

Clustering Marketing Strategy Based on Applications for Power Upgrading Customers

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ABSTRACT

The growing electricity demand in Indonesia has led PT State Electricity Company (Perusahaan Listrik Negara/PLN), specifically PLN UID Lampung, to enhance power upgrade services for efficiency and customer-focused solutions. However, electricity sales growth at PLN UID Lampung remains below the national average, hindered by generalized marketing strategies. To address this, implementing a Customer Relationship Management (CRM) application with clustering-based segmentation can provide tailored and targeted promotions, improving sales and competitiveness in the energy sector. This study explores the use of LRFM analysis and K-Means clustering within CRM applications to improve customer management in PLN UID Lampung's power upgrade program. By analyzing customer transaction data, the study identifies four customer clusters with distinct electricity usage behaviors. Cluster 4, the highest revenue contributor, is prioritized for loyalty programs and premium services. Clusters 0 and 1 require educational initiatives and special promotions to increase engagement. The findings suggest optimizing CRM applications for better customer monitoring and segmentation. Recommendations include focusing loyalty programs on Cluster 4, enhancing educational campaigns for Clusters 0 and 1, and regularly evaluating marketing strategies to boost efficiency and retention. These targeted strategies are expected to drive power upgrade program success and strengthen PLN UID Lampung's position in the competitive energy market.

Keywords: Application, Customer segmentation, K-Means Clustering, Marketing strategy, Power Upgrade

ABSTRAK

Meningkatnya permintaan listrik di Indonesia telah mendorong PT Perusahaan Listrik Negara (PLN), khususnya PLN UID Lampung, untuk meningkatkan layanan peningkatan daya untuk efisiensi dan solusi yang berfokus pada pelanggan. Pertumbuhan penjualan listrik di PLN UID Lampung masih di bawah rata-rata nasional, terhambat oleh strategi pemasaran umum. Untuk mengatasi hal ini, penerapan aplikasi Customer Relationship Management (CRM) dengan segmentasi berbasis clustering dapat memberikan promosi yang disesuaikan dan tepat sasaran, meningkatkan penjualan dan daya saing di sektor energi. Studi ini mengeksplorasi penggunaan analisis LRFM dan clustering K-Means dalam aplikasi CRM untuk meningkatkan manajemen pelanggan dalam program peningkatan daya PLN UID Lampung. Dengan menganalisis data transaksi pelanggan, studi ini mengidentifikasi empat cluster pelanggan dengan perilaku penggunaan listrik yang berbeda. Cluster 4, kontributor pendapatan tertinggi, diprioritaskan untuk program loyalitas dan layanan premium. Cluster 0 dan 1 memerlukan inisiatif pendidikan dan promosi khusus untuk meningkatkan keterlibatan. Temuan tersebut menyarankan pengoptimalan aplikasi CRM untuk pemantauan dan segmentasi pelanggan yang lebih baik. Rekomendasi yang diberikan meliputi pemusatan program loyalitas pada Klaster 4, peningkatan kampanye edukasi untuk Klaster 0 dan 1, dan evaluasi strategi pemasaran secara berkala untuk meningkatkan efisiensi dan retensi. Strategi yang terarah ini diharapkan dapat mendorong

JIMKES

Kata kunci: Aplikasi, Segmentasi Pelanggan, K-Means Clustering, Strategi Pemasaran, Peningkatan Daya

INTRODUCTION

The increasing need for electricity in Indonesia has spurred PT State Electricity Company (*Perusahaan Listrik Negara/PLN*) (Persero) to continue developing additional power services for customers to meet increasingly diverse demands. In facing this challenge, the company is faced with the need to adopt a more effective and data-based marketing strategy. The Customer Relationship Management (CRM) application is one solution, enabling comprehensive customer data management to create strategies that are relevant to the needs of each customer segment (Nopus & Ichwanudin, 2021; Aini et al., 2022). PLN Distribution Main Unit (*Unit Induk Distribusi/UID*) Lampung has utilized CRM in managing customer data, including electricity consumption patterns, promotional activities, and customer feedback. However, the marketing strategies implemented are still general, such as the use of flyers or mass broadcasts on social media, so their effectiveness is limited.

