International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 3, Issue 7 (February 2014) PP: 56-62

AHP Method for Selecting Third Party Logistics Provider: Application in Emergency Department

Jlassi Jihene
[1]*ISGI de Sfax Route Mharza, Km 1.5-B.P954-3018 Sfax., Tunisia*

ABSTRACT:-*The selection of third party logistics (TPL) providers is an important issue for enterprises to outsource their logistics business. In this paper we propose a comprehensive evaluation model for TPL suppliers based on AHP method. Furthermore, we Base on the evaluation index system including logistics cost, the logistics operation efficiency and the basic qualities of service. The efficiency and application of the proposed approach has been illustrated with a case study in Emergency Department of Sfax hospital.*
Keywords: - *Third Party Logistics, AHP, Emergency Department*

I. Introduction

Third party logistics (TPL) has become more important for logistic sector in recent years. Companies want to reduce the costs and provide customer satisfaction exactly. They don't want to deal with logistics problems, so they prefer special firms for some or all of their logistics operations. Therefore, a third party logistics (TPL) business is emerging and developing rapidly to fulfill the demands for advanced logistics services, in such fields as, transportation, warehousing, freight consolidation and distribution, product marking, labeling and packaging, inventory management, cross docking, product returns, order management and logistics information systems (Rabinovich *et al* , 1999).

Many definitions and interpretations of TPL can be found in the literature (Skjoett-Larsen, 2000). According to Lieb (1992), TPL involves the use of external companies to perform logistics functions that have traditionally been performed within an organization. The functions performed by the third party can encompass the entire logistics process or selected activities within that process.

Bask (2001) describes TPL as relationships between interfaces in the supply chains and third-party logistics providers, where logistics services are offered, from basic to customized ones, in a shorter or long term relationship, with the aim of effectiveness and efficiency.

Coyle *et al*. (2003) suggest that TPL involves an external organization that performs all or part of a company's logistics functions.

In order to concentrate on their main business, enterprises often outsource their logistics to a third-party logistics provider. So they can not only save the cost of logistics enterprises related, but also enhance their flexibility and adaptability. Therefore, how to choose the most suitable third-party logistics provider becomes an important problem for enterprises.

To achieve this objective, we present in the first section, the TPLs providers characteristics. In the second section, criteria for selecting of TPL provider are examined. The third section gives a description the TPL supplier methods review. The section four presents a proposed model followed by an interpretation of the results. We end with some conclusions and further research directions.

II. Criteria for Selection of TPL Provider

The selection of a supplier for partnership is perhaps the most important step in creating a successful alliance. Rushing into buyer–supplier relationship without adequate preparation or understanding of partners needs often lead to the failure of relationships (Vanhaverbeke *et al*, 2002).

Supplier selection decisions are complicated by the fact that various criteria must be considered throughout the decision making process. Analysis of such criteria and measuring suppliers' performances has been the focus of many researchers for approximately four decades. (Tug˘ba, 2007).

The study conducted with several customers of TPLs providers in 2003 by the International Warehouse Logistics Association (IWLA), which gathers more than 550 logistics companies of North America, shows the change in the selection criteria rankings (see table1) (Aicha Aguezzoul *et al*, 2006)

Table 1. TPL providers' selection factors

Factor	2003	1999	1994
Price	1	4	11
Reliability	2	2	2
Service quality	3	1	1
On-time performance	4	3	3
Cost reduction	5	6	14
Flexibility and	6	5	7
Good communication	7	10	4
Management quality	8	7	8
Location	9	12	13
Customise service	10	13	9
Speed of service	11	8	6
Order cycle time	12	9	10
Easy to work with	13	16	12
Customer support	14	11	5
Vendor reputation	15	15	15
Technical competence	16	18	19
Special expertise	17	14	16
Systems capabilities	18	17	17
Variety of available	19	20	20
Decreased labour	20	23	22
Personal relationships	21	19	18
Decreased asset	22	22	23
Early notification of	23	21	21
Increased competition	24	24	24
Global capabilities	25	25	25

Penny（2002）put forward an index system of third-party logistics provider selection including environmental facilities, customer service, warehousing and storage, financial status, customer relationship management, transportation, leadership and technical staff, geography, education and training, value-added service, etc.

