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Fuzzy based approach for Temporary objective identification

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Abstract:

This paper presents a new fuzzy-based approach which identifies the most effective temporary objective of an enterprise, which is usually set based on the pure judgment of top management members or enterprise's experts. The method is based on fuzzy-decision-making system and makes robust utilization of enterprise's experts' knowledge, intuition and expertise. A simple illustrative example is provided to demonstrate how the method can be efficiently and effectively used in practice. The proposed approach can be used to identify the short-term objective of any profit- making-enterprise, and is specially applicable to business industries that are full of qualitative, stochastic, uncertain, and vague variables such as the case in automobile business (e.g., cars, trucks, gears, bearings etc), and is generally applicable to any other business sector.

Keywords: Temporary Objectives, fuzzy decision-making-system, fuzzy expert-system

1. Introduction

Managerial commitment to producing specified results in a specified time frame are the objectives. They direct attention and energy to what needs to accomplish. There are two types of objectives: permanent objectives, and temporary objectives. The company's Permanent objectives, such as maximization of return on investment, and societal welfare, called Permanent organizational goals. On the other hand temporary objectives, such as maximization of sales volume, maximization of profit margin, maximization of customer satisfaction, reinforcing company's competitive position are taken up for a temporary period (a year, quarter, ... etc.) to reflect the most important beneficial focus of the top management. temporary objectives are adjustable and adoptable periodically to cope with the rapidly changing environmental forces and economic conditions, such as fluctuating costs of resources, changing competition level, new forecasts, new technology, new ideas and products, new opportunities, new threats, new regulations and taxes, and other various changing variables. The problem of setting temporary objectives of an enterprise have been dealt with subjectively, in that it is usually a decision which is based on the pure judgment intuition, experience of the top management members or company's experts, without a scientific treatment and quantification of various effects of input quantitative and qualitative factors. The proposed approach makes use of such intuition, knowledge, and expertise of the company's experts, but in a fuzzy based, systematic way.

2. Method

The aim of this article is to develop a Fuzzy-based, systematic approach to identify the current period temporary objective of an enterprise based on the aggregation of the enterprise's expert's opinions, some of which might be conflicting, and taking into account the vague, uncertain, and dynamic nature of the input factors affecting such decision. The approach is to be used as a reliable expert model assisting the top management vigorously in temporary objective identification. In order to develop the proposed method,

first a subjective study of the logical and causal relationships among most relevant company objectives, from one side, and the determinants, or motivators of such objectives, in the other side, is conducted. A quantification of such determinants is then proposed, which is necessary to permit inclusion of qualitative determinants along with quantitative ones. Fuzzy decision making system is then to be adapted to model the problem to give finally an output, which is the most important current-period objective to focus upon Fuzzy set theory was introduced by Zadeh to deal with vague, imprecise and uncertain problems. The lack of data is the reason for uncertainty in many daily problems. Fuzzy set theory has been used as a modeling tool for complex systems that are hard to define precisely, but can be controlled by human expert. Human expert can make decision in the absence of clearly defined boundaries based on the expertise and general knowledge of the task of the system in consideration. The human's decision and actions are based on IF-THEN rules developed over years of knowledge and experience.

3. Fuzzy Interference System for temporary objectives

Depicts the Fuzzy decision making system adapted to model the Relationship between the company's objective, as an output, and the determinants of objectives as inputs. The fuzzification interface converts the ranges of values of quantitative determinants and quantified qualitative factors into corresponding universes of discourses, and then divides them into fuzzy sets. The current actual values of input determinants are converted into fuzzy sets by applying the maximum operator. The inference engine then applies the relevant experts' If-Then decision rules contained in the rule-base on the fuzzified input values, which express the experts' opinions about how the values of input determinants are converted into objective decision. A set of rules may fire each of which gives its opinion about what the objective should be in form of an implied fuzzy set. The defuzzification interface finally combines the consequents of all fired rules to give final crisp consequent that is the most significant temporary objective, which constitutes a compromise of the requirement of multiple input determinants.