The implementation of targeted CRM can increase customer satisfaction and promotional effectiveness through more targeted customer segmentation (Erislan, 2023; Fahrudin & Surianto, 2024). Data on power-additional promotions at PLN UID Lampung show varying results. Several programs, such as Ramadan Peduli in 2021 and Super Merdeka Electric in 2022, managed to exceed their targets, reaching 145.74% and 108.79%, respectively. However, other programs, such as Turn on Independence in 2023, only reached 58.71% of the target. The realization of electricity sales growth in 2023 at PLN UID Lampung is also still below the national average, which is 7.35% compared to 8.62%. This condition highlights the need for a more targeted and data-based marketing strategy. Data-based marketing strategies are useful for identifying, analyzing, and understanding consumer behavior and market trends (Grandhi et al., 2021; Rosário & Dias, 2023).

The CRM-based clustering method can be a solution to increase the effectiveness of promotions (Arumdani et al., 2024). By dividing customers based on characteristics such as electricity consumption patterns, loyalty, and additional power needs, PLN can design more personalized and relevant promotions. This approach allows the company to increase marketing efficiency and ensure that the services provided are in accordance with customer needs. The application of clustering can be an important step to overcome the limitations of conventional marketing strategies that have been used so far (Lopez et al., 2019; Ezugwu et al., 2022; Alpiana et al., 2024). This study aims to optimize the use of clustering-based CRM at PLN UID Lampung to support the achievement of sales targets and increase the company's competitiveness in the competitive energy industry. By directing marketing strategies to the right customer segments, it is hoped that additional power promotions will be more effective, increase customer loyalty, and support sustainable business growth (Widayati et al., 2023; Putri & Rachman, 2024). This strategy is also relevant in meeting increasingly complex customer needs amidst technological developments.

METHODS

This study uses a mixed-method approach that combines descriptive quantitative methods and qualitative case studies to analyze PLN's power-added customer segmentation based on CRM application data (Sugiyono, 2017). Using the K-means clustering method, customers are grouped based on the number of hours of use, transaction frequency, and total transactions. The case study was conducted at PLN UID Lampung, using 2023 power-added promo data from 3,624 customer samples.

This segmentation is the basis for formulating a marketing strategy based on the Recency, Frequency, Monetary (LRFM) model. Determination of the optimal K value for clustering is carried out using the silhouette method, while cluster quality is evaluated using the Within-Cluster Sum of Squares (WCSS). The results of this segmentation are combined with in-depth interviews with PLN UID Lampung management to explore strategic views that are in accordance with customer needs. The research stages include collecting customer data, pre-processing to ensure data is ready to use, clustering simulation using the K-means algorithm, and analyzing segmentation results. Furthermore, in-depth interviews were conducted to integrate managerial perspectives into marketing strategy recommendations. This approach produces recommendations for marketing strategies that are more effective and relevant to the characteristics of PLN UID Lampung's additional power customers. This data-based strategy is expected to improve marketing performance through a deeper understanding of customer behavior. The results of the study not only provide insight for PLN UID Lampung management but can also be used as a reference for developing similar marketing strategies in other units. The integration of quantitative and qualitative analysis provides a comprehensive approach to creating a more targeted and evidence-based marketing strategy.

RESULTS

The Length, Recency, Frequency, Monetary (LRFM) analysis is a powerful tool for customer segmentation, enabling businesses to better understand and categorize their customers. This method evaluates customers across four key dimensions: Length, which measures the duration or number of hours a customer engages with a company's services; Recency, which indicates how recently a customer made a purchase; Frequency, which tracks how often transactions occur; and Monetary, which assesses the total spending by the customer. Through LRFM analysis, companies can uncover valuable insights into customer preferences, behaviors, and engagement patterns. These insights allow for the development of highly targeted and efficient marketing strategies. For instance, businesses can identify high-value customers who are consistent in their spending and engagement, enabling them to focus retention efforts and design loyalty programs for this segment. Similarly, identifying less engaged customers helps in crafting reactivation campaigns or personalized offers to boost their participation. The analysis also aids in resource allocation by prioritizing customer groups based on their potential contribution to revenue. This data-driven approach aligns with modern marketing trends, which emphasize the importance of personalization and customer-centric strategies. As highlighted by Xiahou & Harada (2022); Ho et al. (2023), LRFM analysis not only strengthens customer relationships but also optimizes overall business performance by aligning marketing efforts with specific customer needs.

