Integrating SEM, Markov Chain, and TRIZ in Customer Loyalty Management and Enhancement

A Case Study in the Bina Mitra Sejahtera Cooperative Probolinggo, East Java

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ABSTRACT
Cooperatives are public service institutions that build and increase the economic potential of their members. Customers will get financial services that can be used to improve social welfare. However, in practice, not all customers are loyal to the cooperative. This could be because the quality of the services provided was not following customer perceptions. In addition, the market share of cooperatives can change from time to time. This study aims to analyze the causal relationship between service quality, customer satisfaction, and customer loyalty and provide suggestions for improvement to increase customer loyalty. In the Structural Equation Modeling (SEM) method, an analysis of the outer model and inner model will be carried out to determine the indicators that are the focus of improvement. Furthermore, the prediction of changes in market share will be carried out using the Markov chain method. After obtaining the outer loading weights from Structural Equation Modeling (SEM) and the results of the market share prediction analysis from the Markov chain, the proposed improvement concept ideas will be designed using the Theory for Inventive Problem Solving (TRIZ) by considering the limitations and objectives of the improvement idea.

Keywords: *Structural Equation Modeling, Markov Chain, Theory Inventive Problem Solving*

1. INTRODUCTION

The escalating competition in Indonesia's business landscape, fueled by Industry 4.0, necessitates a focus on customer loyalty for companies like Bina Mitra Sejahtera Probolinggo Cooperative. This research addresses this critical need by investigating the factors influencing customer loyalty. The ever-growing cooperative sector, evident from a 0.66% increase in cooperatives in 2017 compared to 2006, intensifies competition and underscores the importance of loyalty management. Notably, Bina Mitra Sejahtera Probolinggo Cooperative hasn't evaluated customer loyalty since 2010, and the recent decline in profits due to the pandemic further necessitates a proactive approach. Building upon existing research on customer loyalty, this study aims to identify key service quality, customer satisfaction, and loyalty indicators. Through Structural Equation Modeling (SEM), we will analyze the causal relationships between these indicators to pinpoint those most impacting loyalty, guiding subsequent improvement efforts. Additionally, the Markov chain method will be employed to predict customer loyalty trends, providing insights into the urgency of improvement and potential market share fluctuations. Finally, the Theory for Inventive Problem Solving (TRIZ) will be utilized to formulate actionable improvement strategies tailored to the specific challenges faced by the cooperative. Overall, this research seeks to equip Bina Mitra Sejahtera Probolinggo Cooperative with the knowledge and tools necessary to cultivate loyal customers and thrive in the evolving business environment.

2. RESEARCH METHODS

This research aims to design improvement recommendations for Bina Mitra Sejahtera Cooperative Probolinggo. The design of improvement recommendations begins with data collection using an online questionnaire survey distributed to 100 customers using Google Forms. The questionnaire consists of 5 sections covering respondent profiles, service quality variables, customer satisfaction, customer loyalty, and Markov chain questions. Service quality variables, customer satisfaction, and customer loyalty will be analyzed using Structural Equation Modeling (SEM) with SMARTPLS software. Market share prediction will then be carried out using the Markov Chain (Steady State Analysis) method, for the growth or reduction of customer loyalty that has implications for the urgency of improvement. The results of the Structural Equation Modeling and Markov Chain analysis will be analyzed using the Theory For Inventive Problem Solving (TRIZ) to provide concept ideas for improvement proposals according to the outer loading weight to maintain and increase customer loyalty. According to Sugiyono (2017), probability sampling is a sampling technique

that gives each element or member of the population an equal chance or opportunity to be selected as a sample. The sampling technique used in this study is a non-probability sampling technique, namely convenience sampling, where sampling is based on the availability of elements and the ease of obtaining them. The sample size for this study is determined using the Lemeshow Formula. This formula is appropriate because the total population size is unknown. The specific calculation details will be provided in a subsequent section.

$$n = \frac{Za^2 \; x \; P \; (1-P)}{L^2} \qquad (1)$$

Equation 1 are the formula used in this study. N is Minimum sample size, Z is Standard value which is 1.96, P is Maximum estimate = 50% = 0.5, and L is Sampling error 10%. Based on the calculation formula, the minimum sample size required is 96.04 respondents ≈ 97 respondents. Therefore, the researcher will collect data from 100 customers during the sampling stage.

3. RESULT AND DISCUSSIONS

3.1. Respondent Profile

Data collection was conducted with 100 customers of Bina Mitra Sejahtera Cooperative Probolinggo, with a majority of male customers aged 31 to 36 years old, self-employed, residing in the Mayangan sub-district, having a transaction frequency of less than 2 times in the last one month, and the most frequently used service is "Sejahtera Savings". The respondent profile indicates that the questionnaire data has met the requirements and appropriate sample target to determine the causal relationship between service quality, customer satisfaction, and customer loyalty of Bina Mitra Sejahtera Cooperative Probolinggo.

