# Evaluation of 3PL Service Quality Using the AHP -An Application to Korean 3PL Service Providers-

**Soon-hoo So*, Ki-ju Cheong**, Jae-jon Kim***, Geon Cho****, Il Ryu*****
*Callcenter Industry Research Center, Chonnam National University, so@callcenter.or.kr
**Department of Business Administration, Chonnam National University, cheong3@chonnam.ac.kr
***Department of Business Administration, Chonnam National University, jaejon@chonnam.ac.kr
****Department of Business Administration, Chonnam National University, gcho@chonnam.ac.kr
*****School of Business Administration and Trade, Sunchon National University, ilryu@sunchon.ac.kr

***Abstract*** *- This study applies the Analytic Hierarchy Process (AHP) to evaluate service quality of Third-Party Logistics (3PL) service providers. For this, we first conceptualize five dimensions of 3PL service quality (i.e. tangibles, reliability, responsiveness, assurance and empathy). We then apply the AHP method to determining the relative weights of five service quality dimensions and eventually selecting the best 3PL service provider. To implement this idea in practice, we conduct an empirical study on four companies providing 3PL services in Korea.*

**Keywords:** Third-party logistics, analytic hierarchy process, service quality, benchmarking, service providers.

## 1 Introduction

The concept of Third-Party Logistics (3PL) has become a growing reality in Korea in recent years, allowing shippers to outsource logistics activities that had previously been conducted in house. As a consequence of the rapid growth of 3PL service applications and the abundance of service providers, the customer (i.e. shipper) is faced with the inevitability of selecting an appropriate service provider. In such scenarios, service quality becomes a benchmark to differentiate services and providers. Therefore, in order to deliver good-quality service and gain customer loyalty, 3PL service providers need to understand how customers perceive and evaluate service quality.

In this paper, we first conceptualized 3PL service quality as a second order construct, with five dimensions: tangibles, reliability, responsiveness, assurance and empathy. We then applied the Analytic Hierarchy Process (AHP) approach for determining the relative importance of five dimensions, and eventually for prioritizing 3PL service providers in the order of the overall service quality scores. To implement this idea in practice, we conducted an empirical study on four companies providing 3PL services in Korea.

## 2 Literature review

### 2.1 Third-party logistics service quality

Third-Party Logistics (3PL) means that using outside specialized logistics firms to perform logistics functions that can be the entire logistics process or selected activities within that process [1]. According to a survey on 3PL customers [2], the activities most frequently outsourced to 3PL service providers are warehousing, outbound transportation, customs brokerage, customs clearance, crossdocking/shipment consolidation, inbound transportation, and freight bill auditing/payment.

Today, it is estimated that over three-quarters of Fortune 500 firms use 3PL services [3]. As competition in the 3PL market intensifies, service quality has become an important differentiator among service providers. Until now, the instrument to measure service quality that is the most widely used, in academic research but also in practice, is the SERVQUAL scale developed by Parasuraman, Zeithaml and Berry [4]. This measurement of service quality by means of SERVQUAL is based on five generic service quality dimensions such as reliability, responsiveness, assurance and empathy [5]. In line with the Gap Analysis model, this instrument measures service quality as the gap between perceptions and expectations for each of the five dimensions.

However, although SERVQUAL is the most widely spread instrument for measuring service quality, empirical research that uses this scale in the 3PL services context is not well founded. In this paper, we thus try to use the five dimensional structure of SERVQUAL to evaluate service quality of 3PL service providers.

- Tangibles: the physical components, such as vehicles or personnel
- Reliability: the conformance to specification or agreement

- Responsiveness: the willingness to help customers and provide prompt service
- Assurance: the skill, knowledge and courtesy of service providers and the confidence that they convey to customers
- Empathy: the caring and individual attention the firm provides for its customers.

## 2.2 Analytic hierarchy process

The Analytic Hierarchy Process (AHP) developed by Saaty [6] has been widely used in multiple criteria decision-making situations and has been applied by a number of researchers and practitioners. Some of its applications include transportation problems, corporate planning problems, budget allocation, project selection, and so on. The AHP is based on the principles of decomposition, pairwise comparisons, and priority vector generation and synthesis.

