Airline Partner Selection Optimization Based on an Improved QSI Model

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Abstract: This paper studies airline partner selection. The international airline operation involves considerable co-operations with other airlines at home and abroad. How to choose the most suitable partners is a realistic issue for Chinese airlines. In this paper the quality of service index (QSI) model is improved by applying more necessary indexes based on the analysis of large scale of data. A partner selection model is established to help airlines identify the best partner(s) in a scientific and effective way among potential candidates. Finally, real data from an airline company in China is applied to test the model. The outcome verify the effectiveness of the partner selection model proposed in this paper. The model can be helpful for selecting more suitable partners and increasing coordination value through cooperation with the partners.

Key words: airline alliance; airline cooperation; partner; optimization model

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0 Introduction

The airline alliance is a strategic group of airlines based on cooperation agreements, reflecting an airline's global integration. Alliances can expand the airline network of respective members covering most parts of the world. It also promotes the international air transport service and makes it easier for passengers to travel between countries. The partnership within an airline alliance framework helps optimize the allocation of resources, enjoy economies of scale for cost saving, and expand the airline network for better international penetration.

At present, the three largest global airline alliances are Star Alliance, SkyTeam and Oneworld. They are playing an important role in the international air transport market, with their capture of more than half of the global air travel demand.

Members of an alliance take benefits from such cooperation. However, partner selection is vital in getting the expected values. For any destination areas (for example west Europe), there would be a number of alliance partners available as the choices for a domestic airlines in China. The partners not just cooperative with each other but also compete against each other due to their own interest. Therefore, it is a realistic problem for the Chinese airlines with regard to how to choose a good partner for enhancing their international market. Different partner selection may lead to different cooperation network and addressing different market needs.

Usually, an airline in China would already have had existing international airline porters. This brings some difficulty in reshaping the cooperation structure after joining an alliance. The exclusivity of an alliance requires new members to

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cooperate only with the partners within the same alliance. No single alliance's network can cover the whole world, not to say an individual one. So there is a recent trend that more airlines are considering cooperation with other carriers outside of their own alliance. The phenomenon has attracted academic attention, but there hasn't been any sufficient research in this area yet.

Many research papers have studied airline alliance but most of them hovered at the strategic level[1]. These literatures focused on the causes of forming[2], management[3-8], development of airline alliances[9], and so on. Recent years, continuing research interest in this topic have occurred. Liou et al.[10] studied the fuzzy preference programming and the analytic network process (ANP), and combined them to form a model for selection of partners within strategic alliance. The other areas addressed were effects of uncertainty and disagreement between decision-makers on operation, as well as interdependency and feedback arising from applying different criteria. Ebrahimian et al.[11] studied airline alliances partner selection in uncertain environment using balanced score card (BSC) methodology for establishing criteria, while at the same time considering passengers' and experts' viewpoints. Fuzzy analytic hierarchy process (FAHP) method was used for computing weight factors and relative importance of main criteria, and the performance of airlines were ranked using Fuzzy TOPSIS. Liou[12] developed an integrated model for the selection of strategic alliance partners in the airline industry. The model addressed interdependency and feedback effects between criteria and alternatives by using the decision-making trial and evaluation laboratory (DEMATEL) and analytic network process (ANP). Silva[13] conducted a single qualitative case study, examining the co-evolution of the Star Alliance from 1997 to 2010. Validation methods, including member checks, triangulation, and peer review, were used to ensure the research trustworthiness. Fu et al.[14] studied the service quality's effects on the selection of a partner airline in the formation of airline alliances. The main concern is how an airline's service quality might affect the selection of its partner airline during the formation of airline alliances. Garg[15] presented a robust hybrid decision model for evaluation and selection of the strategic alliance partner. It applied analytic hierarchy process (AHP) for evaluation of criteria and fuzzy technique for order performance by similarity to ideal solution (FTOPSIS) to select strategic alliance partners.

The research works above were mainly about the evaluation and analysis using AHP, ANP, FAHP, etc., instead of modelling partner selection with assessment on potential cooperation effectiveness. Partner selection is a key decision for airline industry. The selection involves a number of complex processes which is the result of combination of various associated factors. In this paper, we choose the most important indexes to forecast the cooperation outcome and study partners' selection with quality of service index (QSI). In Section 1, we try to improve QSI model through choosing more necessary indexes based on the analysis of large scale of data. In Section 2, a partner selection model is established to effectively assisting airlines to identify the best partners from a number of possible candidates. In Section 3, a case study is carried to demonstrate the effectiveness of the partner selection model proposed in this paper. Conclusions come in Section 4.

