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"Towards A Fuzzy Logic Rule Based Prediction for Effective Adoption of E-Procurement System on Cloud Environment"

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Abstract*: *E-Procurement Solution on Cloud Platform is a cost efficient method to get better buyers and sellers relationship. This will brought a new revolution in the field of E-Procurement. In this paper author has emphasized on effectiveness of cloud based e- Procurement and also suggested the prediction based on fuzzy method to quantify it, here an algorithm has been given and related guideless for cloud e- Procurement. In this paper algorithm and guidelines are based on quality and security criteria for migration of the traditional ERP based system to Cloud based e procurement systems has also been delivered. The fuzzy based algorithms have been validated by applying it to a MATLAB. This piece of writing will show the consequence of cloud environment acceptance on e procurement system in the fast increasing industry, as an benefit of this mechanization continue to develop, business will pay out less on multifaceted systems, it will make available better way of communication.

Index Terms: E-Procurement, Cloud environment, Fuzzy Prediction, Cloud Quality, Cloud Security, Cloud Computing

I. INTRODUCTION

Expert forecasts are approximately unquestionable in reporting that, surrounded by the after that 18 months, more than 50% of all business communication, as well as network infrastructure will be store and operate commencing beginning to end by some category of cloud system . This shift will have an effect on how companies to make the most of procurement to both buy and sell products in the region of the globe. As highly developed automation continue to develop, business will use up less on composite systems, have access to more options, and get better communication in the supply chain [8].

II. COST EFFECTIVE E-PROCUREMENT SOLUTION

E-procurement expertise vendor are altering as of huge many-sided ERP-built technology in good turn of simpler platform. The analytics that is stored in the cloud to a convinced degree than onboard external drives. as a result, the cloud-based mechanization is more cost-effective and require little to no maintenance. Business owner are looking for the Enterprise procurement solutions which be budget-friendly as well as can turn cloud computing systems.

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III. CHARACTERISTICS OF CLOUD COMPUTING E-PROCUREMENT SYSTEM

Cloud computing is a approaches for empowering pervasive, advantageous, on-request arrange access to a common perspective of configurable computing assets that can be quickly provisioned with negligible administration exertion or specialist organization connection. Summarizes of the characteristics of cloud based e-procurement system are shown in figure 1. Cloud based e-procurement system is a web based computing system, which helps in sharing different parameters and information to computer systems and different environment. Cloud based e-procurement system is one of the most popular innovations which gives various perspective work, for example, computing, databases, virtual machines, servers, investigation, and some more. Cloud gives these administrations over web which makes it adaptable and subsequently encourages the endeavors to wipe out the capital consumption on obtaining equipment for their associations.

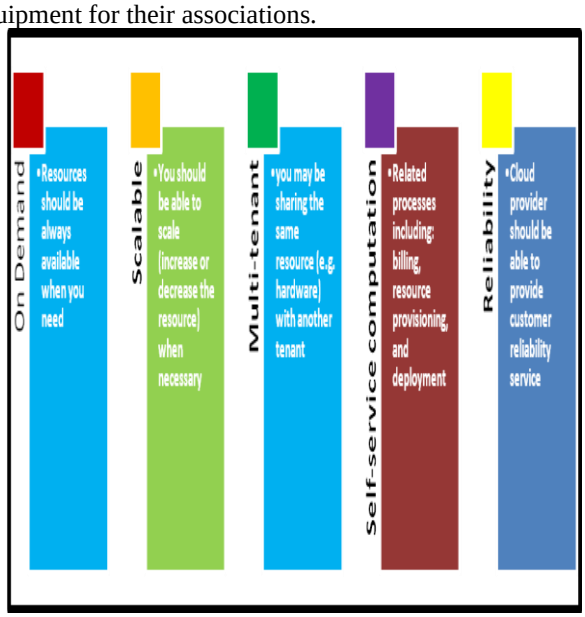

Figure 1 Cloud based E-Procurement System Characteristics

IV. OMPONENTS OF CLOUD COMPUTING E-PROCUREMENT SYSTEM

One of the apprehension of buyers and suppliers on in collaboration ends of the supply chain is that cloud- based e-procurement platform perhaps will also be full of smaller amount essential components bring into being in conventional software programs. Developers have just watered down all the indistinguishable features hooked on a denser, low-cost system with no eliminating the compulsory fundamentals [4][3]. You'll be able to utilize all the same features in the cloud such as:-

A. **Spend Analysis -** Cloud-based apps can collect, cleanse, categorize, and analyze spending data to show where you can decrease the costs and can improve the overall presentation of the e-Procurement process [6].

