criteria is presented in Table 4.21. The sub-criteria are sorted from largest to smallest, with the total weight (global weight) calculated from the sub-criterion's weight (local weight) multiplied by the criterion weight (weight).

Table 21 Weights and Ranking Sub-criteria

Criteria	Code	Weight	Sub-criteria	Code	Local Wight	Global Weight	Rank
Market potential	C1	0,489	Number of customers	C11	0,251	0,123	3
			Number of PLN Mobile user	C12	0,651	0,318	1
			Number of cash-based payment channel	C13	0,096	0,047	7
Technological factor	C2	0,237	Data secutiry and privacy protection	C21	0,094	0,022	10
			Digital literacy index	C22	0,225	0,053	6
			Access network	C23	0,680	0,161	2
Human resources related	C3	0,122	Number of billing management workforce	C31	0,702	0,085	4
			Self-efficacy	C32	0,166	0,020	11
			Social influence	C33	0,131	0,016	12
Economy	C4	0,100	Income per capita	C41	0,092	0,009	14
			Cost of cash-based transaction	C42	0,587	0,058	5
			Financial inclusion	C43	0,319	0,032	8
			Number of complaints	C51	0,122	0,006	15
Quality of services	C5	0,053	Number of transactions	C52	0,604	0,032	9
			Consumer protection	C53	0,273	0,014	13

Figure 2 presents the ranking of sub-criteria in increasing financial transactions through PLN Mobile at PLN UP3 Palembang.

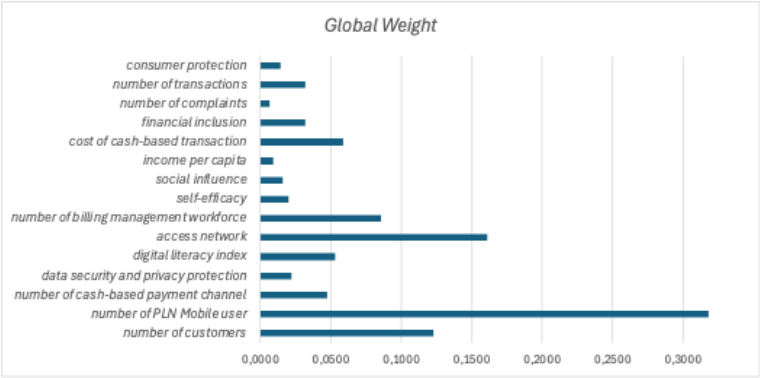

Figure 2 Ranking Sub-criteria in Increasing PLN Mobile Transactions at PLN UP3 Palembang

5. Compile a weighted normalization decision matrix.

The initial value of the sub-criteria of number of customers, number of PLN Mobile users, number of billing management workforce, income per capita, and number of transactions was obtained from PLN's internal data, while other sub-criteria were assessed by experts. The subjective factor of the expert is converted on a general scale as presented in Table 4.22.

Table 22 Intangible Scale Sub-criteria

Atribut *Cost*	Scale	Attribute *Benefit*
Very high	1	*Very low*
High	3	*Low*
***Average* (cukup)**	5	*Average* (cukup)
Low	7	*High*
Very low	9	*Very high*

The sub-criteria of number of customers, number of PLN Mobile users, data security & privacy protection, digital literacy index, access network, number of billing management workforce, self-efficacy, social influence, income per capita, financial inclusion, number of transactions and consumer protection are sub-criteria with benefit attributes. Meanwhile, the number of cash-based payment channels, the cost of cash-based transactions and the number of complaints are sub-criteria with cost attributes. Furthermore, Table 23 presents the initial decision matrix with alternatives referring to Table 2.

The next step is to normalize the decision matrix by adding each column (equation 3) so that the normalization matrix as presented in Table 24 is obtained.

The next step is to calculate the weighted normalization decision matrix. The weighted normalization decision matrix was obtained by multiplying the normalization matrix by the global weight of each sub-criterion. Meanwhile, global weight is obtained by multiplying the local weight of each sub-criterion by the weight of the main criterion. The weighted normalization decision matrix is presented in Table 25.