Table 1. Recapitulation of RFM Analysis Results for the Period June - December 2023

Rates	Length	Frequency	Monetary
B1	0.211	0.255	IDR 1,648,172.00
B2	0.186	0.118	IDR 657,584.00
I2	0.000	0.008	IDR 45,257.00
P1	0.633	0.672	IDR 3,944,348.00
P3	0.830	0.322	IDR 1,784,572.00
R1	28.733	11.284	IDR 75,405,274.00
R1M	6.707	2.576	IDR 16,934,543.00
R2	0.027	0.031	IDR 171,449.00
R3	0.025	0.053	IDR 308,815.00
S2	0.992	0.478	IDR 3,134,536.00
Grand Total	38.344	15.797	IDR 104,034,550.00

The results of the LRFM analysis for the period June to December 2023 at PT PLN UID Lampung show customer segmentation based on tariffs with diverse distribution.

Customers with the R1 tariff have the highest number of Length and Frequency transactions, namely 28,733 Length and 11,284 Frequencies, with a Monetary value reaching IDR 75,405,274.00, indicating the dominance of this group in financial contributions. On the other hand, customers with the I2 tariff recorded the lowest Length and Frequency transactions, respectively 0 and 8, with a Monetary of only IDR 45,257.00. Other customer segments, such as P1 and P3 also showed significant contributions, namely IDR 3,944,348.00 and IDR 1,784,572.00, respectively. The total of all segments recorded was Length 38,344, Frequency 15,797, and Monetary IDR 104,034,550.00. This data provides a clear picture of customer behavior and the potential of each segment in supporting CRM application-based marketing strategies at PLN UID Lampung.

K-Means cluster analysis is an effective technique in grouping data based on similar characteristics, and is often used in various fields, including business, marketing, and research. In the context of PT PLN UID Lampung, the K-Means method can help identify customer segments that have similar behavioral patterns based on parameters such as length, frequency, and monetary contribution. By implementing this analysis, companies can understand more deeply about the characteristics of existing customers, so they can develop more targeted marketing strategies, improve services, and maximize customer satisfaction.

Table 2. SSE Evaluation Based on Number of Clusters

Number of Clusters (k)	Sum of Squared Errors (SSE)
1	0
2	0.9816
3	3
4	0.9296
5	0.9254
6	0
7	0.5978
8	0.9983
9	0.998
10	0.9308

Based on Table 2, SSE is used to measure the squared error in data clustering, the smaller the value indicates that the cluster model is better at clustering data. From the table, it can be seen that at k = 6, the SSE reaches a value of 0, indicating that dividing the data into 6 clusters is the most optimal. Meanwhile, at k = 2, the SSE reaches 0.9816, and the SSE value decreases slightly with increasing number of clusters, such as at k = 4 with 0.9296 and k = 5 with 0.9254. However, although the SSE value at k = 6 is the best, other results, such as k = 7 and k = 10, show higher values, 0.5978 and 0.9308 respectively, indicating that a larger number of clusters does not always provide better results.

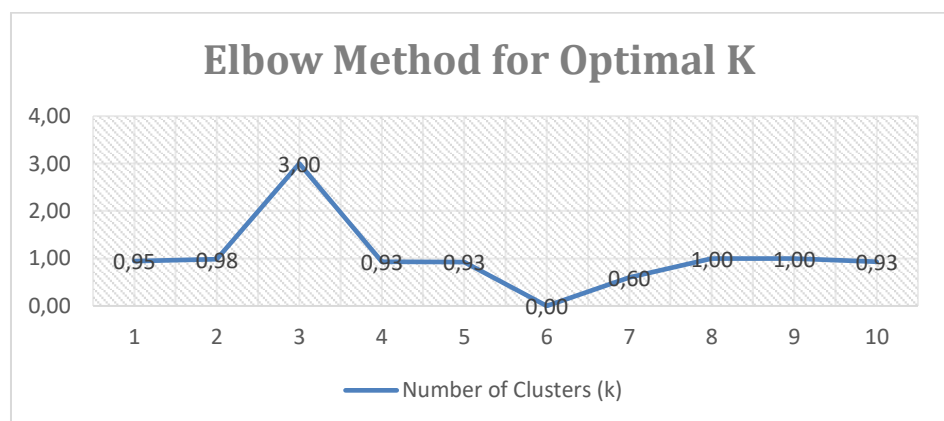


Figure 1. Elbow Method Graph

The Elbow Method graph shows that as the number of clusters (k) increases, the Sum of Squared Errors (SSE) value decreases significantly. Initially, from $k = 1$ to $k = 2$, the SSE decreases quite drastically, indicating that adding clusters in this range greatly improves data separation and reduces errors. However, after $k = 3$ it increases rapidly. Based on the shape of this graph, the optimal number of clusters is probably 3, because after this point, adding clusters does not significantly improve data separation. Thus, using 4 or 5 clusters offers the best balance between model complexity and error reduction efficiency in data clustering.