In this paper, we utilize the AHP method to solve a 3PL service provider selection problem because the AHP approach is well suited for attaining our purpose of study that is related to determining the relative importance of five dimensions and choosing the best 3PL service provider that satisfies customer needs. The use of AHP method to determine how customers evaluate 3PL service providers' service quality and make a selection would make the managers understand clearly more which service quality factors is more important, thus providing insights to formulate strategies and enhance performance.

# 3 Application of the AHP to 3PL service quality evaluation

We conducted an empirical study on an Internet shopping mall in Korea, which wanted to contract with an ideal 3PL service provider. Four companies were considered as potential 3PL service providers, which were represented as 3PL *A*, 3PL *B*, 3PL *C* and 3PL *D*.

## 3.1 Structuring the AHP hierarchy

We first structured the decision hierarchy in which all decision elements were classified into four levels as shown in Figure 1. The highest level (Level 1) of the hierarchy stands for the ultimate goal that is to evaluate 3PL service quality and select an ideal 3PL service provider. The five dimensions identified to achieve this goal are located at the second level (Level 2). At the third level (Level 3), Liberatore's five-point rating scale [7, 8] is introduced into this model to rate each alternative according to each criteria in the level just above. In our case, since the decision maker has not enough knowledge or experience about all the alternatives, it is quite difficult to directly compare the alternatives with each other. Therefore, differently from the usual AHP approach, the use of a rating scale can eliminate these difficulties as the decision maker can assign a rating to an alternative without making direct comparisons. The lowest level (Level 4) contains the alternatives to be evaluated, namely four different 3PL service providers.

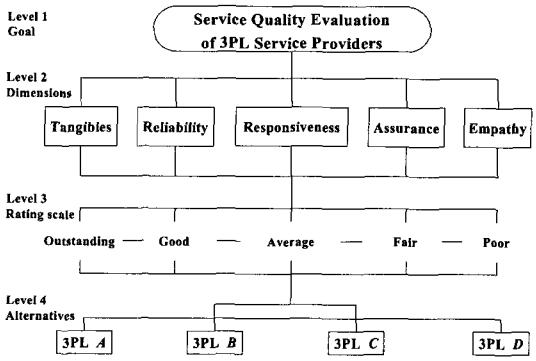


Figure 1. Decision hierarchy for evaluating 3PL service quality

## 3.2 Making the pairwise comparison matrix

Once the decision hierarchy is structured, the next step is to make a pairwise comparison matrix in order to determine the relative importance (priority) of five dimensions in level 2. Notationally, the pairwise comparison matrix $A$ for comparing $n$ elements is $A=\left[a_{ij}\right]$ (where $a_{ij}=1/a_{ji}$, $a_{ii}=1$, $i,j=1,2,...,n$). If element $i$ is more important than element $j$, then $a_{ij}$ gets assigned a numerical value from the ratio scale of 1 to 9, where 1 indicates equal importance and 9 indicates extreme importance.

In order to perform pairwise comparison among five dimensions, a questionnaire was designed and sent out to customers of the four alternative 3PL service providers in February 2005. The target respondents were the general managers or logistics managers of the sampled shippers companies. A total of 104 customers, comprising of 24 customers of 3PL *A*, 27 customers of 3PL *B*, 31 customers of 3PL *C* and 22 customers of 3PL *D*, replied to the questionnaire for a response rate of 49.5%.

The pairwise comparison data collected from the questionnaire were organized in the form of a matrix and the consistency ratio of the matrix was checked to be less than 0.1 which is typically considered acceptable. The consistency ratio (*CR*) is defined as $CR=CI/RI$ where consistency index (*CI*) is given by $CI=(\lambda_{max}-n)/(n-1)$, with $\lambda_{max}$ as the principal eigenvalue for the matrix, and random index (*RI*) is the

mean random consistency index for a matrix of order $n$ (see Saaty, 1980).

As a result, 67 individual pairwise comparison matrices with consistency ratio of less than 0.1 were aggregated using the geometric mean method. The aggregate pairwise comparison matrices are presented in Table 1.

