

Modeling For Supplier Selection through Fuzzy Logic

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Abstract- The success of an industry depends on optimization of product cost and for achieving above goal supplier selection should be error free and efficient. The supplier selection Problem is a multi objective problem involving both qualitative and quantitative factors. These factors and their interdependencies make the problem highly complex one. The supplier selection issue has been founded out as one of the fundamental operation in the supply chain. In this study, a fuzzy expert decision support system has been developed for solving the supplier selection problem with multiple objectives. Basic important factors considered for supplier selection are price, quality and service. The fuzzy based model is necessary to ensure the suitability by considering important factors and simulate the factors with data given by the experts in those fields.

Keywords: Supply chain management, Supplier selection, fuzzy based model, price, quality, service.



INTRODUCTION

Supplier evaluation and selection is one of the most important components of supply chain, which influence the long term commitments and performance of the company. A supply chain is composed of entities involved in designing new products and services, procuring raw materials, transforming them into semi-finished and finished products, and delivering them to end customers. Different parts of a product may, and often do, come from all over the world. This practice creates longer and more complex supply chains, and therefore changes requirements for the new supply chain management. Supply chains exist both in service and manufacturing organizations. The problem becomes more critical in manufacturing units where lot of time and revenue is spent on purchase. Good suppliers allow enterprises to achieve good manufacturing performance and make the maximum benefits for practitioners. A well-implemented integrated supply chain management can affect every part of an organization, increasing asset uptimes, reducing maintenance costs, increasing profits, and enhancing the creditability of the business with its customers in supply chain is a group decision making under multiple criteria, Chen et al. [1]. Swaminathan and Tayur [2] describe major issues in traditional supply chain management and provide an overview of relevant analytical models to be used in the area of e-business and supply chain management. Kumara, [3] has formulated a vendor selection problem as a fuzzy mixed integer goal programming vendor selection problem that includes three primary goals: minimizing the net cost, minimizing the net rejections and minimizing

the net late deliveries. There are some restrictive assumptions in the fore mentioned formulation. For example, only onetime is supposed to be purchased from one vendor.

Jiann Liang Yang et al. [4] proposed an integrated fuzzy multiple criteria decision making (MCDM) techniques for vendor selection problems. Jiann utilized triangular fuzzy numbers to express the subjective preferences of evaluators With respect to the considered criteria. This paper presents a methodology which is based on fuzzy logic scheme to provide a better way of decision making supplier selection problem. Therefore, the most important factors like prices, quality and service are taken into account. Fuzzy Logic Toolbox with MATLAB is a tool for solving problems with fuzzy. The result shows that the selection of a supplier is acceptable and suitable for the case situation considered.

CONCEPT OF FUZZY LOGIC SYSTEM

The human brain interprets imprecise and incomplete sensory information provided by perceptive organs. Fuzzy set theory provides a systematic calculus to deal with such information linguistically and it performs numerical computation by using linguistic labels stipulated by membership functions. Fuzzy set theory provides a framework for handling the uncertainties. Zadeh[5] initiated the fuzzy set theory. Bellman [6] presented some applications of fuzzy theories to the various decision-making processes in a fuzzy environment. It can be seen as special rule-based systems that use fuzzy logic in

their knowledge base and derive conclusions from user inputs and fuzzy inference process (Kandel A[7]).According to Li-Xin, Wang [8] functions make up the knowledge base of the system. In other words a “fuzzy if-then” rule is a “if then” rule which some of the terms are given with continuous functions.

A fuzzy logic system (FLS) when selected properly can effectively model human expertise in a specific application. . The basic terminology of fuzzy logic is discussed & working of fuzzy logic system has been shown through a block diagram in fig 1.

There are four parts of fuzzy logic system

- I. Fuzzifier;
- II. Knowledge base;
- III. Inference engine;
- IV. Defuzzifier;

The fuzzifier performs measurements of the input variables (input signals, real variables), scale mapping and fuzzification (transformation). Thus, all the monitored signals are scaled, and fuzzification means that the measured signals (crisp input quantities which have numerical values) are transformed into fuzzy quantities. This transformation is performed using membership functions E.W.T. Ngai., [9]. In a conventional fuzzy logic controller, the number of membership functions and the shapes of these are initially determined by the user. A membership function has a value between 0 and 1, and it indicates the degree of belongingness of a quantity to a fuzzy set. If it is absolutely certain that the quantity belongs to the fuzzy set, then its value is 1, otherwise it will be 0. The membership functions

Fuzzy logic is conceptually easy to understand. The mathematical concepts behind fuzzy reasoning are very simple. What makes fuzzy nice is the “naturalness” of its approach and not its far-reaching complexity. Fuzzy logic is flexible enough there by it can be layered at any level (any variable/vendor) in the ongoing process/system .initially, all the variable parameters (vendor potential) are imprecise which further increases when degree of inspection level increases .

