Supplier Selection Using Integrated MCDM Model Combines Analytic Hierarchy Process and Genetic Algorithm

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Abstract

In today's severe competitive environment the selection of appropriate suppliers is a significantly important decision for effective supply chain management. Appropriate suppliers reduce purchasing costs, decrease production lead time, increase customer satisfaction and strengthen corporate competitiveness. Due to multiple criteria effects the evaluation and selection process, deciding which criteria have the most critical roles in decision making is a very important step for supplier selection, evaluation and particularly development. Supplier selection is a multi-criterion decision making problem under uncertain environments. Analytic Hierarchy Process (AHP) is a common tool used to solve the MCDM problem. Since AHP has been introduced, it has been applied in numerous situations with impressive results. However, AHP has been also criticized mainly in priority derivation procedure. One of the main problems in current AHP as priority derivation procedure is; Inconsistency of the judgment, and accuracy performance of the prioritization method. To solve the criticism and the problems; this paper proposes new and more reliable model (Analytic Hierarchy Process-Genetic Algorithm prioritization model, AHPGA) to drive and optimize the weights of AHP. The propose framework combines the power of genetic algorithm (GA) with Analytic Hierarchy Process (AHP). The new model minimizes Euclidian distance of Least Squire Method as objective function. Effectiveness of new proposed model is measured by comparing model results with AHP original model which exploits Average Normalized Column (ANC) weighting method to estimate priority vector and with other prioritization methods in the literature. The proposed model gives better results compare to the other prioritization methods based on accuracy of derived priorities.

Keywords: Supplier Selection, Multi-Attribute Decision-Making (MADM), Analytic Hierarchy Process (AHP), Genetic Algorithm (GA), Evolutionary Computing.

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1. Introduction

Today, organizations that wish to carry on the sustainable growing need a robust strategic performance measurement and evaluation system because of changing demands of consumers, reduced product life cycle, competitive and globalized markets. Supplier selection with order allocation represents one of the most important functions to be performed by the purchasing decision makers, which determines the long-term viability of the company a good supplier selection makes a significant difference to an organization's future to reduce operational costs and improve the quality of its end products. There have been a lot of factors in todays global market in which that influence companies to search for a competitive advantage by focusing on purchasing raw materials and component parts represents the largest percentage of the total product cost. For instance, high technology products such as motor vehicles, railroad& transport equipment, machinery& equipment components, purchased materials and services account for up to 80% of the total product cost. Therefore, selecting the right suppliers is a key to the procurement process and represents a major opportunity for companies to reduce costs. On the other hand, selecting the wrong suppliers can cause operational and financial problems, Mithat Zeydan et al. [1].

1.2. Evaluation Criteria

Evaluation criteria can be classified in different groups. Ho, W., Xu,X. [2]reviewed the literature on supplier evaluation related methods of decision making. They introduced the most popular criterion which is quality, delivery, cost/price, manufacturability, services, management, technology, research and development (R&D), finance, flexibility, reputation, relationship, risk and safety, and environment as the major criteria for evaluation of suppliers. Each of the major criteria could have sub-criteria. Betty Chang et. al.[3], presents a study pioneers in using the fuzzy decision- making trial and evaluation laboratory (DEMATEL) method to find influential factors in selecting supply chain management (SCM) suppliers. The DEMATEL method evaluates supplier performance to find key factor criteria to improve performance and provides a novel approach of decision-making information in SCM supplier selection. This research designs a fuzzy DEMATEL questionnaire sent to seventeen professional purchasing personnel in the electronic industry. This study uses an expert interview method. The objects were professional experts working in purchasing departments of electronic industries in Taiwan. The evaluation criteria in this study are as follows: product quality, product price, technology ability, service, delivery performance, stable delivery of goods, lead-time, reaction to demand change in time, production capability and financial situation.