Colson and Dorigo (2004) present a software tool which allows selecting public warehouses. Their extensive list of decision criteria includes: storage surface and volume, dangerous items, possibility for temperature control, separation of storage areas, control for temperature humidity, ventilation, offices on site, geographical distance to highway connection, train, waterways, certification (ISO 9001/9002, SQAS, HACCP), opening hours, assistance with customs, use of technology such as RFID/Barcoding, modem connection, handling equipment (electric, gas and diesel/petrol forklifts) number and characteristics of docks.

The table 2 below presents the different criteria selection used in the tool of Aicha Aguezzoul *et al* (2006) paper.

Table 2. Main and secondary criteria of the tool (Aicha Aguezzoul *et al*, 2006)

Main criteria	Secondary criteria
Services price	National transport cost, international transport cost, storage cost.
Quality control	Logistics audit, TQM, ISO 9000, ISO 9002, OHSAS 18001, etc.
Geographic cover	World set up, national set up, countries served
Firm culture	Alliance types, strategic groups (guide, integrator with the chain, mediator, compromise), 3Ps ' customers
Firm size	Sales turnover, manpower, warehouses number, warehouses area, etc.
On-time performance	Lead-time
The range of services offered	Transport, storage, distribution, valued services added (customization, co-packing, co-manufacturing, inventory for customer), services management (reverse logistics, promotion and collection management, consulting supply management, flows management), customers services (call center, setting in ray, service after sale, installation on site).
Computing performance	Internal solutions (WMS, GPS, ECR, etc.), connexion with the customer (EDI, Internet portals, etc.), tracking and tracing.

Hao-Tien Liu *et al* (2009) select the following criteria for the subsequent evaluation process (table 3)

Table3. Evaluation criteria for provider selection (Hao-Tien Liu *et al*, 2009)

C1	Price
C2	Financial considerations
C3	Experience in the similar industry
C4	Location
C5	Asset Ownership
C7	Growth forecasts
C8	Market share
C9	Logistics equipment
C10	Optimization capability
C11	Customer service
C12	EDI capacity
C13	Customer service
C14	On-time shipments and deliveries
C15	Capability to handle specific business requirements
C16	Responsiveness
C17	Service quality
C18	Continuous improvement
C19	Value-added services
C20	KPI (Key Performance Indicator) measurement and reporting
C21	Accessibility of contact persons in urgency
C22	Cultural fit
C23	General reputation
C24	Service concellation
C25	Human resource policies
C26	Availability of qualified talent

The proposed decision-making methodology of Govindan Kannan *et al* (2009) have been applied to a case of battery recycling industry in India where all the elements of batteries are recycled and reused by manufacturing companies. In order to reduce the total cost incurred in battery manufacturing, the spent or used lead-acid batteries are collected by the 3PRLP and they are broken down and separated into components to begin the recycling process.

Therefore, how to choose the most suitable third-party logistics provider becomes an important problem for enterprises. Seven criteria, as given in table 4, were identified for decision-making on 3PRLP.

Table 4. Criteria used for the selection of 3PRLP (Govindan Kannan *et al*, 2009)

Criteria	Explanation
1. Quality (Q)	It covers product performance, accuracy, etc. and also 3PRLP's quality awareness, inspection methods, etc.
2. Delivery (D)	It refers to 3PRLP's ability to meet delivery schedules. It covers flexibility and reliability of delivery, lead time, etc.
3. Reverse Logistics Cost (C)	It includes inspection cost, inventory cost, transportation cost, packaging cost, material handling cost, warehousing cost, etc.
4. Rejection rate (R)	It refers to inability of the returned product to meet the quality specification consistently for the recycling process.
5. Technical /Engineering Capability (T)	It refers to the availability of technical manpower, state of art reprocessing technology. R&D facilities, capability to perform reverse logistics function, etc.
6. Inability to meet future requirement (I)	It refers to the inability to meet the expected demand, ie. Return ramp-up co-ordination.
7. Willingness and attitude (W)	It refers to the attitude of the 3PRLP towards the buyer and its willingness to do reverse logistics business with the buyer

Therefore, how to choose the most suitable third-party logistics provider becomes an important problem for enterprises.