1 Improving QSI Model

Among the existing research works, the most representative method to estimate the market share of aviation industry is QSI model developed by Boeing's operation research laboratory[16], which is considered as an effective tool for calculating market share[17]. However, the classic QSI model gave a rather rough result in practice, for only a few of attributes on market share introduced.

For any origin-destination pair (OD) market, various of attributes, such as route, departure time, aircraft type, ticket fares, deviation ratio, usually marked as $f_1, f_2, \cdots, f_n$, may affect its market share. The following formula is used to calculate QSI value of flight i

$$QSI_i = \alpha_1 f_1 + \alpha_2 f_2 + \cdots + \alpha_n f_n \tag{1}$$

where α are the coefficients of the attributes which can be obtained with regression analysis of historical data. The QSI model is a linear prediction model. If the QSI values of all flights are calculated by Eq. (1) for an OD pair, the market share of flight i can be obtained by

$$M_i = \frac{QSI_i}{\sum_{k \in N} QSI_k} \tag{2}$$

where N is the set of all flights in the OD market. The key of using QSI to forecast market share is to select the effective attributes to calculate QSI value. This section is focused on finding the more suitable indexes (i. e. the attributes) and calculating their corresponding coefficients based on a large scale of historical data, so that the improved QSI model can predict the market share of flight in international airline market more reasonably.

Based on the research work of Refs. [14,16, 17] as well as industry application (such as the Delta Airlines Inc and the Royal Holland Airlines), this paper selects the candidate indexes as follows: The flight frequency (Freq), available seats (Type), deviation time rate (TimeCode), transfer service (TransferSV), alliances and cooperation relations (AllCo), airport coordinate ability (AptCo), degree of market competition (Competition), market situation (SaleNet), turnover share at hub airport (AptShare) and Frequent Flyer Program (FFP) etc. Due to unavailable data of ticket price, the indexes Competition and SaleNet are adopted to replace the role of ticket price in the model.

We use the real data of international OD pairs (data sources: Paxis, MIDT, China Southern Airline, OAG) in 2014 to establish a database, which has more than 3 900 000 records. Correlation analysis, step wise regression and regression analysis are then carried out. The following result (QSI model) is obtained.

$$QSI = f(\text{Freq}, \text{Competition}, \text{TimeCode}, \text{AptShare}, \text{Type}, \text{SaleNet}, \text{TransferSV}, \text{AptCo}, \text{FFP}) \tag{3}$$

where the estimated values and relative standard errors of weights of all indexes are given in Table 1.

Table 1 Results for QSI indexes

Index	Estimate	Std. error	t	$P(>\|t\|)$
(Intercept)	−9.82E−02	3.21E−03	−30.614	<2E−16
Freq	1.01E−03	2.40E−05	42.052	<2E−16
Competition	−7.60E−05	2.31E−06	−32.885	< 2E−16
TimeCode	−1.12E−02	5.17E−04	−21.648	< 2E−16
AptShare	−2.81E−02	1.75E−03	−16.106	<2E−16
Type	4.78E−05	3.46E−06	13.811	<2E−16
SaleNet	−4.14E−04	9.68E−05	−4.274	<0.000 019 3
TransferSV	3.47E−02	6.39E−04	54.225	< 2E−16
AptCo	2.92E−02	1.08E−03	26.981	< 2E−16
FFP	−4.96E−02	1.36E−03	−36.488	< 2E−16

Note: Multiple R-squared: 0.633 8, Adjusted R-squared: 0.633 6, F-statistic: 2 159 on 9 & 33 974 DF, P-value: < 2.2E−16.

QSI model (3) extends the indexes of classic one[16]. The P values of all indexes are less than 0.05 and thus are prominent. The F-statistic of the model is 2 159, far greater than 1.

In order to test the improved QSI model, we select the OD markets between China and United States, as shown in Table 2. The schematic diagram of the prediction is shown in Fig. 1.

