Assessment of Customer Relationship Management for Global Shipping Carrier-based Logistics Service Providers in Taiwan: An Empirical Study

JI-FENG DING
Department of Aviation and Maritime Transportation Management
Chang Jung Christian University
No. 396, Sec. 1, Chang-Rong Rd., Gui-Ren, Tainan City 71101
TAIWAN
jfding@mail.cjcu.edu.tw

Abstract: - The aim purpose of this paper is to empirically study the assessment of customer relationship management (CRM) for global shipping carrier-based logistics service providers (GSLPs) in Taiwan. At first, an evaluation framework integrated three methods and with combination of three stages questionnaires is developed. Three methods are threshold and importance analysis (TIA) approach, importance-performance analysis (IPA) approach, and fuzzy quality function deployment (FQFD) approach, respectively. Continually, an empirical analysis for the evaluation is performed to demonstrate the computational process of three methods adopted by this paper. Finally, the empirically results show that: (1) sixteen suitable CRM assessment indicators are evaluated via the TIA approach; (2) thirteen CRM assessment indicators of needing improvements are selected to position on the 'concentrate here' in quadrant 2 and 'low priority' in quadrant 3 by using the IPA approach; (3) the top four quality technology deployment plans for GSLPs in Taiwan are prioritized by experts via FQFD approach, including 'customized service,' 'interactive marketing,' 'data mining,' and 'creation of new value,' respectively.

Key-Words: - Customer relationship management (CRM); Shipping; Logistics service; Fuzzy

1 Introduction

The concept of "customer service above all" has already pervaded many types of service industries. Accordingly, apart from continuing to emphasize the core benefits that they receive from providing goods/services, companies are placing additional importance on customers' willingness to make repeat purchases. The long-term partnerships (cultivated by means of relationship marketing and customer relationship management (CRM) [1]) will bring them even greater revenue and profit. If a company strives to provide good customer service, it will consequently wish to make customers aware that the benefit of the service it provides is greater than the sacrifice entailed. Its service can therefore enhance customer value, and is worthy of customer commitment. It is therefore vital for companies, if they are to create long-term relationships benefiting both themselves and their customers. In today's highly competitive operating environment, gaining a full understanding of customers' needs and creating new customers is an important part of corporate management [2].

Maintaining the loyalty of existing customers can be a difficult task due to customers' increasingly high service quality demands and the individualized customer needs. According to the study of Liang et al. [3], most companies lose an average of 25% of their customers every year. Developing a new customer requires roughly five times the cost of maintaining an existing customer. In the wake of globalization, companies must therefore deal with vast amounts of customer data. Hence, the CRM has become a key focus of corporate operations.

During the last few years, large international container carriers have steadily entered the international logistics service market. They are relying on investment in subsidiaries under their own brands to establish global shipping carrier-based logistics service providers (GSLPs). The GSLPs have been established by large international container carriers in order to create a win-win shipping environment and achieve their transport and logistics goals. As a result, large container carriers have gradually shifted to outsourcing GSLP functions, which has led to the emergence of third-party logistics service providers (3PL) [4].

Container carriers usually rely on alliances involving container communities [5] spanning international logistics chains to create the greatest

possible customer value and loyalty, enhance productivity, reduce operating costs and risk, and increase profitability. Customers and carriers are both concerned about whether cargo can be safely transported to its destination. In order to ensure that this goal is reached, cargo logistics effectiveness is especially important to GSLPs. From a marketing perspective, a vital issue is how to enable GSLPs to become efficient logistics service stations creating significant added value for customers [6], and thereby ensuring full-scale customer success and maintaining the GSLPs' competitiveness.

It can be inferred from this discussion that, in the face of an increasingly competitive global shipping logistics market, successful CRM is the key to customer satisfaction and loyalty for GSLPs. In order to effectively achieve customer loyalty, GSLPs must investigate the issue of CRM assessment with an eye to boosting customer satisfaction and loyalty. This study's chief motivation to research this issue is to provide GSLPs with a concrete CRM assessment framework.

A large body of research and analysis [1-3, 7-16] has focused on the topic of CRM in recent years. The amount of research on this topic has been growing steadily, which reveals the increasing importance placed on CRM. Although some past literature focused on CRM issues involving industries peripheral to the shipping industry [3, 8, 9, 14-16], there has been no in-depth past research addressing the so-called GSLPs, which are the focus of this study. This provides a second motivation to research this topic.

In light of this, the aim of this paper is to empirically study the assessment of CRM for GSLPs in Taiwan. The main contribution of this paper is to construct assessment models of CRM for business application of GSLPs. The following section (Section 2) presents the research procedures and content. Consequently, the assessment models with three approaches are constructed and described in Section 3. The empirical survey is studied in Section 4. Finally, some conclusions are drawn in the last section.

2 Research Procedures and Content

This paper's research procedures are geared to investigating two chief issues, namely (1) CRM assessment indicators and (2) assessment of CRM technical needs strategies.

2.1 CRM assessment indicators

An effective CRM business model and strategy requires quantifiable assessment indicators, which can be used to calculate changes in performance before and after the implementation of CRM. Taking the financial industry as an example, Körner and Zimmermann [13] proposed the management of customer relationship in business media (MCR-BM) concept, which calls for management of those customer relationships with the greatest current and future economic value, and suggested that customer needs should guide MCR-BM system design, development, and application. In addition, certain indicators should be used to assess CRM in order to facilitate the determination of service quality factors and ensure that a company can establish excellent relationships with its customers and provide good service quality.