III. The Third- Party Logistics Supplier Methods Review

In the process choosing the third-party logistics providers, the methods are mainly two types of qualitative and quantitative. Supplier selection methods are mainly qualitative experience to determine the method, public tender law, selection method consultation, benchmarking method, etc. Currently, domestic and international supplier selection method for the study focused on quantitative models. (Guoyi Xiu *et al*, 2012)
The tool proposed in the paper of Aicha Aguezzoul *et al* (2006) used ELECTRE method to classify the TPLs providers from the best one to the worst regarding a set of criteria.

The paper of Hao-Tien Liu *et al* (2009) presented an integrated fuzzy approach for the evaluation and selection of TPL providers. This method consists of three different techniques: (1) used fuzzy Delphi method to identify important evaluation criteria; (2) applied fuzzy inference method to eliminate unsuitable TPL providers; and, (3) developed a fuzzy linear assignment approach for the final selection. The proposed method enables decision analysts to better understand the complete evaluation process of TPL selection.

Yaohuang Guo (1999) established an AHP judgment matrix of supplier evaluation with quality, price, technical ability and distribution reliability.
Pengju Ma *et al* (1999) used fuzzy analytic hierarchy process (F-AHP) to choose partners.

In the paper of Guiyun Liu *et al* (2012), a new integrated model was put forward for selecting 3PL providers based on support vector machine (SVM) and fuzzy analytic hierarchy process (FAHP). In the first stage, the support vector machine (SVM) was used to classify the primary TPL provider samples into four types which are excellent, good, medium and bad respectively. Then authors can obtain the excellent samples which are the candidates for the second stage selection. In the second stage, the FAHP was used to evaluate the selected excellent samples in the first stage, so they can obtain the sorting results for the excellent samples and the optimal samples. The results of the case study show that the model was reasonable and effective and it can provide an important reference for enterprises to select TPL providers.

In the study of Govindan Kannan *et al* (2009) as multi-criteria group decision making (MCGDM) model in fuzzy environment was developed to guide the selection process of best 3PRLP. The interactions among the criteria were also analyzed before arriving at a decision for the selection of 3PRLP from among 15 alternatives. The analysis was done through Interpretive Structural Modeling (ISM) and fuzzy technique for order preference by similarity to ideal solution (TOPSIS). Finally the effectiveness of the model was illustrated using a case study on battery manufacturing industry in India.

Through the above analysis, in actual work, analytic hierarchy process (AHP) is used more mature evaluation model; therefore it is feasible to use AHP as the evaluation model TPL.

IV. Proposed Model

IV.1. Method presentation

The Analytical Hierarchy Process (AHP) is a powerful and flexible decision-making process (Saaty, 2000) to help managers set priorities and make the best decision when both qualitative and quantitative aspects of a decision need to be considered. AHP occurs in two phases: hierarchy design, which involves decomposing the decision problem into a hierarchy of interrelated decision elements (i.e., goal, and evaluation criteria) and hierarchy evaluation, which involves determining the weights of the criteria and synthesizing these weights and preferences to determine alternative priorities.

IV.2. Case Study

Emergency Department is one of the most in the hospital. The Centre for Disease Control defines an "emergency department" as a hospital facility for the provision of unscheduled outpatient services to patients whose conditions require immediate care and is staffed 24 hours a day.

The World Health Organisation has defined provision of basic life support to all risk situations involving people and goods as a main objective of an Emergency Medical Services.