In addition to the above literature, Chang et al., **Error! Reference source not found.**and Liao and Kao [4]have summarized economic criteria that have appeared in previous articles and have concluded the most important criteria are quality, price, and delivery performance.A very recently work by S. Senthil, et. al.[5]proposed a hybrid method using Analytical Hierarchy Process (AHP) and the Fuzzy Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS). The relevant criteria for the selection of a contractor, which are widely discussed in the literature, are presented in this study according to literature survey.

1.3. MCDM Techniques:

Historically, different approaches have been proposed to evaluate, select and monitor potential suppliers by evaluating multiple criteria, using methodologies and techniques from diverse fields such as operations research, artificial intelligence, and decision analysis theory. Ho, Xu, and Dey [2]presented a literature review of the multi-criteria decision making approaches for supplier evaluation and selection. The authors pointed out that the most commonly approaches to model the problem are namely data envelopment analysis (DEA), multi-objective programming (MOP), analytic hierarchy process (AHP), case-based reasoning (CBR), fuzzy logic, genetic algorithms (GA), and artificial neural networks (ANN). Many other reviews for supplier selection criteria and methods are found in studies belong to Weber, Current, and Benton [6], Degraeve, Labro, and Roodhooft [7], De Boer, Labro, and Morlacchi [8], and Aissaoui, Haouari, and Hassini [9],

Recently Junyi C.et al. [10] provides a systematic literature review on articles published from 2008 to 2012 on the application of DM techniques for supplier selection. In this review a number of classical for MCDM techniques have been employed in problem-solving processes. Based on the principle behind these MCDM techniques, the authors classify them into four categories: (1) multi attribute utility methods such as AHP and ANP, (2) outranking methods such as Elimination and Choice Expressing Reality (ELECTRE) and Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE); (3) compromise methods such as Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) and Multi-criteria Optimization and Compromise Solution (VIKOR), and (4) other MCDM techniques such as Simple Multi-attribute Rating Technique (SMART) and Decision-Making Trial and Evaluation Laboratory (DEMATEL).

Supplier selection is a MCDM problem containing both quantitative and qualitative criteria which, together, are in conflict. The tangible and intangible factors in supplier selection problem cause vagueness and ambiguity in decision-making process. Fuzzy Set Theory (FST) is applied as an efficient tool to handle this uncertainty effectively and convert human judgments into meaningful results. Chen, Lin, and Huang [11]presented an extended version of TOPSIS based on FST to select best supplier in a single sourcing problem. Guneri, Yucel, and Ayyildiz [12]developed an integrated model based on FST and linear programming. In proposed model, integration with linear programming enabled decision-makers to assign order quantities to each supplier considering the Total Value Purchase (TVP) maximizing objective. Faez, Ghodsypour, and O'Brien [13]applied a model that adds fuzzy logic concept into Case Based Reasoning (CBR) method and integrates with a mixed integer programming model for supplier selection and order allocation.

Also in supplier selection problems, hybrid methods have been developed to complement the weaknesses of each method and construct effective selection systems. Ha and Krishnan [14]proposed a hybrid method that incorporates AHP, DEA and Neural Network (NN) techniques into an evaluation process in order to select competitive suppliers in supply chain. The integrated method enables to solve single sourcing and multiple sourcing problems by calculating Combined Supplier Score (CSS). GA is a kind ofglobal search technique used to identify approximate solutionsfor complex optimization problems. Conceptually following thesteps of the biological process of evolution, GA is considered a heuristic method considering that it cannot guarantee a truly optimal solution. Many researchers considered typical GA for Supplier selection includes Yang, Wee, Pai, and Tseng [15]as well as Yeh and Chuang [16].