Within the MCR-BM concept, Körner and Zimmermann propose seven assessment criteria, namely customer interaction, added value, customer profiling, virtual communities, trust, processes, and controlling, respectively. Körner and Zimmermann also believe that MCR-BM assessment criteria can be adjusted on the basis of an industry's characteristics. Since the current paper assumes that (1) GSLPs do not establish virtual communities, (2) the two criteria of processes and controlling are linked with other criteria, and (3) GSLPs do not have any problems with transaction security or failure to maintain customer data confidentiality. This paper consequently employs the three assessment criteria - customer interactions, added value, and customer profiling - to assess CRM, and proposes the use of these criteria by GSLPs.

Because assessment of customer relationships and service quality can employ service quality records provided to GSLPs by their customers. Hence, this study used the MCR-BM concept and a review of literature [3-5, 8-10, 13-16] on transport service quality attributes to determine twenty preliminary CRM assessment indicators. The code names of these ones are shown in the parentheses.

(1) Customer interaction (C_1). Assessment indicators include 'active transmission of information (C_{11}),' 'active contact and communication (C_{12}),' 'active establishment of channels of interaction (C_{13}),' 'provision of individualized consulting service (C_{14}),' 'effective and rapid response (C_{15}),' 'establishment of sales feedback mechanisms (C_{16}),' and 'provision of diversified logistics solutions (C_{17}).'

(2) Added value (C_2). Assessment indicators include 'differential pricing (C_{21}),' 'enhancement of transport accuracy and correctness (C_{22}),' 'enhancement of cargo transport safety and

convenience (C_{23}),' 'enhancement of carrier's reputation and level of professional knowledge (C_{24}),' 'enhancement of service communication ability (C_{25}),' and 'enhancement of service handling speed and quality (C_{26}).'

(3) Customer profiling (C_3). Assessment indicators include 'establishment of a customer database (C_{31}),' 'collection of customer transaction data (C_{32}),' 'analysis of customer contact data (C_{33}),' 'screening of target or potential customers (C_{34}),' 'analysis of special customers (C_{35}),' 'new customer development (C_{36}),' and 'use of information applications (C_{37}).'

2.2 A technology needs strategy for CRM assessment

This study has drafted a plan for quality technology deployment needs addressing customer relationship and service quality attributes requiring prioritized improvement. After conducting a review of the literature [3, 8-10, 14, 17, 18], interviews with experts, and examination of CRM systems, and investigation of factors promoting the success of CRM (such as support from upper management, establishment of a corporate culture, establishment of a service mindset, high-quality customer data, establishment of a customized, appropriate customer management system, participation by sales personnel, and effective integration with existing systems) and CRM technologies and approaches (such as one-to-one marketing, data storage, data mining, use of information technology, and creation of new values, etc.). This study concluded that a specific plan for the successful implementation of CRM should embody the two levels of "use of information technology to create relationship marketing information and channels" and "establishment of a customer-oriented learning organization and culture." Here, on the former level, the information technology should include data mining, data storage, online analysis, and the Internet. On the latter level, customized service, establishment of a CRM culture, interactive marketing, training of CRM manpower, and creation of new values can be used to realize the benefits of CRM. This paper employs nine quality technology deployment items, which are explained and described in Table 1.

Table 1. Proposed quality technology deployment plans

Plans		Description of characteristics
Establishing a customer-oriented learning organization and culture	Customized service (A_1)	Provision of customized products and services to customers making large contributions to profits can increase customer satisfaction and willingness to make repeated purchases.
	Establishment of a CRM culture (A_2)	The establishment of a CRM-oriented organizational culture can enable all employees of a company to makes maximal contributions to the company's image and customer satisfaction.
	Interactive marketing (A_3)	A company can win the trust of its customers and create new opportunities through the use of interactive database marketing, technology, communications applications, and maintenance of close interaction with customers.
	Training of CRM manpower (A_4)	The training of valuable CRM manpower can provide the human resources needed to achieve the successful use of CRM.
	Creation of new value (A_5)	Enhances the perception among customers and potential consumers that the organization is an excellent company, and able to promptly respond to and satisfy customers' needs.
Using information technology to establish relationship marketing information and networks	Data mining (A_6)	Data mining can be used to locate relevant models from large databases, automatically extract forecasting information, and establish models that can be used to automatically forecast customers' behavior.
	Data storage (A_7)	Data from different sources can be combined in a data storage system, and mined for useful information giving decision-makers a clearer view of the situation.
	Online analysis and processing (A_8)	Online data analysis allows users to rapid analyze large amounts of data from different angles, enabling the compilation of reference reports.
	The Internet (A_9)	Increases interaction with customers, and enables real-time customer service.

3 The Assessment Models

This paper proceeds with basic two points, i.e. (1) the CRM assessment indicators and technical needs

strategies, and (2) the assessment models. The first point is introduced in the above section, whereas the second one will be described in this section. Hence, this paper will propose the applications of three-stage questionnaires with interlinking three assessment models - threshold and importance analysis (TIA) method, importance-performance analysis (IPA) method, and fuzzy quality function deployment (QFD) method, respectively. The following three methods are briefly introduced in this paper.

3.1 TIA approach

The excessive items regarding with preliminary CRM assessment indicators may increase the difficulty and complexity of evaluating process. To check the suitable indicators for decision-makers (DMs), refining on influential indicators using scientific analysis is an important matter. The common and useful method is to set up a certain threshold; and then to refine the above threshold to identify the assessment indicator. To effectively represent the multiple DMs' consensus opinions [19], the geometric mean is employed to aggregate all information generated by first-stage questionnaire. In this paper, these steps [20] can be summarized as follows.