Emergency Departments is the place of welcome of all patients that present themselves to the hospital for a consultation or a hospitalisation and whose hold has not been programmed in charge. (Bellou *et al*, 2003).
Hospital emergency departments (ED) provide the first line of response to life-threatening injuries and illnesses. The ED is the one place in the health care delivery system where a person cannot be denied services regardless of insurance coverage or ability to pay. The ED also serves as the provider of last resort for persons who cannot access care elsewhere.

IV.3. Context this study

Habib Bourguiba hospital is presented as follows:

- Hospital-academic centre since 1985 ;
- Erected in public establishment of health since 1993.

The missions of the hospital are:

- To lavish current pathology cares and essentially cares of reference;
- To assure the formation convenient of basis and retraining of the medical and decorate-medical personnel
- To develop the activity of research in the medical domain and cares male nurses.

The hospital includes 18 Departments; most important it is the Emergency Department that represents the door of entrance of the hospital.

The geographical situation of the Sfax city to the centre of the country, point of link between the south and the north of the country, makes that the Emergency Department receives an important number of casualties of the public way. As second economic and industrial pole sheltering a lot of companies, the city knows an elevated number of work casualties.

The department includes:

- 2 rooms of care;
- 1 room of plaster;
- 2 post office;
- 1 room of general surgery ;
- 1 room of orthopedy;
- 1 room of visiting medical;
- The average number of patients in day is +_300,
- The number of personnel is 13.

The process of the patient is for the arrival of the patient, we distinguish 2 possibilities: either he will come by himself or, in dangerous cases, he will be transported by the ambulance. At the arrival, the patient will pass by a triage process that will define the Emergency degree and then the process that will be taken by the patient. In fact, as shown in the above model, there are two processes that can be taken by the patient, given the result of the triage process.

In both cases, the remaining process will be almost the same. In fact, the main difference concerns the administrative process. Thus, for a dangerous case, this process will be reported at the end of the patient process while for a non dangerous case, this process will be at the beginning of the whole process.

The remaining tasks of the process are the same as those of a normal consultation process. In fact, the patient will see a doctor who will determine the patient's state and if necessary ask for supplementary analysis. Given the analysis results, the doctor will either care the patient by him self or ask for a specialist. In both cases, the patient could be hospitalized or go home.

We notice according to results obtained by (Jlassi *et al*, 2007) and (Jlassi, 2009) that the waiting time of the specialist doctors occupies the big part of time of patient waiting, it is between 0 and 300 minutes. Then we find that the waiting time of analysis occupies the second part of patient waiting time (about 170 minutes). Physicians dedicate waiting time of 35 minutes. Finally we conclude that the radiology and the standardization occupy the last class of time of patient waiting.

In thesis of (Jlassi, 2009) we proposed and tested some solutions in order to decrease the waiting time of the specialist physicians to use simulation model and multicriteria decision method.

In this paper we'll be interested by decreasing the waiting time of analysis. In this way we have proposed to responsible of the department to outsourcing this activity and to choose the best third party logistics.

IV.4. Application

Our model is based on the evaluation index system including cost, operation efficiency and quality of service. In this paper the evaluation and selection of TPL' service is based on AHP.

We'll base on the same process of Jianliang Peng (2012). The evaluation of TPL'service is presented by this figure:

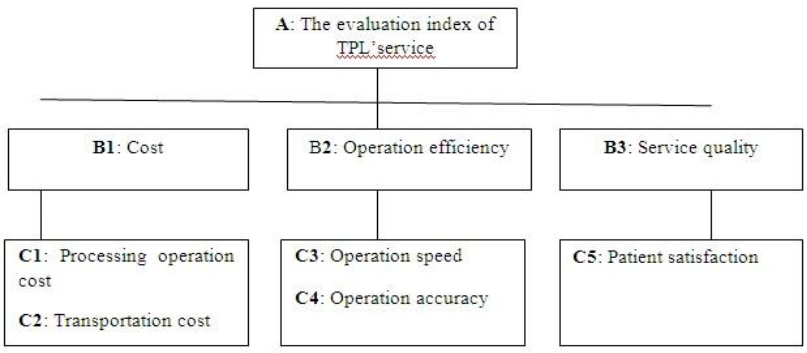

Figure1. The hierarchical analysis model of logistics service supplier evaluation

Table 5 presents the judgment matrix of goals.

