Critical Analysis of Profit using Fuzzy based Model in Manufacturing Unit

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Abstract :- The main objective of any manufacturing company is to earn profit in present and in the future. The aim is to develop a Fuzzy-based, systematic approach to increase in profit 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 order to develop the proposed method, first a subjective study of the logical and causal relationships among considered inputs in the company.

Key Words - Fuzzy Logic, linguistic Variable, Manufacturing, Management

I. INTRODUCTION

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. The human's decision and actions are based on IF-THEN rules developed over years of knowledge and experience. 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. Some of the input variables are quantitative and some are qualitative in nature such as Company's competitive strength, Competition level and management.

Table 1 :- Input functions

| S.NO	INPUT FUNCTION	ABB
1	Expected sales Volume (in Rupees)	E1
2	Average unit manufacturing cost (Rupees/unit)	E2
3	Inventory Level (units)	E3
4	Company's product price (Rupees)	E4
5	Competitor's product price (Rupees)	E5
6	Company's competitive strength	E6
7	Competition level	E7
8	Labour	E8
9	Demand	E9
10	Due Date	E10
11	Machine Break down	E11
12	Management	E12

II. METHODOLOGY

The fuzzy model so presented considers the Constraints (variables) which are affecting the output Profit. These constraints are both quantitative and qualitative in nature. This manufacturing unit has traditional set up with staff of 250 members (Labour (skilled, unskilled), managers etc) per shift.

Table 2 :- Details of Input Variables and its linguistic function

	INPUT ABB	LINGUISIC VARIABLES(ABBREVATIONS)				
1	E1 (0-500)	VL	L	M	H	VH
		0-50	45-175	170-330	300-460	450-500
2	E2 (0-30)	VL	L	M	H	VH
		0-5	4-13	12-19	18-24	23-30
3	E3 (0-300)	VL	L	M	H	VH
		0-50	40-110	100-210	200-280	270-300
4	E4 (0-40)	VL	L	M	H	VH
		0-8	7-12	12-20	18-30	28-40
5	E5 (0-35)	L		M	H	
		0-15		12-25	22-35	
6	E6 (0-100)	VL	L	M	H	VH
		0-20	12-35	30-65	60-85	80-100
7	E7 (-10 to +10)	L	M		H	
		-10 to-4	-6 to 6		4 to 10	
8	E8 (0-100)	UNSKILLED	SEMI SKILLED		SKILLED	
		0-40	35-70		65-100	
9	E9 (0-35)	L	M		H	
		0-15	10-30		25-35	
10	E10 (0-50)	SHORT	MEDIUM		HIGH	
		0-12	10-30		25-50	
11	E11 (0-5)	L	M		H	
		0-2	1-3		2-5	
12	E12 (0-10)	INADEQUTE	GOOD		EXCELLENT	
		0-5	3-7		6-10	

