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Grey Incidence Analysis of Correlations between Leadership-member Exchange and Automobile After-sales Service Quality

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Abstract

The Chinese automotive industry is the largest in the world. Although after-sales services are known to be associated with profitability, it has not obtained its rightful prominence in the Chinese industry. To investigate how the quality of leader-member exchange can influence after-sales services in the Chinese automobile industry, we collected data from individual employees and customers and analyzed it using grey theory model. Based on the results, we proposed the industry to pay more attentions to tangible after-sales service. While previous studies tended to adopt an either customer or employee perspective, our research contributes to the literature by offering a more comprehensive perspective from both the standpoints of the organization and consumers, and our grey theory analytic approach offers a viable option for researchers who are interested in reducing biases in data due to the data aggregation process.

Keywords: *After-sales Service Quality (ASQ), Leadership-member Exchange (LMX), Grey Incidence Analysis, Automobile Industry*

1. Introduction

The China automobile industry has expanded rapidly since the early 1990s. According to China Association of Automobile Manufactures, the automobile sales volume had increased from 2.08 million in 2000 to 9.38 million in 2008, and the automotive industry in China has become the largest in the world measured by automobile unit production [1]. In 2009, the Chinese sales volume reached 13 million units, and annual production of automobiles in China exceeded that its European Union, American and Japanese counterparts. In 2010, the Chinese sales and production reached 18 million units (which included 13.76 million passenger cars), setting a historical record [2]. The trend continued in 2013, and both figures exceeded 21 million.

In comparison to the feat of the automobile industry, the automobile after-sales market is still in the infant stage. Customer complaints are rampant, and its performance lags behind that of the manufacturing industry [3]. Therefore, there is an increasing need for automotive manufacturers and dealers to give more emphasis on after-sales services. Studies on service quality in the service sector have drawn substantial attention from scholars and practitioners over the ages.

Results from past studies had found service quality to be associated with profitability, as service quality would usually result in repeated sales, positive word-of-mouth feedback, customer satisfaction and loyalty. Indeed, there are quite a number of publications that focused on service quality issues confronted by the service sector over the world, particularly those of developed countries. However, research that focuses on after-sales service quality (ASQ) in the China automobile industry is lacking.

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Service sector depends a lot on the abilities of boundary employees to deliver their services. Organizational factors influence the behavior of boundary employees, and the behavior of boundary employee influences consumers' service quality perception [4]. To provide better service, organizational factors are thought to be essential, and we choose to focus on leader-member exchange (LMX) in this study. As ASQ is perceived by customers while LMX is perceived by employees, individual data need to be aggregated; then we use Grey Preference Analysis to explore how LMX can influence ASQ.

The remaining part of this paper is organized as follow. Section 2 reviews the literatures of ASQ and LMX. Section 3 discusses the development and application of grey incidence analysis and we develop the grey preference model for this study. In section 4 an empirical study is designed for data collecting, aggregating and analyzing, and the core research findings and discussions are presented in Section 5.

2. Literature Review

2.1. After-sales service quality

Service Quality refers to "the extent of discrepancy between customers' expectations or desires and their perception" [5]. The "SERVQUAL" service quality model was developed by a group of American researchers in 1988. They based their theory on service banking, securities, credit cards and merchandise maintenance, and they identified ten elements of service quality. However, in later works, these ten factors were collapsed into five factors (RATER - reliability, assurance, tangibles, empathy and responsiveness), and it usually measured by a questionnaire that is made up of 22 statements on individuals' perception of the quality of services received [6]. When customer expectations are greater than their perceived service quality, service quality is deemed low. The instrument was most widely used so far in different service sectors, including maintenance services.

Two clusters of criticisms about SERVQUAL emerge based on theoretical and operational criteria; one prominent challenge is from Cronin and Taylor (1992). They proposed SERVPERF instruments with the same dimensions but combining expectations and perceptions into a single measurement of performance according to expectation [7]. With good reliability and Parsimony, the performance-based study contributed enormously to the measurement development of service quality.

