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CONSUMER SENTIMENT ANALYSIS TO THE SERVICE PERFORMANCE OF THE INDONESIAN STATE ELECTRICITY COMPANY DURING THE COVID-19 PANDEMIC

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Abstract

This study aims to identify problems in the service performance of the State Electricity Company/PLN in Indonesia during the Covid-19 pandemic and to formulate priority solutions for service improvement. The methods used in this research are Naïve Bayes Classifier, Text Associations, and Analytic Network Process (ANP). The Naïve Bayes Classifier and Text Associations methods identify the most dominant problems based on social media's consumer perceptions. The recognized text associations refer to the marketing mix elements, including product, price, promotion, place, physical evidence, people, and process. The data sources in this study are consumer comments submitted on Twitter, Facebook, and PLN Mobile for the period March-June 2020. Furthermore, the ANP method is used to determine service improvement priorities, where the decision-makers in the weighting come from the company management. Based on Text Associations results, several dominant problems were identified: rising bills, slow response to consumer complaints, frequent power outages, unstable power supply voltages, and unreliable PLN-mobile applications. When referring to the marketing mix elements, these problems fall into product, price, and process. Furthermore, based on the ANP method's application, the main priority for improvement is to change the recording system for consumer kWh meters that are still using the conventional system (postpaid) to a token system (prepaid). This recommendation is considered appropriate to solve problems during the Covid-19 pandemic. There is no need to assign PLN employees to manually record bills through direct visits to consumer locations through its implementation. The next priority for improvement is the readjustment of distribution transformers and the upgrading of electricity grid technology. The combination of Naïve Bayes Classifier and Text Associations to Analytic Network Process (ANP) can broadly capture today's consumers' needs and wants to be used as a frame of reference in developing decision-making models to formulate priority solutions for service improvement.

Keywords: Analytic Network Process, Marketing Mix, Naïve Bayes Classifier, Sentiment Analysis, Text Associations.

INTRODUCTION

PLN is one of the state-owned enterprises in Indonesia that provides electricity supply services to the public, industry, institutions, and various other groups. Based on the reviews on social media, multiple problems are widely discussed by consumers in 2020, especially related to the quality of PLN services during the Covid-19 pandemic. Of course, the high level of complaints must be followed up by PLN to improve service quality. In Figure 1, the word cloud results are presented based on consumer comments or reviews regarding PLN services' performance using Indonesian.

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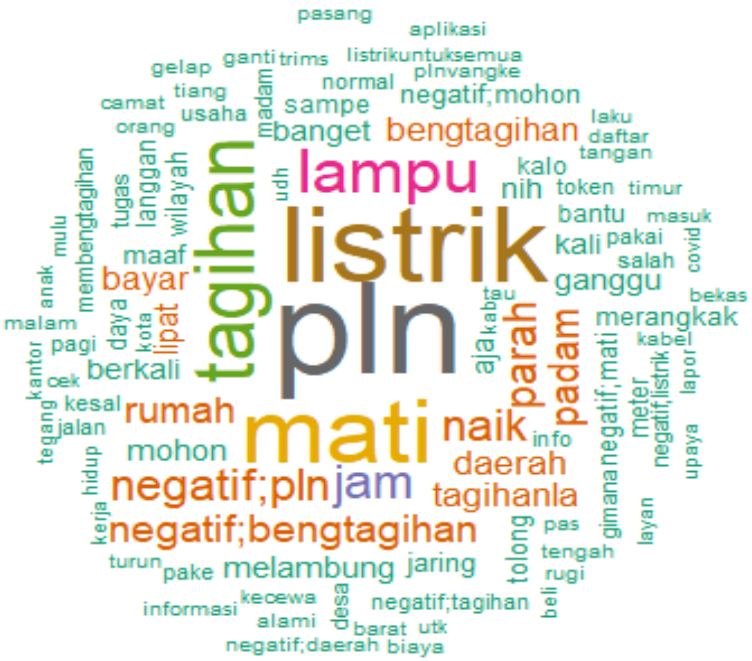

Figure 1: Word Cloud Negative Comments

Comments that emerged included power outages, high bills, slow response, and others. One way that can be used to identify customer complaints is big data analytics through the application of sentiment analysis.