3.2. Determining Question Attributes

In this study, the attributes for the questionnaires were derived from the indicators of the service quality variables, which include three indicators each for tangibles, reliability, responsiveness, assurance, and empathy. The indicators for the customer satisfaction variable are expectations, product desires, system, reputation, and completeness. Additionally, the indicators for the customer loyalty variable are word of mouth, reject another, and repeat purchasing.

3.3. Structural Equation Modeling Analysis

This study employs Structural Equation Modeling (SEM) to investigate the relationships between service quality, customer satisfaction, and customer loyalty in Bina Mitra Sejahtera Cooperative Probolinggo. Data was collected from 100 customers using a questionnaire. The SEM analysis involved both outer and inner model assessments. The outer model evaluation comprised validity and reliability assessments. The initial outer model iteration revealed that service quality variables SQ3 and SQ8 fell below the 0.4 threshold, necessitating their elimination and re-evaluation. Subsequent iterations led to the removal of SQ11 as well, ensuring that all variables exceeded the 0.4 threshold. The Convergent Validity and Average Variance Extracted (AVE) values for service quality, customer satisfaction, and customer loyalty variables confirmed their validity. Composite reliability scores exceeding 0.7 further established the reliability of all constructs. The initial inner model iteration indicated that the Path Coefficient and T-statistic values did not meet the significance criteria. This suggested that customer satisfaction did not significantly influence customer loyalty. Consequently, the model was re-evaluated.

The revised inner model iteration revealed a 45.5% influence of exogenous variables on customer satisfaction and a 26.9% influence on customer loyalty. In the context of cross-sectional survey data, Setiaji (2008) suggests that R2 values of 0.2 or 0.3 are considered adequate. The Path Coefficient analysis demonstrated that service quality positively impacts customer satisfaction (0.675) and customer satisfaction positively impacts customer loyalty (0.792). Statistical significance was established based on positive T-statistic values exceeding the T-table value of 1.96. The analysis confirmed that service quality significantly influences customer satisfaction and customer loyalty. The Blindfolding method yielded predictive relevance values of 0.287 for customer satisfaction and 0.172 for customer loyalty, both exceeding 0. This indicates that the exogenous latent variables effectively predict the endogenous variables. The model fit value of 0.754 or 75.4% suggests that the SEM model is appropriate and adheres to the Structural Equation Modeling (SEM) framework. The finalized model, with service quality on the left, customer satisfaction in the center, and customer loyalty on the right, is presented as follows:

