Research on Customer Loyalty Impact Factors and Strategy Optimization Based on Automotive Testing and Certification Industry

Huang Huatong* and Li Yingyi

***Abstract*—Based on Kevin Lane Keller's Customer-Based Brand Equity Model (CBBE Model), this article explores the influencing factors of loyalty and develops a customer loyalty model for the automotive testing and certification industry. Through interviews and expert opinions, this article extracts eight loyalty determinants and 25 estimated performance indexes to adapt the loyalty assessment dimensions of this industry. This article innovatively combines Partial Least Squares-Based Structural Equation Modeling (PLS-SEM) and Importance-Performance Analysis (IPA) to quantify the extent of influence of each determinant on loyalty and to provide guidance for the prioritization of actions. The advantage of combining the two models is identifying the company's weaknesses and quantifying the effects of improvements. Data were collected through questionnaires, and SmartPLS 4.0 was used to verify the proposed hypothesis. The analysis concludes that the company should improve the quality of certificate reports in the short term and provide more added value for customers in the long term. The model has a substantial application value and enables companies to identify problems, prevent business churn, optimize their overall management system, and improve market competitiveness.**

***Index Terms*—Loyalty, Partial Least Squares-Based Structural Equation Modeling (PLS-SEM), Importance-Performance Analysis (IPA)**

I. Introduction

Improving and maintaining customer loyalty toward the brand is essential for business management. Customer loyalty usually refers to customers' long-term support for a specific brand or company, manifested by customers' willingness to repeat purchases, pay higher prices, and actively promote the company and its products (Mittal, 2001). A company's loyal and quality customer base can bring long-term and stable revenue, reduce marketing costs, enhance brand awareness, and increase market share.

American scholar Kevin Lane Keller proposed the Customer-Based Brand Equity Model (CBBE Model). The model is created to answer the following two questions: firstly, what elements constitute a strong brand; Secondly, how does a company build a strong brand. In the model shown in Fig. 1, the customer-brand relationship refers to customer loyalty, including attitudinal and behavioral loyalty. Rational and emotional brand responses mediate the customer-brand relationship (Keller, 2011). However, more factors must be considered for the automotive testing industry to establish customer loyalty. This article uses face-to-face interviews, questionnaire research, and expert advice to build a brand equity valuation model consistent with the automotive testing industry.

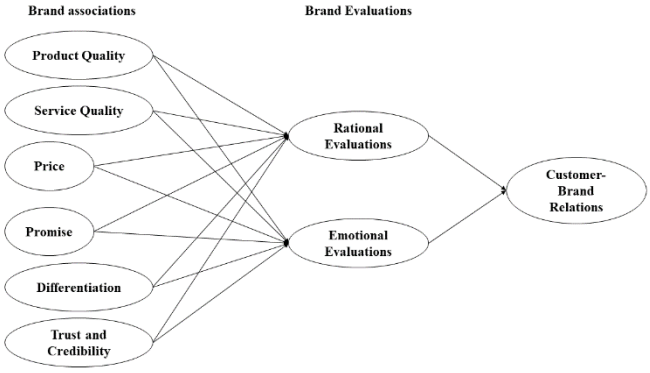

Fig. 1. General customer-based brand equity model.

Previous studies focused on the influence mechanism between impact factors and brand loyalty. However, in practical application, such models ignore assessing a firm's current performance. When a company performs well enough in a particular aspect, although improving that aspect can bring higher customer loyalty, it will cost more for the company to achieve the effect according to the law of diminishing marginal benefit. Based on the current situation of enterprises, this article establishes a comprehensive evaluation model for enterprises, combined with the brand equity evaluation model, to provide strategic optimization suggestions for enterprises.

II. Methodology and Data

A. In-depth Interviews

The in-depth interview aimed to examine the impact factors of customer loyalty in the automotive testing industry. The interview was conducted in a one-to-one, face-to-face conversation with twenty-six interviewees, involving nine companies. Adopting an on-site conversation helps create a friendly and cooperative atmosphere and obtains more accurate empirical information than a survey. In addition, the investigator can ask additional questions on the spot to further explain the research purpose, requirements, and questions, which helps to understand the interviewees' views and opinions more clearly.