Step 1: Find the importance value of all preliminary CRM assessment indicators. Let $a_{jk}, k = 1, 2, \ldots, m,$ be the importance value, measured by the Likert's 5-point scale, given to the CRM assessment indicator *j* by DM *k*.

Step 2: Use geometric mean technique to integrate the opinions of all DMs. Let a_j denote the consensus opinion evaluation value of the CRM assessment indicator *j*, then $a_j = \left(\prod_{k=1}^{m} a_{jk} \right)^{1/m}$.

Step 3: Set up the threshold value. Threshold value is subjectively decided by researchers. In this stage questionnaire, the very high threshold of the top 80% is suggested by Chen [21] or the threshold value 4 is taken.

Step 4: Compare geometric mean a_j with threshold value. If $a_j \geq 4$, then retain the item of the CRM assessment indicator; otherwise, delete the one. The retained items are considered as the suitable CRM assessment indicator for this paper.

3.2 IPA approach

In order to determine whether the CRM assessment indicators are valued by customers, or whether they are factors that should be improved by the GSLPs. This study used the IPA approach, as proposed by Martilla and James [22] in 1977. Therefore, this study intends to generalize the CRM assessment values of the GSLPs, and further identify the important CRM assessment indicators that should be maintained or improved. In this section, a stepwise description of the IPA approach is briefly introduced in the following.

Step 1: Assess the degrees of importance and satisfaction of the CRM assessment indicators. Let b_{iq} and c_{iq} $i = 1, 2, \ldots, r;$ $q = 1, 2, \ldots, n,$ be the importance value and satisfaction value, measured by Likert's 5-points scale, given to the refined CRM assessment indicator *i* by a DM *q*, respectively. It is obvious that $1 \leq b_{iq} \leq 5$ and $1 \leq c_{iq} \leq 5$.

Step 2: Use the geometric mean technique to integrate the opinions of all DMs. Let b_i and c_i denote the consensus opinion evaluation values of importance and satisfaction of the refined CRM assessment indicators, respectively, then we can obtain $b_i = \left(\prod_{q=1}^{n} b_{iq} \right)^{1/n}$ and $c_i = \left(\prod_{q=1}^{n} c_{iq} \right)^{1/n}$, respectively.

Step 3: Set up the threshold values (TVs). In this paper, the TV of importance (i.e. first TV) and the TV of satisfaction (i.e. second TV) of all questionnaires are calculated by the arithmetic mean of all refined CRM assessment indicators *r*. That is, the first and second TVs are $\bar{y}_b = \sum_{i=1}^{r} b_i \Big/ r$ and $\bar{x}_c = \sum_{i=1}^{r} c_i \Big/ r$, respectively.

Step 4: Skeletonize the relative position of all refined CRM assessment indicators as shown in Figure 1.

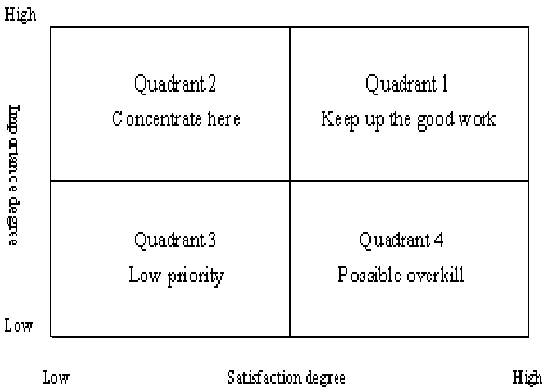

Figure 1. The importance-performance matrix
Source: [22]

The figure is plotted in a two-dimensional matrix, which is composed by 'keep up the good work' (in quadrant 1), ' concentrate here' (in quadrant 2), 'low priority' (in quadrant 3), and 'possible overkill' (in quadrant 4). That is

(1) The quadrant 1 represents the importance and satisfaction values are relative higher than first and second TVs; that means the CRM assessment indicators in this quadrant zone should be 'kept up the good work.' The setting up standard of this zone is $b_i \geq \overline{y}_b$ and $c_i \geq \overline{x}_c$, respectively. This zone of quadrant 1 is the place of competitive advantage for GSLPs.

(2) The quadrant 2 represents the importance value is higher than first TV, but the satisfaction value is lower than second TV; that means the CRM assessment indicators in this quadrant zone should be 'concentrated here.' It indicates the CRM assessment indicators should have a first priority of improvement. The set up standard of this zone is $b_i > \overline{y}_b$ and $c_i < \overline{x}_c$, respectively.

(3) The quadrant 3 represents the importance and satisfaction values are lower than first and second TVs; that means the CRM assessment indicators in this quadrant zone is 'low priority.' It indicates the CRM assessment indicators should have a second priority of improvement. The set up standard of this zone is $b_i < \overline{y}_b$ and $c_i < \overline{x}_c$, respectively.

(4) The quadrant 4 represents the importance value is lower than first TV, but the satisfaction value is higher than second TV; that means the CRM assessment indicators in this quadrant zone is 'possible overkill.' The set up standard of this zone is $bi < \overline{y}_b$ and $c_i > \overline{x}_c$, respectively. Some resources of this zone can be transferred to the improved place for GSLPs.

3.3 FQFD approach

Some basic concepts of the QFD model and the fuzzy sets theory are introduced to propose the steps of the FQFD approach.