3.1 Fuzzy Logic for Objectives for an enterprise

The expert of enterprise has recognized that the every-period objective of company should be selected among one of the following objectives

Obj(1) : Maximize profit margin

Obj(2) : Maximize sales volume

Obj(3) : Maximize customer satisfaction

Obj(4) : Increase Market Share

Obj(5) : Reinforce company's policy

One of these temporary objectives is to be taken up each period (1year, 2 years etc.). Let the company's experts have also recognized that the essential determinants and motivators of the current period objectives include 5 quantitative factors and 2 qualitative factors as follows:

E(1) : Expected sales Volume(in Rupees)

E(2) : Average unit manufacturing cost (Rupees/unit)

E(3) : Inventory Level(Rupees)

E(4) : Company's product price(Rupees)

E(5) : Competitor's product price(Rupees)

E(6) : Company's competitive strength

E(7) : Competition level

Hereinafter are the four components of the adapted fuzzy-decision-making system.

3.2 Fuzzification of input determinants

In this step, the values of input variables, the determinants of objectives, and the output variable, the objective, are fuzzified based on opinion of the experts and/or the analysts, a membership functions shapes are chosen. For simplicity, and it is most commonly used, triangular membership functions are assumed. Five fuzzy sets are used for quantitative determinants: “Very Low” as VL, “Low” as L, “Medium” as M, “High” as H, and “Very High” as VH. Examples of how quantitative variables could be fuzzified are in Figures 2, 3, 4, and 5. The maximum operator (for resolve the partial membership in two fuzzy sets) is used to determine fuzzy sets for actual current values of variables. As an example, in Figure 2, the value of sales $E1 = 325$ belongs partially in two fuzzy sets “Medium” with degree of membership, $\mu = 0.75$, and “High” fuzzy set with the degree of membership, $\mu = 0.25$. Then, the maximum operator assigns this value to the fuzzy set which has the maximum degree of membership; here the “Medium” fuzzy set. For the remaining two qualitative determinants, company competitive strength, and competition level, they must be first quantified, and then fuzzified. Let us consider first the company competitive strength. The procedure described by Thompson-Strickland (1987) used to rate the competitive strength of the company is followed. The competitive strength of both company and rivals are judged based on a number of key success factors and competitive measures revealed through industry and competitive analyses. First, key success factors are listed, the experts are asked to rate each company with respect to each key success factors, using a rating scale from 1 to 10. 1 equal very weak, whereas the rate of 10 equal very strong. Then the individual strength of a company is summed to obtain an overall competitive strength rate. Table 1 illustrates the procedure. The company competitive strength is rated 61. The nearest strength rating is for rival 1 (58), and this will be considered the first competitor to the company. It is clear that the procedure of quantification of the qualitative variable, which is based on rating made by the human experts, reveals the importance of using fuzzy logic sets to handle values of such kind of variables, since such ratings should be viewed as vague or inexact, because it is based on pure judgment of a human. The determinant competitive strength is fuzzified as in Figure 7. The last input determinant is the competition level. The level of competition is rated by the experts utilizing the rating scale described, see Figure 8.

Similarly, the output objective is fuzzified to enable evaluation of multiple implied fuzzy sets from multiple rules (Figure 9). Now, after fuzzification of input determinants, the actual values of input determinants for the current period is to be manipulated by the model through finding the relevant fuzzy set and associated membership degree. Table 2 shows the relevant fuzzy sets and associated membership degrees.

3.3 Rule-base

The rule-base contains experts’ knowledge about how the values of input determinants are mapped into the output objective decision. This knowledge is expressed in form of If-Then decision rules. The structure and design of rule-base depends mainly on the view of experts about correlated variables, and joint relationships between input determinants.

If Expected sales are High and manufacturing cost is Low, then objective is to Maximize customer satisfaction. Or in short:

If E1 is H and E2 is L then Objective is Obj (3).

If Company's price is Low and Competitor's price is High, then objective is to Maximize sale volume. Or in short:

If E4 is L and E5 is H then Objective is Obj(2).

If Competition level is Collusion, then objective is to Maximize profit margin. Or in short:

If E7 is L then Objective is Obj(1).