Table 2 Testing data

OD market	Flight frequency (direct or transfer) in OD market	Route number in OD market
PEK-LAX	183	51
PEK-SFO	142	28
PEK-ORD	218	52
PVG-LAX	194	43
PVG-SFO	180	39
PVG-ORD	200	46
CAN-LAX	62	15
CAN-SFO	54	28
CAN-ORD	40	21
LAX-PEK	202	66
LAX-PVG	164	39
LAX-CAN	49	18
SFO-PEK	123	16
SFO-PVG	112	18
SFO-CAN	41	19
ORD-PEK	97	10
ORD-PVG	88	11
ORD-CAN	28	17
Total	2 177	537

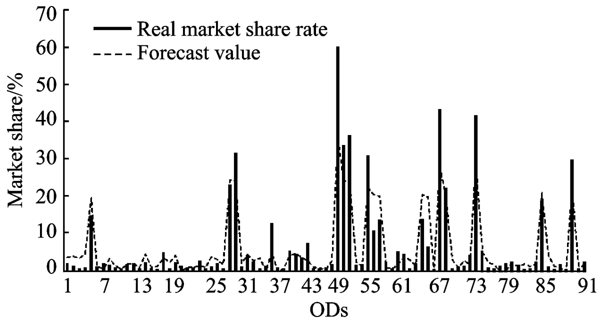

Fig. 1 Prediction of the improved QSI model for case testing

The black bars in Fig. 1 are the true value of the market share, and the dotted line is the predictive value obtained by using the QSI model (3). From Fig. 1 we can see that the predictive market shares match with the real ones well and the model is effective.

Comparing the QSI model here with the existing ones, we extend the following process: firstly, adding more indexes effective to the model, such as alliances and cooperation relations (AllCo), airport coordinate ability (AptCo), degree of market competition (Competition) etc.; secondly, using large scale real data of international airlines to fit QSI and obtaining the indexes' coefficients. Therefore, we obtain better forecasting results than that with existing QSI model.

We will use the QSI model improved in this section to establish partner selection model in next section.

2 Partner Selection Model

Network of an airline alliance has a structure of multi-communities in which the network of any member is a relatively independent community and there is one or more international routes, called "bridges", between any two communities.

The model to be built should be able to simplify the problem and focus on selection of after-bridge carrier partners. In order to simplify the model, we define object airlines as an airline company which operates a domestic community (i. e. domestic network). It is also a member of an alliance and is seeking cooperation partners.

Assuming that the object airlines operates the domestic flight legs and bridge legs, and need to choose after-bridge carriers as cooperation partners. Partners can be members of the same alliance or non-alliance airlines, and they are selected to maximize the profit of object airlines.

(1) The parameters involved in the model are as follows.

A: Set of airlines to be chosen as partners, including alliance's members and non-alliance airlines, $i \in A$ is any one in the set;

J: Set of flight paths for all ODs operated by object airlines and all possible cooperation partners, $j \in J$ is any one in the set;

$\mathrm{OpenCost}_{i,j}$: The cost of carrier i operating path j;

$\mathrm{Fare}_{i,j}$: The average fares of carrier i on path j;

$\mathrm{Cost}_{i,j}$: The flight cost per seat of object airlines on path j cooperating with partner i;

FP: The flight frequency of object airlines;

Seat: Available seat of the aircraft type operated in international market by object airlines;

Load: The expected flight load ratio of object airlines;

$\mathrm{QSI}_{i,j}$: The QSI value of carrier i on path j;

$\mathrm{SaleNet}_i$: The score of carrier i's sales network for calculation of QSI;

$\mathrm{TransferSV}_i$: The score of carrier i's transit service for calculation of QSI;

AptCo_i: The score of carrier i's airport coordination for calculation of QSI;

FFP_i: The score of carrier i's frequent flyer program for calculation of QSI;

S_{W}: The coefficient of sales network for calculation of QSI;

T_{W}: The coefficient of transit service for calculation of QSI;

A_{W}: The coefficient of airport coordination for calculation of QSI;

F_{W}: The coefficient of FFP for calculation of QSI;

Demand_j: The passenger demand in OD market j;

$\mathrm{TotalQSI}_j$: The sum of all QSI values currently operating in OD market j.

(2) Decision variables of the model are listed as follows.

$x_{i,j}$: Equals 1 when path j is operated by carrier i, otherwise 0;

$\mathrm{Pax}_{i,j}$: The number of passengers on path j operated by carrier i;

$\mathrm{NewQSI}_{i,j}$: The QSI value of carrier i to be optimized in path j, which is equal to the original QSI value plus change of the value:

$$\mathrm{NewQSI}_{i,j} = \mathrm{QSI}_{i,j} + x_{i,j} \times (S_{\mathrm{W}} \times \mathrm{SaleNet}_i + T_{\mathrm{W}} \times \mathrm{TransferSV}_i + F_{\mathrm{W}} \times \mathrm{FFP}_i + A_{\mathrm{W}} \times \mathrm{AptCo}_i) \quad (4)$$

The total profit of cooperation with all partners equals the total operation revenue minus the total operation cost. The difference between the total profits before and after cooperation is the coordination value. Since the pre-cooperation profits are known, the objective function of model is chosen to maximize the total profit after cooperation.