FUZZIFICATION FOR PRICE

Price; The sum or amount of money at which a product is valued, or the value which a seller sets on his goods in market. It is a affected by total cost, suitable price police and payment period.

can take many forms including triangular, Gaussian, bell shaped, trapezoidal, etc. The knowledge base consists of the data base and the linguistic control rule base. The data base provides the information which is used to define the linguistic control rules and the fuzzy data manipulator in the fuzzy logic controller. The rule base defines (expert rules) control goal actions by means of a set of linguistic rules. In other words, the rule base contains rules which could be provided by an expert. The FLC looks at the input signals and by using the expert rules determines the appropriate output signals (control actions). The rule base contains a set of if-then rules.

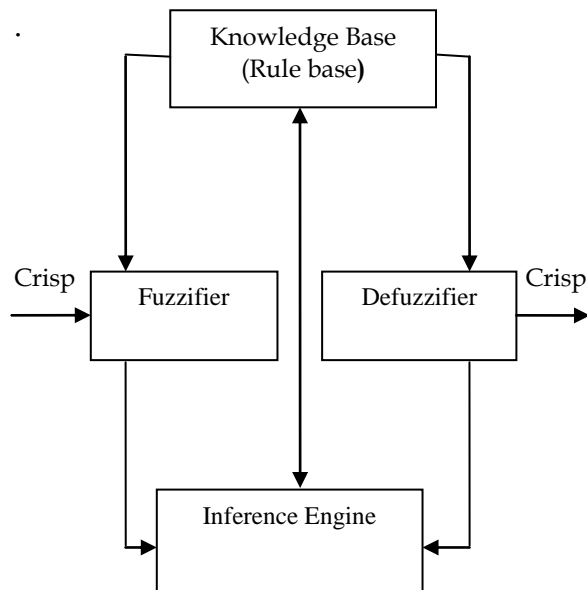


Fig.1. Fuzzy logic inference system.

Table1.Range for price

Fuzzy	Variable	Range
1	Less	0-10
2	Medium	5-15
3	High	10-20

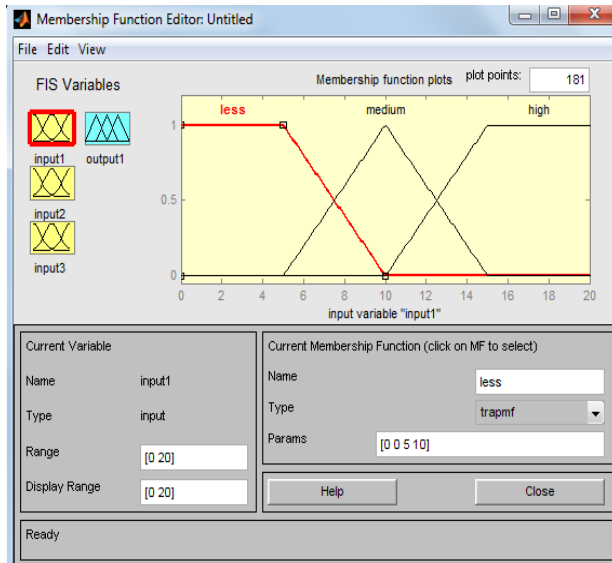


Fig.2. membership functions for price.

FUZZIFICATION FOR QUALITY

A reliable product or process performs its intended function is said to be a quality product. Quality is a combination of low quality rate, product design, packaging ability and supplier certification.