Despite research in service quality has gained its momentum over the years, there is a dearth in literature focusing on scale development. Such research faced both theoretical and empirical challenges. For example, Bouman and Wiele (1992) developed a scale to measure auto service quality, and the findings of their study did not support the five-dimension structure of SERVQUAL [8]. Hence, in this study, we use SERVPERF to develop measurement instrument for after-sales service quality, and survey in Chinese 4S shop.

2.2. Leader-member Exchange

Leader - member exchange theory was originally proposed by Graen and Dansereau in 1972, and it has received wide attention. The theory proposes that the creation and maintenance of amicable relationship between the leaders and members is an important antecedent for organizational success, productive employee behavior, lower turnover rate, organizational commitment, job satisfaction, *etc.*, [9, 10].

The theory focuses on the exchange between supervisors and subordinates, and it suggests that leaders hold different types of relationships with individual employees [11]. LMX quality influences subordinates' responsibility, decision, access to resources and performance. High quality LMX (in-group) is characterized by mutual trust, respect, liking and reciprocal influence [12].

Research has proved that LMX is a multidimensional construct (loyalty, contribution and affect) [13]. Liden and Maslyn proposed an additional dimension professional respect in 1998 to form the LMX-MDM scale [14]. Research has shown that that LMX-MDM scale had good psychometric quality in the Chinese organizational context [15]. As relationship is an important component of the Chinese business world, we believe that LMX is an important antecedent to employee behavior.

3. The Grey Theory and Model of Grey Preference

3.1. Grey Incidence Analysis

Grey system targets the uncertain system which is the "small samples, poor information" with "some known information and some unknown". Through generating, developing and extracting of valuable information, grey system gives correct description of running on the system behavior and evolution and also monitors effectively [16]. Among many grey system models, grey incidence analysis is one of most popular.

Grey incidence analysis, known as relational analysis (GRA) has been applied in various areas of practical applications of grey theory. Lin and Wu use GRA to predict financial crisis, the result illustrates that the proposed GRA model demonstrates better prediction accuracy than the conventional ones [17], Lee and Lin apply a multiple attribute decision-making approach into GRA to evaluate the energy performance of buildings [18]. Based on GRA, Murat Ar, *et al.*, present a ranking approach to explore the teaching performance of Turkish Business Schools, and determine the degree of importance of factors affecting the teaching performance. The result confirms that the results obtained from the ranking orders using the proposed methods are reliable [19].

The essential idea of grey incidence is to distinguish similarity degree between many factors, after comparing geometry curves of systems sequences [20]. If the geometry curves of system sequences are closer, the correlations between them are greater. From the philosophy of grey incidence, scholars define grey incidence with different viewpoints., such as Deng's grey incidence degree, absolute grey incidence degree, relative grey incidence degree, grey slope incidence degree, and so on [21].

3.2. The Theory of Grey Preference

In grey system, when the reference sequences (*i.e.,* System's characteristic behaviors) and compared sequences (*i.e.,* relevant factors) are both more than 2, we can conduct preference analysis for a system's behaviors or relevant factors by making use of the grey incidence matrices of grey, and try to find the dominant factors [20].

Assume that $Y_1, Y_2, ..., Y_s$ are sequences of a system's characteristic behaviors, and $X_1, X_2, ..., X_m$ are behavioral sequence of relevant factor. If the sequences Y_i and X_j have the same length, γ_{ij} (i=1,2,⋯,s; j=1,2,⋯,m) is the degree of grey incidence of Y_i and X_j, then

$$\Gamma = (\gamma_{ij}) = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \cdots & \gamma_{1m} \\ \gamma_{21} & \gamma_{22} & \cdots & \gamma_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ \gamma_{s1} & \gamma_{s2} & \cdots & \gamma_{sm} \end{bmatrix}$$

is called the matrix of grey incidence.