6. Determine the ideal solution and the anti-ideal solution of each sub-criterion

The ideal solution and the anti-ideal solution for each sub-criterion are determined using equations (9) and (10). The values of ideal solutions and anti-ideal solutions for each sub-criterion are presented in Table 26

The ideal solution

$$yi^{+} = \{\max(cij)\} \quad 9$$

Anti-ideal solution

$$yi^{-} = \{\min(cij)\} \quad 10$$

Table 23 Decision Matrix

Sub-Criteria	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43	C51	C52	C53
A1	147.062	143.125	3,00	7,00	9,00	9,00	38	7,00	7,00	121.154	5,00	7,00	1,73	32.006	5,00
A2	218.551	208.420	3,00	7,00	9,00	7,94	42	7,00	7,00	121.154	3,87	5,92	1,00	51.914	5,00
A3	226.1	219.7	3,0	7,0	9,0	9,0	33	7,0	7,0	121.1	5,0	7,0	1,0	47.02	5,0

	16	54	0	0	0	0		0	0	54	0	0	0	1	0
A4	186.154	177.351	3,00	5,92	9,00	7,94	37	7,00	7,00	121.154	3,87	5,92	1,00	36.803	5,00
A5	100.091	98.078	7,00	5,00	5,00	3,00	16	5,00	5,00	44.734	1,00	3,00	3,00	9.054	3,00
A6	123.834	118.792	5,00	5,00	5,00	3,87	23	5,00	5,00	44.734	3,00	3,00	3,00	1.108	3,00
A7	79.996	71.582	7,94	5,00	5,00	3,87	18	5,00	5,00	142.138	3,00	3,00	3,00	9.083	3,00

Table 24 Decision Matrix Normalization

Sub-Criteria	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43	C51	C52	C53
A1	0,340	0,345	0,228	0,437	0,451	0,498	0,462	0,425	0,425	0,421	0,503	0,501	0,302	0,371	0,444
A2	0,505	0,502	0,228	0,437	0,451	0,439	0,510	0,425	0,425	0,421	0,389	0,424	0,174	0,601	0,444
A3	0,523	0,529	0,228	0,437	0,451	0,498	0,401	0,425	0,425	0,421	0,503	0,501	0,174	0,545	0,444
A4	0,431	0,427	0,228	0,369	0,451	0,439	0,450	0,425	0,425	0,421	0,389	0,424	0,174	0,426	0,444
A5	0,232	0,236	0,532	0,312	0,250	0,166	0,194	0,304	0,304	0,155	0,101	0,215	0,522	0,105	0,266
A6	0,286	0,286	0,380	0,312	0,250	0,214	0,279	0,304	0,304	0,155	0,302	0,215	0,522	0,013	0,266
A7	0,185	0,172	0,603	0,312	0,250	0,214	0,219	0,304	0,304	0,494	0,302	0,215	0,522	0,105	0,266

Table 25 Weighted Normalization Decision Matrix

Sub-Criteria	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43	C51	C52	C53
Global Weight	*0,123*	*0,318*	*0,047*	*0,022*	*0,053*	*0,161*	*0,085*	*0,020*	*0,016*	*0,009*	*0,058*	*0,032*	*0,006*	*0,032*	*0,014*
A1	0,0418	0,1097	0,0108	0,0098	0,0240	0,0801	0,0395	0,0086	0,0068	0,0039	0,0295	0,0160	0,0019	0,0019	0,0064
A2	0,0622	0,1598	0,0108	0,0098	0,0240	0,0706	0,0437	0,0086	0,0068	0,0039	0,0229	0,0136	0,0011	0,0092	0,0064
A3	0,0643	0,1685	0,0108	0,0098	0,0240	0,0801	0,0343	0,0086	0,0068	0,0039	0,0295	0,0160	0,0011	0,0074	0,0064
A4	0,0530	0,1360	0,0108	0,0082	0,0240	0,0706	0,0385	0,0086	0,0068	0,0039	0,0229	0,0136	0,0011	0,0036	0,0064
A5	0,0285	0,0752	0,0252	0,0070	0,0133	0,0267	0,0166	0,0061	0,0048	0,0014	0,0059	0,0069	0,0034	0,0034	0,0039
A6	0,0352	0,0911	0,0180	0,0070	0,0133	0,0345	0,0239	0,0061	0,0048	0,0014	0,0177	0,0069	0,0034	0,0004	0,0039
A7	0,0228	0,0549	0,0285	0,0070	0,0133	0,0345	0,0187	0,0061	0,0048	0,0046	0,0177	0,0069	0,0034	0,0034	0,0039

Table 26 Weighted Normalization Decision Matrix with Ideal Solution and Anti-ideal Solution