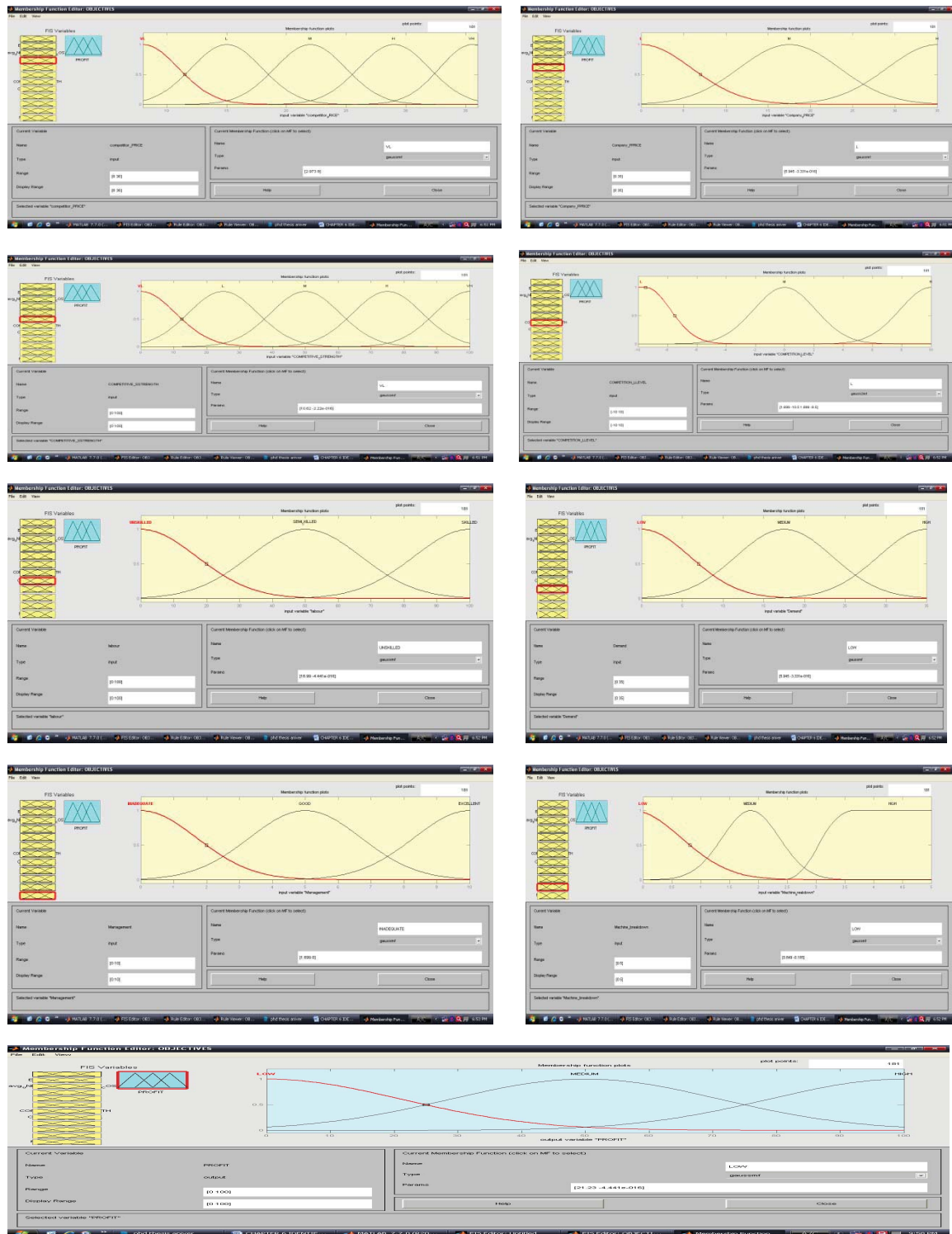Input and Output variables with Membership functions for Increasing the Profit
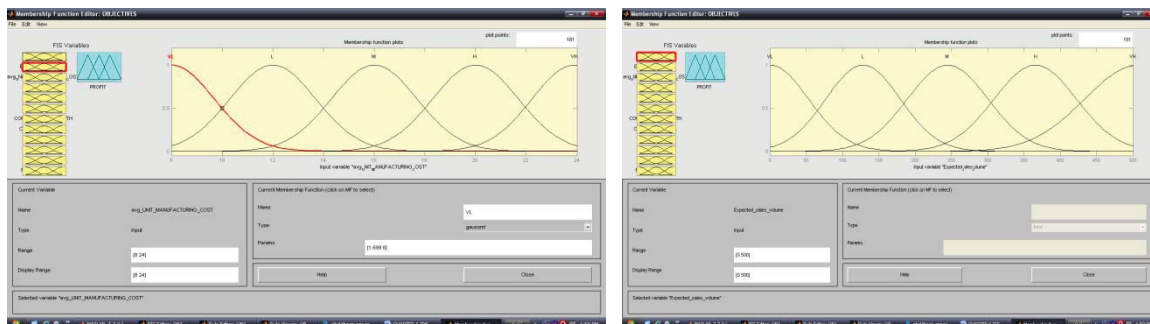
Figure 1. Fuzzy based model for input and output variable with linguistic variable

III. RULE-EDITOR AND RULE VIEWER FOR INCREASE IN PROFIT

Due to the various applications of fuzzy logic and rule-based reasoning, this field is also called fuzzy expert system, Fuzzy inference systems, and fuzzy rule-based system. In order to convert the inputs into the outputs, fuzzy inference system is utilized. To implement the proposed fuzzy expert system, in this research, following cases have been considered.