If competitive strength as input, is VL then Objective is Obj(5),

If competitive strength as input, is L then Objective is Obj(5),

If competitive strength as input, is M then Objective is Obj(5),

If competitive strength as input, is H then Objective is Obj(1),

If competitive strength as input, is VH then Objective is Obj(1),

If competition Level as input, is L then Objective is Obj(1),

If competition Level as input, is M then Objective is Obj(4)

If competition Level as input, is H then Objective is Obj(5)

All experts' decision rules of the rule-base, as specific to our demonstrative example of pair-wise motivators, are tabulated in the tables below (see Tables 3, 4,and 5,). Generally, the table of all combinations of motivators can be considered. Then the inference procedure will be different.

3.4 Inference engine

Two tasks are performed:

3.4.1 Matching: In this task, the fuzzified values of input determinants are matched with the corresponding value of input determinants in the premises of the rules contained in the rule-base. The matched rules are said to fire. In our example application, the current values of input determinants fire the following rules:

Rule 1:

If Expected sales (E1) is M and Manufacturing costs (E2) are High, then objective (Obj) is to Maximize profit margin Obj(1).

Rule 2:

If Expected sales (E1) is M and Inventory level (E3) is H, then objective (Obj) is to Maximize sales volume Obj(2).

Rule 3:

If Company's price (E4) is M and Competitor price (E5) is H, then objective (Obj) is to Increase market share Obj (4).

Rule 4:

If Company's competitive strength (E6) is M, then objective (Obj) is to Reinforce company's competitive position share Obj(5).

Rule 5:

If Competition level (E7) is L, then objective (Obj) is to Maximize customer satisfaction (Obj(3).

3.4.2 Inference: In this task, the consequent of each rule is determined. The consequent is the implied fuzzy set, the objective that should be adopted by the company currently, and the associated degree of membership, its truth. This membership value is determined by applying the minimum operator to the membership values of fuzzy sets contained in the premise of the rule. The following are the rules consequents inferred:

Rule 1: Consequent: **Obj(1)**, Truth: 0.79

Rule 2: Consequent: **Obj(2)**, Truth: 0.78

Rule 3: Consequent: **Obj(4)**, Truth: 0.57

Rule 4: Consequent: **Obj(1)**, Truth: 0.56

Rule 5: Consequent: **Obj(3)**, Truth: 0.67

3.5 Defuzzification

In order to identify the crisp temporary objective, the composite-maximum defuzzification method is used to directly identify the objective that is considered the most important to focus on. According to the composite-maximum method, the final crisp output is the center value of the implied fuzzy set which has the maximum truth. Investigating the inferred implied fuzzy sets, the consequent of the 5th rule fired has the maximum truth, 0.79; hence, according to the requirements of the input determinants, the current-period

objective that the company should concentrate on, is: **Obj(2) and Obj(2)** : Maximize sales volume and Maximize profit.

4. Application and economic impact

The proposed method can be applied in any scientific field to efficiently determine the temporary objectives. In manufacturing exhibit a lot of uncertainty, vagueness, and subjectivity are strong candidates for relying upon experts and fuzzy models. The method can be used in any industrial company to assess the impact of qualitative, quantitative, stochastic, and vague variables on the decision regarding the objective. The method can be also applied to nonprofit institutions, where the problem of objectives determination exhibits a lot of subjective variables. The economic impact of utilizing method is implied through focusing on the most beneficial objective that will lead to a logical economic improvement. In addition, the method identifies the short-term objective, instead of relying on the pure experts, or management members' judgment, and incurring the associated economic risk.

5. CONCLUSION

A method for setting temporary objectives has been described. The method is based on the fuzzy decision-making systems for the purpose of dealing with the vague, stochastic, uncertain, and subjective, and dynamic nature of the input variables and relationships involved in such problem. This paper has showed how fuzzy approach can ably deal with such problems. The fuzzy method has demonstrated how efficiently human experts' knowledge expressed in natural language and in form of If-Then decision rules is conveniently utilized to solve complex problems for which the use a conventional quantitative approaches is unfeasible. The method can handle any types of input variables, subjective or objective, and permit any arbitrary quantification of qualitative variables, the inclusion of which is essential for obtaining realistic solutions. The method can accept conflict opinions of a group of experts, and give finally a compromise solution for them. Finally, the main achievement of this article is the development of a scientific non-conventional method to identify the most significant current period short-term objective, that quantifies opinions of a group of valid experts, and to be able to dynamically repeat the process each adequate period.