B. Questionnaire Research

The questionnaire method is a structured survey in which

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the format, order of questions and range of answers are fixed and can be more easily processed and statistically analyzed. Large-scale surveys provide data support for subsequent structural equation modeling that gain insight into respondents' thoughts, attitudes, and behaviors. The questions for the survey are based on literature studies, brand equity measurement instruments, in-depth interviews, and focus groups developed.

In order to study the influence mechanism among the variables, this article designed the corresponding questionnaire of the measurable variables. It used a combination of written and online surveys to distribute questionnaires to customers during March 2023. The target audience of this survey is automotive companies with testing needs. The questionnaire contains three sections to estimate and test the PLS-SEM and the IPA models. The first section collected 40 general questions measuring latent variables. The second section mainly collects the importance and performance evaluation of the eight determinants, which include 16 questions in total. The third section mainly collects demographic information, including company type, job category, business area, and basic personal information.

The values of the significant variables in this study are based on the 5-point Likert scale method. After analyzing the returned questionnaires, 155 valid questionnaires were collected after excluding repetitive or contradictory responses.

C. Partial Least Squares Structural Equation Modeling (PLS-SEM)

PLS-SEM is a structural equation model based on partial least squares regression analysis that can be used to explore the relationship between multiple latent variables. The structural equation model is divided into two sections, the structural model and the measurement model, as shown in Fig. 2.

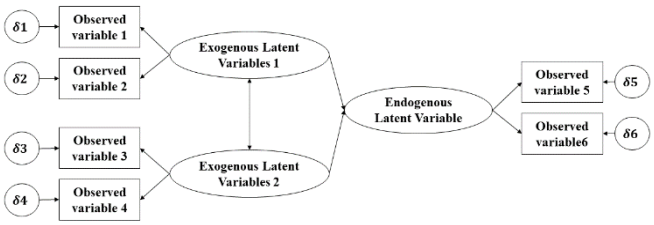

Fig. 2. The path diagram for a structural equation model.

The advantages of PLS-SEM are: (i) the distribution of the sample can be non-normal; (ii) the latent variables can be measured by a small number

of observed variables; (iii) the theoretical model can include a large number of latent and observed variables; (iv) it can flexibly handle formative measurement models and reflective measurement models (Hair Jr, 2014).

PLS-SEM is chosen as the research method, mainly considering: The information contained in the latent variables is a combination of each observed variable; Besides, the model in this article is complicated, involves formative constructs, has a non-normal data distribution, and has a relatively small sample size.

In this article, the structural equation model with eight potential variables is constructed, and the model is estimated and evaluated by SmartPLS 4.0 with the results of questionnaire research. The R^2 , external weights, and external loading factors reflect the model's explanatory power. The path coefficients and Bootstrapping test results reflect the causal relationship between the model variables.

D. Importance-Performance Analysis (IPA)

IPA assesses and compares the importance and performance of different determinants. IPA can help companies understand the level of customer expectations on different determinants and the company's actual performance on these determinants to guide management decisions and resource allocation. The IPA model is structured with importance as the horizontal axis, performance as the vertical axis, and the total average of customer ratings of product or service attribute importance and performance as the coordinate point (X, Y). Finally, the four quadrants of the IPA matrix are formed:

Quadrant A (Stable Maintenance Zone): High importance and high performance;

Quadrant B (Adjustment Balance Zone): Low importance and high performance;

Quadrant C (Secondary Improvement Zone): Low importance and low performance;

Quadrant D (Priority Improvement Zone): High importance and low performance.

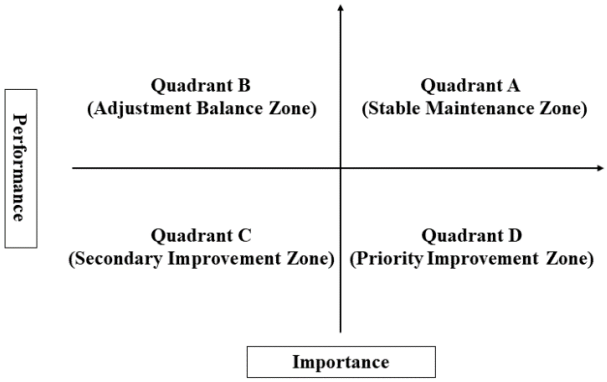

Fig. 3. IPA framework.