The rule-base contains experts' knowledge about how the values of input determinants are mapped into the output objective decision. The structure and design of rule-base depends mainly on the view of experts about correlated variables, and joint relationships between input membership functions. In MATLAB Rule Editors the IF-Then decision rules are expressed and 104 Rules are been used to get better results.
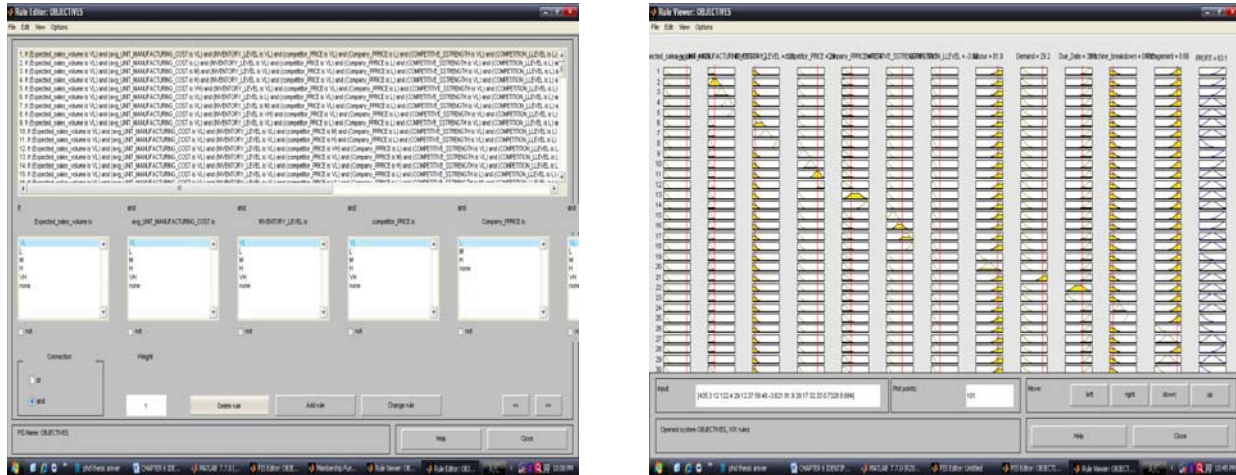
Figure 2. Rule Editor and Rule Viewer for increase in profit in manufacturing

IV. CRITICAL ANALYSIS OF MODEL FOR INCREASE IN PROFIT IN MANUFACTURING

The objective is to increase profit so we have considered twelve variables which are affecting the profit of the company. These twelve variables are Expected sales Volume (in Rupees), Average unit manufacturing cost (Rupees/unit), Inventory Level (Unit) , Company's product price (Rupees), Competitor's product price (Rupees), Company's competitive strength, Competition level, Labour, Demand, Due Date, Machine Break down and Management, Some variables are Quantitative and some are qualitative in nature so the fuzzy model for profit as output the twelve input variables are considered and then results for the profit is analyzed.
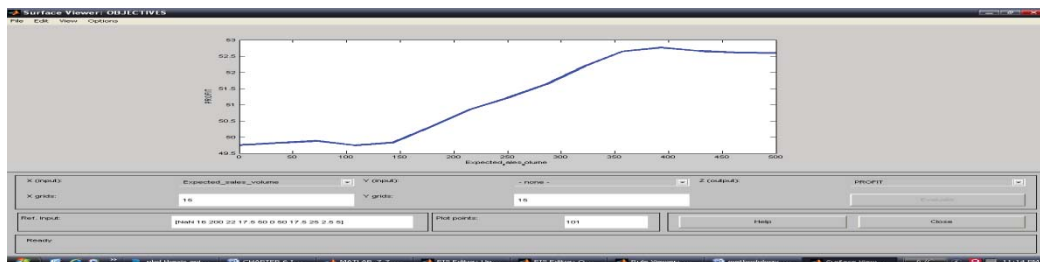