Table 3. Cluster Summary

Cluster	Rates	Number of Data Per Cluster	Average Length	Average Frequency	Average Monetary
1	B1, B2, I2, R2, R3	5	0.090	0.093	IDR 566,855
2	P1, P3, S2	3	0.818	0.491	IDR 2,954,485
3	R1M	1	6.707	2.576	IDR 16,934,543
4	R1	1	28.733	11.284	IDR 75,405,274

The results of the Cluster Summary Measurement identified four clusters, each of which has different characteristics. The first cluster consists of tariffs B1, B2, I2, R2, and R3, with 5 data per cluster. The average Length and Frequency in this cluster are 0.090 and 0.093, while the average Monetary reaches IDR 566,855. The second cluster includes tariffs P1, P3, and S2, with 3 data. The average Length in this cluster is 0.818, the frequency is 0.491, and the average Monetary is IDR 2,954,485. The third cluster includes tariffs R1M, with 1 data, and shows an average Length of 6.707, Frequency of 2.576, and a very high average Monetary of IDR 16,934,543. Finally, the fourth cluster consists of the R1 rate, with a data count of 1, showing a very large value on the average Length (28.733), frequency (11.284), and Monetary which reaches IDR 75,405,274.

DISCUSSION

The Length, Frequency, and Monetary (LRFM) analysis at PT PLN UID Lampung underscores the significance of customer segmentation in shaping marketing strategies through CRM applications. In this analysis, the R1 customer category stands out for its high scores in all LRFM dimensions, reflecting strong customer loyalty and substantial revenue contributions. According to Keller (2020), focusing on high-value customers is crucial for long-term business success. To retain these customers, PLN should prioritize retention strategies such as reward programs and priority services, ensuring a stable revenue stream. The B1 customer category also demonstrates potential with favorable length and frequency metrics, making it an ideal target for optimization through cross-selling or upselling strategies. This aligns with the Customer Lifetime Value (CLV) concept, which highlights the importance of offering additional products or services to enhance customer relationships (Verhoef et al., 2015). In contrast, the I2 category poses challenges due to low engagement and financial contribution. As per Reichheld & Teal's (1996) Loyalty Effect theory, low interaction rates indicate a risk of customer churn. PLN can address this through reactivation strategies leveraging CRM data, such as offering tailored discounts or special service packages.

Interviews with the Senior Commercial Manager of PLN UID Lampung and Assistant Commercial Managers across four PLN Implementation Units validate the prioritization of high-value customers. These customers often require advanced services, such as additional power requests. Boppana (2021) confirms that effective CRM strategies targeting high-value segments can boost customer loyalty while reducing acquisition costs. Overall, the LRFM analysis highlights the necessity of customer clustering to guide resource allocation and develop personalized, data-driven marketing programs (Lemon & Verhoef, 2016). This approach ensures PLN can enhance relationships with existing customers while increasing participation from less active segments. The clustering results further reveal four distinct customer groups. Cluster 1,

with tariffs such as B1, B2, I1, R2, and R3, records the lowest scores in length, frequency, and monetary value. Wedel & Kamakura (2002) suggest, such low-activity segments require tailored strategies to boost engagement, including promotional campaigns or discounts. Keller (2020) supports this, emphasizing intensive reactivation efforts for underperforming segments to prevent churn. Cluster 2 performs slightly better but still exhibits medium-low activity. This group, comprising small households and businesses, could benefit from upselling and cross-selling strategies, such as electrifying lifestyle services or introducing energy-efficient smart meters (Buttle & Maklan, 2019).