3.3.1 Basic concept of the QFD model

The QFD model [23-25] can be used to translate customer requirements into product specifications. It is a tool to deploy the voice of customer (VOC) into searching for best solutions of product development. Cohen [23] had proposed the four-phase QFD model to discuss the product development, i.e. the customer requirement planning (CRP), the product characteristics deployment (PCD), the process and quality control (PQC), and the operative instruction (OPI), respectively. In this paper, we focused on the CRP phase, which has been used to develop the procedures to identify the solutions of quality technology deployment. The CRP is a matrix, also called the "House of Quality (HOQ)," which is used matrices to show multiple relationships between customer's requirements (i.e., the 'what' factors needed to improve) and technical specifications (i.e., the 'how' solutions of quality technology deployment). In this paper, the matrices of HOQ are used for organizing the 'what' problems and evaluating priorities of the 'how' solutions.

The typical chart of the HOQ (the American style) is shown in Figure 2, which consists of six basic steps. The difference between the American style and the Japanese style of HOQ is that latter one lacks Area *E* in Figure 2. Due to the fact that the Japanese style is easy to use, hence, the Japanese style will be applied in this paper.

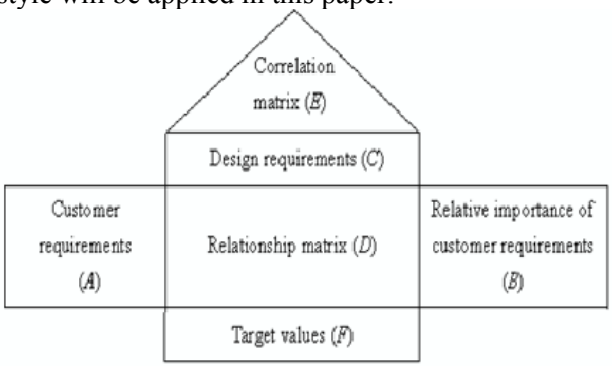

Figure 2. House of quality (HOQ)
Source: [26]

(1) Area *A* represents customer needs and requirements, which is the VOC to be identified. In this paper, those needs and requirements are the refined CRM assessment indicators via IPA approach. These selected indicators are the first and second priorities of improvements in the quadrant 2 and 3 of Figure 1.

(2) Area *B* represents the relative importance of the refined CRM assessment indicators. In this paper, the computations can be evaluated by the questionnaires.

(3) Area *C* represents design requirements or technical specifications, which means the 'how' solutions of quality technology deployment. In this paper, this 'how' question is the main issue, which is identified solutions of quality technology deployment.

(4) Area *D* represents relationship matrix, which is the core element of the HOQ. In this paper, the relationship strength is showed with linguistic variables.
(5) Area *E* represents correlation matrix, which expressed how design requirements affect each other. Correlations are showed with symbols or a rating scheme of 1-3-9 or linguistic variables.
(6) Area *F* represents target values of design requirements. In this paper, the priority of solutions of quality technology deployment can be measured.

3.3.2 Basic concept of the fuzzy theory

The fuzzy set theory [27] is designed to deal with the extraction of the primary possible outcome from a multiplicity of information that is expressed in vague and imprecise terms. Fuzzy set theory treats vague data as possibility distributions in terms of set memberships. Once determined and defined, the sets of memberships in possibility distributions can be effectively used in logical reasoning. In this paper, the concepts of the fuzzy theory and fuzzy logic [28] are applied to the CRM in the context of GSLPs. Moreover, many applications of soft computing in many different fields - e.g. Cheng and Tang [29], Ding [4, 20, 26], Hajeeh [30], Jiang et al. [31], Liang et al. [32], Neri [33] - were discussed in academic literature.

(I). Triangular fuzzy numbers and the algebraic operations

A fuzzy number A [34] in real line $\Re$ is a triangular fuzzy number if its membership function $f_A : \Re \to [0, 1]$ is

$$f_A(x) = \begin{cases} (x-c)/(a-c), & c \le x \le a \\ (x-b)/(a-b), & a \le x \le b \\ 0, & otherwise \end{cases}$$

with $-\infty < c \le a \le b < \infty$. The triangular fuzzy number can be denoted by (c, a, b).

Let $A_1 = (c_1, a_1, b_1)$ and $A_2 = (c_2, a_2, b_2)$ be fuzzy numbers. According to the extension principle [27], the algebraic operations of any two fuzzy numbers A_1 and A_2 can be expressed as

- Fuzzy addition:
  $A_1 \oplus A_2 = (c_1 + c_2, a_1 + a_2, b_1 + b_2)$,
- Fuzzy subtraction:
  $A_1 \ominus A_2 = (c_1 - b_2, a_1 - a_2, b_1 - c_2)$,
- Fuzzy multiplication:
  (i) $k \otimes A_2 = (kc_2, ka_2, kb_2), k \in \Re,\ k \ge 0$;
  (ii) $A_1 \otimes A_2 \cong (c_1c_2, a_1a_2, b_1b_2)$,
  $c_1 \ge 0,\ c_2 \ge 0$,
- Fuzzy division:
  (i) $(A_1)^{-1} = (c_1, a_1, b_1)^{-1}$
  $\cong (1/b_1, 1/a_1, 1/c_1), c_1 > 0$;
  (ii) $A_1 \oslash A_2 \cong (c_1/b_2, a_1/a_2, b_1/c_2)$,
  $c_1 \ge 0, c_2 > 0$.

(II). Linguistic variables

Linguistic variables [35] are represented by triangular fuzzy numbers, which are employed to express the fuzzy relationship strength between the customer requirements and solutions of quality technology deployment. According to the practical needs and for matching the FQFD approach developed in this paper, the triangular fuzzy numbers are utilized to describe the set of relationship degree as $S = \{High, Medium, Low, Non\}$, where the linguistic values are defined as *High* = (0.5, 0.75, 1), *Medium* = (0.25, 0.5, 0.75), *Low* = (0, 0.25, 0.5), and *Non* = (0, 0, 0), respectively.