Figure 3. Relationship between Expected sales volume and Profit

The graph shows that with increase in sales volume Profit will also increase
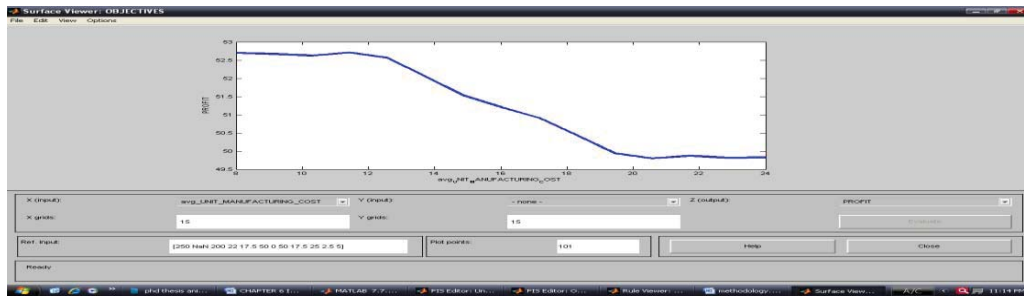
Figure 4. Relationship between Average Manufacturing cost and Profit

The graph shows the trend that if the average manufacturing cost is less the profit will be high and profit will decrease with increase in manufacturing cost.
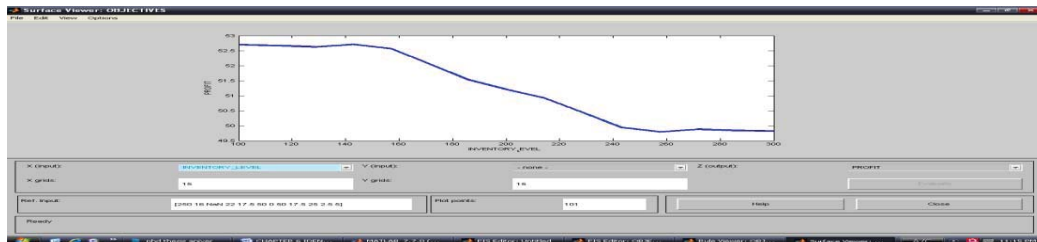

Figure 5. Relationship between Inventory Level and Profit

The graph shows the trend that if the inventory is low the profit will be high and profit will decrease with increase in inventory.
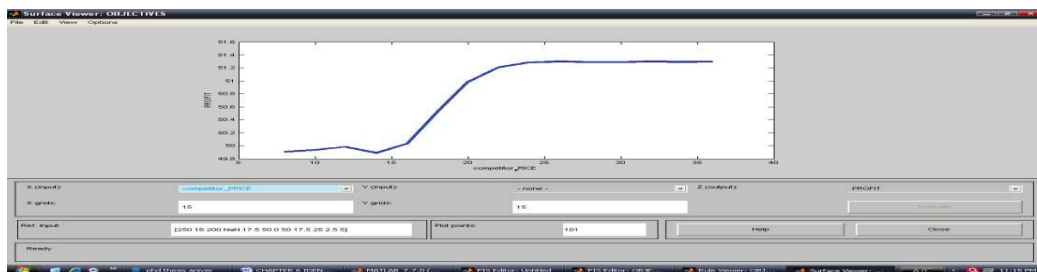