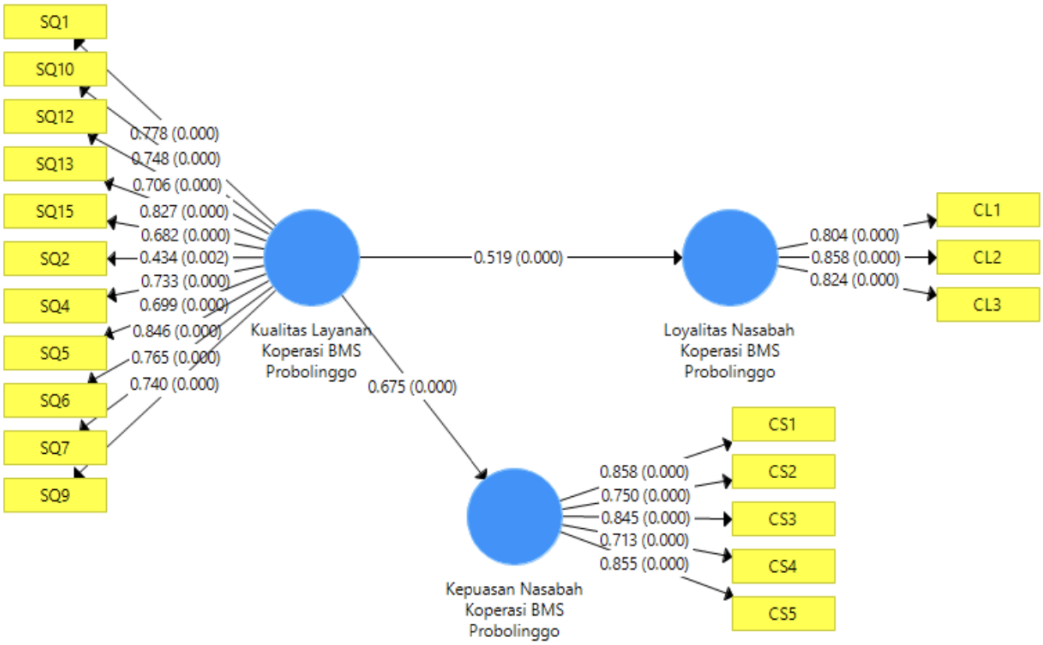

Figure 1. SEM-PLS Finalized Model

3.4. Markov Chain Analysis

Table 1. Transition Probability Matrix

Cooperative Name	To Cooperative					Total
	BMS	CU	MP	BPR	BAL	
BMS	83/93	7/93	1/93	1/93	1/93	1
CU	1/2	0	0	0	0	1
MP	1/1	0	0	0	0	1
BPR	0	1/1	0	0	0	1
BAL	2/3	0	0	0	1/3	1

Table 2. Initial State Vector

BMS	CU	MP	BPR	BAL
0,93	0,02	0,01	0,01	0,03

Table 3. Comparison of Initial Period Probability Values with Equilibrium

Cooperative Name	Probability Value		Difference
	Early Period	Equilibrium Period	
BMS	93%	84,163%	(8,837%)
CU	2%	7,239%	5,239%
MP	1%	0,905%	(0,095%)
BPR	1%	0,905%	(0,095%)
BAL	3%	6,787%	3,787%

This study employs Markov chain analysis to investigate customer loyalty patterns in Bina Mitra Sejahtera Cooperative Probolinggo. The analysis utilizes transition probability matrices (Table 1) and initial state vectors (Table 2) to assess customer loyalty dynamics. The results indicate that the equilibrium period is reached in the 10th period (June 2022). Initially, customer loyalty stands at 93%. However, in the equilibrium state, customer loyalty declines by 8.837%. This highlights the need for immediate improvement strategies to enhance customer loyalty. The study proposes utilizing the Theory for Inventive Problem Solving (TRIZ) to develop effective improvement concepts.

3.5. Theory For Inventive Problem Solving Analysis

Table 4. Result Analysis

No	Concept Ideas for Improvement Proposals	5 Whys	Interview	Benchmarking	PUF
A	Implement a self-service slip writing system to minimize waiting times for customers.	V	V	-	3
B	Develop a cooperative app that includes payment features for various services, such as Payment Point Online Banking and others.	V	-	V	2
C	Establish a cooperative hotline system with a quick reply feature to address frequently asked questions efficiently.	V	-	V	1
D	Implement stricter COVID-19 health protocols to ensure the safety and well-being of both customers and staff.	V	-	-	1
E	Utilize social media platforms to provide customers with easily accessible and up-to-date information.	V	-	V	2
F	Introduce periodic promotional programs, such as special offers during national holidays like Independence Day and New Year, to attract and retain customers.	V	-	-	3

Table 5. Contradiction analysis and elimination

Idea	Improving Feature	Worsening Feature	Inventive Principles	Selected Principles
A	Ease of repair (34)	Area of Stationary object (6)	Partial or excessive actions (16) Self-service (25)	Self-service (25)
B	Shape (12)	Quantity of substance (26)	Phase transitions (36) Blessing in Disguise or Turn Lemons into Lemonade (22)	Phase transitions (36)
C	Stability of the object's composition (13)	Duration of action by a stationary object (16)	Insert atmosphere (39) Local quality (3) Parameter changes (35) Feedback (23)	Local quality (3) Feedback (23)
D	Ease of manufacture (32)	Quantity of substance (26)	Parameter changes (35) Feedback (23) Segmentation (1) Intermediary (24)	Segmentation (1) Intermediary (24)
E	Adaptability or versatility (35)	Duration of action by a stationary object (16)	Separation (2) Partial or excessive action (16)	Separation (2) Partial or excessive action (16)
F	Reliability (27)	Quantity of substance (26)	Hurrying or skipping (21) Mechanical interaction substitution (28) Composite Material (40) Local quality (3)	Mechanical interaction substitution (28)

Table 4 presents the results of the problem definition phase, encompassing situation analysis, ideation, and contradiction analysis. Situation analysis delves into service systems and attributes employing 5 Whys, benchmarking, and interviews to address customer dissatisfaction and strong dissatisfaction with service quality indicators. Opportunities for improvement are identified based on real-world observations. Ideation involves translating insights from Whys Analysis, interviews, and competitor benchmarking into improvement concept proposals. Diagram functions are utilized to model problems, determine the consequences of improvement concepts, and define the primary useful function (PUF) of each concept. This enables the formulation of improving and worsening features for each improvement concept. Contradiction analysis, presented in Table 5, identifies improving and worsening features as conflicting aspects. The application of 40 inventive principles generates alternative solutions for each improvement concept. Table 6 showcases contradiction elimination, which involves eliminating inventive principles specific to each improvement concept to reduce contradictions. This process utilizes inventive principles and selection methods to eliminate contradictions and generate creative improvement concept proposals.