1.4. AHP Approach

AHP, multi-attribute utility method, essentially attempt to assign a utility value to each alternative. The utility value represents the preference degree that can be the basis for ranking or choice.AHP uses pair-wise comparisons along with expert judgments to handle the measurement of qualitative or intangible attributes. AHP is the most important and commonly used components that constitute up-to-date decision approaches for Supplier selection. Mafakheri, Breton, and Ghoniem [17]provided an AHP-based two-stage dynamic programming approach. Bhattacharya, Geraghty, and Young [18]provided an integrated AHP and quality function deployment (QFD) for ranking alternative suppliers. Kull and Talluri [19]provided an evaluation model that used AHP for calculating a risk index based on each alternative supplier. Ordoobadi [20]provided an integrated decision model using AHP and the Taguchi loss function. In this model, AHP was used to determine the weights that represent the importance of tangible and intangible decision factors. The weighted Taguchi loss scores were calculated for ranking suppliers. Levary [21]introduced AHP to rank potential suppliers in manufacturing industries; Chan and Chan [22]applied AHP in the fast-changing apparel industry. Ishizaka, Pearman, and Nemery [23]developed a new variant of AHP for the sorting of suppliers into predefined ordered categories. Such indexes were then incorporated into a GP model for selecting suppliers. This model was applied to a case on product life cycle.

AHP techniques, is exploits when considering uncertain decision environments. These techniques can be divided into three categories: (1) AHP-based fuzzy logic hybridization approaches, (2) AHP and triangular fuzzy set integrated approaches, and (3) AHP-based non-fuzzy hybridization approaches. In the first category, Labib [24]introduced a simple decision model that integrated AHP with the basic fuzzy logic. Sevkli et al.[25] provided a hybrid decision model that used AHP to determine the weights of criteria and weighted fuzzy LP to rank suppliers. Two articles Chan, Kumar et al.[26], Bottani & Rizzi, [27] utilized the AHP technique and linguistic pair-wise comparisons for ranking suppliers under triangular fuzzy environments. In the third category,Pitchipoo, et al. [28]developed a hybrid decision model via the integration of the AHP technique with GRA. In this model, AHP was used to determine the weights of the valuation criteria, whereas GRA was used to identify the best supplier.

1.5. Work Objectives

Supplier selection greatly impacts the supply chain management (SCM) relationship. Improper management of the supply chain relationship affects SCM effect directly. Hence, this study uses a quantitative method to solve the problem and promote SCM performance through good supplier selection. Since AHP has been introduced, it has been applied in numerous situations with impressive results. However, AHP has been also criticized mainly in priority derivation procedure. One of the main problems in current AHP as priority derivation procedure is; inconsistency of the judgment, and accuracy performance of the prioritization method.
Then, the objectives of this paper is two folds: First, is to propose an integrated AHP-GA optimization model (AHPGA) to deal with falls of the AHP method in handling the uncertainties and imprecision of multi-criteria decision making system. This model uses Genetic Algorithm (GA) which can drive more accurate priorities from consistent and inconsistence comparison matrices. The new model minimizes Euclidian distance of Least Squire Method as objective function. And the second, to exploit the verified proposed model to the problem of supplier selection in production companies. Effectiveness of new proposed model is measured by comparing model results with other prioritization methods in the literature.

2. Materials and Methods

This paper used AHP prioritization tool which contains several methods. In this section we describe and discuss tools used to develop the new model. Procedure and steps of the new model also discussed in this section.

2.2. Analytic Hierarchy Process Prioritization Methods

Analytic hierarchy process has many prioritization methods. The proposed AHPGA prioritization model uses two methods, Average Normalized Columns (ANC) and Direct Least Square. The following part discusses these methods.

2.2.1. Average Normalized Columns (ANC)

The decision weights for each preferential matrix can be obtained after the consistency check by the aforementioned methods related to eigenvector and consistency ratios. Consequently, the final decision weights of the alternatives can be aggregated by a series of multiplications of the rearrangements of the preferential matrixes, average of normalized columns (ANC) one of these methods. If we have consistent matrix ANC is to divide the elements of each column by the sum of the column and then add the element in each resulting row to form average normalized matrix A^*, and divide this sum by the number of elements in the row (n). This is a process of averaging over the normalized columns. In mathematical form, the vector of priorities can be calculated as follows:

$$W_{\mathrm{i}} = \frac{1}{n}\sum_{j=1}^{n}\frac{a_{\mathrm{ij}}}{\sum_{i}^{n} a_{\mathrm{ij}}} \quad , \quad i\,, j = 1,2, \dots n \tag{1}$$