In the survey, respondents are asked to answer the importance and performance ratings for each of the eight determinants in their minds. The quadrant in which each determinant is located helps the company understand customer needs and identify directions for improvement to enhance the performance level and customer satisfaction. In the Stability Maintenance Zone, companies should maintain current levels and closely monitor them to prevent undesirable changes from negatively impacting customer satisfaction. In the Adjustment Balance Zone, companies should balance determinants that have achieved exemplary performance and those underperforming. In the Secondary Improvement Zone, determinants in this quadrant have a low level of importance, and the company may not need to invest too much for now; In the Priority Improvement Zone, companies should focus on improving those determinants that contribute significantly to overall satisfaction but are underperforming.

III. Analyses and Results

A. Modeling of Structural Equations

Through the in-depth interviews, the critical statements of interviewer responses were extracted by analyzing and summarizing the content of the interviews and summarized into eight exogenous latent variables and 25 estimated performance indexes. Based on the CBBE model, Basic Elements, Service Price, Service Staff, Service Flow, Report Quality, Trust and Credibility, Promise, and Differentiation, are used as exogenous latent variables. Rational Evaluation, Emotional Evaluation, and Customer-Brand Relations are used as endogenous latent variables. Fig. 4 visually represents the estimated performance indexes for latent variables and their relationships. This visualization aids in comprehending and explaining the importance and impacts of different variables within the structural equation model in an academic research context.

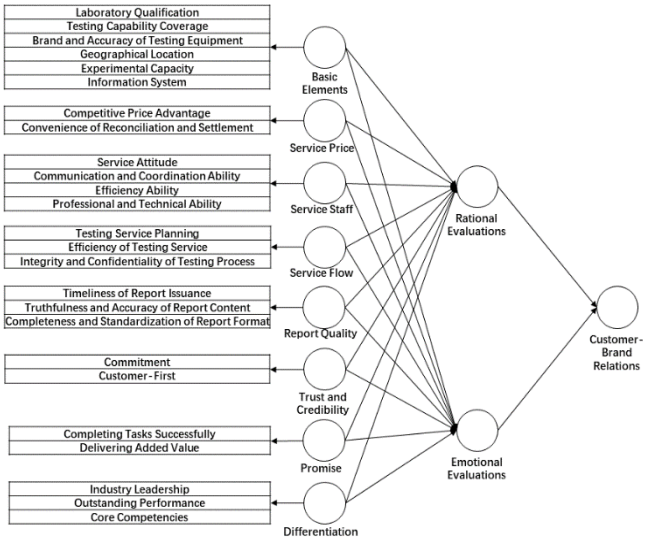

Fig. 4. Customer-based Brand Equity Model.

The structural equation model contains all the hypothesized relationships in Fig. 4, and the model describes the relationships and causal paths between the variables. Statistical tests were used to determine whether the relationships between variables were significant, and then relationships that did not have a significant effect were gradually removed. After each removal of an insignificant relationship, the model was re-estimated and re-tested, and the significance of the remaining relationships continued to be tested until all relationships were significant at the level of 0.05, ultimately creating a structural equation model with high explanatory power and reliability.

B. Results of Structural Equations

The model was estimated as shown in Fig. 5, which shows the relationships between the latent variables that passed the significance test. The path coefficients reflect the strength and direction of the relationships between the latent variables. Path coefficients are unstandardized effects that represent the expected change in other latent variables due to variation in the performance index of a particular latent variable. For example, if Report Quality increases by one unit, Rational Evaluation is expected to increase by 0.306 units. It also suggests that the quality of testing certification reports positively impacts the rational response, which can be quantified and estimated by the path coefficient.

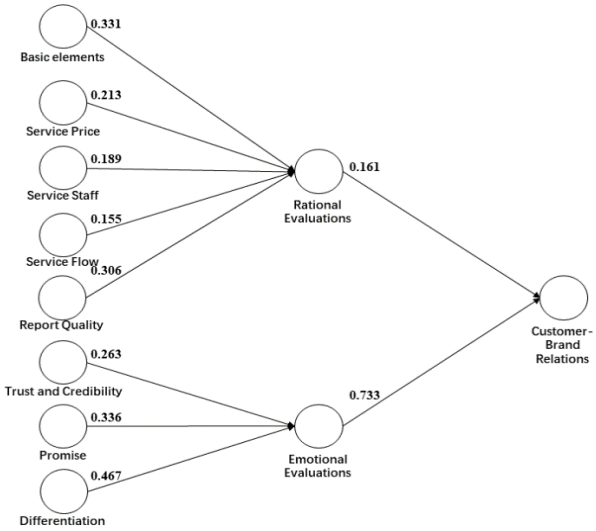

Fig. 5. Estimated Customer-based Brand Equity Model.