REFERENCES

Boesel, J., Jr., R. O. B., Glover, F., Kelly, J. P., and Westwig, E. (2001). "Future of Simulation Optimization." Winter Simulation Conference, Arlington, Virginia, **USA**, 1466-1469.

Dweiri F., Meier F.A. (1996): "Application of Fuzzy Decision Making in Facilities Layout Planning". International Journal of Production Research, ***34***: 3207–3225.

Frantti, T., & Mahonen, P. (2001). Fuzzy logic-based forecasting model. *Engineering Applications of Artificial Intelligence*, **14**, 189-201.

Gamila, M. A. and Motavalli, S. (2003) "A modeling technique for loading and scheduling problems in

FMS", *Robotics and Computer Integrated Manufacturing*, **19**(1-2), 45-54.

Hedjar, R. (2008). Fuzzy control of periodic-review state-dependent production systems with unknown deterioration rate. *International Journal of Operational Research*, **3(6),** 632-642.

Mahata, G. C., & Goswami, A. (2009). A fuzzy replenishment policy for deteriorating items with ramp type demand rate under inflation. *International Journal of Operational Research*, **5(3),** 328-348.

Ross T.J. (1995): "Fuzzy Logic with Engineering Applications". McGraw-Hill, Inc., Singapore.

Zadeh L.E. (1965):"Fuzzy Sets. Information and Control"***,8***: 338–353.

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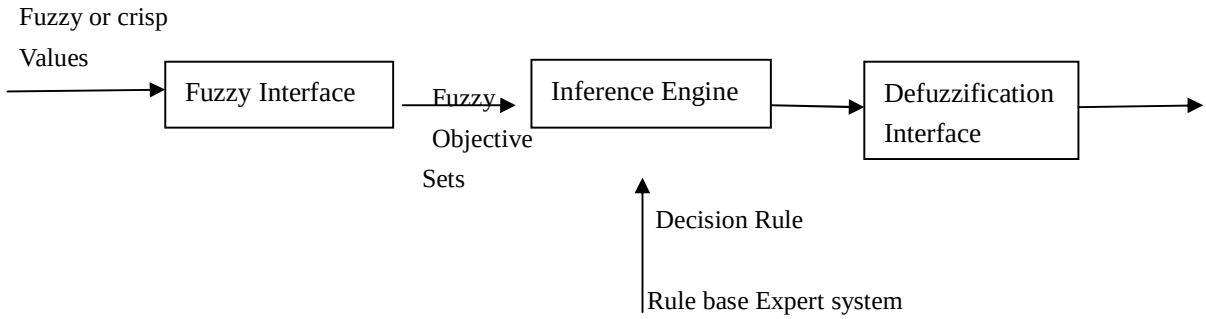