1^0 If there exist $k, i \in \{1, 2, \cdots, s\}$ satisfying $\gamma_{kj} \geq \gamma_{ij}$ $(j = 1, 2, \cdots, m)$, then we say the system's characteristic Y_k is more favorable than Y_i, denoted as $Y_k \succ Y_i$.

2^0 If $\forall i = 1,2,\cdots,s, i \neq k$, we always have $Y_k \succ Y_i$, then Y_k is said to be the most favorable characteristic.

3^0 If there exist $k, i \in \{1,2,\cdots,s\}$ satisfying $\sum_{j=1}^{m} \gamma_{kj} \geq \sum_{j=1}^{m} \gamma_{ij}$, then the system's characteristic Y_k is more quasi-favorable than Y_i, denoted as $Y_k \underset{\_}{\succ} Y_i$.

In the same way, the most favorable and quasi-favorable factor are defined.

3.3. The Grey Preference Model of After-sales Service Quality

After-sales service quality was a kind of performance of boundary employees. Boundary employees view the perceived supervisors support as representative of the organization's favorable or unfavorable orientation toward them, and supervisors facilitate employee performance by providing key resources, such as equipment and training. If an employee perceives that supervisors show more concern s and provide more support for worker in general, it will lead to a positive appraisal of the environment and increase their performance. Based on what we found from LMX and ASQ, we propose the grey preference model of after-sales model, with ASQ as the sequence of system's characteristic behavioral (i.e. Y), while LMX as the behavioral sequence of relevant factors (*i.e.*, X).

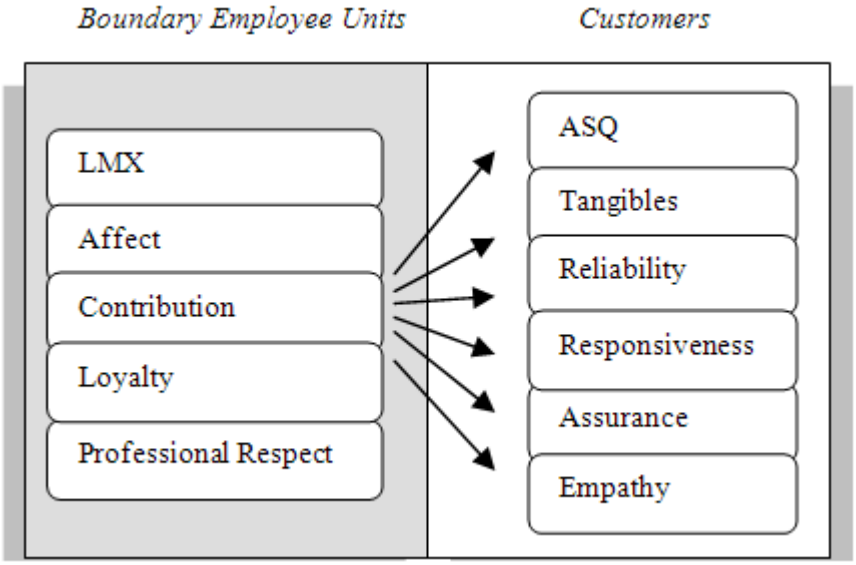

Figure 1. The Grey Preference Model Of After-sales Service Quality

(1) Relevant Factors Variables

For both LMX and ASQ, we adopted existed scales by keeping structure and items, and modified in Chinese automobile background. As for LMX construct, we used Wang and Niu (2004) scale with four dimensions: Affect, Contribution, Loyalty and Professional Respect, and every dimension was measured by 3 items. For example, Affect is measured by the following three items: "like my supervisor very much as a person"; "My supervisor is a lot of fun to work with"; "My supervisor is the kind of person one would like to have as a friend". So the sequence of relevant factors is conducted as following: $X = \{X_1, X_2, X_3, X_4 X_5\}$, Where the variables:

X_1 = LMX

X_2 = Affect

X_3 = Contribution

X_4 = Loyalty

X_5 = Professional Respect

(2) System's Characteristic Behavioral Variables

As for ASQ construct, based on SERVPERF, We kept 5 structures and 22 items of RATER scale: reliability, assurance, tangibles, empathy and responsiveness. For example, tangibles were measured by: advanced repair tools, clean cars in the showroom, clean company grounds, neat company property and attractive promotion materials. So the sequence of system's characteristic sequences as following: $Y = \{Y_1, Y_2, Y_3, Y_4, Y_5, Y_6\}$, where the variables:

Y_1 =ASQ, the overall after-sales service quality;

Y_2 =Tangibles, including appearance of physical facilities, equipment, personnel and communication materials;

Y_3 = Reliability, ability to perform the promised services dependably and accurately;

Y_4 =Responsiveness, willing to provide prompt service to customers;

Y_5 =Assurance, knowledge and courtesy of employees, and their ability to convey trust and confidence;

Y_6 =Empathy, caring and paying individualized attention for customers.

All of the variables were phrased as statements, asking the respondents to indicate their degree of agreement or disagreement with the statement. A five-point response format was adopted, where 1 corresponded with strongly disagree and 5 with strongly agree.

4. Case Study

4.1 Sample and Data Collection

(1) Research Design

The study was conducted in The Yangtze River Delta region as it was one of the most densely populated regions. A questionnaire was developed according to the former studies, and distributed to respondents. 25 units (4S automobile stores) were randomly chosen, and information was collected from two sources: employees and customers. After-sales service quality was evaluated by customers, while leadership-member exchange was evaluated by employees. Both employees and customers received questionnaires in person; researchers were presented to help employees and customers in case they had any difficulties filling in the questionnaire. The questionnaire survey processes took approximately 20 minutes. Therefore, data from employees and customers was a kind of individual, while data from 4S automobile stores was a kind of unit level.

(2) Descriptive Analysis

Ten customers were randomly selected from 4S store and invited them to participate in the study. When a customer declined to participate, another customer from the same store was randomly invited. These customers received similar after-sales services and maybe shared similar experience. In total, the sample of customers consisted of 230 useful customers from 250 respondents (78% men and 22% women). Of the respondents, 85% were under 45, 51% family monthly income varied from RMB 5,000 to 10,000, and two and three carriage cars were 68%.

Five employees were randomly selected from 4S store and invited them to participate in the study. When an employee declined to participate, another one from the same unit

was randomly selected. These employees worked together in the same store, shared supervisors and customers. In total, we received 92 usable responses from 125 staff. 91% respondents were under 35; mean tenure rate was 2.35 years; 69% held some college degree and a further 12% held four-year degree qualifications.

(3) Reliability Analysis

Reliability can be considered a measure assessing the relative consistency of responses among raters [22]. Before aggregation and modeling, we assessed the reliability of measures. The internal reliability of the scales demonstrated good internal reliability according to the 0.70 criterion: the "affect" items (alpha=0.83), the "contribution" items (alpha=0.92), the "loyalty" items (alpha=0.89), the "impact" items (alpha=0.83) and LMX (alpha=0.78).

As for the construct of ASQ, reliability analysis demonstrated a high level of internal consistency among the items: the "tangibles" items (alpha=0.85), the "reliability" items (alpha=0.89), the "responsiveness" items (alpha=0.91), the "assurance" items (alpha=0.79), the "empathy" items (alpha=0.87), and LMX (alpha=0.85).

4.2 Data Aggregation

In the multilevel organizational literature, reliability is often assessed by aggregation indices of the Intra-class Correlation Coefficient (ICC). This index compared intraunit variance by using the mean score of the members who responded in each unit, and determine whether the units shared their perceptions enough to be taken as a unit entity. The internal homogeneity was confirmed in some of the units with the ICC indices. First, the mean ICC value of employees' was .19 whereas the mean ICC value of the customers it was .13. As both values were above .12, and according to this index, therefore it was possible to aggregate the data from individuals into units [23].