The use of sentiment analysis to identify online public perceptions has been applied in various fields (Bach et al., 2019), including applying the Hierarchy Naïve Bayes technique to analyze the sentiment of online retail shop users in Indonesia (Fiarni et al., 2016); using K -Nearest Neighbor and Naïve Bayes Classifier Algorithm in determining the classification of healthy card Indonesia giving to the poor (Safri et al., 2018); conducted a sentiment analysis of Naïve Bayes on laptop products based on the results of consumer reviews on Amazon (Hassan et al., 2017); performed opinion mining and sentiment analysis on online customer review (Kumar et al., 2017); utilizing big data to analyze district mayor who might be elected (Wulandari et al., 2019); using sentiment analysis to predict candidates of Indonesian President (Asrofi et al., 2016).

Based on the results of the review of previous studies, it is found that, in general, the results of these studies are still at the stage of identifying the most dominant public sentiment. To provide valuable recommendations for users, the research results should be followed up by a decision support system.

One of the widely applied decision-making models is the Analytical Network Process (ANP) method. Academics and practitioners have used the ANP method to solve multi-criteria decision-making problems in various fields (Shukla et al., 2018).

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Several studies have applied ANP to solve multiple industrial problems, including using the ANP method to map the spatial tendency of debris flow as a basis for decision making for river flow management (Sujatha & Sridhar, 2017), use the ANP Model to facilitate assessments and provide more detailed information for decision-makers regarding the control of the livestock sector in Iran (Islami et al., 2018), evaluating the priority criteria by using ANP to determine the facilities needed to create comfort for pedestrians (Naharudin et al., 2019), measure the influence index of each stakeholder using the ANP method from the point of view of the project manager to set the guidelines for the stakeholder management in the future (Aragonés-Beltrán et al., 2017), take an integrated approach using Fuzzy ANP to identify the most critical internet of things (IoT) development challenges and determine their development priorities (Mohammadzadeh et al., 2018).

This study aims to identify consumer sentiment towards PLN service performance using the Naïve Bayes Classifier and Text Associations to identify the dominant problems based on negative words' appearance on social media.

Furthermore, based on these results, the ANP method is used to provide recommendations for decision-making in determining service improvement priorities.

LITERATURE REVIEW

Data Mining is a process that uses statistical techniques, mathematics, artificial intelligence, machine learning to extract and identify useful information and related knowledge from various large databases (Turban et al., 2007). Some other terms have the same meaning as data mining: knowledge discovery in databases (KDD), knowledge extraction, data/ pattern analysis, business intelligence, data archaeology, and data dredging (Larose & Larose, 2014).

Text data mining is a technique of gaining new knowledge from the text automatically or semi-automatically, in which knowledge extracted from a great number of text (Maylawati et al., 2018).

The Naïve Bayes Classifier is a simple probabilistic classification that calculates a set of probabilities by summing the frequencies and value combinations from a given data set. In this method, firstly, the search for the probability and maximum likelihood values of each attribute for each class is carried out (Asrofi et al., 2016).

A marketing mix is a marketing tactic that a company can use to create superior value to its customers. Marketing mix services consist of seven elements: product, price, place, promotion, people, physical evidence, and processes (Abedi & Abedini, 2017).

The ANP method is a development of the Analytical Hierarchy Process (AHP) method. The objective is to improve the AHP method's weaknesses by accommodating the linkages between criteria or alternatives. The relations discussed in the ANP method are divided into two types, namely inner dependence and outer dependence.

This linkage causes the ANP method to be able to solve more complex problems than the AHP method (Saaty & Kułakowski, 2016).

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RESEARCH METHODS

The stages in this research are as follows:

1. Crawling and scraping on Twitter, Facebook, and the PLN Mobile application to find out responses to PLN services;
2. Perform data preprocessing to select unstructured data from the crawling of Twitter, Facebook, and the PLN Mobile Application;
3. Carry out labeling and weighting to find out whether the data is included in positive or negative sentiment;
4. Sentiment classification using the Naïve Bayes Classifier to analyze the results of labeling and weighting and the level of accuracy in reading the labeling data generated based on consumer opinions or opinions about PLN services;
5. Conducting Text Associations to identify words that often appear and are discussed a lot by consumers regarding PLN service issues, either in the form of positive or negative sentiments;
6. Conduct problem analysis based on negative Text Associations results;
7. Classify negative sentiments into marketing mix elements;
8. Conducting interviews with PLN internal parties to obtain alternative remedial solutions to problems identified in the previous stage through the development of the ANP model;
9. Collecting and processing data using Super Decision Software;
10. Delivering recommendations on the priority order of service improvements.