B. **RFQ-** The input to e-procurement is good organization and accurateness when request quotes or bids Cloud computing be able to put all buyers and suppliers on the identical page and permit everyone to view the necessary information during the RFQ process [6]

C. **Reverse Auction-** Cloud-based apps offer turn just about auction description that give buyers the leverage they call for to drive reimburse for prices downward from suppliers [3] [4]

D. **P.O. and the Invoice Automation-** now a day's buyers are further mobile than ever. Cloud- base technology allows you to send P.O. This speed up the purchase process as well as ensure that the supply chain is running effortlessly [6].

E. **Contract Management** - Cloud computing allow you to monitor past purchase performance by way of any supplier so that you take in negotiating pressure at what time drawing up prospect contracts. You and the supplier include on-demand reports that you can request honestly as of the cloud no matter where you are.[2] [3]

F. **Seamless Integration between Different Systems** One of the largely ordinary challenges in e-procurement is in receipt of dissimilar systems to contribute to information directly within the supply chain. There was no inmost position to upload or download documents, reports, and other vital information. Buyers and suppliers had to make multiple streams of message to make, initiate [6]

V.CLOUD BASED E-PROCURED LAYERS AND DEPLOYMENT MODEL APPROACHES

The architecture of cloud based environment have separated mainly four layers base on the service, activity as well as set of task and also provide to the end users. The cloud architecture has also known as layered model which consists of same layer that is hardware layer, infrastructure layer, platform layer as well as application layer [2][6]. The layer of cloud computing involved the set of action which associated to a specific manners.

Cloud computing are divided into the different types of cloud services such as software as a service, platform as a service and infrastructure as a service to e-procurement system [4][5]. Services models are used such as analysis of data, grid services, and independency of devices. These are:-

- ✓ **Software as a Service (SaaS)** - cloud service layer in which an application hosted as a service to customer who access it with the internet. Enterprise Resource Planning (ERP),Customer Resource Management (CRM) ,E-Commerce System , E-Auditing , E-Payment is the some services which is govern by the cloud based e-procurement system The advantages are Web Reliability is more reliable, Web Security is improved and Web Quality is improved and effectiveness is enhanced.
- ✓ **Platform as a Service (PaaS)** is another layer in which application software is delivered without having to download and install in a system and allow all the required resources to build application and services completely from the internet. It includes e-procurement application design, development, testing, deployment and hosting of the cloud based e-procurement system. It also provides team collaboration in buying and biding of the tender in the e-procurement system, maintaining time to time security and quality of the system, updating database integration, networking .
- ✓ **Hardware as a Service (HaaS)** or **Infrastructure as a Service (IaaS)** is the next layer which simply offer the hardware resources without having to download and install in a system. It includes Server space, Network equipments Memory storage CPU cycles, and internet connectivity. So that authentication, authorization, flexibility to entire system is maintained. So that the result the integrity is maintained and quality standards are maintained.
- ✓ **Database as a Service (DaaS)** is the last layer which avoid the complexity and cost of running own database. No data redundancy is occur , database updation is done time to time , integration with other services such as calendar for event , e-mail , calculator . Microsoft SQL Server Data Services (SSDS) and Oracle are some database services to cloud based e-procurement system users.

VI. CLOUD BASED E-PROCUREMENT SYSTEM DEPLOYMENT MODELS

The deployment models of cloud are based on environment.

- ✓ **Public cloud** is a type of computing process where use by anyone, that is to say the general public, has access and during it can associate to any environment. Because a public Cloud has few or no restrictions, users call for to be wary of possible security risks when accessing the cloud based e-procurement system.
- ✓ **Private clouds** are a decision for organizations that officially possess server farm and created IT infrastructure and have specific needs around security or execution. They are a superior decision for the organization server farm than Legacy servers in such a significant number of ways, bringing numerous benefits got from virtualization of cloud based e-procurement system
- ✓ **Hybrid Cloud**, uses both private and public clouds, but can remain separate entities A hybrid cloud is huge for scalability, flexibility as well as security.