Sub-	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43	C51	C52	C53

Criteria															
Attribute	*MAX*	*MAX*	*MIN*	*MAX*	*MAX*	*MAX*	*MAX*	*MAX*	*MAX*	*MAX*	*MIN*	*MAX*	*MIN*	*MAX*	*MAX*
A1	0,0418	0,1097	0,0108	0,0098	0,0240	0,0801	0,0395	0,0086	0,0068	0,0039	0,0295	0,0160	0,0019	0,0119	0,0064
A2	0,0622	0,1598	0,0108	0,0098	0,0240	0,0706	0,0437	0,0086	0,0068	0,0039	0,0229	0,0136	0,0011	0,0192	0,0064
A3	0,0643	0,1685	0,0108	0,0098	0,0240	0,0801	0,0343	0,0086	0,0068	0,0039	0,0295	0,0160	0,0011	0,0174	0,0064
A4	0,0530	0,1360	0,0108	0,0082	0,0240	0,0706	0,0385	0,0086	0,0068	0,0039	0,0229	0,0136	0,0011	0,0136	0,0064
A5	0,0285	0,0752	0,0252	0,0070	0,0133	0,0267	0,0166	0,0061	0,0048	0,0014	0,0059	0,0069	0,0034	0,0034	0,0039
A6	0,0352	0,0911	0,0180	0,0070	0,0133	0,0345	0,0239	0,0061	0,0048	0,0014	0,0177	0,0069	0,0034	0,0004	0,0039
A7	0,0228	0,0549	0,0285	0,0070	0,0133	0,0345	0,0187	0,0061	0,0048	0,0046	0,0177	0,0069	0,0034	0,0034	0,0039
Y^+	0,0643	0,1685	0,0180	0,0098	0,0240	0,0801	0,0437	0,0086	0,0068	0,0046	0,0059	0,0160	0,0011	0,0192	0,0064
Yi^-	0,0228	0,0549	0,0285	0,0070	0,0133	0,0267	0,0166	0,0061	0,0048	0,0014	0,0295	0,0069	0,0034	0,0004	0,0039

7. Calculates the distance of each alternative to the ideal solution and the anti-ideal solution.

Once the ideal solution and the anti-ideal solution are determined, the next stage is, the next stage is to calculate the distance of each alternative to the ideal solution and the anti-ideal solution. The distance of each to the ideal solution and the anti-ideal solution can be calculated by equations (11) and (12).

Distance to the ideal solution

$$d_j^+ = \sqrt{\sum_j (y_i^+ - y_{ij})^2} \tag{11}$$

Distance to anti-ideal solution

$$d_j^- = \sqrt{\sum_j (y_i^- - y_{ij})^2} \tag{12}$$

8. Calculating the relative distance of each alternative to the ideal solution

Once the distance of each alternative to the ideal solution and the anti-ideal solution is known, the next stage is to calculate the relative distance of each alternative. The relative distance can be calculated with the equation 13.

$$C_j = \frac{d_j^-}{d_j^+ + d_j^-} \tag{13}$$

9. Compile alternative rankings based on relative distance

The last stage is to Compile an alternate ranking sequence based on relative distance. The greater the relative distance value of an alternative, the better the alternative. On the other hand, the smaller the relative distance value of an alternative, the smaller the weight of the alternative.

The results of the calculation of alternative distances to ideal solutions and anti-ideal solutions, relative distances and ratings of each alternative are presented in Table 27.

Table 27 Proposed Priorities of PLN Mobile Marketing Area and Relative Distance Value

Code	Alternatif	d_j^+	d_j^-	C_j	*Rank*
A1	ULP Rivai	0,0677	0,0862	0,5599	4
A2	ULP Kenten	0,0215	0,1270	0,8550	1
A3	ULP Sukarami	0,0255	0,1365	0,8427	2
A4	ULP Ampera	0,0404	0,1030	0,7184	3
A5	ULP Mariana	0,1194	0,0320	0,2112	6
A6	The Milk of the Milk	0,1005	0,0428	0,2986	5
A7	ULP Sekayu	0,1352	0,0149	0,0994	7

Figure 3 presents the ranking of Customer Service Units (ULPs) for marketing programs in increasing financial transactions through PLN Mobile at PLN UP3 Palembang.

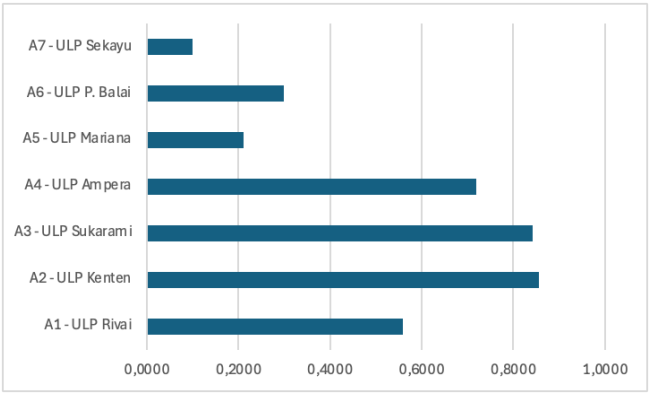

Figure 3 Customer Service Unit Ranking for PLN Mobile Marketing

C. Analysis and Discussion

The PLN Mobile application is a strategic instrument of PLN in supporting the digitization of services, especially for payment transactions. However, the level of use still varies between regions.

Therefore, the determination of the priority of PLN Mobile's marketing area is the right decision, with a multi-criteria decision-making approach, using the Analytic Hierarchy Process (AHP) method to determine the weight of the importance of criteria and sub-criteria, as well as the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to conduct alternative service area (ULP) rankings.