Text Associations data in this study are sourced from consumer comments submitted on Twitter, Facebook, and the PLN Mobile application for the period March-June 2020. The identification process refers to the marketing mix concept, which includes the product, price, promotion, place, physical evidence, people, and process. The development of the decision hierarchy in the ANP model is based on the dominant marketing mix problems obtained from Text Associations' results. Furthermore, identifying alternative solutions to the problem originating from the types of activity plans in the company. The calculation of the weight of the criteria, sub-criteria, and alternatives in this study used pair-phase comparisons obtained from the organization's internal expert judgments. The scale used is a limited scale of 1-9, starting from equally preferred to extremely preferred (Sayyadi & Awasthi, 2020).

RESULT AND DISCUSSION

Naïve Bayes Classifier dan Text Associations

The first stage is to determine the dominant problem based on crawling and scraping using the Naïve Bayes Classifier and Text Associations methods, and the results are presented in Table 1.

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Table 1: Naïve Bayes Classifier and Text Associations

Predictions	Actual		Class Specificity
	Negative	Positive	
Negative	7.250	8	99.55%
Positive	3	1.758	0.45%
Class Sensitivity	99.96%	0.36%	
	Accuracy 99.88%		

Table 1 is the result of the confusion matrix using the Naïve Bayes Classifier method. Based on the table, the prediction results show that 7,250 reviews fall into the negative class classified correctly. Three reviews that cannot read as negative words are not classified correctly, so that the predictive value for the negative class is 99.96%.

Furthermore, 1,758 reviews fall into the positive class classified correctly, and eight reviews that are not precisely clarified, so that the positive class's predictive value is 99.55%. Furthermore, overall, the accuracy rate is 99.88%.

In Table 2, the results of Text Associations that often appear based on negative sentiment classes are presented in Indonesian.

Table 2: Word Associations in Negative Class

Product		Price		Process	
Outage	0.30	Bill	0.35	Slow	0.32
Stability	0.19	Rates	0.20	Long	0.13
Application	0.17	Rising	0.19	Handling	0.11
		Expensive	0.17		

The process identified in Table 2 refers to marketing mix elements. Based on Text Associations results, the problems that often arise can be classified into elements: product, price, and process.

After the issues are identified, the next step is to apply the ANP method to determine the priority for service improvements.

ANP

The first stage in ANP is developing a hierarchy of decisions (Pérez et al., 2018). Hierarchy of Decision aims to identify all of the criteria and potential alternative solutions implemented in the company (Taborga et al., 2018; Torkabadi & Mayorga, 2018).

The criteria used in determining the priority for improvement refer to the classification results of Text Associations, namely: product, price, and process.

Furthermore, these results are conveyed to the internal company through Focus Group Discussion (FGD) activities to formulate sub-criteria and alternative decision solutions.

Table 3 provides a description of the criteria, sub-criteria, and alternative solutions obtained based on the results of the FGD.

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Table 3: Criteria, Sub-Criteria, and Alternative Decisions

No.	Criteria	Sub-criteria	Alternative Decisions
1	Product	1. Electricity often outages 2. Electricity is often unstable 3. The PLN Mobile application often has errors	1. Readjustment of distribution transformer 2. Fix bugs and improve the quality of the application system 3. Expand the application of electricity tokens 4. Upgrading electricity network technology 5. Improving the complaint handling system by optimizing the use of information technology 6. Increase the role of outsourcing
2	Price	1. The bill does not match the electricity meter record 2. Electricity costs rise up	
3	Process	1. Slow in responding to complaints 2. Slow in solving problems	

After the hierarchy of decisions is formed, the next step is weighting the priorities using pairwise comparisons. Respondents who were assessed in this study were three people representing the management of the company. In Table 4, the calculation of the criteria weight and the level of inconsistency is presented.

Table 4: Weights of Criteria and Level of Inconsistency

Inconsistency: 0.06239	
Product	0.18839
Price	0.73064
Process	0.08096

Based on Table 4, it can be seen that the criterion that has the highest weight is price. Furthermore, based on the calculation of the level of inconsistency, information is obtained that the weighting results against all criteria are consistent because the value below 0.1, so the calculation can be continued at the next level (Aulawi et al., 2018). In Table 5, the measure of the weight of the sub-criteria against the criteria is presented.

