Service Quality Assessment Based on Customer Satisfaction in International Freight Forwarding Industry: An Empirical Study in East Asia

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Abstract

The purpose of this paper is to improve service quality of freight forwarders and explore the quality function deployment (QFD) in terms of quality management technique. Freight forwarder business is mainly characterized by lower capital investment and entry barrier comparing with a shipping line. Freight forwarders usually work closely with shipping or airline companies as intermediary agent and their major customers are small or medium size manufactures or traders. Providing the quality service to enhance customer satisfaction is the key mission since every company provides similar service and the competition is extremely severe especially after global economic crisis. The QFD is one of the distinctive procedures to describe the requirements of customer and transform them into managerial missions by cross-relations evaluation between customer requirements and technical measures. The relative weight of each customer requirement would be calculated by applying fuzzy analytic hierarchy process (FAHP). Furthermore, the feature of the study by using QFD approach would not only identify key technical measures but also explore meaningful business solution as direction of quality improvement. The empirical study is performed to investigate service quality of freight forwarding industry by focusing on a group of anonymous leading forwarders in East Asia. In conclusion part, we would explore the empirical result and managerial meaning for decision making.

Keywords: Quality function deployment; Freight forwarder; Shipping line; Fuzzy analytic hierarchy process.

1. Introduction

The world trade is the vital force drive the growth of both regional and global economy. International trade brings a lot of benefits to countries and business units to enjoy the profits from comparative advantages as well as provides consumers a variety of options to purchase their daily needs. Today’s trade and business activities rely on transportation to connect cargo, people and country to facilitate business growth and regional prosperity. Transportation also provides time utility and place utility from the point of merchandise production to the point of consumption for the business supply chain management. Governments also make effort to lower logistics cost through improve infrastructure to overcome the trade barriers and vitalize their manufactures and products to stay competitive in the global market. According to the maritime review of UNCTAD, around 90\% of the global trade is completed by ocean transportation and the rest of the cargo is dependent on air transportation. International shipping business plays a significant role to complete these economic activities and support enterprises with various logistics solution. Until 2012, more than 500 registered major freight forwarders in Japan and over one million registered logistics providers in China provide logistics service in the market. After global financial crisis, key issues such as bunker prices, exchange currency, economic downturn, and constant change of supply chain and future uncertainty of market make the operation much more complex. Some major carriers suffer financial loss more than billions dollars, and this is why K+N’s executives also advises the freight forwarders especially in Europe to prepare for the downswing and low margin for future outlook as shipping lines suffer particularly in 2013. Some carriers adopt several aggressive measures such as new formation of G6 alliance and Daily Maersk to develop the clear strategies for the future. On the other hand, shipper wants better, cheaper, safer, reliable, speedy and
professional service. Customer’s requirement is getting demanding and picky than ever, so it is necessary for forwarders to redefine standards and strategies to face the changing market and challenges. In 2013, our research team interview executives of leading forwarder A in Taiwan and forwarder B in Korea (Company name keeps confidential), they emphasize the current market condition is fully competitive and not so profitable. From marketing perspective, the business cycle for forwarders in East Asia is in the recession period as one executive mentioned. The market structure and competition makes the providers difficult to survive. Though they already achieve the economies of scale to reduce our cost but their key weapons to gain core competency is through providing high quality service. For general customer, they will provide general or no frill services. Sales staff should have regular visit our important customer to understand their needs and adjust our operation to cater their requirement. They care about price as well as diversified services such transit time, logistics support, slot supply and customized ability. Nowadays, customer wants not only good service but great service and service providers may soon lose a client if they only cause little failure or criticism. They stress there is almost no entry and exit barriers in this industry and have more flexibility to change than carrier because the capital investment is much lower. Therefore, this research is motivated by these insights and perspectives, and then we empirically explore the important technical measures for enhancement of customer satisfaction. The research process is shown in Figure 1.