(III). Ranking of fuzzy numbers

In a fuzzy decision-making environment, ranking the alternatives under consideration is essential. To match the FQFD approach developed in this paper, and to solve the problem powerfully, the graded mean integration representation (GMIR) method, proposed by Chen and Hsieh [36] in 2000, is employed to rank the final ratings of alternatives. Let $A_i = (c_i, a_i, b_i),\ i = 1, 2, \ldots, n,$ be n triangular fuzzy numbers. By the GMIR method, the GMIR value $P(A_i)$ of A_i is $P(A_i) = (c_i + 4a_i + b_i)/6$.

Suppose $P(A_i)$ and $P(A_j)$ are the GMIR values of the triangular fuzzy numbers A_i and A_j, respectively. We define:

(i) $A_i > A_j \Leftrightarrow P(A_i) > P(A_j)$;
(ii) $A_i < A_j \Leftrightarrow P(A_i) < P(A_j)$;
(iii) $A_i = A_j \Leftrightarrow P(A_i) = P(A_j)$.

3.3.3 The proposed FQFD approach

The systematic steps of FQFD approach [26, 32] are proposed below.

Step 1. Identify customer requirements. In this paper, the refined CRM assessment indicators were selected via IPA approach. These indicators are

needed to be improved and are identified as the customer requirements in this paper.

Step 2. Compare the CRM assessment indicators between the importance and satisfaction degrees. The CRM assessment indicators can be measured by Likert's 5-points [26, 32] to evaluate the gaps between importance and satisfaction degrees. If the latter is greater than the former, it implies the indicator is acceptable. On the other hand, if the former is bigger than the latter, this implies that some measures or solutions should be identified, and then proceeding with Step 3. In this paper, the author will evaluate discrepancies in perceptions of CRM assessment indicators via a questionnaire.

Step 3. Identify technical solutions. In this paper, two dimensions with nine plans of quality technology deployment are suggested, as shown in Table 1.

Step 4. Calculate the priorities of the CRM assessment indicators. As mentioned in the Step 2, the importance and satisfaction degrees for each CRM assessment indicators are compared to obtain the arithmetic averages of all importance and satisfaction levels. The priorities of selected CRM assessment indicators have to be calculated to evaluate the perception of the VOCs. This is because that the higher the importance levels and the lower the satisfaction levels, the higher the selected CRM assessment indicators should be improved.

Let $\overline{I_t}$ and $\overline{S_t}$, $t = 1, 2, \ldots, u,$ be the arithmetic averages of importance and satisfaction levels for each selected CRM assessment indicator C_t, $t = 1, 2, \ldots, u$. Since the priority of each CRM assessment indicator has a direct relationship with the importance level, whereas the priority has an inverse relationship with the satisfaction level. Thus, the original priority v_t of C_t can be denoted by $v_t = \overline{I_t}(6 - \overline{S_t})$. For being convenient to compare with the priorities, these crisp weights are normalized and denoted by $w_t = v_t \Big/ \sum_{t=1}^{u} v_t$.

Step 5. Construct the fuzzy relationship matrix. The fuzzy relationship matrix can be constructed to link between the selected CRM assessment indicators C_t ($t = 1, 2, \ldots, u$) and technical solutions A_s ($s = 1, 2, \ldots, z$). Let x_{ts}^h, $h = 1, 2, \ldots, E,$ be the linguistic variable [35] given to t^{th} CRM assessment indicator corresponding to s^{th} technical solution by h^{th} expert. At first, the linguistic relationship degree in the position (t, s) of the matrix should be transferred into triangular fuzzy numbers [26, 32]. Then, we calculate the integrated fuzzy relationship degree R_{ts} by arithmetic mean method. Hence, the integrated fuzzy relationship matrix can be constructed as $[R_{ts}]_{u \times z}$.

Step 6. Calculate the fuzzy relationship strength. Let $R_{ts} = (c_{ts}, a_{ts}, b_{ts})$, $t = 1, 2, \ldots, u;$ $s = 1, 2, \ldots, z,$ be the triangular fuzzy numbers of integrated fuzzy relationship degree in the fuzzy relationship matrix. After integrating the opinions of all E experts, the fuzzy relationship strength corresponding to each technical solution can be denoted by

$$RS_s = \left(\sum_{t=1}^{u} c_{ts} \Big/ u, \sum_{t=1}^{u} a_{ts} \Big/ u, \sum_{t=1}^{u} b_{ts} \Big/ u \right),$$

$s = 1, 2, \ldots, z$.

Step 7. Defuzzify the fuzzy relationship strength to rank the priority. We use the GMIR method, proposed by Chen and Hsieh [36] in 2000, to defuzzify the fuzzy relationship strength RS_s. Finally, the priorities of the fuzzy relationship strength RS_s can be denoted by

$$P(RS_s) = \left(\sum_{t=1}^{u} c_{ts} + 4 \sum_{t=1}^{u} a_{ts} + \sum_{t=1}^{u} b_{ts} \right) \Big/ 6u,$$

$s = 1, 2, \ldots, z$.

4 Empirical Study

In this section, an empirical study of evaluating CRM for GSLPs is carried out to demonstrate the computational process of three methods as described in the above-mentioned section.

4.1 Obtaining the suitable CRM assessment indicators

The first-stage questionnaire is based on the preliminary twenty CRM assessment indicators. The valid questionnaires are designed and employed to refine the suitable CRM assessment indicators. The reliability [37], i.e., Cronbach α, of this stage questionnaire is 0.906, obtained by using statistical software SAS. The survey is conformed to the

content validity and the construct validity [37]. A total of 119 respondents (shippers/customers), most are working over 5-15 years, participated in the survey.