We can conceder this method an approximation of EV, Consistency ratio (CR) can be calculated from the following equations:

$$\mathrm{CR} = [(\boldsymbol{\lambda}_{\mathrm{max}} - n) / (n - 1)] / \mathrm{RI} \tag{2}$$

$$\boldsymbol{\lambda}_{\boldsymbol{max}} = \frac{1}{n}\sum_{i=1}^{n}\frac{(a_{\mathrm{ij}}\, w)_{i}}{w_{i}} \tag{3}$$

Where: CR consistency ratio, n matrix size, $\boldsymbol{\lambda}_{\mathbf{max}}$ maximum Eigen-value is the item weight referring to priority vector and RI random index, could be selected according to matrix size from table 1.

Table1: Random index values [29].

Size of matrix *n*	1	2	3	4	5	6	7	8	9	10
Random Index RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Some distance minimizing methods such as the least squares method (LSM), logarithmic least square method (LLS) are of the possible tools for computing the priorities of the alternatives. All these are optimization methods.

2.2.2. Direct Least Square

In the DLS method the objective is to find a consistent ratio-scale matrix which minimizes the Euclidean distance from consistent ratio-scale matrix. That is,

$$Min \sum_{i=1}^{n}\sum_{j=1}^{n}\left(a_{\mathrm{ij}} - \frac{w_{\mathrm{i}}}{w_{\mathrm{j}}}\right)^{2} \tag{4}$$

$$s.t. \sum_{i=1}^{n} w_{\mathrm{i}} = 1 \tag{5}$$

The nonlinear optimization problem in this equation has no special tractable form and therefore is difficult to solve numerically.

2.3. Proposed AHPGA Prioritization Model

In solving optimization problem for deriving priorities by using AHPGA, it involves three operators which are selection, crossover, and mutation. In this model these operators are selected as follow, rank selection for selection, one point crossover for crossover and uniform mutation for mutation. In order to ensure that only the best population always survives, elitism has also been applied as an additional selection strategy.

2.3.1. Chromosome Representation

This model is using a set of binary numbers (binary encoding) for each population or chromosome in initial population. Then this binary numbers translated to real numbers or (Permutation encoding) for fitness calculation. Real numbers are used because it is more natural and useful representation of priorities in AHP.

2.3.2. Initialization

The initial population of candidate solution is generated randomly across the search space. Search space is the space for all possible feasible solutions. Every solution can be marked by its value of the fitness of the problem. Random numbers are used for initial population to give AHPGA starting point. Each single population is generating randomly based on number of criteria or alternative in AHP hierarchy setting.

2.3.3. Fitness Function

In general, fitness function F(x) is first derived from the objective function and used in successive genetic operations. Total deviation (TD) equation used as an objective function to be optimized. Once an offspring population is created or the population is initialized, the fitness values of candidate solution are evaluated.

$$F(x) = TD, \qquad TD = \sum_{i=1}^{n} \left(\sum_{j=1}^{n} \left(a_{ij} - \frac{w_i}{w_j} \right)^2 \right)^{1/2} \tag{6}$$

After calculate each initial population fitness function, that chromosome will set as parent. That parent also will produce offspring and store the offspring chromosome. Besides that, that parent also will go to selection step.Pseudo code of implementation AHPGA model is presented as follow:

m= Population size

n= matrix size

Input pair-wise comparison matrix A

1. dev=1, f_o=0
2. generate random number which the priority
   W=[w1,w2,…w_n]
3. while dev > ε , (i.e. ε = 10^{-5})

4. calculate total deviation TD

$$TD = \sum_{i=1}^{n}\left(\sum_{j=1}^{n}\left(a_{ij} - \frac{w_i}{w_j}\right)^2\right)^{1/2}$$

5. dev=fitness value, f – old fitness value, f_o
6. old fitness value, f_o = fitness value, f
7. do selection, crossover, and mutation
8. end while
9. print priority vector

2.3.4. Parameter Setting

By using GA, parameter setting is the important part in getting the better result. The performance of GA is greatly dependent on its turning of parameter. This model proposes a new parameter setting. Population size is 1000; Crossover rate is 50 % and 10 % for Mutation.