The optimization model of partner selection is as follows

$$\max \text{ profit} = \sum_{i \in A} \sum_{j \in J} \mathrm{Fare}_{i,j} \times \mathrm{Pax}_{i,j} - \sum_{i \in A} \sum_{j \in J} \mathrm{OpenCost}_{i,j} \times x_{i,j} - \mathrm{FQ} \times \mathrm{Seat} \times \sum_{i \in A} \sum_{j \in J} \mathrm{Cost}_{i,j} \times x_{i,j} \quad (5)$$

$$\text{s. t. } \mathrm{Pax}_{i,j} \leqslant \mathrm{Demand}_j \times \mathrm{NewQSI}_{i,j} \Big/ \sum_{i \in A} \mathrm{NewQSI}_{i,j} \quad i \in A,\ j \in J \quad (6)$$

$$\sum_{i \in A} \mathrm{Pax}_{i,j} \leqslant \mathrm{Demand} \times \sum_{i \in A} (x_{ij} \times \mathrm{NewQSI}_{i,j}) / \mathrm{TotalQSI}_j \quad j \in J \quad (7)$$

$$x_{i,j} \times M \geqslant \mathrm{Pax}_{i,j} \quad i \in A, j \in J \quad (8)$$

$$\mathrm{Pax}_{i,j} \leqslant \mathrm{Seat} \times \mathrm{FQ} \quad i \in A, j \in J \quad (9)$$

$$\sum_{i \in A} x_{ij} \geqslant 1 \quad j \in J \quad (10)$$

$$\mathrm{Pax}_{i,j} \geqslant 0 \quad x_{i,j} = 0,1;\ i \in A, j \in J \quad (11)$$

where objective Eq. (5) is the total profit to be maximized. Constraint (6) requires the passenger number transported by carrier i on j is not greater than the forecast with QSI; constraint (7) ensures that the total number of passengers transported on j through cooperation is not greater than that of the forecast result by QSI model; constraint (8) is a logical condition between $x_{i,j}$ and $\mathrm{Pax}_{i,j}$, that is, if route j is not operated by carrier i, the number of passengers on route j transported by carrier i is 0, where M is a positive constant large enough to satisfy the logic relation; constraint (9) limits that the number of passengers transported by any cooperation partner is not greater than the available seat number provided by object airlines; constraint (10) ensures that at least one partner for path j should be selected.

If only one partner is needed for path j, the constraint (6) is replaced

$$\sum_{i \in A} x_{ij} = 1 \quad j \in J \quad (12)$$

In general, object airlines often cooperate with multiple partners on an OD pair.

Since the above model is a deterministic mixed integer programming problem, it can be solved by branch and bound method. We can also use ILOG, AMPL, AIMMS and other optimization software to solve this model.

3 Case Study

In this paper, we set an airline company of China as object airlines, and obtained the actual flight information data through survey on the airlines. KLM Royal Dutch Airlines (IATA: KL) and Alitalia Airlines (IATA: AZ) were set as the candidate partners within the alliance; British Airways (IATA: BA) as a possible non-alliance partner. Amsterdam Airport (IATA: AMS), Rotterdam Airport (IATA: RTM), Rome Fiumicino Airport (IATA: LMC), Iceland Airport (IATA: LIN), Venice Airport (IATA: VCE), Lyon Airport (IATA: LYS), and Paris Charles de Gaulle Airport (IATA: CDG) were set as the cooperation service points in Europe.

According to the survey data on object airlines, the cost per seat was about 0.3—0.7 yuan / km for the domestic airline network operated by object airlines, as the flight distance was less than 2 000 km; the average aircraft seat number was 228; the monthly frequency was 62; and the average airline operation cost was about 10 million a month based on the real data. According to the

QSI method, we obtained the optimal weights of sales network, frequent passenger program, transit service and airport coordination by the data test. The flight data for cooperation partner selection are shown in Table 3.

In the last four columns of Table 3, the scores of the four attributes used in Eq. (4) were obtained with expert scoring method. An expert survey was conducted through the international affairs department of object airlines, requesting their experts to set a score on the four attributes of alliance's members and non-alliance airlines.