Figure 6. Relationship between Competitor Price and Profit

The graph shows the trend that competitor price will be high and profit will be high.
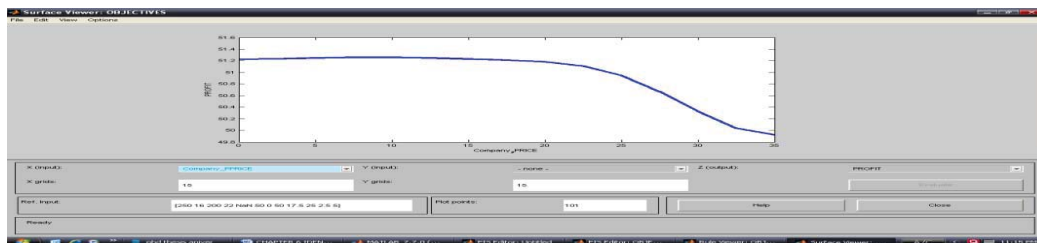
Figure 7. Relationship between Company Price and Profit

The graph shows that if company price is low the profit is high and profit reduces with increase in company price.
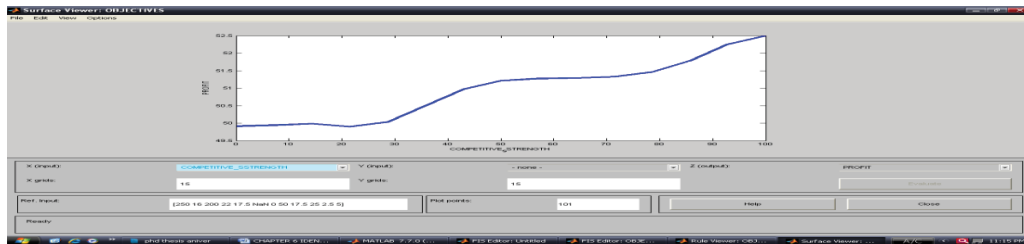
Figure 8. Relationship between Competitive strength and Profit

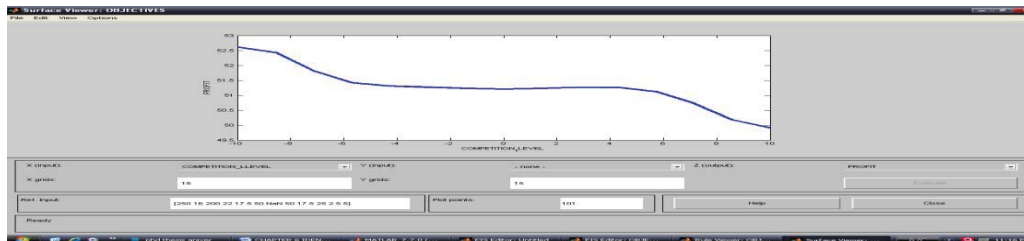The graph shows increase in competitive strength profit increases

Figure 9. Relationship between Competition Level and Profit

The graph shows with increase in completion level profit decreases
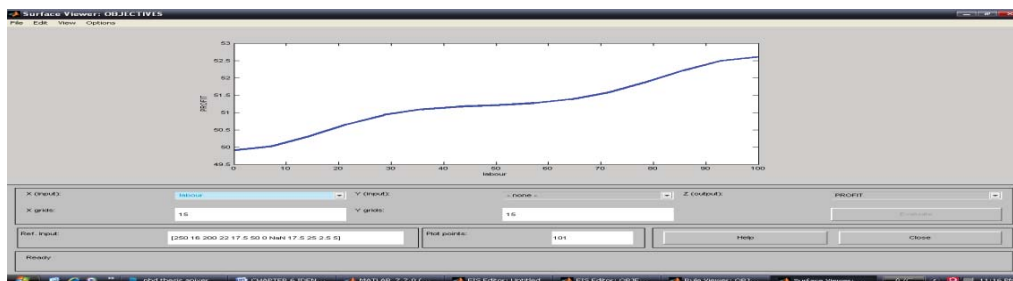

