SUPPLIER SELECTION FOR HOSPITAL PHARMACY THROUGH ARTIFICIAL NEURAL NETWORK

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Abstract:

In this paper, we develop supplier selection for hospital pharmacy through artificial neural network that give grades to vendors on a group of criteria and an objective function to pick outthe most effective vendor. On this process, The supplier selection normally depends on many criteria such as cost, delivery of the product, service, flexibility with the consumer, etc. supplier selection process for health sector are limited up to pharmaceutical.Vendor score is further used for ranking the vendors among the quantity of options available. The purchase managers in hospital pharmacy are not aware about the influence of MCDM techniques in supplier selection process. The decision makers determined the weights of the criteria and subcriteria and evaluate the alternatives and ranks. The choice of pharmacy supplier plays an important role in improving the level of service and total value cost.Finally compare the results obtained by MCDM methods and select the appropriate supplier which helps to improve the overall efficiency of the pharmacy.

Keywords: Vendor selection, Artificial neural network,decision making model, optimization, Multi-criteria decision making, MCDM.

Introduction

Seller determination and merchant assessment is one the main movement in the administration of inventory network. Selection and assessment of vendor is perhaps the most basic exercises of an organization and an essential buying choice that submits critical assets effects the complete exhibition of the firm was taken as Gupta et al. (2012). Agarwal et al.((2011) [1] discussed a review of multi-criteria decision making techniques for vendor evaluation and selection.Gupta et al.(2012) [19] proposed by a survey on vendor relationship in e-procurement in Indian organisations.Ariffin et al. (2013) [2] suggested by hybrid method using analytic hierarchical process and artificial neural network for vendor selection.Arsovski, et al. (2011) [3] dealing with multiobjective vendor selection using genetic algorithm: a comparison between weighted sum and SPEA method.Arunkumar et al (2007)[4] descried by an optimization technique for vendor selection with quantity discounts using genetic algorithm.

1. One supplier can meet all the requirements of a buyer (single sourcing)

2. A single supplier cannot meet all the requirements of a buyer / customer (multiple sourcing).

In this conditions, the board needs to part arrange amounts among vendor for various reasons, which incorporates establishing a steady climate of intensity.Branch network performance relies heavily on identifying good salespeople.just searching for vendors that is offering most reduced cost isn't effective sourcing any more, different rules are should have been considered while choosing vendors.

Pharmacies are willing to devote their enormous financial resources, to the supplier selection process. In return, pharmacy managers expect reliable suppliers to deliver full-performance, on-time delivery at lower cost compared to other suppliers [4]. Due to the inclusion of qualitative and quantitative data, multiple criteria are considered during the supplier selection process, and one of the required approaches is multiple-criteria decision (MCDM) analysis [5]. There are various mathematical methods for MCDM problems, including analytic hierarchy process (AHP), data entanglement analysis (DEA), analytic hierarchy process (ANP), FAHP, ANP, goal planning, and geneticAlgorithm (GA) etc. [5], [6]. In current situation, the hospital as well as private pharmacies are facing lot of issues due to lack of inventory knowledge leading to stock outs, storage of expired drugs for sale, inefficient supplier and strive hard to fulfil the customer needs in an efficient way.

The assurance of the way of thinking for dealer decision. Among the current procedures, Artificial /Neural network model deal with dealer decision issue: ANN awards answers for issues where various goals ought to be satisfied meanwhile, loads in the ANN can be changed with any various methodologies adequately, ANN can summarize, can anticipate new outcomes on past designs, ANN can be helpfully consolidated with various procedures, ANN show arranging limits

The supplier selection process serves as the main reason behind all the major issues facing pharmacies. In addition, supplier selection is a key criterion for improving the efficiency of inventory management atpharmacies. While many researchers have worked on warehousing in a variety of technical applications, few have reported on warehousing in health care. The main purpose of this paper is to improve the efficiency of pharmacies by selecting the right supplier from the pool of suppliers through multi-criteria decision-making methods such as Artificial Neural Network.