The participants were requested to record the importance based on the Likert's 5-point scale. After coding these data and using the TIA approach, we set the threshold value as 4 for the CRM assessment indicators. The author refined the numbers of suitable CRM assessment indicators from twenty to sixteen. The results are shown in Table 2.

Table 2. The results of suitable CRM assessment indicators using TIA approach

Preliminary indicators	Geometric mean	Retain (√) or Delete (×)
C_{11}	4.841	√
C_{12}	4.542	√
C_{13}	4.362	√
C_{14}	4.169	√
C_{15}	4.514	√
C_{16}	3.569	×
C_{17}	4.192	√
C_{21}	4.249	√
C_{22}	4.364	√
C_{23}	4.291	√
C_{24}	4.219	√
C_{25}	4.261	√
C_{26}	4.319	√
C_{31}	4.169	√
C_{32}	3.469	×
C_{33}	3.347	×
C_{34}	4.164	√
C_{35}	3.637	×
C_{36}	4.194	√
C_{37}	4.216	√

Note: The full names of all indicators can be seen in Section 2.1.

4.2 Selecting the CRM assessment indicators needed to improve

The sixteen suitable CRM assessment indicators are designed in the second-stage questionnaire. We used the IPA approach to identify the CRM assessment indicators of the needed improvement. Regarding the reliability analysis of the importance and relative satisfaction, the Cronbach's α of this stage questionnaire were 0.912 and 0.901, respectively. This indicated that there is a good consistency of this stage questionnaire. As to validity analysis [37], the survey is conformed to the content validity. The total score was subtracted by the score of individual items, the new total-item correlation coefficient was 0.3, which was significant and indicated good construct validity. Since the correlation coefficients of items in this stage questionnaire were 0.478-0.675, they were significant and indicated good construct validity. A total of 116 effective samples (shippers/customers), most are working over 5-15 years, were returned in the survey.

The participants were requested to record the importance and relative satisfaction based on the Likert's 5-point scale. After coding these data and using the IPA approach, we set the values of 4.265 and 3.451 to represent both threshold values of first TV and second TV in this study. According to the steps of the IPA approach and empirical questionnaire surveys, the findings indicate that nine suitable CRM assessment indicators were in quadrant 2, four indicators in quadrant 3, one indicator in quadrant 1, and two indicators in quadrant 4. The thirteen CRM assessment indicators plotted in the quadrant 2 and quadrant 3 were needed to improve in this paper due to the fact that the satisfaction values are lower than the threshold values. The analytical results are shown in Table 3.

Table 3. The results of CRM assessment indicators needed to improve

Suitable criteria	Geometric mean		Results
	Importance	Satisfaction	
C_{11}	4.526	3.241	**Quadrant 2**
C_{12}	4.513	3.163	**Quadrant 2**
C_{13}	4.249	3.428	**Quadrant 3**
C_{14}	4.110	3.489	Quadrant 4
C_{15}	4.524	3.397	**Quadrant 2**
C_{17}	4.218	3.249	**Quadrant 3**
C_{21}	4.195	3.316	**Quadrant 3**
C_{22}	4.432	3.417	**Quadrant 2**
C_{23}	4.294	3.267	**Quadrant 2**
C_{24}	4.124	3.364	Quadrant 4
C_{25}	4.313	3.168	**Quadrant 2**
C_{26}	4.316	3.461	Quadrant 1
C_{31}	4.339	3.268	**Quadrant 2**
C_{34}	4.311	3.249	**Quadrant 2**
C_{36}	4.316	3.367	**Quadrant 2**
C_{37}	4.163	3.267	**Quadrant 3**

Note: The full names of all indicators can be seen in Section 2.1.

4.3 Prioritizing the solutions of quality technology deployment plans

In this paper, the author combined the nine quality technology deployment plans (as shown in Table 1) and the thirteen CRM assessment indicators of needing improvement (as shown in Table 3) to construct a matrix table to evaluate the relationship strength. Due to the fact that the relationship strength is generated by a group of professional experts [38]; hence, the fifteen experts of senior managers in the global shipping logistics services,

most are working fifteen to twenty years, were selected to fill in this stage questionnaire in this survey. The author used the systematic steps of the proposed FQFD approach to obtain the final results, which can be shown as Table 4. Finally, the empirical results show that the top four quality technology deployment plans for GSLPs in Taiwan, including 'customized service (A_1),' 'interactive marketing (A_3),' 'data mining (A_6),' and 'creation of new value (A_5),' respectively.

Table 4. The results of FQFD approach

Plans	A_1	A_2	A_3
Fuzzy relationship strength	(0.571, 0.689, 0.784)	(0.414, 0.512, 0.543)	(0.542, 0.637, 0.751)
GMIR	0.6852	0.5008	0.6402
Ranking	**1**	**7**	**2**
Plans	A_4	A_5	A_6
Fuzzy relationship strength	(0.501, 0.582, 0.613)	(0.518, 0.618, 0.728)	(0.516, 0.621, 0.740)
GMIR	0.5737	0.6197	0.6233
Ranking	**5**	**4**	**3**
Plans	A_7	A_8	A_9
Fuzzy relationship strength	(0.451, 0.541, 0.584)	(0.375, 0.441, 0.492)	(0.314, 0.392, 0.413)
GMIR	0.5332	0.4385	0.3825
Ranking	**6**	**8**	**9**

Note: The full names of all plans can be seen in Table 1.