![Figure 1. Method application design for service quality assessment in freight forwarding industry](image-url)
2. **Brief description of the freight forwarder service**

In order to effectively consolidate LCL (Less than container loaded) cargo to containers especially for small medium size manufactures or traders, it is necessary for them to use the service providing by international freight forwarders as intermediary connection to efficiently complete the delivery. In general, the duties of forwarders may include space booking on a ship or aircraft, non-vessel operating carriers (NVOCCs), organizing local and international shipping, providing necessary paperwork and custom clearance, delivery and distribution service, information service, warehousing, consolidation and other related formalities. On the other hand, forwarder’s target market is slightly different from liner carrier. Forwarders tend to target on LCL customer for consolidation while liner carriers focus more on attracting FCL (Full container loaded) container cargo. The market is extremely competitive because service providing by freight forwarder seems to be same or similar to one another, along with the increasing number of new entrants. It is necessary to explore appropriate measures to enhance customer satisfaction in East Asian region. Thus, competitive advantage of freight forwarders only based on cheaper price is not enough. Delivering high quality of service becomes strategic and survival issue for forwarders to stay competitive and build sustainability.

Measuring service quality of freight forwarder is not an easy task due to its heterogeneity, intangibility and inseparability. Perceived service quality is the description of interaction between customer and service provider, so we could obtain service quality requirement from shipper with quantitative and qualitative surveys. On the other hand, through past academic literature and practical publication, we could find some researches regarding to the service quality requirement of related logistics or freight forwarding industry. Brooks (1985) classifies the service attributes of liner shipping industry for consideration of decision maker such as transit time, directness of sailings, carrier’s reputation for reliability, frequency of sailing and next ship leaving. Bernanl (2002) empirically explore the international network development of regional forwarders. Collaboration between competing forwarders may create favourable condition and network sharing for each other. Gardiner (2004) found the reasons that affect the airport choice of freight operators with increasing levels of congestion at the major cargo hubs and further restrictions on noise and night-time flying. They evaluate several factors such as passenger hub location, airport quality, airline network configuration and other works relating to airport choice to paint a full picture of the current research in this area. Lai and Cheng (2004) empirically study the freight forwarding industry in terms of demographic profiles, capabilities of providing different type of logistics services, service performance and the perceived prospects in Hong Kong. He explains many forwarders have high capability to provide freight forwarding and traditional logistics service, but they seem to lack the ability to provide other value-added service. Rau (2006) applied a learning-based approach to analyze negotiation between shipper and forwarders in terms of price, delay penalty, due date and shipping quantity. Lu (2007) indentifies seven capability dimensions for liner shipping including purchasing, operation, human resource management, customer service, information integration, pricing, and financial management. Results show four factors are significant differ between shipping companies and agency: marine equipment, information equipment, operation, and information integration. Chow (2007) stated the downturn of Hong Kong freight forwarding industry owing to the growing competition and challenge from the neighbouring ports of Yantian and Shekou in China, which operated in a much cheaper way. He suggested a tactical knowledge-based scheduling system implemented in a local freight forwarder for supporting the scheduling process of a shipping plan. The result reveals that both customer retention rate and resource utilization has increased significantly with introduction of this technique. Liang et al. (2008) pointed out four critical service items for an ocean freight forwarder. The four service items include operations convenience and response ability, integrated service, transportation ability, and price. Tongzon (2009) empirically studied on port choice issue from the freight forwarders’ perspective in Southeast Asia. Efficiency is found to be the most significant factor followed by shipping frequency, adequate infrastructure and location. Lun et al. (2009) examine liner shipping from network perspective with an aim to develop a descriptive framework for operation and development of liner shipping networks. The framework supports liner shipping companies and their partners for cost and service improvement in renovating their networks. Bach (2010) proposed a real-time-oriented control approach for freight forwarders to expand load consolidation, reduce empty vehicle trips, and handle dynamic disturbances. Feo (2010) explored the preference analysis of Spanish freight forwarders modal choice between short sea shipping and door-to-door road transport in terms of value of time, value of reliability and value of frequency in freight transport. Ministry of land, infrastructure and Transportation (2011) investigates important service quality items for third party logistics providers in Japan,
including price, speedy delivery, schedule reliability, staff ability, trouble handling, logistics solution and information providing. After logistics diagnosis by consultant group, several strategies are proposed such as improving technical support, solution to reduce cost and time, total logistics strategies, customer service support system and web-based information sharing. Yang (2012) applied multiple regression analysis to explore the critical logistics service capabilities for ocean freight forwarders such as logistics service reliability, logistics value-added service capability, flexibility capability and logistics information capability. These factors had significant positive effects on financial performance. Shang (2012) empirically examines customer relationship management (CRM) and its impacts on performance of freight forwarder services in Taiwan. The understanding of relationships among IT, client response, KM application, profit and managerial performance may offer a reference as to how freight forwarders can amend customer relationship to improve their performance. James Marks (2013), supply chain consultant Crimson, says more demanding standards should be defined to European fresh food supply chains, but the cost may be high. The standards will define the details about if the responsibility is belonging to origins of food, transport supplier or the retailers. The standards could help all the party to pay attention to quality and source of food and monitor the supply chain from food supplier to end customer.