3. Verification of Proposed Model

Two examples are used to illustrate and verify the potential applications of the proposed AHPGA model. The illustration presents the advantages of the proposed model and verifies model consistency with the previous work.

Case No. (1)

Ying-Ming Wang et al. [30] proposes a linear programming method for generating the most favorable weights (LP-GFW) from pair-wise comparison matrices. LP-GFW incorporates the variable weight concept of DEA into the priority scheme of the AHP. This model generates the most favorable weights for the underlying criteria and alternatives on the basis of a crisp pair-wise comparison matrix. In this example, a study has been conducted based on data that are taken from example used in study of Ying-Ming Wang et al.which is borrowed from Saaty’s study as shown below.

$$A = \begin{bmatrix} 1 & 4 & 3 & 1 & 3 & 4 \\ 1/4 & 1 & 7 & 3 & 1/5 & 1 \\ 1/3 & 1/7 & 1 & 1/5 & 1/5 & 1/6 \\ 1 & 1/3 & 5 & 1 & 1 & 1/3 \\ 1/3 & 5 & 5 & 1 & 1 & 3 \\ 1/4 & 1 & 6 & 3 & 1/3 & 1 \end{bmatrix} \quad (7)$$

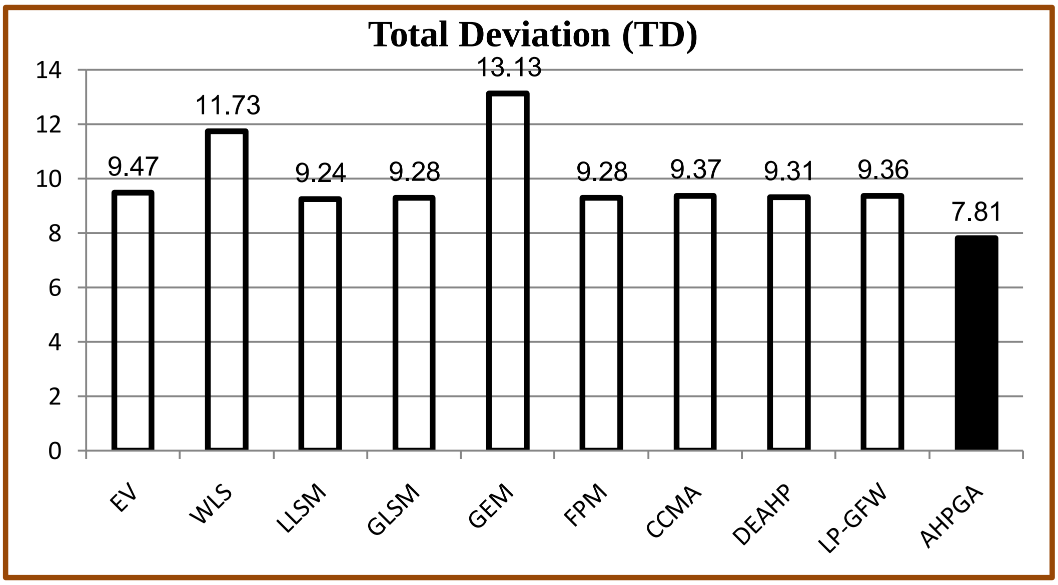

Figure 4: Deferent prioritization methods results for example 1

The results of this case (figure 4) shows that, AHPGA prioritization model in case of high inconsistent matrices produces the smaller or close to zero the value of TD as comparing criteria (i.e. AHPGA model is the best solution). When compare between AHPGA with different prioritization methods, and with new approach as integrated model of data envelopment analysis and AHP (DEAHP), and correlation coefficient maximization approach (CCMA).