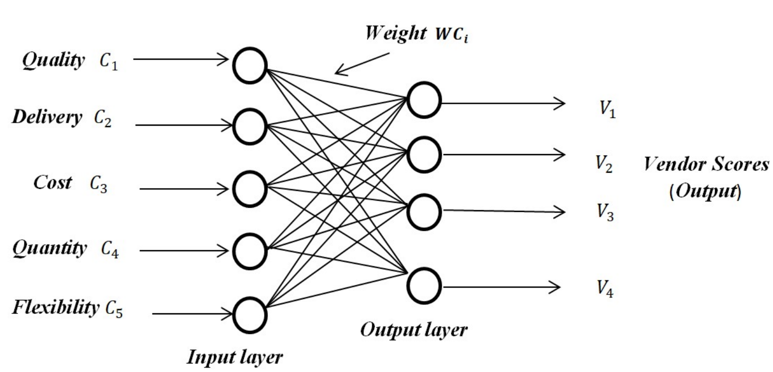

Figure:

Multi-Criteria Decision Making (MCDM) techniques:

The step by step procedure for calculation of vendor score is given below:

Vendor Selection Model:

Step 1: Determine the number of vendors
Step 2: Determine the number of vendor criteria
Step 3: Define the reference scale
Step 4: Apply the data from each provider
Step 5: Generate a matrix to compare each criterion
Step 6: Create a matrix to calculate the weight of CriteriaSpecified Criteria Weight = Specified Criteria Value / Total column values
Step 7: Generates a comparison matrix Provider with references to a given criteria.
Step 8: Create a matrix to calculate the weights of suppliers by referring to the criteria. Weights of Vendor with corresponding criteria = Total of specific provider values / column values
Step 9: Create a hidden layer matrix using the following formula

Calculations:

Table 1 Vendor data

Vendor	*Quality*	*Delivery*	*Cost*	*Quantity*	*flexibility*
V1	10	3	2400	400	100
V2	5	2	2800	500	200
V3	20	5	1800	200	100
V4	10	4	2190	400	150

❖ Quality ($C1$): related to percentage of defectives.

❖ Delivery ($C2$) : related to lead time, on-time delivery and no limitations in the quantity of an item to deliver.

❖ Cost ($C3$) : related to the cost of products from the supplier

❖ Quantity ($C4$) : related to methods followed for processing the order warehouse capabilities, return policies and responsiveness for customer needs.

❖ Flexibility ($C5$) : related to change of order quantity based on demand.

Weights for input value can be found by pair wise comparison of criteria. In this pharmacy, quality was given preference over other criteria's, followed by delivery time, unit cost, quantity, and flexibility.

Let as assume that:

❖ quality is somewhat important than delivery – 3

❖ quality is more important than unit cost – 5

❖ quality is much more important than quantity – 7

❖ quality is very much more important than flexibility– 9

Table 1 Vendor data

Vendor	C_1	C_2	C_3	C_4	C_5
V1	10	3	2400	400	100
V2	5	2	2800	500	200
V3	20	5	1800	200	100
V4	10	4	2190	400	150

Table 2	**Pair wise comparison of criteria 's**				
	C_1	C_2	C_3	C_4	C_5
C_1	1	3	5	7	9
C_2	1/3	1	3	5	7
C_3	1/5	1/3	1	3	5
C_4	1/7	1/5	1/3	1	3
C_5	1/9	1/7	1/5	1/3	1
$\sum$	1.8	4.7	9.5	16.3	25

Table 3	Weights of criteria's					
	C_1	C_2	C_3	C_4	C_5	**Avg**
C_1	0.56	0.64	0.52	0.43	0.36	0.5
C_2	0.19	0.21	0.31	0.31	0.28	0.26
C_3	0.11	0.07	0.1	0.18	0.2	0.13
C_4	0.08	0.04	0.03	0.06	0.12	0.07
C_5	0.06	0.03	0.02	0.02	0.04	0.03

Based on the pairwise comparison of the criteria as shown in Table 2 and the subsequent calculation of their weights as shown in Table 3.

Multi-Criteria Decision Making (MCDM) techniques:

The step by step procedure for calculation of vendor score is given below:

Vendor Selection Model:

Step 1: Determine the number of vendors
Step 2: Determine the number of vendor criteria
Step 3: Define the reference scale using Saaty's popularscale
Step 4:Apply the data from each provider
Step 5: Generate a matrix to compare each criterion

Step 6: Create a matrix to calculate the weight of CriteriaSpecified Criteria Weight = Specified Criteria Value / Total column values

Step 7: Generates a comparison matrix Provider with references to a given criteria.

Step 8: Create a matrix to calculate the weights of suppliers by referring to the criteria. Weightsof Vendor with corresponding criteria = Total of specific provider values / column values

Step 9: Create a hidden layer matrix using the following formula.