After reviewing the above literature regarding to measure the service quality of freight forwarder, consulting with experienced executive, professor academic as well as shippers, we choose 12 customer requirements (CRs) in Table 1 and 12 technical measures (TMs) to evaluate the service quality of freight forwarders in Table 2.

<table>
<thead>
<tr>
<th>Customer requirements</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1. Instant response</td>
<td>Speed to respond customer’s request</td>
</tr>
<tr>
<td>2. Cheaper agency fee</td>
<td>Offer lower prices for customer.</td>
</tr>
<tr>
<td>3. Global service ability</td>
<td>Ability to provide global and local service</td>
</tr>
<tr>
<td>4. Tailor-made service</td>
<td>Provide service according to the request for individual customer</td>
</tr>
<tr>
<td>5. Door to door ability</td>
<td>Ability to deliver freight to customer’s warehouse or designated location</td>
</tr>
<tr>
<td>6. Schedule reliability</td>
<td>No delay or cancel of delivery service</td>
</tr>
<tr>
<td>7. Consult service</td>
<td>Expert consult to provide supply chain and logistics solution</td>
</tr>
<tr>
<td>8. Excellent reputation</td>
<td>Company has good business records and trustworthy</td>
</tr>
<tr>
<td>9. Stable space supply</td>
<td>Ability to provide the space or handle large delivery</td>
</tr>
<tr>
<td>10. Fast document handling</td>
<td>Speed and easiness of documentation handling</td>
</tr>
<tr>
<td>11. Instant cargo tracking</td>
<td>Provide sophisticated dynamic or on-line tracking</td>
</tr>
<tr>
<td>12. Regular visit</td>
<td>Commercial visit to VIP customer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Measures</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall information system</td>
<td>Implementing the system for information sharing</td>
</tr>
<tr>
<td>2. Paperless and simple procedure</td>
<td>Easiness and convenience to handle customer paperwork</td>
</tr>
<tr>
<td>3. Quality manual and certificate</td>
<td>Clear procedure to define corporate goal and job details</td>
</tr>
<tr>
<td>4. Customer clearance and manual</td>
<td>Efficient custom clearance procedure</td>
</tr>
<tr>
<td>5. Service point and network</td>
<td>Office or service centre overseas and service route</td>
</tr>
<tr>
<td>6. Customer relationship management</td>
<td>Work closely with customer to build relationship and commitment</td>
</tr>
<tr>
<td>7. IT implementation</td>
<td>Applying new technology to improve efficiency of cargo operation (RFID)</td>
</tr>
<tr>
<td>8. Human resource management</td>
<td>Train potential employees for their valuable contribution in the future</td>
</tr>
<tr>
<td>9. Strong intermodal ability</td>
<td>Ability to provide efficient mode combination to complete delivery</td>
</tr>
<tr>
<td>10. Marketing strategy</td>
<td>Clear marketing goal to both VIP or general customer</td>
</tr>
<tr>
<td>11. Free consulting service</td>
<td>Free market and supply chain information consulting</td>
</tr>
<tr>
<td>12. Green shipping policy</td>
<td>Environmental friendly transport and low CO2 emission commitment</td>
</tr>
</tbody>
</table>