Case No. (2)

This example is investigated by Ramanathan using DEAHP, [31]. In Ramanathan study data envelopment analysis (DEA) is proposed to generate local weights of alternatives from pair-wise comparison judgment matrices used in the analytic AHP.

Table 3: TD values for criteria and alternatives.

Prioritization method	Value of TD				
	P1	**P2**	**P3**	**P4**	**P5**
Eigenvector method (EVM)	3.2443	2.4151	3.1315	0.3796	0.0029
Data envelopment analysis and AHP	4.7262	1.6448	2.2215	0.3477	0.0029
Linear programming for generating the most favorable weights (LP-GFW)	3.2883	2.2735	2.8649	0.3773	0.0029
AHP + Genetic Algorithm (AHPGA)	**2.6909**	**1.5243**	**1.9873**	**0.2999**	**0.1880**

Results of this example (table 3) confirms the following conclusion, in general AHPGA prioritization model produces the smaller the value of TD (as comparing criteria) comparing with different prioritization methods, and with new approach as integrated model of data envelopment analysis and AHP (DEAHP), Linear programming for generating the most favorable weights (LP-GFW). In case of high consistent matrix (P5, CR=0) AHPGA prioritization model not the best one because GA is a random search technique. So, AHPGA model should be modified in case of high consistent matrices.

4. Supplier Selection Using AHPGA Model

In this section Jianliang Peng. [32] application is solved using proposed AHPGA model and comparison between Jianliang AHP model and AHPGA results is made. It is feasible to use AHP as the evaluation model of logistics outsourcing services. Based on the evaluation index system including logistics cost, the logistics operation efficiency, the basic qualities of service suppliers and logistics technology level has more targeted and practicability. In this paper the evaluation and selection of logistics outsourcing service suppliers carried out based on AHPGA and studied the actual case of a frozen food enterprise. It provides a reference for an enterprise to choose logistics outsourcing service suppliers.

In the evaluation index system of logistics supplier, the top layer is the target to choice logistics outsourcing service suppliers, namely the first level evaluation index. The intermediate layer is the criterion, and depends on the four secondary indexes: the logistics cost, logistics operating efficiency, fundamental service quality and logistic technology level. To establish the three-level index by further subdivision index of the intermediate layer, show in figure 5. [32].