Table 5: Weights of the Sub-Criteria against the Criteria

Sub-criteria	Weight	Ranking
Product		
Electricity often outages	0.54416	1
Electricity is often unstable	0.35973	2
The PLN Mobile application often has errors	0.09611	3
Price		
The bill does not match the electricity meter record	0.73584	1
Electricity costs rise up	0.26416	2
Process		
Slow in responding to complaints	0.58719	1
Slow in solving problems	0.41281	2

In Table 5, it can be seen that in the product criteria, the problem that needs to be a priority for improvement is the frequent occurrence of power outages. This condition often occurs, especially in rural areas; this is very disturbing considering that in the Covid-19 pandemic, the intensity of electricity use has increased because many people are doing work from home.

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The next priority is to improve the PLN Mobile application considering that many consumers' complaints often have errors. The last focus is to repair voltage stability; this is especially the case in rural areas. Many consumers complain that electronic components are often damaged due to unstable electric voltages. In the price criteria, the main priority is solving bills that do not match the consumer's kWh meter records.

This condition occurs especially in postpaid electricity consumers because the calculation of accounts is done manually through a visit by PLN employees to the location/domicile of the consumer. Recording errors often occur because, in the conditions of the Covid-19 pandemic, PLN employees' access to consumer locations is limited, so bills are often recorded based on estimates rather than referring to actual records in the field.

The next problem is the increase in consumer bills, but this is understandable considering that in the Covid-19 pandemic, the level of consumer electricity consumption tends to increase. In the process criteria, the problem that needs to be prioritized is the slow response to consumer complaints.

The next priority is the slow pace in solving problems; this condition occurs because the number of PLN technicians in the field is limited, and the network technology used by PLN is not yet able to detect if there is network disruption/ damage fully automatically.

Hence, the problem handling process often takes a long time. After the weight of the criteria and sub-criteria is known, the next step is to determine the improvement solution's priority.

In Table 6, the results of the overall alternative weight calculation are presented.

Table 6: The Weight of Alternative Decisions

Alternative Decisions	Weight	Ranking
Readjustment of distribution transformer	0.24615	2
Fix bugs and improve the quality of the application system	0.10229	4
Expand the application of electricity tokens	0.29113	1
Upgrading electricity network technology	0.22946	3
Improving the complaint handling system by optimizing the use of information technology	0.04846	6
Increase the role of outsourcing	0.08251	5

Based on Table 6, it can be seen that the priority for improvement is to migrate from the postpaid to the prepaid system using the token system. This solution is considered appropriate for solving problems during the Covid-19 pandemic because it can anticipate inaccuracies in the manual billing recording process when using a conventional (postpaid) system.

On the other hand, this transfer causes company activities to be more efficient because there is no need to assign employees to carry out direct checks kWh meter to the consumer. In the migration process, it is also necessary to evaluate and upgrade the obsolete token meter. If the device's performance has decreased, it will cause the absorption of a power increase that has implications for soaring billing costs.

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The second priority for improvement is the evaluation of the distribution transformer readjustment. This solution is considered relevant considering that in the conditions of the Covid-19 pandemic, the level of consumer electricity consumption has increased significantly; the consequence is that evaluation and improvement of electricity distribution must be carried out to prevent shortages of electricity supply and unstable voltage.

The third priority for improvement is upgrading the electricity network technology, primarily related to automation in detecting network disturbances/damage. Through this upgrading, the company will solve electrical problems effectively and efficiently.

CONCLUSION

The results show that the application of the Naïve Bayes Classifier, Text Associations, and Analytic Network Process (ANP) can help PLN in setting priority service improvement solutions. Based on the marketing mix perspective, three elements need to focus on attention, product, price, and process.

Furthermore, the results show that the main priority for improvement is to expand the application of electricity tokens. In the conditions of the Covid-19 pandemic and facing new normal conditions in the future, these efforts are felt to contribute significantly to reducing the mobility of PLN employees, especially in the process of recording electricity bills to each customer.

The next priority for efforts is to readjust the distribution transformer and upgrade the electricity network technology. For further research, it is proposed to apply the Naïve Bayes Classifier, Text Associations, and Analytic Network Process (ANP) methods to formulate company strategy.

Recommendations are given considering that the combination of big data analytics and multi-criteria decision-making can broadly capture today's consumers' needs and wants to be used as a frame of reference in developing decision-making models in determining corporate strategy. These methods can complement each other to produce a strategy formulation that is genuinely oriented towards creating superior value to the target market customers.

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