5 Concluding Remarks

In the face of an increasingly competitive global shipping logistics market, successful CRM is the key to customer satisfaction and loyalty for GSLPs. In order to effectively achieve customer loyalty, GSLPs must investigate the issue of CRM assessment with an eye to boosting customer satisfaction and loyalty. In light of this, the aim of this paper is to empirically study the assessment of CRM for GSLPs in Taiwan. The main contribution of this paper is to construct assessment models of CRM for business application of GSLPs.

At first, the preliminary twenty CRM assessment indicators are conducted by literature review with combination of experts' opinions. Secondly, an evaluation framework integrating three methods (i.e., TIA approach, IPA approach, and FQFD approach) and with combination of three stages questionnaires are developed. Continually, an empirical analysis for the evaluation is performed to demonstrate the computational process of three methods adopted by this paper. Finally, the empirically results show that:

(1) Sixteen suitable CRM assessment indicators are evaluated via the TIA approach.
(2) Thirteen CRM assessment indicators of needing improvements are selected to position on the 'concentrate here' in quadrant 2 and 'low priority' in quadrant 3 by using the IPA approach.
(3) The top four quality technology deployment plans for GSLPs in Taiwan are prioritized by experts via FQFD approach, including 'customized service (A_1),' 'interactive marketing (A_3),' 'data mining (A_6),' and 'creation of new value (A_5),' respectively.

In summary, some discussions were presented for the top four quality technology deployment plans for GSLPs in Taiwan, as follows:

(1) For customized service. Especially in this customer-oriented age, because the quality of service provided by a GSLP may affect a shipper's continued patronage, customized service is a powerful means of securing customer loyalty. In addition, custom-tailored services addressing the needs of specific customers can reduce customers' losses. It should be borne in mind that developing a new customer requires roughly five times the cost of maintaining an existing customer.
(2) For interactive marketing. The greatest benefit of the use of interactive database marketing lies in its ability to reduce the time and cost of locating and tracking potential customers. Not only can interactive marketing allow companies to continuously track marketing and sales development, it also enables the maintenance of close contact with customers, and creation of opportunities through the establishment of customer trust, via use of customer data, an interactive database, and communications tools.
(3) For data storage. The emphasis of data storage should be placed on data management, data organization, and data display. Data from different sources can be combined in a data storage system, and mined for useful information giving decision-makers a clearer view of the situation. The management, sorting, and display of data can not only yield a better understanding of the status of existing customers, but also shed light on potential customers. In view of the fact that large amounts of data in existing customer data systems, extracting the characteristics and degrees of contribution of individual customers can greatly facilitate the improvement of customer service quality.
(4) For creation of new value. Creation of new value enhances the perception among potential

consumers that the organization is an excellent company, and able to promptly respond to and satisfy customers' needs. Although the development of potential customers can be quite costly, inducing potential customers to voluntarily seek out one's company and request service will create limitless opportunities and value.

Acknowledgement

This paper is partially based upon the result of the research sponsored by National Science Council of the Republic of China, under the project number of NSC 99-2410-H-309-015.

References:

[1] P. Kotler, *Marketing Management: An Asian Perspective*, Singapore: Prentice-Hall Inc., 2000.

[2] R. P. Ramsey and R. S. Sohi, "Listening to Your Customers: The Impact of Perceived Salesperson Listening Behavior on Relationship Outcomes," *Journal of the Academy of Marketing Science*, Vol.25, No.2, 1997, pp. 127-137.

[3] G. S. Liang, J. F. Ding and Y. C. Yeh, "Investigating Customer Loyalty from the Perspectives of Customer Relationship Management and Relationship Value: An Empirical Study of Air Cargo Industry in Taiwan," *East-Asia Review*, Vol.451, 2006, pp. 49-75.

[4] J. F. Ding, K. L. Lee and S. C. Lin, "An Empirical Study on Assessing Brand Equity for Global Shipping Carrier-based Logistics Service Providers," *African Journal of Business Management*, Vol.5, No.16, 2011, pp. 6756-6763.

[5] J. Martin and B. J. Thomas, "The Container Terminal Community," *Maritime Policy and Management*, Vol.28, No.3, 2001, pp. 279-292.

[6] B. Cable, "Emerging Issues in Transport, Communications and Infrastructure Development: Globalization and Integration of Transport," *Ports & Harbors*, Vol.46, No.10, 2001, pp. 12-17.

[7] W. Boulding, R. Staelin, M. Ehret and W. J. Hohnston, "A Customer Relationship Management Roadmap: What is Known, Potential Pitfalls, and Where to Go," *Journal of Marketing*, Vol.69, No.4, 2005, pp. 155-166.

[8] T. Y. Chou and M. C. Chen, "An Application of Customer Relationship Management for Shipping Freight Forwarder," *Ling Tung Journal*, Vol.17, 2005, pp. 9-32.

[9] J. F. Ding, A. S. Nir and Y. C. Su, "Constructing Evaluation Models of Customer Relationship Management for International Container Shipping Lines: An Empirical Analysis," *Journal of Quality*, Vol.18, No.6, 2011, pp. 539-559.

[10] S. Durvasula, S. Lysonski and S. C. Mehta, "Technology and Its CRM Implications in the Shipping Industry," *International Journal of Technology Management*, Vol.28, No.1, 2004, pp. 88-102.

[11] S. L. Gordon, "CRM: The Intelligent Enterprise," *Intelligent Enterprise*, November, 1999, pp. 8-13.

[12] J. Kandell, "CRM, ERM, One-to-one Decoding Relationship Management Theory and Technology," *Trusts & Estates*, April, 2000, pp. 49-53.