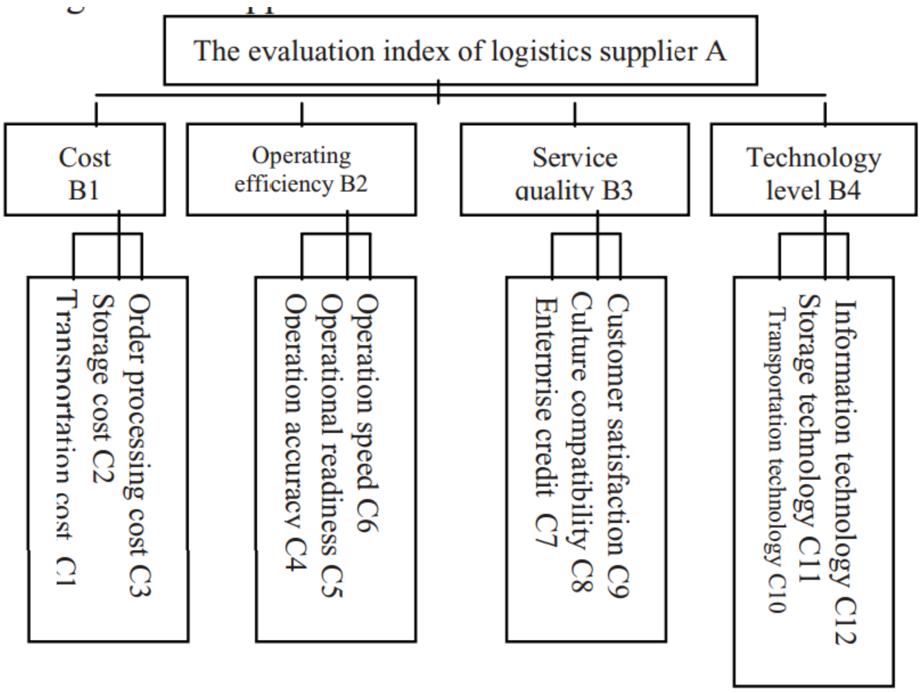

Figure 5: The hierarchical analysis model of logistics service supplier evaluation[32].

Basic situation of the case

A company belongs to the frozen food industry, specially established a team of experts who are responsible to research and evaluate the feasibility of logistics outsourcing by comprehensive analysis. They finally decided to measure from following A, B and C third-party logistics services in three preferred choice to solve the problem of logistics operation. Third party logistics company A as a state-owned enterprise logistics supplier, provides the all directional logistics solutions to customers all over the country to delivery to the terminal or clients with the logistics branches in 24 hours. Its business scope involves transportation, warehousing, distribution and overall logistics packaging and design. Company A is the lowest logistics cost in 3 candidates' enterprises, but the assignment speed is slower, and the prestige and transportation technology are relatively backward. Logistics Company B owns many professional companies in refrigeration, hotel, real estate, logistics and distribution, import and export trade. The transportation and warehousing logistics cost of Company B is the highest in three candidates' enterprises, but the operation accuracy is general, the compatibility of enterprise is poor culture, and the information technology is relatively backward. As one of modern refrigeration logistics enterprises, Logistics Company C is an integrated modern logistics enterprise specialized in the cold storage, distribution and information processing integration. Using modern information and network tools, the company provides goods transportation, storage, fresh goods and logistics distribution, etc. in a scientific and orderly logistics flow. The operation accuracy and readiness are the highest. And its logistics information technology is the most advanced [32].

Tables 4 through 8 presents the results of proposed AHPGA model based on model parameter setting proposed in this paper.

Table 4: Judgment matrix of goal layer

A	B1	B2	B3	B4	W
B1	1	2	3	2	0.3945
B2	1/2	1	2	1	0.2383
B3	1/3	1/2	1	1/2	0.1250
B4	1/2	1	2	1	0.2305

Table 5: Judgment matrix of logistics cost

B1	C1	C2	C3	W
C1	1	3	2	0.5508
C2	1/3	1	1	0.2031
C3	1/2	1	1	0.2422

Table 6: Judgment matrix of logistics operation efficiency

B2	C4	C5	C6	W
C4	1	3	2	0.1680
C5	1/3	1	1	0.3281
C6	1/2	1	1	0.5000

Table 7: Judgment matrix of logistics service quality

B3	C7	C8	C9	W
C7	1	0.6667	2	0.3320
C8	1.5	1	3	0.5000
C9	1/2	1/3	1	0.1641

Table 8: Judgment matrix of logistics technology level

B4	C10	C11	C12	W
C10	1	0.6667	2	0.3320
C11	1.5	1	3	0.5000
C12	1/2	1/3	1	0.1641

Total hierarchy sorting

Total sorting means the same level of all factors for target layer (top) the relative weight in order of importance. Total sorting weight synthesis the weight in single criterion under from top to down. Calculation results shows in table 9.

Table 9 Total hierarchy sorting matrix

Criterion layer / **Scheme layer**	**B1**	**B2**	**B3**	**B4**	**CW**
	0.3945	0.2383	0.125	0.2305	
C1	0.5508				**0.2173**
C2	0.2031				0.0801
C3	0.2422				0.0955
C4		0.167			0.0398
C5		0.333			0.0796
C6		0.500			**0.1191**
C7			0.332		0.0415
C8			0.500		0.0625
C9			0.164		0.0205
C10				0.332	0.0765
C11				0.500	**0.1152**
C12				0.164	0.0378

Comparison with other indexes, the transportation cost is the most important; the total weight is 21.7%.In addition, the storage technology and operation speed is more important, their weights are 11.9% and 11.5%.