The results of data processing show that the proposed decision-making system is able to accommodate various aspects that affect the success of PLN Mobile adoption, both in terms of market, technology, human resources, economic conditions, and service quality. Thus, the applied AHP-TOPSIS model has proven to be effective in determining the weight of interests and ranking alternative areas of PLN Mobile marketing areas in an objective and structured manner.

1. Weighting Criteria and Sub-criteria Analysis with AHP

The results of the analysis of the criteria with sub-criteria and their weight are greatly influenced by the perceptions, opinions, experiences and assessments of the Company's experts involved in this study as resource persons. The aggregate assessment from the experts was analyzed so that according to Table 15, the market potential criteria were obtained, which is the most influential criterion among other criteria.

Likewise for the sub-criteria, from Figure 2 it is known that the sub-criterion number of PLN Mobile users is the sub-criterion with the greatest influence compared to the other 14 sub-criteria.

2. Alternative Rating Analysis with TOPSIS

Some of the sub-criteria in this study have secondary data from the company's internal, while the rest are assessed by experts. The results of the assessment and data are compiled into a decision matrix where the ideal solution and the anti-ideal solution are then selected based on the benefit or cost sub-criterion attributes. Furthermore, for each alternative, the distance to the ideal solution, the distance to the anti-ideal solution and its relative distance are calculated.

The TOPSIS method determines that the best alternative is the closest to the ideal solution and the furthest from the anti-ideal solution, which is indicated by the value of the greatest relative distance. Table 27 shows that Alternative 2 (ULP Kenten) has the best ranking, and Alternative 7 (ULP Sekayu) has the last ranking.

3. Factors and Recommendations in Determining the Priority Scale of Marketing Areas to Increase Financial Transactions Through PLN Mobile at PLN UP3 Palembang

a. Inhibiting Factors

In this study, the inhibiting factor is the unavailability of access to PLN Mobile application analytics data. Data analytics is an important element in digital marketing research because it provides a comprehensive picture of user behavior, application usage patterns, and the level of effectiveness of marketing programs. The inability of the researcher to obtain technical data (such as daily active users (DAU), monthly active users (MAU), retention rate, churn rate, etc.) caused this study to not be able to explore the dynamics of application use in more depth.

b. Supporting Factors

The factors that support this study are the availability of complete and easily accessible macro data, such as the number of subscribers, the number of application downloaders, and the realization of PLN Mobile transactions per ULP. The macro data plays an important role in the AHP-TOPSIS modeling process because it is able to provide a comprehensive picture of the market potential, application penetration rate, and transaction performance in each ULP. With the availability of adequate macro data, the analysis process runs more efficiently and objectively, and provides confidence that the conclusions produced have sufficient validity in the context of strategic decision-making at the management level.

This research is also helped by the availability of competent internal sources. Internal resource persons at PLN UID S2JB have a deep understanding of regional characteristics, customer behavior, field operational conditions, and dynamics of PLN Mobile in each ULP.

Meanwhile, the resource persons at PLN Head Office have a deep understanding of the development of the PLN Mobile application and its marketing program.

The combination of the availability of complete macro data and in-depth insights from internal sources is an important factor that improves the quality of analysis and the reliability of the results of this study.

c. Recommendations

To open up more comprehensive analysis opportunities, including the behavior of using the PLN Mobile application in each regional segment, in the next study, it is recommended to use analytical data such as daily active users (DAU), monthly active users (MAU), retention rate, churn rate, etc.

CONCLUSION

This study successfully identified five main criteria and fifteen sub-criteria used to determine the priority scale of marketing areas. These criteria and sub-criteria were derived from a literature review and further refined through discussions with PLN experts. The study successfully applied the Analytic Hierarchy Process (AHP) method to determine the priority weights of the criteria and sub-criteria, and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to establish the alternative priority scale of ULPs for PLN Mobile marketing. The results of the AHP–TOPSIS analysis indicate that the top-priority alternative is Alternative 2 (ULP Kenten) with a score of 0.8550, while the lowest-priority alternative is Alternative 7 (ULP Sekayu) with a score of 0.0994. The main obstacle in determining the marketing area priority scale at PLN UP3 Palembang is the lack of access to PLN Mobile analytics data, which limits the study's ability to explore application usage dynamics in greater depth. Supporting factors in this research include the availability of comprehensive and easily accessible macro-level data, such as the number of subscribers, application downloaders, and realized PLN Mobile transactions per ULP, as well as access to competent internal resource persons. For future research, it is recommended that analytical data from the PLN Mobile application be incorporated as additional criteria. This will allow for more in-depth analysis of application usage patterns and the factors influencing the increase in PLN Mobile financial transactions across different regional segments.

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