3. METHODOLOGY

3.1. 1st Definition of quality function deployment

Quality function deployment is a unique procedure to transform quality requirement into business practice through analyzing the relationship between technical measures and requirements. Many literature reviews show us several criticism and inadequacy of traditional QFD and how to improve this method. (Duru et al,
Therefore, many scholars take advantage of these characteristics and combine QFD with other techniques such as fuzzy, process management, DEA, MSE and SERVQUAL to solve the product design, manufacture and service quality problems. The combination of the techniques makes the research result more accurately and overcomes the original weakness and criticism of QFD method. Vanegas and Labib (2001) explain the QFD is an important tool to translate the Voice of customer (VOC) into the technical requirement. He applies the fuzzy numbers to optimize the relationship between customer requirement and technical requirement for the car door design and manufacture considering the cost, technical and market factors. Orgener (2003) stresses the evolution and advantage of QFD for product design and service management. However, the teamwork concept is key factor to make QFD successful because it will take more time and effort to get the best result. Shahin and Chan (2006) improve QFD methodology by introducing the concept of customer requirement segmentation (CRS) for a four-star hotel. The contribution is to overcome the problems and difficulties such as ambiguities of VOC, handling of larger HoQ, conflict of each CR. Chen (2009) innovatively integrates the concept of QFD and process management techniques to meet customer requirement and company goals in terms of product design, process management in semiconductor industry. Process management is an important concept of Six Sigma implementation and may be significantly improved by applying the QFD method. Ip (2009) creates a model for business succession such as assessment of current situation of business, successor and competencies analysis and planning of necessary tasks for future development by utilizing the QFD method. Dror and Sukenik (2011) combine QFD and mean square error (MSE) criterion to evaluate the bank service. The important service dimensions are service quality, staff attitude, information providing, technology and management feature. Pakdil et al. (2012) apply QFD to analyze the after sales services both qualitatively and quantitatively for a manufacture firms. SERVQUAL and factor analysis are also used to include the house of quality. Munuzuri et al (2013) explore the Spanish small medium sized enterprises to discuss their certified quality management systems and logistics performances. Their current standard is ISO 9001. The authors proposed the more specific logistics management standards may be needed to improve the process.

The QFD framework is proposed to translate CRs into TMs by constructing the House of Quality (HoQ) matrix. We can obtain the priority degree of TMs through computing the sum product of relative weight of each CR. After normalizing the value of result, the obtained relative weight could show the relationship degree of TM for enhancing customer satisfaction. The QFD framework is proposed to translate CRs into TMs by constructing the House of Quality (HoQ) matrix. We can obtain the priority degree of TMs through computing the sum product of relative weight of each CR. After normalizing the value of result, the obtained relative weight could show the relationship degree of TM for enhancing customer satisfaction.

The conventional HoQ matrix consists of seven major parts including the customer requirements (CRs), the priority degree for requirements, technical measures (TMs), the correlation matrix (between TMs), relationship matrix (between TMs and CRs), sum products of priority degrees and relationship degrees, \( w_j \), and the priority degree of TMs, \( w'_{nj} \) (As shown in Figure 1). The correlation matrix is mainly practical for developing strategies to improve technical measures. In some cases, a technical measure has a positive or negative correlation and an improvement may give to another or deteriorate it. For evaluation of the balance of improvements, correlation matrix signifies such interactions.

The numerical procedure for assignment of priority degree of TMs is as follows:

Given \( m \) customer requirements signified by \( CR_i \), \( (i = 1,2,\ldots,m) \) and \( n \) technical measures signified by \( TM_i \), \( (i = 1, 2,\ldots,n) \). Let \( d_i \), \( (i = 1, 2,\ldots,m) \) be the priority degree for the \( i \)th \( CR \), among the whole set of CRs, whereas \( w_j \), \( (j = 1, 2,\ldots,n) \) signifying the relative weight of importance of the \( j \)th TM, is determined from the relationship between TMs and CRs. Let \( R \) be the relationship matrix between TMs and CRs, the component \( R_{ij} \) signifies the level of impact of the \( j \)th TM on satisfaction of the \( i \)th CR. The value of \( R_{ij} \) is assigned by an indicator value of 9 (Strong relationship, ■), 5 (Moderate relationship, ▲), 1 (Low relationship, ●) or 0 (No relationship, “Ø”). The sum product of the priority degree, \( d_i \) of the \( i \)th \( CR \), and \( R_{ij} \) is calculated as follows;

\[
 w_j = \sum_{i=1}^{m} d_i R_{ij}, j=1,2,\ldots,n
\]

\( w'_j \) is the normalised value of \( w_j \) which signifies the priority degree of the \( j \)th TM for customer satisfaction. The priority degree for the CRs, \( d_i \), is defined by an original FAHP process through the pair wise comparison survey. The following section discusses the FAHP method under the synthetic extent analysis.
3.2. Fuzzy analytic hierarchy process

After introducing fuzzy method by Zadeh (1965), Laarhoven and Pedrycz (1983) extended analytic hierarchy process (AHP) by using fuzzy approach to deal with vagueness of human thought for decision making problem. They used a triangular fuzzy numbers (TFNs) to develop fuzzy-AHP (FAHP) method. In the FAPH method, the judgement matrix is formed in a pair-wise comparison matrix which is calculated fuzzy arithmetic and fuzzy aggregation operators and the procedure calculated a sequence of weight vectors that can be used to choose main attribute. In existing literature, many studies investigate the decision problems under uncertainty condition by using FAHP methods (Bozbura & Beskese, 2007; Buckley, 1985; Bulut, Duru, Keçeci, & Yoshida, 2012; Cakir & Canbolat, 2008; Dağdeviren & Yüksel, 2008; Duru, Bulut, & Yoshida, 2012; Ertuğrul & Karakaşoğlu, 2008; Gumus, 2009; Güngör, Serhadlıoğlu, & Kesen, 2009). In this paper, Chang’s approach is used for the FAHP calculation and its algorithm is as follows (Chang, 1996); Let $X=\{x_1, x_2, \ldots, x_n\}$ be an object set and $U=\{u_1, u_2, \ldots, u_m\}$ be a goal set. According to the method of extent analysis, each object is taken and extent analysis for each goal is performed, respectively (Chang, 1996). Therefore, $m$ extent analysis values for each object can be obtained, with the following signs:

$$M^1_{g_{i}}, M^2_{g_{i}}, \ldots, M^m_{g_{i}}, \quad i=1, 2, \ldots, n,$$  \hspace{1cm} (2)

where all the $M^j_{g_{i}} (j=1,2,\ldots,m)$ are TFNs.

The steps of Chang’s extent analysis can be given as in the following:

**Step 1:** The value of fuzzy synthetic extent with respect to the $i$th object is defined as

$$S_i = \sum_{j=1}^{m} M^j_{g_{i}} \otimes \left[ \sum_{i=1}^{n} \sum_{j=1}^{m} M^j_{g_{i}} \right]^{-1} \quad (3)$$

To obtain $\sum_{j=1}^{m} M^j_{g_{i}}$, the fuzzy addition operation of $m$ extent analysis values for a particular matrix is performed such as:
And to obtain \[ \sum_{j=1}^{m} \frac{M_j^i}{M_{E_l}} = \left( \sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right) \] (4)

the fuzzy addition operation of \( M^j_l \) \((j=1, 2, \ldots, m)\) values is performed such as:

\[
\sum_{i=1}^{n} \sum_{j=1}^{m} \frac{M^j_l}{M_{E_l}} = \left( \sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i \right)
\](5)

and then the inverse of the vector in Eq. (5) is computed, such as:

\[
\left[ \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{M^j_l}{M_{E_l}} \right]^{-1} = \left( \frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i} \right)
\]

(6)

**Step 2:** The degree of possibility of \( M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1) \) is defined as

\[
V(M_2 \geq M_1) = \sup_{y \geq x} \min(\mu_{M_1}(x), \mu_{M_2}(y))
\]

(7)

and can be expressed as follows:

\[
V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 
1, & \text{if } m_2 \geq m_1, \\
0, & \text{if } l_1 \geq u_2, \\
l_1 - u_2, & \text{otherwise.}
\end{cases}
\]

(8)

**Figure 2** illustrates Eq. 8 where \( d \) is the ordinate of the highest intersection point \( D \) between \( \mu_{M_1} \) and \( \mu_{M_2} \). To compare \( M_1 \) and \( M_2 \) we need both the values of \( V(M_2 \geq M_1) \) and \( V(M_1 \geq M_2) \).