However, only 19 units out of the original 25 did reach the degree of internal homogeneity required to be aggregated according to the ICC, which meant having to eliminate 6 units because they did not share the perceptions that considered a unit to have one self entity. Firstly, we calculated t variables value by factor scores except for ASQ, and the sum of five sub-dimensions was calculated as ASQ according to its definition. For those satisfying the ICC index, we calculated mean value of the specific variable in one unit as aggregation data (Table 1).

Table 1. Aggregation Data of Observational Objects and Indicators

	unit1	unit2	unit3	unit	unit16	unit17	unit18	unit19
X_1	3.3	3.1	2.6	.....	2.6	2.6	2.7	2.6
X_2	2.9	3.0	2.6	.....	2.9	2.9	2.7	2.9
X_3	2.4	2.2	2.6	.....	2.5	2.3	2.8	2.6
X_4	2.5	2.4	2.9	.....	2.6	2.6	2.8	2.6
X_5	5.3	5.1	2.2	.....	2.3	2.7	2.8	2.4
Y_1	11.9	12.8	13.0	.....	12.8	12.7	12.3	12.4
Y_2	2.4	2.6	2.5	.....	2.6	2.6	2.5	2.4
Y_3	2.6	2.6	2.7	.....	2.7	2.7	2.3	2.7
Y_4	2.3	2.5	2.6	.....	2.5	2.4	2.5	2.4
Y_5	2.4	2.4	2.8	.....	2.5	2.5	2.3	2.5
Y_6	2.2	2.7	2.5	.....	2.5	2.6	2.7	2.4

4.3 Grey Preference Analyses

As different degrees of grey incidence are used in different situation, synthetic degree of grey incidence was chosen in this study. In this study, we calculated absolute degrees of grey incidence and relative degrees of grey incidence, and then synthetic degrees were calculated by giving weights to absolute degrees and relative degrees.

(1) Procedure of Calculation

Firstly, we calculated the absolute degree. The absolute degree of grey incidence of X_0 and X_i is defined as ε_{0i} , and the computation is as formula (1). This degree is only related to the geometric shape of X_0 and X_i .The more X_0 and X_i are geometrically similar, the greater ε_{0i} ; and vice versa.

$$\varepsilon_{0i} = \frac{1+|s_0|+|s_i|}{1+|s_0|+|s_i|+|s_i - s_0|} \qquad (1)$$

$$\text{Where,} \quad 0 < \varepsilon_{0i} \le 1, \quad s_i = \int_1^n \left(X_i - x_i(1) \right) dt$$

Secondly, we calculated the relative degree. The relative degree of grey incidence of X_0 and X_i is defined as γ_{0i} , and the computation is as formula (2). The concept is a quantitative representation of the rates of change of X_0 and X_i relative to their starting points. The closer the rates of change of X_0 and X_i are, the greater γ_{0i} is.

$$r_{0i} = \frac{1+|s_0'|+|s_i'|}{1+|s_0'|+|s_i'|+|s_i' - s_0'|} \qquad (2)$$

$$\text{Where,} \quad 0 < \varepsilon_{0i} \le 1, \quad s_i' = \int_1^n \left(X_i' - x_i(1)' \right) dt, \quad X_i' = X_i \Big/ x_i(1)$$

Thirdly, we calculated the synthetic degree. The synthetic degree of grey incidence of X_0 and X_i is defined as ρ_{0i} , and the computation is as formula (3). The concept of synthetic degree of grey incidence is a numerical index that well describes the overall relationship of closeness between sequences. It reflects the similarity between the zigzagged lines X_0 and X_i , and also depicts the degree of closeness of the individual rates of change of X_0 and X_i with respect to their initial points.