Table 1. Aggregate pairwise comparison matrix for five dimensions

| | Tan | Rel | Res | Ass | Emp | Priority |
|---|---|---|---|---|---|---|
| Tan | 1.000 | 1.267 | 0.915 | 1.036 | 0.962 | 0.205 |
| Rel | 0.789 | 1.000 | 0.790 | 1.088 | 1.005 | 0.185 |
| Res | 1.093 | 1.266 | 1.000 | 1.272 | 1.036 | 0.224 |
| Ass | 0.965 | 0.920 | 0.786 | 1.000 | 0.859 | 0.180 |
| Emp | 1.040 | 0.995 | 0.965 | 1.164 | 1.000 | 0.205 |

1) $\lambda_{max} = 5.011$, $CI = 0.002$, $RI = 1.12$, $CR = 0.002$

2) Tan:= Tangibles, Rel:= Reliability, Res:= Responsiveness, Ass:= Assurance, Emp:= Empathy

### 3.3 Calculating the priority weights

After the pairwise comparison process is completed, the priority vector for five dimensions is obtained by the following two-stage procedure.

First, each entry in column $i$ of the matrix $A$ is divided by the sum of the entries in column $i$. This yields a normalized matrix $\overline{A}$ which is defined as:

$$\overline{A} = [\overline{a}_{ij}] \text{ where } \overline{a}_{ij} = a_{ij} \Big/ \sum_{k=1}^{n} a_{ik} \text{ for } i, j = 1,2,...,n$$

Second, the average value of the entries in row $i$ of the normalized matrix $\overline{A}$ is computed to get the priority weights or eigenvector, which is determined by:

$$W = [w_k] \text{ where } w_k = \sum_{i=1}^{n} \overline{a}_{ij} \Big/ n \text{ for } j, k = 1,2,...,n$$

According to the calculation procedure described above, the priority vector for five dimensions was determined as shown in the last column of Table 1. It denotes the order of relative importance of the five dimensions and also demonstrates that *Responsiveness* is considered as the most important dimension perceived by 3PL customers in this empirical study.

As mentioned earlier, we used the five-point rating scale of outstanding (O), good (G), average (A), fair (F) and poor (P) to rate alternative 3PL service providers according to five dimensions in level 2. Using pairwise comparisons as suggested by Liberatore, the priority weights of these five scales were determined as 0.513, 0.261, 0.129, 0.063 and 0.034, respectively.

The customers of the four alternative 3PL service providers were then asked to assign the rating scale to their 3PL service provider with respect to each of the five dimensions in the questionnaire. The final group judgments, expressed in the mathematical mean of individual judgments, are presented in columns 3, 5, 7 and 9 of Table 2.

### 3.4 Determining overall scores for each alternative

The final step of the AHP is to synthesize the priority weights of the elements at each level of the decision hierarchy in order to determine the overall score for each 3PL service provider and selection of the best one. The overall score $S_i$ for the $i$-th 3PL service provider is computed as follows:

$S_i = \sum_{j=1}^{n} w_j \, r_{ij}$ for $i = 1,2,...,n$ where $w_j$ is the priority weight of $j$-th dimension in level 2 and $r_{ij}$ is the rating scale of $i$-th 3PL service provider with respect to $j$-th dimension.

Table 2. Overall scores of four alternative 3PL service providers

| Dimensions | Priority Weights | 3PL *A* | | 3PL *B* | | 3PL *C* | | 3PL *D* | |
|---|---|---|---|---|---|---|---|---|---|
| | | Rating Scores | Global Weights | Rating Scores | Global Weights | Rating Scores | Global Weights | Rating Scores | Global Weights |
| Tangibles | 0.205 | 0.261 | 0.054 | 0.129 | 0.026 | 0.129 | 0.026 | 0.063 | 0.013 |
| Reliability | 0.185 | 0.129 | 0.024 | 0.063 | 0.012 | 0.261 | 0.048 | 0.034 | 0.006 |
| Responsiveness | 0.224 | 0.261 | 0.058 | 0.129 | 0.029 | 0.513 | 0.115 | 0.063 | 0.014 |
| Assurance | 0.180 | 0.063 | 0.011 | 0.063 | 0.011 | 0.129 | 0.023 | 0.034 | 0.006 |
| Empathy | 0.205 | 0.129 | 0.026 | 0.063 | 0.013 | 0.261 | 0.054 | 0.063 | 0.013 |
| Overall scores | - | - | 0.174 | - | 0.091 | - | 0.266 | - | 0.052 |
| Renormalized scores | - | - | 0.298 | - | 0.156 | - | 0.456 | - | 0.090 |