[13] V. Körner and H. D. Zimmerman, "Management of Customer Relationship in Business Media: The Case of the Financial Industry," *Proceeding of the 3rd Hawaii International Conference on System Sciences*, 2000, pp. 1-10.

[14] G. S. Liang, J. F. Ding and H. J. Shih, "A Study on Applying Quality Function Deployment to Customer Relationship Management of Airfreight Forwarder," *Civil Aviation Journal*, Vol.7, No.2, 2005, pp. 27-54.

[15] H. S. Lin and Y. L. Fu, "The Effects of Customer Relationship Management on Customer Loyalty for the Science Park Logistics Service Providers," *Transportation Planning Journal*, Vol.38, No.1, 2009, pp. 1-40.

[16] K. C. Shang and C. S. Lu, "Customer Relationship Management and Firm Performance: An Empirical Study of Freight Forwarder Services", *Journal of Marine Science and Technology*, Vol.20, No.1, 2012, pp. 64-72.

[17] D. B. Clark, "Is CRM in Your Company's Future," *Trusts and Estates*, Vol.139, No.6, 2000, pp. 20-24.

[18] R. Kalakota and M. Robinson, *E-business 2.0 - Roadmap for Success*, New York: Addison Wesley Longman Inc., 2001.

[19] T. L. Saaty, *The Analytic Hierarchy Process*, New York: McGraw-Hill, 1980.

[20] J. F. Ding, "Identifying Key Capabilities to Determine Core Competence for Ocean Carrier-based Logistics Service Providers," *International Journal of Innovative Computing,*

Information & Control, Vol.5, No.9, 2009b, pp. 2627-2644.

[21] J. H. Chen, "Venture Capital Companies Investing High-tech Industry by Fuzzy Multi-Criteria Methods: Biology Industry as Example," *Fu Jen Management Review*, Vol.9, No.2, 2002, pp. 87-110.

[22] J. A. Martilla and J. C. James, "Importance-Performance Analysis," *Journal of Marketing*, Vol.41, No.1, 1977, pp. 577-79.

[23] L. Cohen, *Quality Function Deployment: How to Make QFD Work for You*, New York: Addison-Wesley Publishing Company, 1995.

[24] J. R. Hauser and D. Clausing, "The House of Quality," *Harvard Business Review*, Vol. 66, No.3, 1988, pp. 63-73.

[25] H. Hjort, D. Hananel and D. Lucas, 'Quality Function Deployment and Integrated Production Development," *Journal of Engineering Design*, Vol.3, No.1, 1992, pp. 17-29.

[26] J. F. Ding, "Applying Fuzzy Quality Function Deployment (QFD) to Identify Solutions of Service Delivery System for Port of Kaohsiung," *Quality and Quantity*, Vol.43, No.4, 2009a, pp. 553-570.

[27] L. A. Zadeh, "Fuzzy Sets," *Information and Control*, Vol.8, No.3, 1965, pp. 338-353.

[28] V. Marques, J. T. Farinha and A. Brito, "Case-based Reasoning and Fuzzy Logic in Fault Diagnosis," *WSEAS Transactions on Computers*, Vol.8, No.8, 2009, pp. 1408-1417.

[29] J. H. Cheng and C. H. Tang, "An Application of Fuzzy Delphi and Fuzzy AHP for Multi-criteria Evaluation of Bicycle Industry Supply Chains," *WSEAS Transactions on Systems and Control*, Vol.4, No.1, 2009, pp. 21-34.

[30] M. A. Hajeeh, "Water Desalination Plants Performance Using Fuzzy Multi-Criteria Decision Making," *WSEAS Transactions on Systems*, Vol.9, No.4, 2010, pp. 422-431.

[31] X. Jiang, B. Zheng and L. Wang, "The Coupled Method Fuzzy-AHP Applies to Solve Multi-criteria Decision Making Problems," *WSEAS Transactions on Mathematics*, Vol.8, No.11, 2009, pp. 657-666.

[32] G. S. Liang, T. Y. Chou and S. F. Kan, "Applying Fuzzy Quality Function Deployment to Identify Service Management Requirements for Ocean Freight Forwarder," *Total Quality Management and Business Excellence*, Vol.17, No.5, 2006, pp.539-556.

[33] F. Neri, "Learning and Predicting Financial Time Series by Combining Evolutionary Computation and Agent Simulation," *Transactions on Computational Collective Intelligence*, Vol. 6, Springer, Heidelberg, Vol. 7, 2011, pp. 202-221.

[34] D. Dubois and H. Prade, "Operations on Fuzzy Numbers," *The International Journal of Systems Science*, Vol.9, No.6, 1978, pp. 613-626.

[35] L. A. Zadeh, "The Concept of a Linguistic Variable and Its Application to Approximate Reasoning, Part 1, 2 and 3," *Information Sciences*, Vol.8, No.3, 1975, pp. 199-249; Vol.8, No.4, 1975, pp. 301-357; Vol.9, No.1, 1976, pp. 43-80.

[36] S. H. Chen and C. H. Hsieh, "Representation, Ranking, Distance, and Similarity of L-R Type Fuzzy Number and Application," *Australian Journal of Intelligent Information Processing Systems*, Vol.6, No.4, 2000, pp. 217-229.

[37] J. F. Hair, W. C. Black, B. J. Babin and R. E. Anderson, *Multivariate Data Analysis: A Global Perspective (7th ed.)*, New York: Prentice Hall Company, 2010.

[38] S. P. Robbins, *Management*, New York: McGraw-Hill, 1994.