Considering the influence factors, according to the actual situation of three logistics outsourcing suppliers A, B and C, scored 12 sub-functions index(score 10 points) and weighted average. According to the evaluation index system in this paper, the indices of logistics outsourcing suppliers A, B and show in table 10.

Table 10: Indices of logistics outsourcing suppliers A, B and C

Suppliers / Indexes	Supplier A	Supplier B	Supplier C	scores of logistics outsourcing suppliers		
				Supplier A	Supplier B	Supplier C
X1	8	6	7	1.738	1.304	1.521
X2	7	5	6	0.561	0.401	0.481
X3	8	7	8	0.764	0.669	0.764
X4	9	6	9	0.358	0.239	0.358
X5	8	8	9	0.637	0.637	0.716
X6	6	9	8	0.715	1.072	0.953
X7	6	8	9	0.249	0.332	0.374
X8	8	6	8	0.500	0.375	0.500

X9	7	7	9	0.144	0.144	0.185
X10	6	8	9	0.459	0.612	0.689
X11	8	8	9	0.922	0.922	1.037
X12	8	6	8	0.302	0.227	0.302
Sum				7.3482	6.9312	**7.8788**

Combined with the calculation result of weight CW, according to formula:

$$y = \sum Cw\ Xi \tag{8}$$

The synthesis scores of logistics outsourcing suppliers A, B and C are 7.348, 6.931 and 7.878 respectively. Obviously, supplier C is the highest scores in three logistics outsourcing service suppliers and is the best choice.

5. Conclusion

Based on the analysis of the characteristics of logistics outsourcing industry, the evaluation index system including logistics cost, the logistics operation efficiency, the basic qualities of service suppliers and logistics technology level has more targeted and practicability. In this paper the evaluation and selection of logistics outsourcing service suppliers carried out based on AHPGA model and studied an actual case. It provides a reference for an enterprise to choose logistics outsourcing service suppliers.

AHP has been criticized on the ground that decision makers (DMs) often cannot provide strictly consistent comparisons. This problem is of a particular concern when the numbers of criteria and alternatives are large. So, the purpose of this paper is to develop new and more reliable prioritization model to deal with this problem, and to improve accuracy and performance of AHP method. This model combines the power of genetic algorithm (GA) with Analytic Hierarchy Process (AHP) to develops the new (AHPGA)model. AHPGA prioritization model accuracy and applicability are validated by comparing its results with other prioritization methods reported in the literature.

The following conclusions could be cited:

1- Analytic Hierarchy Process (AHP) using average normalizing column (ANC) as weighting method is an acceptable prioritization method and gets acceptable results in this work
2- AHPGA model results are in close agreement with other prioritization methods results.
3- The proposed AHPGA prioritization model is a successful and applicability prioritization tool. In general AHPGA model gives acceptable (logic ranking of criteria) and more accurate results (minimum total deviation value) in all cases used to verify the model in this work.
4- In case of height inconsistent matrix (CR> 0.229), the AHPGA results may be not the better one than anther prioritization methods and optimization techniques used. So, AHPGA model may need some modification in GA parameter setting.

5- .In case of high consistent matrix (CR< 0.003), the AHPGA results lead to the same ranking of criteria compared with another prioritization methods and optimization techniques used to optimize AHP. Although that, the total error (TD value) may be greater than the TD values of the other methods.
6- As a recommendation for the future work, more deep research is required to improve accuracy of proposed AHPGA prioritization and Modification in GA parameter setting may be needed in case of high consistent (CR < 0.003) and high inconsistent (CR > 0.229) matrices.
7- Application of the model to supplier selection resulted in simplicity of application and same result compared to that found in literature.

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