The model established in Section 1 was used to optimize cooperation partner selection with AIMMS(as seen in Fig. 2). The optimized results are shown in Table 4. If the profit before cooperation was 0, through the cooperation with the partners selected by the model, the total profit increment was coordination value which is 39.34 million yuan.

Table 3 Flight information for cooperation partner selection

Airline	Airport	Price/yuan	Seat cost/yuan	Number of passengers	QSI value	SaleNet	FFP	TransferSV	AptCo
BA	AMS	1 894	267	10 302	0.14	5	0	3	0
KL		2 205			0.17	5	8	10	6
BA	RTM	1 640	375	1 905	0.16	5	0	3	0
KL		1 902			0.15	5	8	10	6
BA	FCO	3 262	722	6 812	0.05	5	0	3	0
AZ		2 985			0.10	5	8	10	6
BA	LIN	2 906	503	4 788	0.03	5	0	3	0
AZ		2 265			0.02	5	8	10	6
BA	VCE	2 782	768	5 722	0.13	5	0	3	0
AZ		3 680			0.12	5	8	10	6
BA	LYS	2 533	344	3 867	0.03	5	0	3	0
AF		2 260			0.04	5	8	10	6
BA	CDG	1 810	324	8 922	0.14	5	0	3	0
AF		1 920			0.17	5	8	10	6

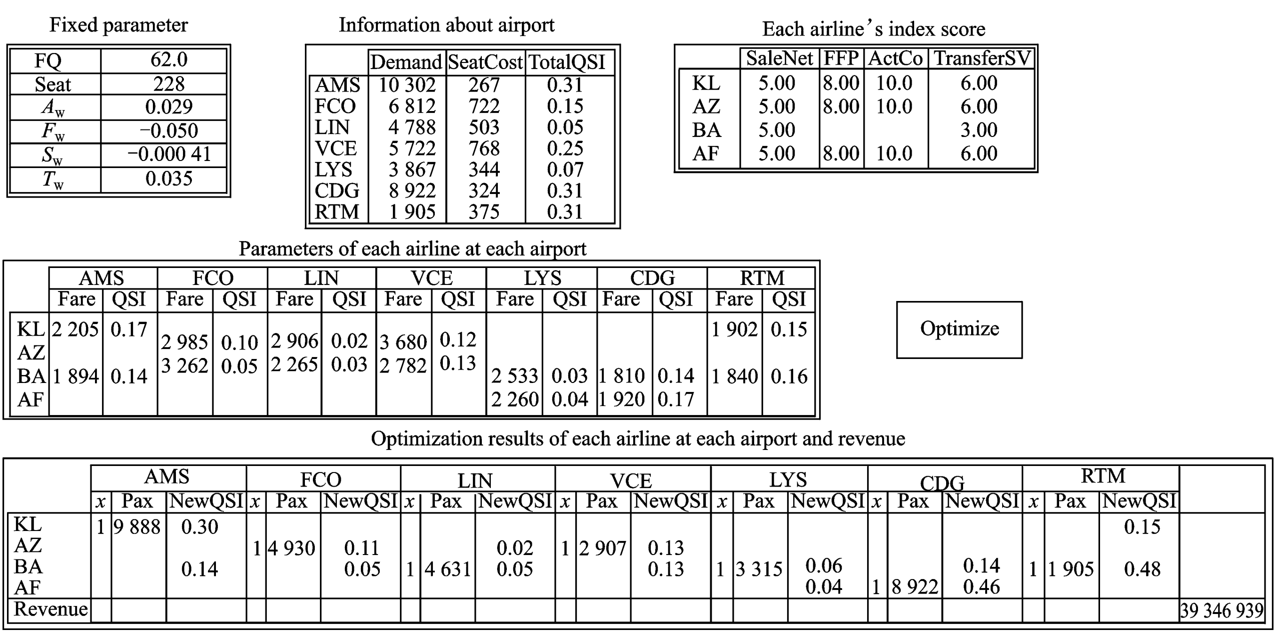

Fig. 2 AIMMS calculation interface of partner selection

The results in Table 4 show that the alliance's members are still the most powerful partners, but on some international route, non-alliance partners can be used as a complement.

Table 4 implies that it is better for object airlines to cooperate with non-alliance partner, BA, in order to transport to airports LIN and LYS, and the cooperation can bring more than 36 561 passengers a year.