Table 2.Range for quality

Fuzzy	Variable	Range
1	poor	0-20
2	acceptable	10-30
3	good	20-40

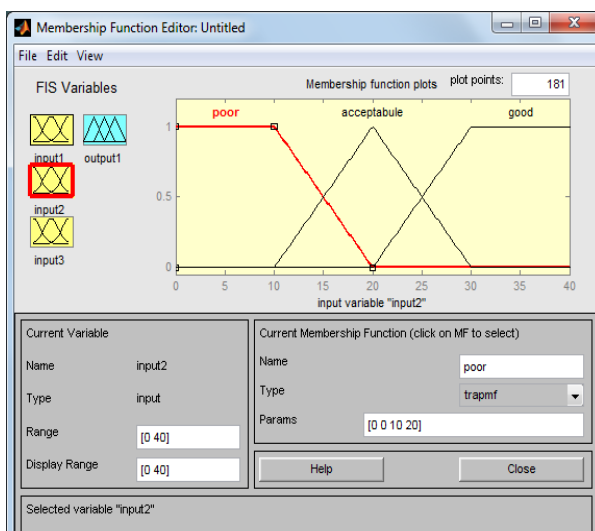


Fig .3.membership functions for quality.

FUZZIFICATION FOR SERVICE

Service is a series of activities designed to enhance the level of customer satisfaction. It is a combination of warranty degree, claim policies, spare parts availability, and delivery period and easy in communication.

Table 3.Range for service

Fuzzy	Variable	Range
1	cheap	0-8
2	optimum	4-12
3	good	8-16

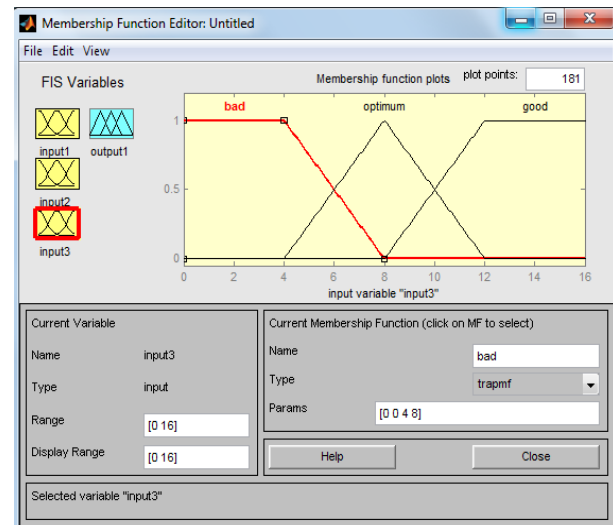


Fig .4.membership functions for service

FUZZIFICATION FOR SUPPLIER

It is a part of supply chain management according to Lai *et al.*[10]and Mentzer [11], effective supply chain increases organizational effectiveness and leads to improved customer value, better resources utilization and improved revenue. Supply chain is supplier evaluation and selection process, which can also include an importer who supplies an item of plant, machinery or equipment?

Table 3.Range for supplier

Fuzzy	Variable	Range
1	reject	0-6
2	Under consider	3-9
3	accept	6-12

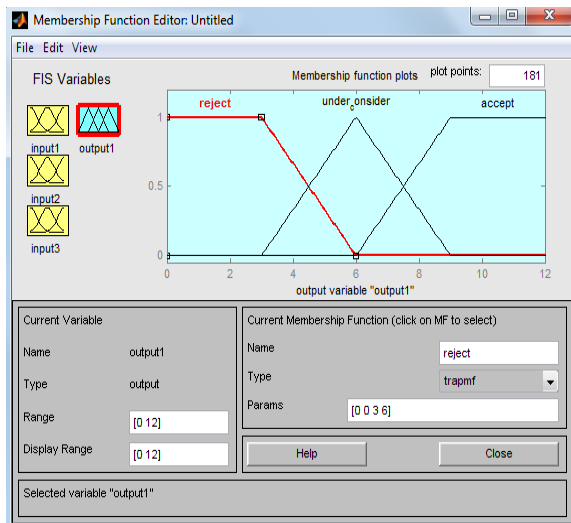


Fig .4.membership functions for supplier

FUZZY RULE CONSTRUCTION

Fuzzy logic system makes decisions and generates output values based on knowledge provided by the designer in the form of IF -condition-THEN-action_-rules. The rule base specifies qualitatively how the output parameter “overall rating” of the supplier proposal is determined for various instances of the input parameters of “price”, “quality” and “Service “and output parameter is supplier selection. For example IF “Price” is cheap AND “Quality” is poor AND “service “is bad THEN “supplier selection” is reject. The following tables 4, 5, and 6 show the formation of fuzzy rules.