Figure 10. Relationship between Labour and Profit

The graph shows with increase in skill of labour profit increases
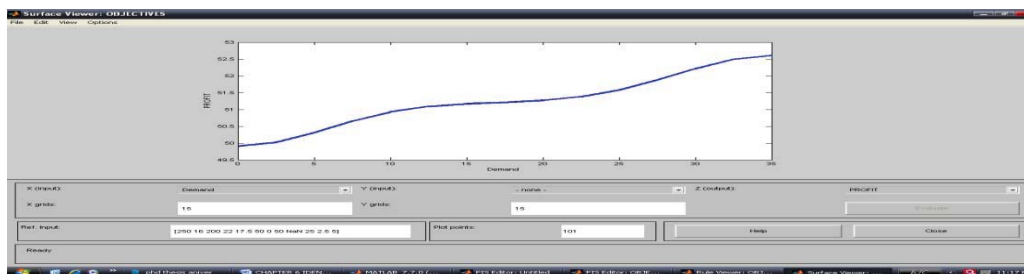

Figure 11. Relationship between Demand and Profit

The graph shows with increase in demand profit increases
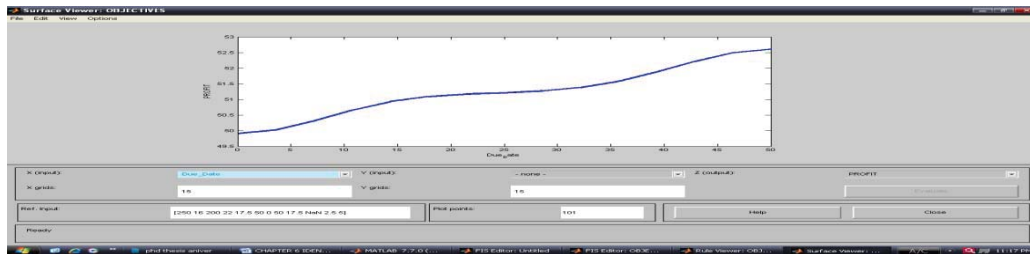
Figure 12. Relationship between Due Date and Profit

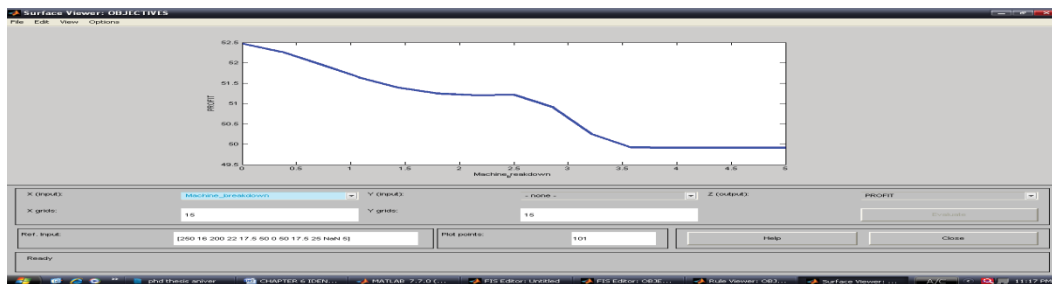The graph shows that profit increases with increase in due date period

Figure 13. Relationship between Machine Breakdown and Profit

The graph shows that less the machine breakdown high is the profit
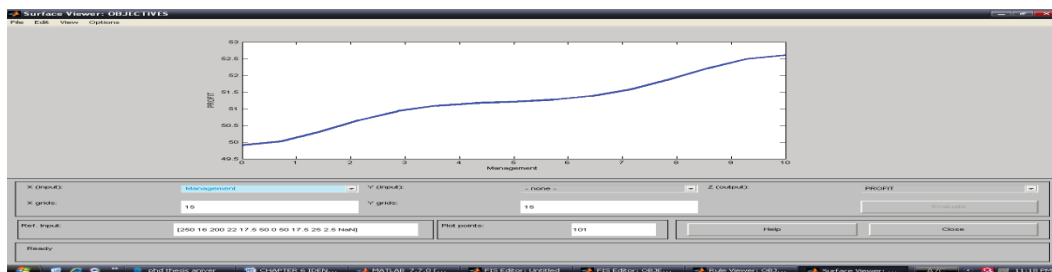