Table I shows the results of the path coefficients and Bootstrapping analysis for each significant variable. If the value of VIF is below 5, multicollinearity is not a severe problem (Hair *et al*., 2011). The results show that VIF < 5 for each path coefficient indicates that the degree of co-linearity between the potential variables is small, and the model's explanatory power is strong. The p-value of each path coefficient < 0.05 indicates that the influence relationship on the path is significant. That is, the path can be considered to exist and has significant explanatory power for the model.

TABLE I: Path Coefficients of Each Significant Variable and the Results of Bootstrapping Analysis

Path	Path Coefficient	VIF	t	P
Basic elements→ Rational Evaluations	0.331	2.667	17.084	0.000
Service Price→ Rational Evaluations	0.213	1.317	11.911	0.000
Service Staff→ Rational Evaluations	0.189	3.342	11.523	0.000
Service Flow→ Rational Evaluations	0.155	3.055	10.058	0.000
Report Quality→ Rational Evaluations	0.306	1.582	9.728	0.000
Trust and Credibility→ Emotional Evaluations	0.263	4.123	15.156	0.000
Promise→ Emotional Evaluations	0.336	4.229	13.097	0.000
Differentiation→ Emotional Evaluations	0.467	3.793	16.860	0.000
Emotional Evaluations→ Customer brand relations	0.733	1.732	6.430	0.000
Rational Evaluations→ Customer brand relations	0.161	1.732	7.386	0.000

The evaluation of models usually includes both external and internal evaluations. External evaluation is mainly used to test the reliability and validity of the model. The reliability is usually measured using Cronbach coefficient alpha and composite reliability (CR values). Cronbach's Alpha $\alpha > 0.7$ measures the reliability of items measuring a construct (Nunnally, 1994). CR values > 0.7 ensure adequate internal consistency (Hair *et al*., 2021). According to J. Nunnally, CR values between 0.6 and 0.7 may be acceptable for exploratory

studies, whereas, for further studies, values between 0.7 and 0.9 may be considered satisfactory. Validity is usually measured by factor loadings and Average Variance Extracted (AVE). The value of Outer Loading > 0.5 (Chin, 1999; Hulland, 1999) can also be considered as the item was considered a good consonant. The AVE value must be greater than 0.5 (Hair *et al*., 2021). The results in Table II show that the Cronbach coefficient of each item is greater than 0.7, and the CR value is greater than 0.7, so the indicator meets the requirements. Meanwhile, the factor loadings of each item are higher than 0.7, and the AVE of each item is higher than 0.5, indicating that the measurement instrument has good validity. Therefore, the scale can be measured relatively reliably and effectively.

TABLE II: MODEL EVALUATION RESULT

Constructs	Items	Loading	Cronbach	CR	AVE
Basic elements	Laboratory Qualification	0.769	0.871	0.852	0.693
	Testing Capability Coverage	0.747			
	Brand and Accuracy of Testing Equipment	0.855			
	Geographical Location	0.696			
	Experimental Capacity	0.840			
Service Price	Information System	0.770	0.762	0.903	0.823
	Competitive Price Advantage	0.872			
	Convenience of Reconciliation and Settlement	0.923			
Service Staff	Service Attitude	0.821	0.894	0.858	0.609
	Communication and Coordination Ability	0.906			
	Efficiency Ability	0.917			
	Professional and Technical Ability	0.841			
Service Flow	Testing Service Planning	0.942	0.925	0.949	0.860
	Efficiency of Testing Service	0.929			
	Integrity and Confidentiality of Testing Process	0.926			
Report Quality	Timeliness of Report Issuance	0.896	0.943	0.957	0.848
	Truthfulness and Accuracy of Report Content	0.925			
	Completeness and Standardization of Report Format	0.940			
Trust and Credibility	Commitment	0.952	0.906	0.900	0.819
	Customer-First	0.960			
Promise	Completing Tasks Successfully	0.931	0.836	0.889	0.801
	Delivering Added Value	0.923			
Differentiation	Industry Leadership	0.902	0.919	0.912	0.776
	Outstanding Performance	0.957			
	Core Competencies	0.923			
Customer Brand Relations	Tendency to Repurchase	0.944	0.878	0.879	0.784
	Tendency to Recommend	0.944			