We should state that in this case analysis we did not put ticket price into QSI model, for we cannot get real data about ticket price from airlines and also almost all the existing QSI models did not include price index, although price is important for passengers' choice. Instead we added some indexes related to price, such as degree of market competition(Competition) etc.

Table 4 Optimization results

Airline	Airport	Choose the partner in this route (1 for yes, 0 for No)	QSI value	Number of passengers (Based on QSI)
BA	AMS	1	0.14	0
KL		0	0.30	9 888
BA	RTM	1	0.48	1 905
KL		0	0.15	0
BA	FCO	1	0.19	4 960
AZ		1	0.11	0
BA	LIN	1	0.05	4 631
AZ		0	0.02	0
BA	VCE	0	0.13	0
AZ		1	0.13	2 970
BA	LYS	1	0.06	3 315
AF		0	0.04	0
BA	CDG	0	0.14	0
AF		0	0.46	8 922

4 Conclusions

The following conclusions can be drawn from the study in this paper.

(1) The proposed model can help domestic airlines select partners better within and outside their own alliance.

(2) Improved QSI model by introducing more sound indexes based on the analysis of large scale data is basically successful.

(3) On some occasions, cooperation with non-alliance partner is effective for object airlines in order to obtain more passengers and coordination value.

In order to make the proposed model more practical, extra effort is needed to improve the results of expert survey so that more reasonable and accurate scores of all the attributes in QSI model could be obtained.

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References:

[1] PARK J H, ZHANG A. Airline alliances and partner firms' outputs[J]. Transportation Research Part E, Logistics & Transportation Review, 1998, 34 (4):245-255.

[2] OUM T H, YU C, ZHANG A. Global airline alliances: international regulatory issues[J]. Journal of Air Transport Management, 2001, 7(1):57-62.

[3] IATROU K, ALAMDARI F. The empirical analysis of the impact of alliances on airline operations[J]. Journal of Air Transport Management, 2005, 11(3): 127-134.

[4] VAARA E, KLEYMANN B, SERISTO H. Strategies as discursive constructions: The case of airline alliances[J]. Journal of Management Studies, 2010, 41(1):1-35.

[5] GOH K, UNCLES M. The benefits of airline global alliances: An empirical assessment of the perceptions of business travelers[J]. Transportation Research Part A, Policy & Practice, 2003, 37(6):479-497.

[6] ITO H, LEE D. Domestic codesharing practices in the US airline industry [J]. Journal of Air Transport Management, 2013, 11(2):89-97.

[7] BRUECKNER J K. The economics of international codesharing: An analysis of airline alliances[J]. International Journal of Industrial Organization, 2001, 19(10):1475-1498.

[8] BRUECKNER J K, WHALEN W T. The price effects of international airline alliances[J]. Journal of Law & Economics, 2000, 43(2):503-546.

[9] PARK J H, ZHANG A. An empirical analysis of global airline alliances: Cases in north Atlantic markets[J]. Review of Industrial Organization, 2000, 16 (4):367-384.

[10] LIOU J J H, TZENG G H, TSAI C Y, et al. A hybrid ANP model in fuzzy environments for strategic alliance partner selection in the airline industry[J].

Applied Soft Computing, 2011, 11(4):3515-3524.

[11] EBRAHIMIAN H, MONTAZER G A. Airline alliances partner selection in uncertain environment: A fuzzy hybrid evaluation model based on BSC[J]. Sid Ir, 2011, 43(1):1-10.

[12] LIOU J J H. Developing an integrated model for the selection of strategic alliance partners in the airline industry[J]. Knowledge-Based Systems, 2012, 28(2):59-67.

[13] SILVA D B. Co-evolution of strategic alliance between multiple partners in the same industry: A case study of a global airline alliance: the star alliance [D]. Atlanta: Georgia Institute of Technology, 2012.

[14] FU J, MUTO S. Service quality's effects on the selection of a partner airline in the formation of airline alliances[J]. Contributions to Game Theory and Management, 2013,6(2):165-177.

[15] GARG C P. A robust hybrid decision model for evaluation and selection of the strategic alliance partner in the airline industry[J]. Journal of Air Transport Management, 2016, 52(1):55-66.

[16] KLOTH R J, EDSALL T J, FINE M, et al. Method and apparatus for implementing a quality of service policy in a data communications network: US6870812 [P]. 2005-03-15.

[17] KOVACIC V, VASIGH B, BABI R S. Quality of service index factors and passengers perspective implication[C]//2013 ATRS Conference of Air Transport Research Society. [S. l.]:[s. n.], 2013.

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