Based on the (renormalized) overall scores of the four 3PL service providers shown in Table 2, we find that the 3PL *C* has the highest overall score among four alternatives. Therefore, it must be selected as the best 3PL service provider satisfying all evaluation criteria for 3PL service quality.

## 4 Conclusions

In this paper, we have presented an application of the AHP to selecting the best 3PL service provider based on service quality evaluation. In order to measure 3PL service quality, we utilized SERVQUAL's five generic dimensions. Although the conceptualization, dimensionality, operationalization, measurement and applications of SERVQUAL have been subjected to some severe criticisms [9], there is a general agreement that the five dimensions are reasonably accurate predictors of perceived service quality [10]. We also applied the AHP approach to solve a 3PL service provider selection problem. The major advantage of this approach is that it can process the relative importance of evaluation criteria and assessment of alternatives based on each criterion.

To implement our idea presented in this paper, we conducted an empirical study on four 3PL service providers in Korea. The result shown in Table 1 indicates that *Responsiveness* (the willingness to help customers and provide prompt service) out of the five service quality dimensions is considered as the most important dimension perceived by 3PL customers. Furthermore, according to the overall service quality scores shown in Table 2, 3PL *C* has been chosen as the best 3PL service provider with respect to service quality. However, in order for this study to be more complete, future research is needed in establishing a set of metrics to quantify each dimension of 3PL service quality proposed.

## References


[1] R.C. Lieb, R.A. Millen, and L.N. Van Wassenhove, "Third Party Logistics Services: A Comparison of experienced American and European Manufacturers", *International Journal of Physical Distribution and Logistics Management*, Vol. 23, No. 6, pp. 35-44, 1993.

[2] C.J. Langley, G.R. Allen, and T.A. Dale, THIRD-PARTY LOGISTICS: Results and Findings of the 2004 Ninth Annual Study, 2004.

[3] Y. Aoyama, S.J. Ratick, and G. Schwarz, "Modeling the Impact of Business-to-Business Electronic Commerce on the Organization of the Logistics Industry", *Geographical Analysis*, Vol. 37, No. 1, pp. 46-68, 2005.

[4] A. Parasuraman, V.A. Zeithaml, and L.L. Berry, "SERVQUAL: A multiple-item scale for measuring consumers perceptions of service quality", *Journal of Retailing*, Vol. 64, No. 1, pp. 22-37, 1988.

[5] A. Parasuraman, V.A. Zeithaml, and L.L. Berry, "Refinement and Reassessment of the SERVQUAL Scale", *Journal of Retailing*, Vol. 67, No. 4, pp. 420-450, 1991.

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

[7] M.J. Liberatore, "An Extension of the Analytical Hierarchy Process for Industrial R&D Project Selection and Resource Allocation", *IEEE Transactions on Engineering Management*, Vol. EM-34, No. 1, pp. 12-18, 1987.

[8] M.J. Liberatore, R.L. Nydick, and P.M. Sanchez, "The Evaluation of Research Papers (Or How to Get an Academic Committee to Agree on Something)", *Interfaces*, Vol. 22, No. 2, pp. 92-100, 1992.

[9] F. Buttle, "SERVQUAL: review, critique, research agenda", *European Journal of Marketing*, Vol. 30, pp. 8-32, 1996.

[10] G.S. Sureshchandar, C. Rajendran, and R.N. Anantharaman, "The relationship between management's perception of total quality service and customer perceptions of service quality", *Total Quality Management*, Vol. 13, No. 1, pp. 69-88, 2002.