Figure 1 Fuzzy logic based objective identifier

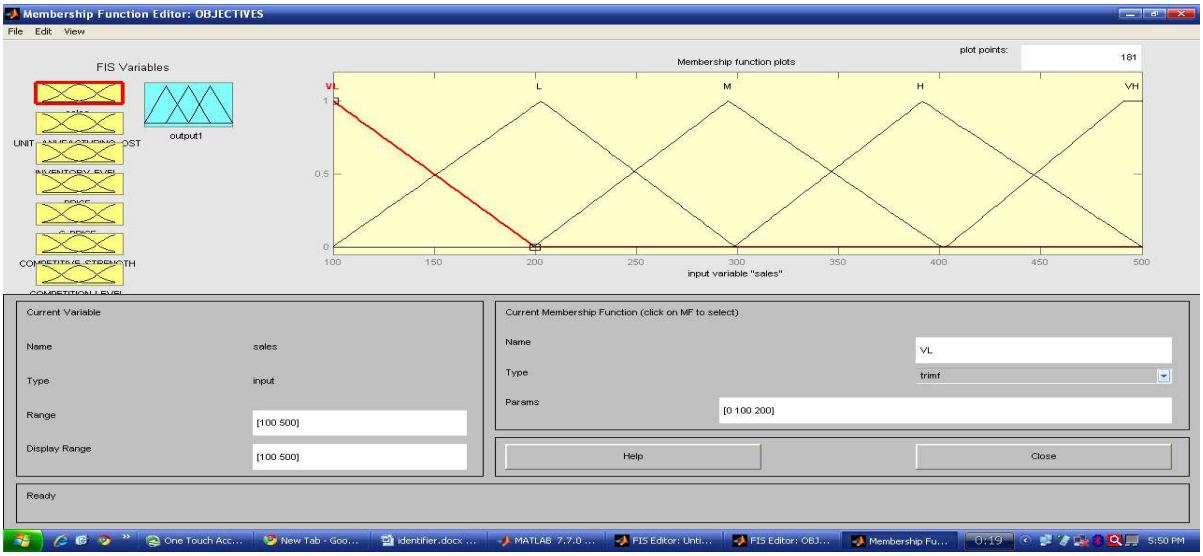

Figure 2 Fuzzification(Input) of Sales

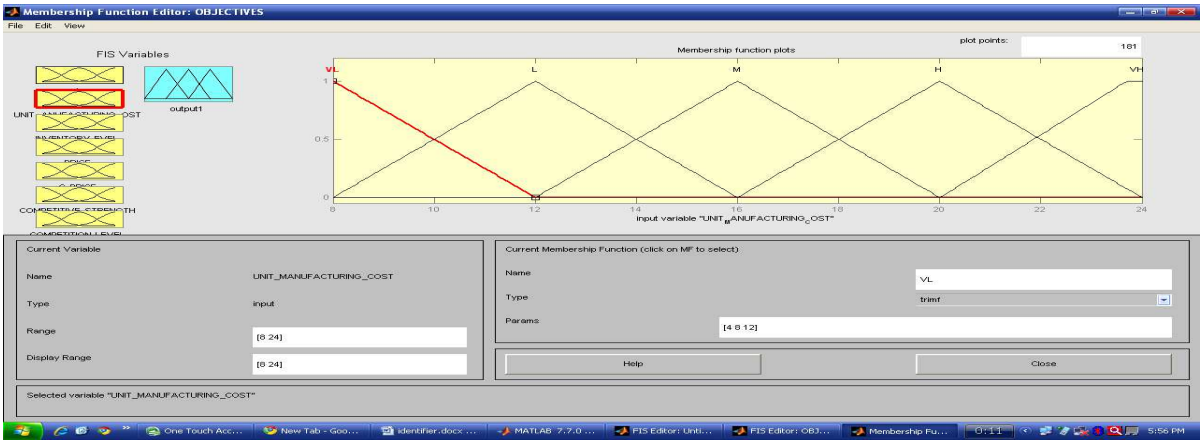

Figure 3 Fuzzification(Input) of unit Manufacturing cost

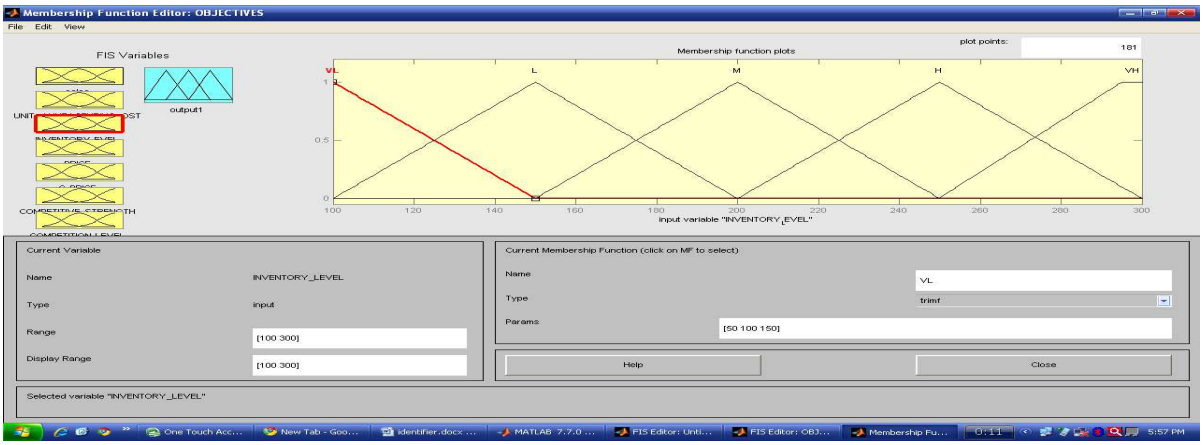

Figure 4 Fuzzification(input) of Inventory Level

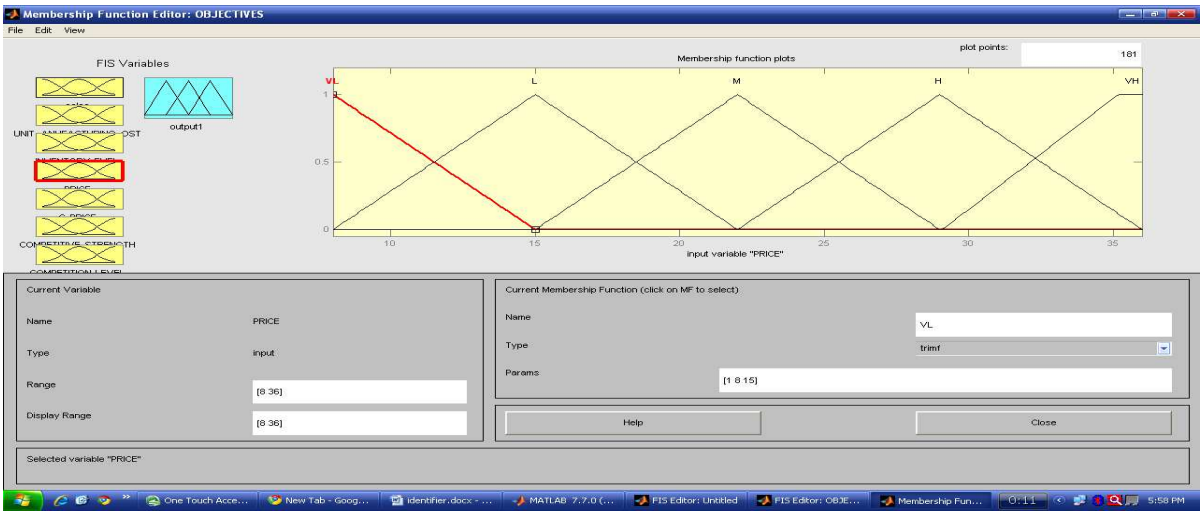

Figure 5 Fuzzification(Input)of Price

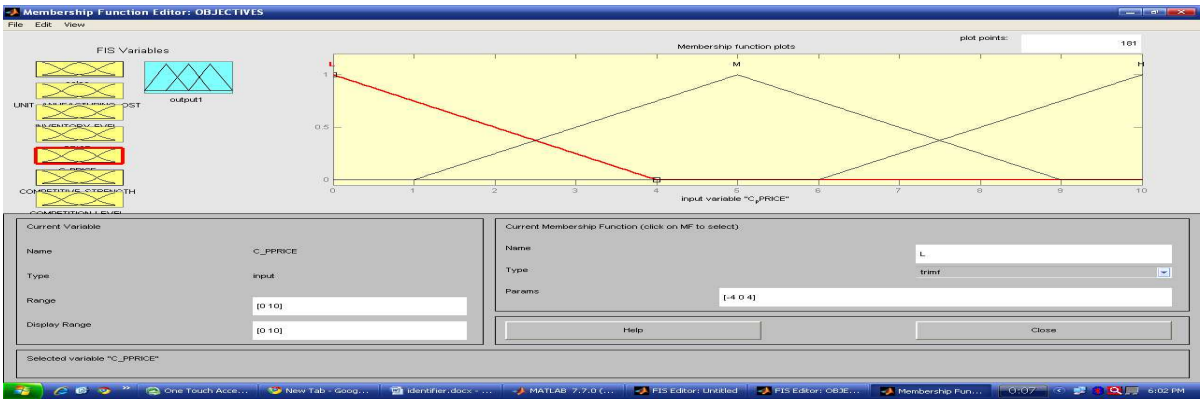

Figure 6 Fuzzification(Input) of Competitor price

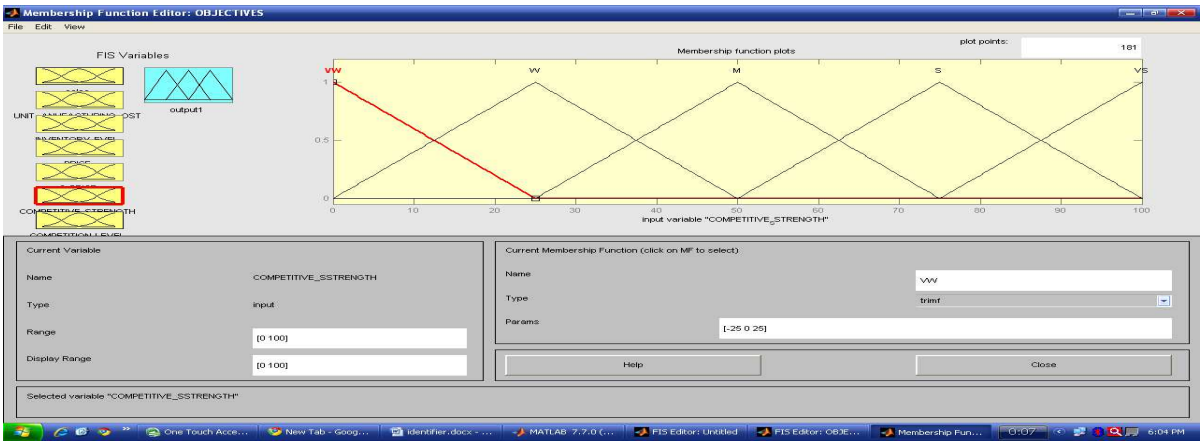

Figure 7 Fuzzification(input) of Competitive strength

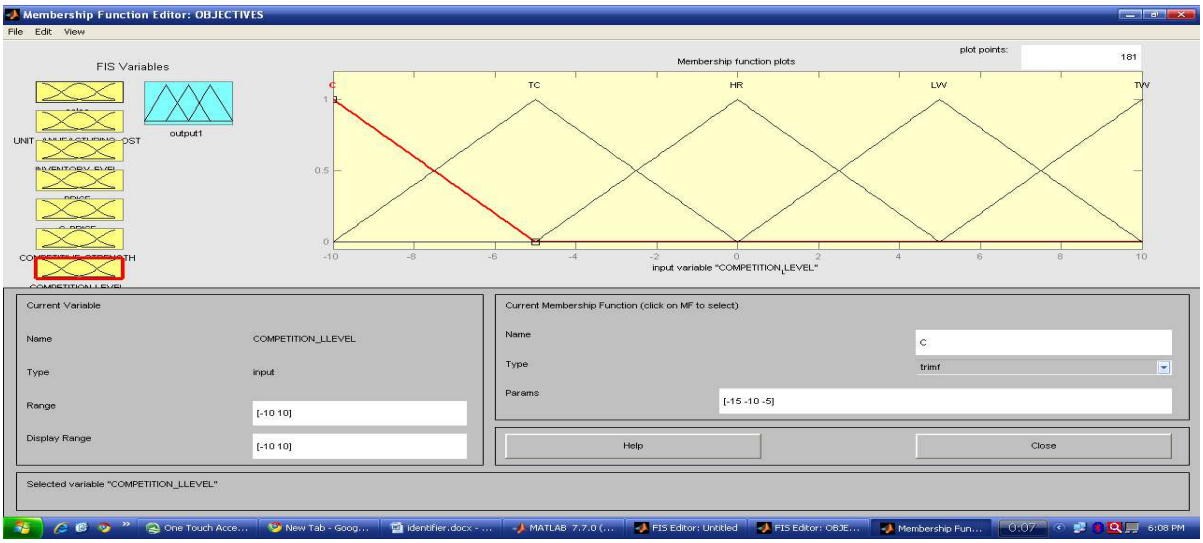