Table 6. Customer Loyalty Outer Loading Percentage

Code	Outer Loading	Outer Loading Percentage
CL1	0,804	32,341%
CL2	0,858	34,513%
CL3	0,824	33,146%
Total	2,486	100%

Table 7. Solution Evaluation

Code	Outer Loading	Outer Loading Percentage	Concept Idea	PUF	Concept Idea Percentage	Priority	
SQ9	0,740	9,299%	A	3	9,299% x 33,146%	0,031	5
SQ1	0,778	9,776%	B	2	9,776% x 34,513%	0,034	4
SQ10	0,748	9,399%	C	1	27,394% x 32,341%	0,089	2
SQ4	0,733	9,211%					
SQ5	0,699	8,784%					
SQ2	0,434	5,454%	D	1	5,454% x 32,341%	0,018	6
SQ13	0,827	10,392%	E	2	37,447% x 34,513%	0,129	1
SQ7	0,765	9,613%					
SQ12	0,706	8,872%					
SQ15	0,682	8,570%					
SQ6	0,846	10,631%	F	3	10,631% x 33,146%	0,035	3
Total	7,958	100%					

The outer loading weights for customer loyalty variables derived from Structural Equation Modeling (SEM) are presented in Table 7. Indicator CL2 (reject another) exhibits the highest weight of 34.513%, followed by indicators CL3 (repeat purchasing) and CL1 (word of mouth) with weights of 33.146% and 32.341%, respectively. Table 8 presents the solution evaluation results, where the proposed improvement concepts are ranked based on the product of outer loading weights for service quality and customer loyalty obtained from structural equation modeling. This prioritization guides the selection of the most promising improvement concepts.

3.5. Implementation of Proposed Improvement Concepts

This analysis prioritizes several key improvement concepts to enhance customer experience and cooperative operations. Firstly, establishing social media platforms (Facebook, Instagram, and TikTok) with readily accessible information and automated reply features on WhatsApp Business (away message, greeting message, quick message) will improve customer interaction and access to information (Concept Idea E). Secondly, a cooperative hotline system with a quick reply feature for frequently asked questions (FAQs) will address customer concerns efficiently (Concept Idea C). To further incentivize transactions, monthly cooperative programs with special dates (e.g., 11.11) will be promoted through social media and brochures (Concept Idea F). For improved operational efficiency, a cooperative app with features for managing savings, financial reports, loans, accounting, statistics, member login, and Payment Point Online Banking (PPOB) will be developed in collaboration with smart-coop (Concept Idea B). Finally, to decrease waiting times and optimize space, self-service slip writing stations with a minimalist design will be implemented (Concept Idea A). Regarding COVID-19 protocols, enhanced measures will be integrated with the PeduliLindungi application. Segmentation based on customer health and priority (priority membership) will help manage costs associated with thermometer stands. The PeduliLindungi application will function as an intermediary process and warning system for all stakeholders (Concept Idea D). This comprehensive plan addresses customer needs, improves operational efficiency, and utilizes technology to enhance the cooperative experience for both members and staff.

4. CONCLUSION

This study employed Structural Equation Modeling (SEM) to analyze the impact of service quality on customer satisfaction and loyalty at Bina Mitra Sejahtera Probolinggo Cooperative. Eleven service quality indicators were categorized as tangible (2), empathy (3), reliability (2), responsiveness (2), and assurance (2). Additionally, five customer satisfaction indicators (expectations, product desires, systems, reputation, completeness) and three customer loyalty indicators (word of mouth, reject another, repeat purchasing) were evaluated. The SEM analysis confirmed the validity and reliability of all these measures. Further SEM analysis revealed a significant positive influence of service quality on customer satisfaction (67.5%) and customer loyalty (51.9%). However, the measured customer loyalty level of 84.163% represents an 8.837% decline from the equilibrium period. This decrease highlights the need for improvement strategies to enhance customer loyalty. Drawing upon the TRIZ methodology and inventive principles, six improvement concepts were prioritized based on their outer loading weights for enhancing customer loyalty. These concepts include the establishment of social media platforms for customer information dissemination, implementation of a cooperative hotline with automated reply features (away message, greeting message, and quick message), offering of monthly cooperative programs promoted through social media and brochures, development of a comprehensive

cooperative app with integrated payment point online banking, provision of self-service tables to reduce waiting times, and Enforcement of enhanced COVID-19 protocols with thermometer stands and PeduliLindungi QR code integration.

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