**Step 3:** The degree possibility for a convex fuzzy number to be greater than \( k \) convex fuzzy \( M_i(i=1,2,\ldots,k) \) numbers can be defined by

\[
V(M \geq M_1, M_2, \ldots, M_k) = V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \ldots \text{ and } (M \geq M_k)] = \min \{ V(M \geq M_i), i=1,2,3,\ldots,k \}.
\]

(9)

Assume that \( d'(A_i) = \min V(S_i \geq S_k) \) for \( k=1,2,\ldots,n; \ k \neq i \). Then the weight vector is given by

\[
W'(d'(A_1), d'(A_2), \ldots, d'(A_n))^T
\]

(10)

Where \( A_i (i=1, 2, \ldots, n) \) are \( n \) elements.

**Step 4:** Via normalization, the normalized weight vectors are

\[
W = (d(A_1), d(A_2), \ldots, d(A_n))^T,
\]

(11)

where \( W \) is a non-fuzzy number.
Table 3 displays the linguistic comparison terms and their equivalent fuzzy numbers in this paper.

<table>
<thead>
<tr>
<th>Fuzzy number</th>
<th>Linguistic scales</th>
<th>Membership function</th>
<th>Inverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_1$</td>
<td>Equally important</td>
<td>$(1,1,1)$</td>
<td>$(1,1,1)$</td>
</tr>
<tr>
<td>$A_2$</td>
<td>Moderately important</td>
<td>$(1,3,5)$</td>
<td>$(1/5,1/3,1)$</td>
</tr>
<tr>
<td>$A_3$</td>
<td>More important</td>
<td>$(3,5,7)$</td>
<td>$(1/7,1/5,1/3)$</td>
</tr>
<tr>
<td>$A_4$</td>
<td>Strongly important</td>
<td>$(5,7,9)$</td>
<td>$(1/9,1/7,1/5)$</td>
</tr>
<tr>
<td>$A_5$</td>
<td>Extremely important</td>
<td>$(7,9,9)$</td>
<td>$(1/9,1/9,1/7)$</td>
</tr>
</tbody>
</table>

3.3. The consistency calculation for the FAHP method

Duru et al. (2012) proposed the centric consistency index (CCI) for the consistency calculation of FAHP method and it is based on geometric consistency index (GCI) (Crawford & Williams, 1985)

The calculation of CCI is as follows;

Let $A=(a_{Lij}, a_{Mij}, a_{Uij})_{n \times n}$ be a fuzzy judgment matrix, and let $w=[(w_{L1}, w_{M1}, w_{U1}), (w_{L2}, w_{M2}, w_{U2}), \ldots, (w_{Ln}, w_{Mn}, w_{Un})]^T$ be the priority vector derived from $A$ using the RGMM. The centric consistency index (CCI) is computed by

$$CCI(A) = \frac{2}{(n-1)(n-2)} \sum_{i<j} \left( \frac{\log(a_{Lij} + a_{Mij} + a_{Uij})}{3} - \log\left(\frac{w_{Lj} + w_{Mj} + w_{Uj}}{3}\right) \right)^2$$

(12)

When $CCI(A)=0$, we consider $A$ fully consistent. Aguarón et al. (2003) also provide the thresholds $(GCI)$ as $GCI=0.31$ for $n=3$; $GCI=0.35$ for $n=4$ and $GCI=0.37$ for $n>4$. When $CCI(A) < GCI$, it is considered that the matrix $A$ is sufficiently consistent. Since the CCI is a fuzzy extended version of the GCI, thresholds remain identical.