Internal evaluation is mainly used to test the model's validity by assessing the structural model's degree of fit. To assess the internal validity of the model, researchers usually examine the R^2 values of the dependent variable (Chin, 1999; Hulland, 1999). When R^2 closes to 1, it means the model can explain the changes in the sample data well, the predictive ability of the model is strong, and the model fit is good. By estimating the model in Fig. 5, we obtained a high level of explanatory power of the final response variable for customer-brand relationships (R^2 =0.754).

C. Action Priority Analysis

IPA and PLS-SEM are both commonly used for data analysis. IPA aims to understand the importance and performance of customers on different determinants. At the same time, PLS-SEM can explore the relationship between determinants and predict their contribution, enabling companies to develop action plans and evaluate effectiveness more precisely by quantifying improvement effects. Combining the IPA model and PLS-SEM can guide the action more comprehensively to achieve the optimal effect of improving loyalty. Based on the questionnaire results, the eight determinants are divided into four quadrants: Stable Maintenance Zone, Adjustment Balance Zone, Secondary Improvement Zone, and Priority Improvement Zone, to determine the most prioritized action plan.

According to the results of IPA and PLS-SEM, Report Quality is the first determinant needed to be improved, and each unit of Report Quality improvement can increase customer loyalty by 4.9%. Trust and Credibility, Basic Elements, Service Staff, and Service Flow have a high degree of importance and performance, which are the determinants that need to be maintained. Currently, the company invests more in Differentiation, which has low importance, but high performance, so resources can be properly redirected to the determinants that need more improvement. Service Price and Promise have low importance and performance. However, it does not mean that these two determinants should be ignored, especially promise, because every unit of Promise improvement can increase customer loyalty by 24.63%.

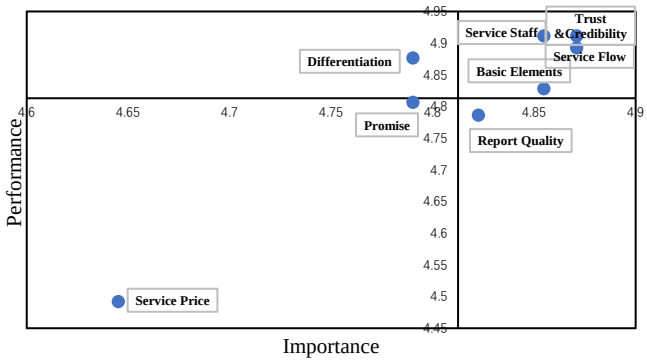

Fig. 6. Results of IPA.

IV. CONCLUSIONS

This article investigates the determinants of customer loyalty in the automotive testing and certification market and develops an innovative customer loyalty model based on Kevin Lane Keller's CBBE Model using PLS-SEM and IPA.

The research shows that Emotional Evaluation has a much more significant positive impact on customer loyalty than Rational Evaluation in the automotive testing and certification industry. Although many determinants of rational evaluation are essential indicators for customers to choose a company's products and services, if the company can provide more added value, the customers will be more loyal. Therefore, in a short period, the company can consider improving the quality of the report first to ensure that the report is complete, standardized, true, accurate, and prompt. Over a long period, the company needs to provide extra services to clients, such as interpreting new standards, building relationships for companies, and helping companies solve complex problems. At the same time, the company should also enhance the industry's position and endorse the testing and certification for car companies.

The loyalty model built in this study applies to the automotive testing and certification industry and has implications for other industries. The combined analysis method of IPA and PLS-SEM can provide better insight into the existing problems of companies and quantify the extent of loyalty improvement to achieve the ultimate goal of helping companies improve overall satisfaction and customer loyalty and achieve sustainable business development.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Huang Huatong built the mathematical model, analyzed the data and wrote the paper; Li Yingyi conducted interviews, designed the questionnaire and wrote the paper. All authors had approved the final version.

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