Table 4.Fuzzy rule when service is cheap

Price Quality	Less	Medium	High
Poor	reject	reject	reject
Acceptable	under consider	reject	reject
Good	under consider	under consider	reject

Table 4.Fuzzy rule when service is optimum

Price Quality	Less	Medium	High
Poor	reject	reject	reject
Acceptable	accept	under consider	reject

Good	accept	under consider	reject
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Table 4.Fuzzy rule when service is good

Price Quality	Less	Medium	High
Poor	reject	reject	reject
Acceptable	under consider	accept	under consider
Good	accept	accept	under consider

DEFUZZIFICATION

If the values considered in the in the fuzzy sets are in terms of degree variation then in the final output the fuzzy values should be converted in to crisp value by using any Defuzzification method. Here defuzzification can be performed by deriving the centre of gravity method with the help of mat lab.

RESULTS AND DISCUSSION

With the help of fuzzy tool box of MATLAB, there are three input can be set within the upper and lower specification limits and the output is calculated as a point that can be translated into linguistic form. For example taking weight of price input 10 (medium),quality input 20 (acceptable) and service input 8 (optimum) then as a resultant data we get 6 it means weight of supplier selection is 6 (under consider). As shown in figure 5. The variation obtained can be further observed from the Mat Lab surface Viewer, which is 3D Graph of two input Vs one output. Where price & quality are input and supplier is output as shown in fig 6.

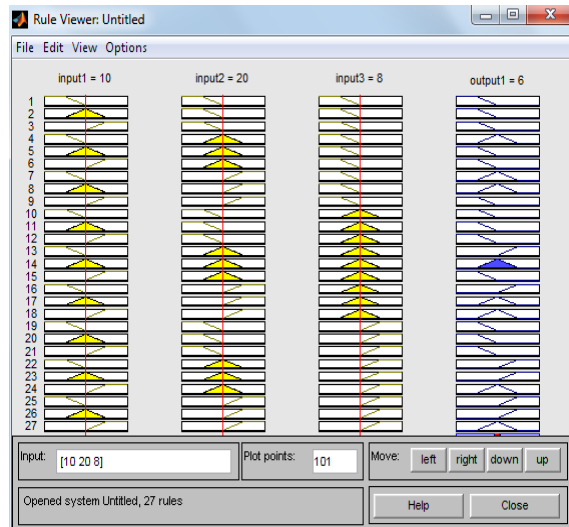


Fig.5. Rules viewer for the membership function

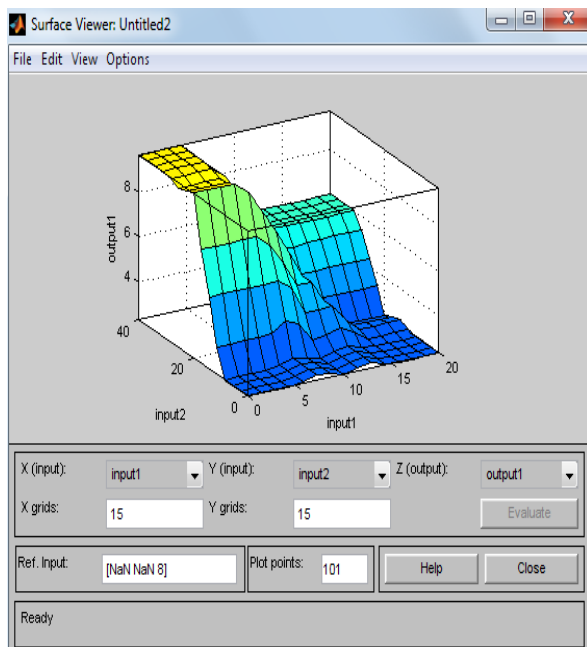


Fig. 6. Surface viewer- 3D graph

CONCLUSIONS

This study proposes a multiple criteria decision model in fuzzy environment for supplier selection problem. This is considered as one of the critical decision making process for effective operation of supply chain. The results of this study show that the factors related to price, quality and services of supplier are the major criteria for assessment and choosing the best supplier in the industry. And one of the main advantages of proposed model is that

we enhance the decision making capacity of a customer for different condition. The model can be used to understand, describe, analyze and prescribe for supplier selection.

Some of the salient conclusions emerged out from the present study is-

- A decision model has been successfully developed for supplier selection.
- Proposed model enhances decision making capability of customer.

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