$$\rho_{0i} = \theta \varepsilon_{0i} + (1-\theta)\gamma_{0i} \qquad (3)$$

(2) Results of Grey Preference Analyses

In this study, we took $\theta = 0.5$, putting equal emphasis to the relative degree and absolute degree. Then matrix of synthetic grey incidence was:

$$\Gamma = \begin{array}{c} \\ Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \end{array} \begin{array}{c} \begin{array}{ccccc} X_1 & X_2 & X_3 & X_4 & X_5 \end{array} \\ \begin{bmatrix} 0.60 & 0.54 & 0.51 & 0.51 & 0.74 \\ 0.53 & 0.56 & 0.91 & 0.61 & 0.74 \\ 0.56 & 0.66 & 0.63 & 0.89 & 0.52 \\ 0.53 & 0.55 & 0.82 & 0.59 & 0.51 \\ 0.53 & 0.58 & 0.80 & 0.71 & 0.52 \\ 0.52 & 0.58 & 0.80 & 0.56 & 0.51 \end{bmatrix} \end{array}$$

From the above result, we found the incidence degrees varied from 0.51 (X_5 and Y_6) to 0.91(X_3 and Y_2) with high identification, showing that grey incidence analysis could

distinguish relationships among units well. The highest degree of 0.91 between X_3 and Y_2 demonstrated that employees' contribution had a profound influence on customers' evaluation of tangibles, even though they were relatively objective perception.

As we asserted neither characteristic behaviors nor relevant factors had most favorable factors in the above matrix, we took a further investigation into quasi-favorable factors. According to then matrix of synthetic grey incidence, it was known that:

$$\sum_{l=1}^{4}\rho_{il}=[2.90 \quad 3.35 \quad 3.25 \quad 3.01 \quad 3.14 \quad 2.98]^{T}$$

As for the sequence of system's characteristic behaviors, the grey incidence order was obtained as following: $Y_2 \succ_{-} Y_3 \succ_{-} Y_5 \succ_{-} Y_4 \succ_{-} Y_6 \succ_{-} Y_1$. From the order, we concluded that tangible were a most typical indicator for automobile after-sales services, more intention should be paid to tangibles rather than all aspects of after-sales service.

As for the behavior sequence of relevant factors, it was know that:

$$\sum_{k=1}^{6}\rho_{kj}=[3.28 \quad 3.47 \quad 4.47 \quad 3.88 \quad 3.54]$$

the grey incidence order of relevant factors was: $X_3 \succ_{-} X_4 \succ_{-} X_5 \succ_{-} X_2 \succ_{-} X_1$, and we concluded that employees' contributions had most important function on after-sales service, and breakthrough choice in improving leadership-member exchange was employees' contribution rather than promoting all efforts.

5. Conclusions and Implications

The Chinese automobile industry is the largest in the world. Although an after-sales service is known to be an important antecedent of increased profitability, the Chinese automobile industry is fraught with low customer satisfaction. We conducted the current study with a focus on the quality of LMX in Chinese 4S stores and their after-sales services quality, we conducted the current study.

As the internal homogeneity was confirmed in some 4S stores, the individual data colleting from employees and customers is aggregated into unit level, and a grey preference model is developed for analyzing. From the empirical surveys in 4S shops, the conclusions are as following:

Firstly, the grey model is a good method for the study with poor unit data. In this study, useful data is collected from 230 customers and 92 employees, but only 19 unit data is aggregated according to ICC indexes. While typical statistic and structure equation model need bigger data, the grey theory characteristic of "small samples, poor information" is definitely a good choice.

Secondly, the grey preference model of ASQ shows its' practicability with high identification of incidence degrees. From the grey incidence order, we find tangibles is a kind of most typical indicator for automobile after-sales services based on characteristic behaviors analysis, more intentions should be paid to tangibles rather than all aspects of after-sales service; employees' contributions had most important function on after-sales service based on relevant factors analysis, and breakthrough choice in improving leadership-member exchange was employees' contribution rather than promoting all efforts.

Although 19 units are suitable for grey model, results definitely will be more universal when more units are investigated, and we will survey more units to further confirm the results. Besides, leadership-member exchange is a key resource providing from organizations, more key factors will be explored in our future work.

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