Table5. Judgment matrix of goals

A	B1	B2	B3
B1	1	0.333	0.2
B2	3	1	5
B3	5	0.2	1

Table6 shows the result of each column element processing the judgment matrix.

Table6. The result of each column element normalized processing of the judgment matrix

A	B1	B2	B3
B1	0.111	0.217	0.032
B2	0.333	0.652	0.806
B3	0.556	0.131	0.162

The results normally processed for Wi are presented in table 7

Table7. The result normally processed for Wi

W1	W2	W3
0.2	0.5	0.3

Table 8 shows the results of two matrix multiplication

Table8. The result of two matrix multiplication

0.426	2.6	1.4

According to the previous results $\lambda_{\max} = 3.996$

Test the consistency and the result is CI= 0.0498

At the same time by checking on the table and the result is: CR= 0.085.

Using the formula and steps the judgment matrix and consistency test result of secondary indexes including cost, operation efficiency and service quality show in table9 and Table 10.

Table9. The judgment matrix of cost

	C1	C2	Wi
C1	1	5	0.6
C2	0.2	1	0.4

$\lambda_{\max} = 2.56$; CI= 0.65; CR= 0

Table10. The judgment matrix of operation efficiency

	C3	C4	Wi
C3	1	0.2	0.4
C4	5	1	0.6

$\lambda_{\max} = 2.65$ CR=0

Can see CR<0.1 for all single sort of secondary index therefore each of the consistency of the judgment matrix is acceptable.

For the total sorting of the matrix, CW is the product between the weight matrix of target layer and the weight matrix of criterion layer. Calculation results shows in table 11.

Table11. Total sorting of the judgment matrix

	B1 0.2	B2 0.5	B3 0.3	CWi
C1	0.6			0.12
C2	0.4			0.08
C3		0.4		0.2
C4		0.6		0.3
C5			1	0.3

Patient satisfaction and operation accuracy are the most important their weights are 30%.

Table12.the indices of TPL A,B and C

	A	B	C
X1	6	7	8
X2	9	6	7
X3	6	8	7
X4	7	6	8
X5	8	7	6

Combined with the calculation result of weight CW, according to formula $Y = \sum Cw X_i$ the synthesis scores of TPL A, B and C are: 7.14, 6.82 and 7.12 respectively. Abviously TPL'A is the best choice.

V. Conclusion

In this paper we evaluated and selected a TPL provider in ED of Sfax hospital to improve the service and to decreasing the waiting time of analysis. The evaluation index system including: cost, operation efficiency and quality of service. We used the AHP method.

In future work we'll propose to add others criteria in the model to choose the TPL provider.

REFERENCES

[1]. Akerkar, R. A.; Lingras, P. An Intelligent Web: Theory and Practice, 1st edn. 2008,Johns and Bartlett, Boston.
[2]. Albert, R.; Jeong, H.; Barab´asi, A.-L. Diameter of the world-wide Web. Nature,1999, 401, pp. 130–131.
[3]. Berry M. W., Dumais S. T., O'Brien G. W. Using linear algebra for intelligent information retrieval, SIAM Review, 1995, 37, pp. 573-595.
[4]. Bharat, K.; Broder, A. A technique for measuring the relative size and overlap of public Web search engines. Computer Networks, 1998, 30(1–7), pp. 107–117.
[5]. Broder, A.; Kumar, R.; Maghoul, F.; Raghavan, P.; Rajagopalan, S.; Stata, R.; Tomkins, A.; Wiener, J. Graph structure in the Web. Computer Networks, 2000, 33(1–6), pp. 309–320.
[6]. Chakrabarti, S. Data mining for hypertext: A tutorial survey. SIGKDD explorations, 2000, 1(2), pp. 1–11.