Figure 8 Fuzzification(Input) of competition level

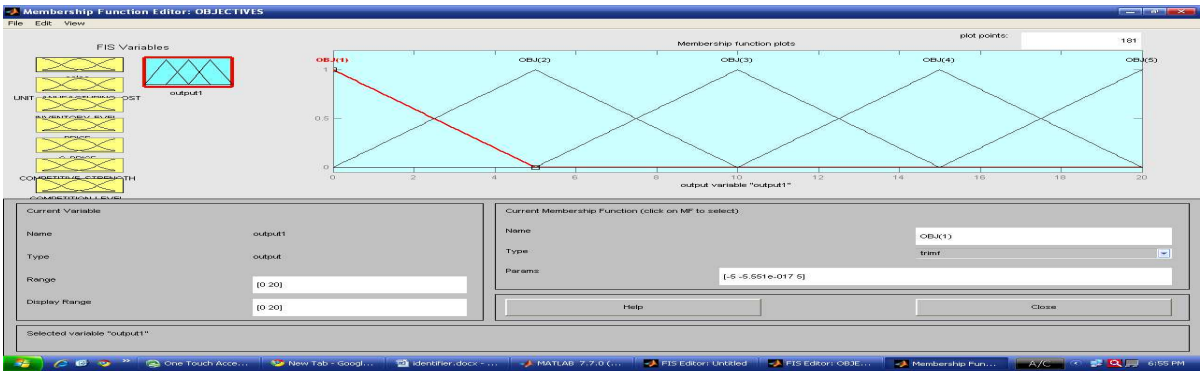

Figure 9 Fuzzifiaction (output) for Temporary objective

Key Factors	Rivals				
	A(our)	B	C	D	E
Dealer Network	9	4	10	5	1
Customer Service	5	7	10	1	4
Relative cost position	5	10	3	1	4
Financial Strength	5	10	7	3	1
Marketing/ Advertising	9	4	10	5	1
Product quality	8	5	10	1	6
Technological Skill	10	1	7	3	8
Manufacturing Capabilities	2	10	4	5	1
Reputation	8	7	10	1	6
Overall rating	61	58	71	25	32

Table 1. Competitive Strength Assessment

Variable Name	Fuzzy Set	
	Label	Degree of membership
E (1) : Expected Sales (in Rupees)	Medium	0.75
E (2) : Unit Manufacturing Cost (Rupees/Unit)	High	0.5