3.4. The prioritization of decision maker

The weight of each decision makers is different than each other because their experience and thought about the problem differ from each other. In this paper, therefore, the reverse value of CCI is considered as their prioritization and it is used the calculation of the aggregated fuzzy judgment matrix for the criteria of customer satisfactions (Duru, et al., 2012).

Let $A=(a_{ij})_{n \times n}$, where $a_{ij} > 0$ and $a_{ij} \times a_{ji} = 1$, be a judgment matrix. The prioritization method refers to the process of deriving a priority vector of criteria $w = (w_1, w_2, \ldots, w_n)^T$, where $w_i \geq 0$ and $\sum_{i=1}^{n} w_i = 1$, from the judgment matrix $A$. 
Let \( D = \{d_1, d_2, ..., d_m\} \) be the set of decision makers, and \( \lambda_k = \{\lambda_1, \lambda_2, ..., \lambda_m\} \) be the priority vector of decision makers. The priority vector of decision makers \( \lambda_k \) is the normalized \( I_k \) for the group of experts which is calculated as follows:

\[
I_k = \frac{1}{CCI_k}
\]

(13)

where \( I_k \) is the inverse of the CCI normalization,

\[
\lambda_k = \frac{I_k}{\sum_{k=1}^{m} I_k}
\]

(14)

where \( \lambda_k > 0, k = 1, 2, ..., m \), and \( \sum_{k=1}^{m} \lambda_k = 1 \).

Let \( A^{(k)} = (a^{(k)}_{ij})_{n \times n} \) be the judgment matrix provided by the decision maker \( d_k \).

\( w_i^{(k)} \) is the priority vector of criteria for each decision maker calculated by

\[
w_i^{(k)} = \left( \frac{\prod_{j=1}^{n} a_{ij}}{\sum_{i=1}^{n} (\prod_{j=1}^{n} a_{ij})^{1/n}} \right)^{1/n}
\]

(15)

The aggregation of individual priorities is defined by

\[
w_i^{(w)} = \frac{\prod_{k=1}^{m} (w_i^{(k)})^{\lambda_k}}{\sum_{i=1}^{n} \prod_{k=1}^{m} (w_i^{(k)})^{\lambda_k}}
\]

(16)

where \( w_i^{(w)} \) is the aggregated weight vector. After the aggregation process, the extent synthesis methodology of Chang (1996) is applied for subsequent choice selection.

4. The Empirical Study on Freight Forwarder in East Asia

Several leading freight forwarders are explored for service quality assessment and selected technical measures are used to evaluate customer satisfaction in East Asian region. The consultation experts include professors, president, senior executives and practitioners and the name of company is kept confidential. The data is collected by email, telephone and personal visits from September 2012 to March 2013. The consultation is performed according to the following steps. In the first step, an initial survey is arranged to define the appropriate customer requirements and technical measures for evaluation. Then, the primary survey is performed to complete cross relationship matrix in the second step. The FAHP is applied to define relative weight for the priorities of customer requirement. An expert group from manufacture is asked to complete a pair wise comparison survey. Table 4 shows the aggregate fuzzy judgement matrix for the customer requirement. CCI is 0.01 which is less than the critical value of 0.37. The top three customer requirements are cheaper agency fee (0.19), door to door ability (0.16) and instant response (0.15) in Table 4. First of all, “cheaper agency fee” is the top customer requirement. Forwarders should provide competitive prices by reducing operational cost or financial planning like Porter’s (1998) cost leadership approach. Second, “door to door ability” shows us the current customer’s high expectation of forwarder’s logistics solution in terms of time, cost and reliability. This means forwarders should work closely with partners such as truck, rail or other inland transportation firms to ensure logistics capability. Third, “instant response” shows the importance of information providing. Forwarders should have sophisticated tracking system and quick response to customer’s question.
The top four relative weight of technical measures are customer relationship management (0.16), overall information system (0.14), service point and network (0.14) shown in Table 5. The evaluation and practical meaning will be explained in next section.