Table 3

Quality C_1 (% def)	Delaytime C_2 (days)	Cost C_3	Quantity C_4	Flexibility C_5	Scale
0–5	0	0–100	0–60	0-50	1
6–10	1	101–200	61–90	51-100	2
11–12	2	201–300	91–120	101-150	3
13–14	3	301–400	121–150	151-200	4
15–16	4	401–500	151–180	201-250	5
17–18	5	501–600	181–210	251-300	6
19–20	6	601–700	211–240	301-350	7
21–22	7	701–800	241–270	351-400	8
23–25	8	801–1000	271–300	401-450	9

Weights (λi) of the output layer are obtained from the relative comparison of vendors for each criteria. Here for the evaluating criteria quality, we compare the vendors as shown in Table 4. On comparing V1 and V3 we see that the difference between the quality (% defective) is '10' so from the scale we denoted it as '2'. Similarly all others vendors are compared.

Table 4 Relative matrix of vendors with respect to quality

	V1	*V2*	*V3*	*V4*
V1	1	1	2	1
V2	1	1	5	1
V3	1/2	1/5	1	1/2
V4	1	1	2	1
∑	3.5	3.2	10	3.5

Table 5 Relative matrix of vendors with respect to quality

	V1	*V2*	*V3*	*V4*	*Avg*
V1	0.29	0.33	0.2	0.29	0.27
V2	0.29	0.33	0.5	0.29	0.35
V3	0.14	0.06	0.1	0.14	0.11
V4	0.29	0.33	0.2	0.29	0.27

These are the weights obtained with respect to quality (% defective). Similarly the relative weights can be obtained for all the criteria's and these are represented in the final weight matrix table as shown in Table 6.

1 Single layer feed forward neural network is used.

2 SIGMOIDAL function is selected.

$\Phi(I) = 1/(1 + e^{-\beta I})$; β = slope parameter; $I = (\sum \lambda i X_i + Bias)$.

It varies between 0 and 1. It gives minimum error in number of iteration.

3 Unsupervised learning has been selected.

4 A bias unit with input value 1 and weight 0.3 is used for both input and output layer.

$Y_i = [1 / (1 + e^{-\beta(\Sigma X_i WC_i)})$

Output value for hidden layer is calculated in table 10 which is the input values for output layer.
Let input value for all bias neuron = 1
Let weight for all bias neuron = 0.3
Xi = Input value for input layer = 1/5 =0.2
Output value for hidden layer $Y_i = [1 / (1 + e^{-\beta(\Sigma X_i WC_i)})]$

Table6

Input X_i	Weight WC_i	Bias	Output of input layer (Y_i)
0.2	0.50	0.3	0.581
0.2	0.26	0.3	0.578
0.2	0.13	0.3	0.576
0.2	0.07	0.3	0.575
0.2	0.03	0.3	0.574

Output layer calculation

Output of input layer $Y_0 = [1 / (1 + e^{-\beta(\Sigma X_i WV_i)})]$
C_i= Input value for output layer
WV_i= Weights of the vendors with respective to criteria
Y_0 = Total score of vendor, α=1

Table7

Input to output layer	**0.581**	**0.578**	**0.576**	**0.575**	**0.574**	**Score**
V1	0.27	0.16	0.24	0.14	0.23	0.7110
V2	0.35	0.47	0.04	0.05	0.23	0.7228
V3	0.11	0.1	0.6	0.67	0.12	**0.7723**
V4	0.27	0.28	0.11	0.14	0.42	0.7318

Total score for all vendors are calculated and
see that vendor 3 is the best vendor because it has maximum
score (**0.7723**) in comparison to all other vendors.

Conclusion

The hospital supply chain is mostly influenced by inventory; it accumulates more budget and lag in providing uninterrupted service to the customers. The pharmacy managers are in the position of decision makers to adopt an efficient inventory management, achieved by selecting the appropriate supplier based on their needs and constraints. The supplier selection process is to identify a potential supplier from the pool of suppliers, which meets the needs consistently and at an affordable cost. A new study of supplier selection process in hospital pharmacy was evaluated by MCDMANN method. During the evaluation process, the decision makers strive hard to consider the uncertainty and vagueness data in the form of linguistic variables. To overcome this drawback, the uncertainty and vagueness data are handled efficiently by utilizing MCDM ANN methods and make the decision makers to take effective decision towards the supplier selection process. The criteria's considered here for evaluation are cost, delivery, service, flexibility and relationship to determine the order of suppliers for selecting the appropriate one. In this study, two methods evaluated the criteria towards the same objective of supplier selection. In MCDM ANN, the pair wise comparisons to be made for each criteria and alternatives with respect to criteria are transformed in to triangular fuzzy numbers. This is for selecting the appropriate supplier based on the priority weights of the criteria and alternatives. The pharmacy managers stated that, the MCDM techniques are quite helpful to improve the overall pharmacy efficiency. The hospital pharmacy should select the appropriate method for the supplier selection process by considering the structure of the problem and consistency in their available data.

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