E(3) : Inventory Level(Rupees)	High	0.8
E(4) : Company's product price(Rupees)	Medium	0.57
E(5) : Competitor's product price(Rupees)	High	0.71
E(6) : Company's competitive strength	Medium	0.56
E(7) : Competition level	Low	0.8

Table 2 Membership Function for input variables

Then Objective	If Expected Sales (E1)					
		VL	L	M	H	VH
And if Unit manufacturing cost (E2)	VL	Obj(2)	Obj(2)	Obj(2)	Obj(3)	Obj(3)
	L	Obj(2)	Obj(2)	Obj(2)	Obj(3)	Obj(3)
	M	Obj(2)	Obj(2)	Obj(4)	Obj(4)	Obj(4)
	H	Obj(1)	Obj(1)	Obj(1)	Obj(1)	Obj(1)
	VH	Obj(1)	Obj(1)	Obj(1)	Obj(1)	Obj(1)

Table 3 Relationship between Sales and unit cost, and the consequent objective

Then Objective	If Expected Sales (E1)					
		VL	L	M	H	VH
And if Inventory Level (E3)	VL	Obj(4)	Obj(4)	Obj(1)	Obj(1)	Obj(1)
	L	Obj(4)	Obj(4)	Obj(1)	Obj(1)	Obj(1)
	M	Obj(2)	Obj(2)	Obj(2)	Obj(4)	Obj(4)
	H	Obj(2)	Obj(2)	Obj(2)	Obj(2)	Obj(2)
	VH	Obj(2)	Obj(2)	Obj(2)	Obj(2)	Obj(2)

Table 4. Relationship between sales and inventory level, and the consequent objective

Then Objective	If Company Price (E4)			
		L	M	H
And if Competitor Price (E5)	VL	Obj(3)	Obj(3)	Obj(3)
	L	Obj(5)	Obj(3)	Obj(3)
	M	Obj(4)	Obj(5)	Obj(3)
	H	Obj(4)	Obj(4)	Obj(5)
	VH	Obj(4)	Obj(4)	Obj(2)

Table 5. Relationship between company price and competitor price, and the consequent objective