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5. Discussion and Conclusion

The top four relative weight of technical measures are customer relationship management (0.16), overall information system (0.14), service point and network (0.14) shown in Table 5. The result and proposed practical application could be useful information and supportive function for decision making process. First, the most important technical measure is “customer relationship management”. In 2013, Copenhagen-based forwarder service provider Damco offers their customer, Mexican retailer HEB, a simple solution to renovate its supply chain by integrating its liner operator and restricting distribution systems. Introducing new supply chain strategies for its carrier and shippers help Damco increase its revenue by 11% and gross profit up 4% in 2012, managing more than 2.5M TEU of freight. HEB says the supply chain management is not advance in Mexico as it is in US but we are moving to that direction. The opportunity here for development of supply chain is to take advantage of large scale to reduce cost and extend network to expand service coverage. As we can see that Damco works close with HEB and understand the operation of customer, so the strong connection makes it easy for Damco to offer a appropriate logistics and supply chain strategy for HEB.

Second, “overall information system” may be an important tool for reducing cost, instant response and efficiency improvement. In 2012, the global freight Forwarder like DHL still increases its revenue up to 2.8% in spite of the economic depression, nature disasters, and great loss of major ocean carriers. All the division meets the targets and the implemented strategy for future development is all under good progress. The secret of their strength is providing owners/shippers with innovative, strategic cargo handling sector and efficient IT solution. Bjorn et al.(2012) also empirically explore how the information systems improve maritime logistics from tracking stock level, vessel space allocation, transport and inventory cost reduction. The utilization can support the decision making from operational, tactical, and strategic levels within maritime logistics. Therefore, implementing advance information system could effectively support the customer and enhance the efficiency. Also, Hutchison Port Holding’s introduction of next generation terminal management system (nGen) with increasing supports the improvement of efficiency and streamlines the global transportation through new technology innovations. The nGen increases total throughput by 28.5% three years after its implementation.

Third, regarding “service point and network” , according to the press of UASC (United Arab Shipping Co) strengthen its brand reputation with new vessels, partnership agreements to expand the service network. Shipping would be much cheaper than rail when oil price rising and increasing vessel size may help achieve scale economics and significant cost savings. Thus, forwarders may expand its service coverage and network through more partnerships with major carriers or local logistics service providers. Many global freight
forwarders play the role as a local company, so the local knowledge and expertise becomes a barrier for market entry. When service and network of forwarder business expands globally, the important of reliable local partner is indispensible factor for business success.

The combination of FAHP and QFD is an appropriate methodology for decision making which provide the decision maker the direction of improvement and importance or relative weight of selected items by quantifying the selected customer requirement and technical measures. The rank of customer requirement and technical measure could provide meaningful information regarding to understand “what” customer wants and “how” to improve them. However, this methodology could not explain “how much” to improve the technical measures since HoQ matrix only contains “what” and “how” without explaining “how much”. This approach successfully provides decision makers right direction of improvement and related business practices but could not answer how much to improve for each technical measure. Future studies may further discuss this gap by applying input and output analysis techniques. On the other hand, the process and strategy for enhancement of customer satisfaction may change drastically because of the advance technology and emerging of potential competitors in the forwarder business. The continuous and periodic research for customer service is still necessary for forwarders to adjust strategies in the fast changing and dynamic shipping market.

6. Acknowledgements

Authors would like to appreciate the academic experts and executives of forwarders to give us valuable insights and future trends of this industry. We would like to thanks them for providing practical comments and materials to support our research.

Table 5: House of quality matrix for customer’s requirements

<table>
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<th>HoQ of Customer Satisfaction</th>
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Max. value in column

Sum product 5.27 0.8 2.72 3 5.09 5.72 3.52 1.67 4.1 2.83 1.56 0.61
Relative weight 0.14 0.02 0.07 0.08 0.14 0.16 0.1 0.05 0.11 0.08 0.04 0.02

*Rank 2 11 8 6 3 1 5 9 4 7 10 12
References


Lloyd’s Register Fairplay's website: http://www.fairplay.co.uk, last access in March 2013.