Figure 14. Relationship between Management and Profit

The graph shows that if management is excellent then profit is high
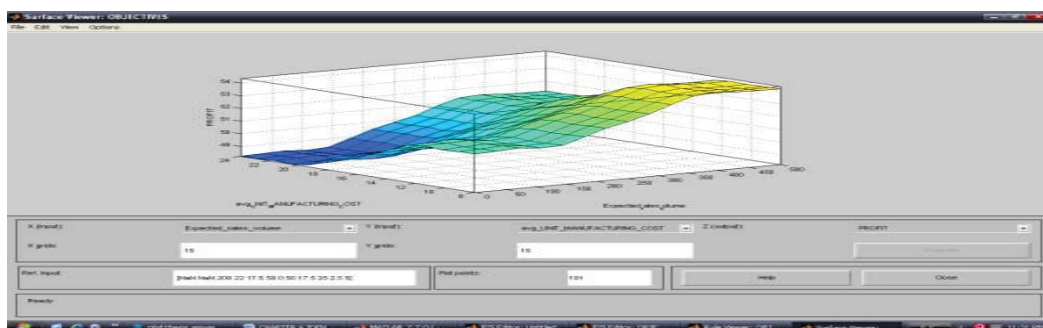

Figure 15. Relationship between Average Manufacturing Cost, Expected Sales Volume and Profit

V. RESULTS AND CONCLUSION

The crisp value for the profit is 63.2% by considering the defuzzification method. In the fuzzy based approach the Profit is increased by 13.2%. The active rules in case of profit as output are only 25 which lead to the

increase in the profit of the company. This model can predict the profit for the future; it can be used as a planning tool. Furthermore constraints can be added to get more fine results as advantage of fuzzy model is that it incorporates both quantitative and qualitative constraints.

REFERENCES

[1] Akçali E., Ungor A., Uzsoy R. (2005), "Short-Term Capacity Allocation Problem with Tool and Setup Constraints", Naval Research Logistics, Vol. 52 Wiley Periodicals, Inc, pp 754- 764.
[2] Halim K.A, Giri B.C and Chaudhuri K.S. (2011), "Fuzzy production planning models for an unreliable production system with fuzzy production rate and stochastic/fuzzy demand rate", International Journal of Industrial Engineering Computations 2, pp 179–192
[3] Li Chang, Q, and Ni, J. (2008), "Data driven bottleneck detection of manufacturing systems", International Journal of Production Research, Vol. 47, No. 18, pp 5019-5036.
[4] Ma Y.H. and Koren Y. (2007), "Operation of Manufacturing Systems with Work in-process Inventory and Production Control", NSF Engineering Research Center for Reconfigurable Manufacturing Systems, University of Michigan, Ann Arbor MI 48109-2125, USA.
[5] Mohanti R.P. Mishra D and Mishra T. (2010), "Production as a Service: An Analysis of Theory of Constraints (TOC) Methods", Journal of Studies on Manufacturing, Vol.1-2010/Iss.2-3, pp 108-119.
[6] Tsourveloudis N.C. & Doitsidis L & Ioannidis S. (2005), "Optimized fuzzy scheduling of manufacturing systems" Intelligent Control Systems and Optimization, pp 196-201.
[7] Yoo J and Shimizu Y. (2008), "A Practical TOC Scheduling Method Using Pull-Push Production Concept" Proceedings of the 9th Asia Pasific Industrial Engineering & Management Systems Conference pp 1912-1919.
[8] Zhang B. & Daniel J. (2006), "A Fuzzy-Logic-Based Methodology for Batch Process Scheduling", Epstein Department of Industrial and Systems Engineering University of Southern California 3715 McClintock Avenue, GER 207 Los Angeles, CA 90089-0193, USA