Cluster 3, characterized by higher usage and financial contributions, represents significant revenue potential. Payne & Frow (2013) advocate for focused retention efforts for such high-value customers, including loyalty programs and special incentives like discounted power services. Meanwhile, Cluster 4, the most dominant group, exhibits the highest LRFM scores. These customers, typically from business or industrial segments with complex energy needs, significantly contribute to revenue. Verhoef et al. (2015) recommend personal, proactive CRM strategies for this cluster, including intensive consultations, energy efficiency programs, and exclusive service packages. Customer clustering through LRFM analysis offers PLN actionable insights into customer behavior and revenue contribution, enabling more targeted marketing strategies. This data-driven approach aligns with modern CRM practices, which prioritize personalization and customer engagement to optimize outcomes (Babin & Harris, 2023). Clusters with high engagement, such as Cluster 3 and 4, require strategies focused on loyalty and retention. In contrast, low-activity clusters, such as 1 and 2, need interventions to enhance their participation, potentially through educational campaigns or promotional offers.

Interviews with PLN UID Lampung's senior management underscore the practical benefits of CRM in customer segmentation. High-activity customers in Clusters 3 and 4 respond well to power-up programs, as their energy needs align with additional service offers. Conversely, Clusters 0 and 1, with lower activity levels, demand personalized marketing efforts to increase engagement. Such strategies include intensive education on additional power benefits and promotional campaigns tailored to customer-specific needs (Buttle & Maklan, 2019; Keller, 2020). The CRM-driven segmentation model adopted by PLN provides a competitive edge in the energy industry. By analyzing electricity usage data, PLN can effectively target customer clusters with specific programs, fostering long-term customer loyalty and revenue growth. Chaffey et al. (2009) emphasize the importance of CRM applications in managing customer interactions and customizing marketing efforts. PLN's segmentation strategy highlights the importance of differentiating approaches across clusters. High-value segments receive focused retention efforts, while lower-value clusters benefit from engagement-enhancing campaigns.

PLN's integrated CRM approach enables the company to design programs that meet the unique needs of different customer groups, ensuring resources are allocated efficiently and business growth is maintained. Supported by CRM theories and insights from interviews, this strategy highlights the importance of customer segmentation. By identifying high-revenue customers, PLN can focus on retention strategies to maintain their loyalty, while simultaneously implementing targeted initiatives to increase participation among less engaged segments. This dual approach combines sustainable customer engagement with personalized marketing efforts, ensuring that every customer group receives attention tailored to their specific behavior and contribution. High-value customers benefit from loyalty programs and specialized services, fostering long-term relationships. Meanwhile, low-activity segments are encouraged to engage more actively through promotional offers and educational campaigns. Such a data-driven strategy strengthens PLN's ability to meet customer expectations, ultimately enhancing satisfaction across all segments. At the same time, it positions the company competitively in the energy sector by leveraging advanced CRM tools to balance customer retention and acquisition. This proactive and customer-focused approach not

only optimizes revenue streams but also supports PLN's commitment to sustainable growth and operational efficiency.

CONCLUSION

Customer segmentation based on hours of electricity use and usage patterns divides additional power customers into four main clusters with distinct behaviors. Cluster 4 emerges as the most significant contributor to revenue due to its high electricity usage, making it a priority for retention strategies. On the other hand, Clusters 1 and 2, characterized by lower usage and fewer hours of operation, require targeted approaches to increase engagement and usage. To address the unique characteristics of each cluster, PT PLN UID Lampung can leverage CRM applications to design and implement effective marketing strategies. For Cluster 4, loyalty programs can help maintain customer satisfaction and encourage continued high usage. In contrast, Clusters 1 and 2 may benefit from educational promotions and energy-saving solutions to boost their engagement and electricity consumption. Similarly, Cluster 3, with moderate usage levels, can be targeted with tailored loyalty programs to solidify their relationship with PLN. The integration of real-time monitoring through CRM enables PLN to efficiently track customer behavior and dynamically adapt marketing strategies. This capability not only enhances customer engagement but also improves retention rates by aligning services with customer needs. Tailored initiatives, such as energy-saving solutions for low-usage clusters, ensure resources are allocated effectively. Regular evaluations of these programs ensure that the marketing efforts remain relevant and impactful. By optimizing CRM applications, PLN can better understand customer behavior, implement data-driven strategies, and improve overall marketing efficiency, leading to higher customer satisfaction and sustained revenue growth.

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