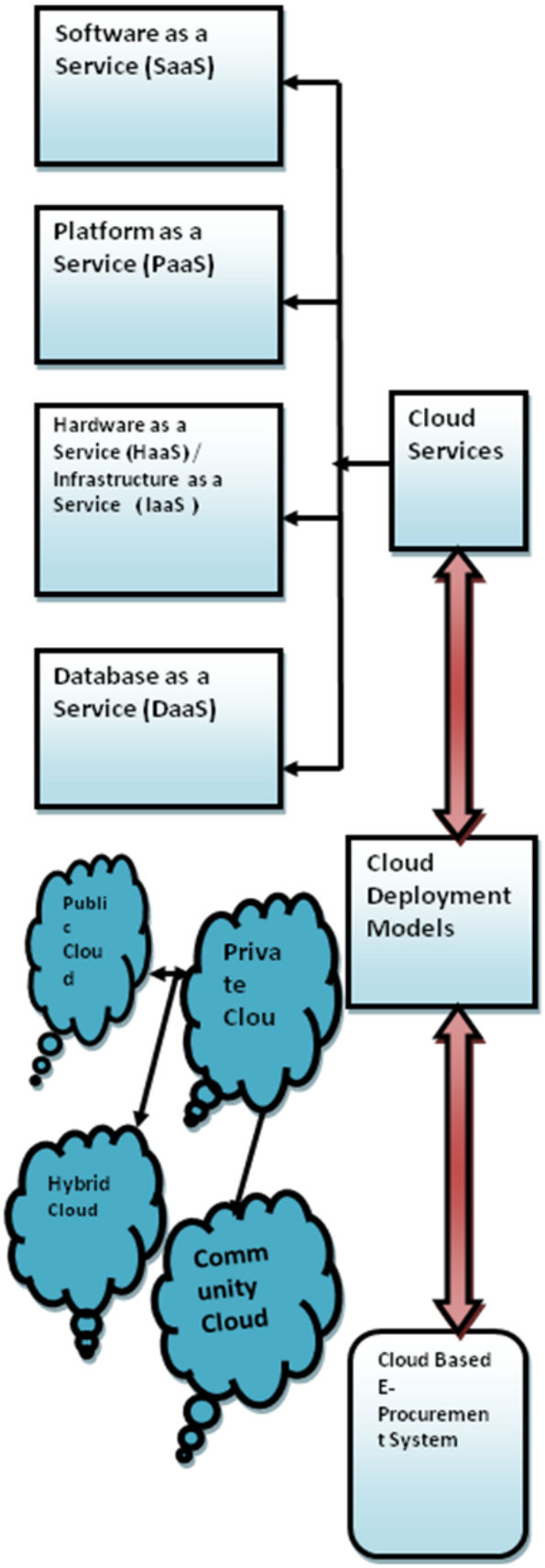

Figure 2 Cloud Computing Architecture

VII. CLOUD BASED EFFECTIVE E-PROCUREMENT SYSTEM ARCHITECTURE FOR ADOPTION

According to author [21][24] there is no benchmarking or standardization of the technical framework making understand the effectiveness of e-procurement system. Hence in order to maintain technical adoption framework it is necessary firstly to identify the factors and to implement the effectiveness of e-procurement system and secondly how the effective e-procurement system is get adopted by cloud computing? After the successful implementation of effectiveness e-procurement system [35] we can concluded that "If we improve security and enhance quality of e-procurement software at design phase then automatically we can get effective e-procurement system ". According to the author [20][21] e-procurement software uses the latest method for development i.e. object oriented software , agile approach , fuzzy logic , cloud computing to create technology models for system . According to literature review [22] [23] already suggest that there is no standard technical framework is presented. Now a days the major business process and government process is moving on cloud. So cloud has introduced a new path for adoption of effective e-procurement system which can be illustrated in figure 3 and 4.

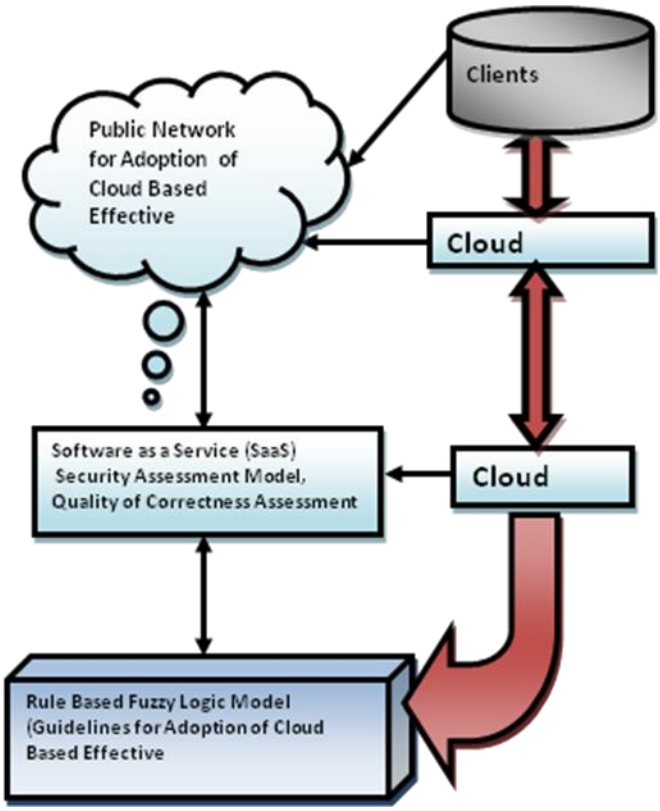

Figure 3 Adoption of Cloud Based Effective E-Procurement System

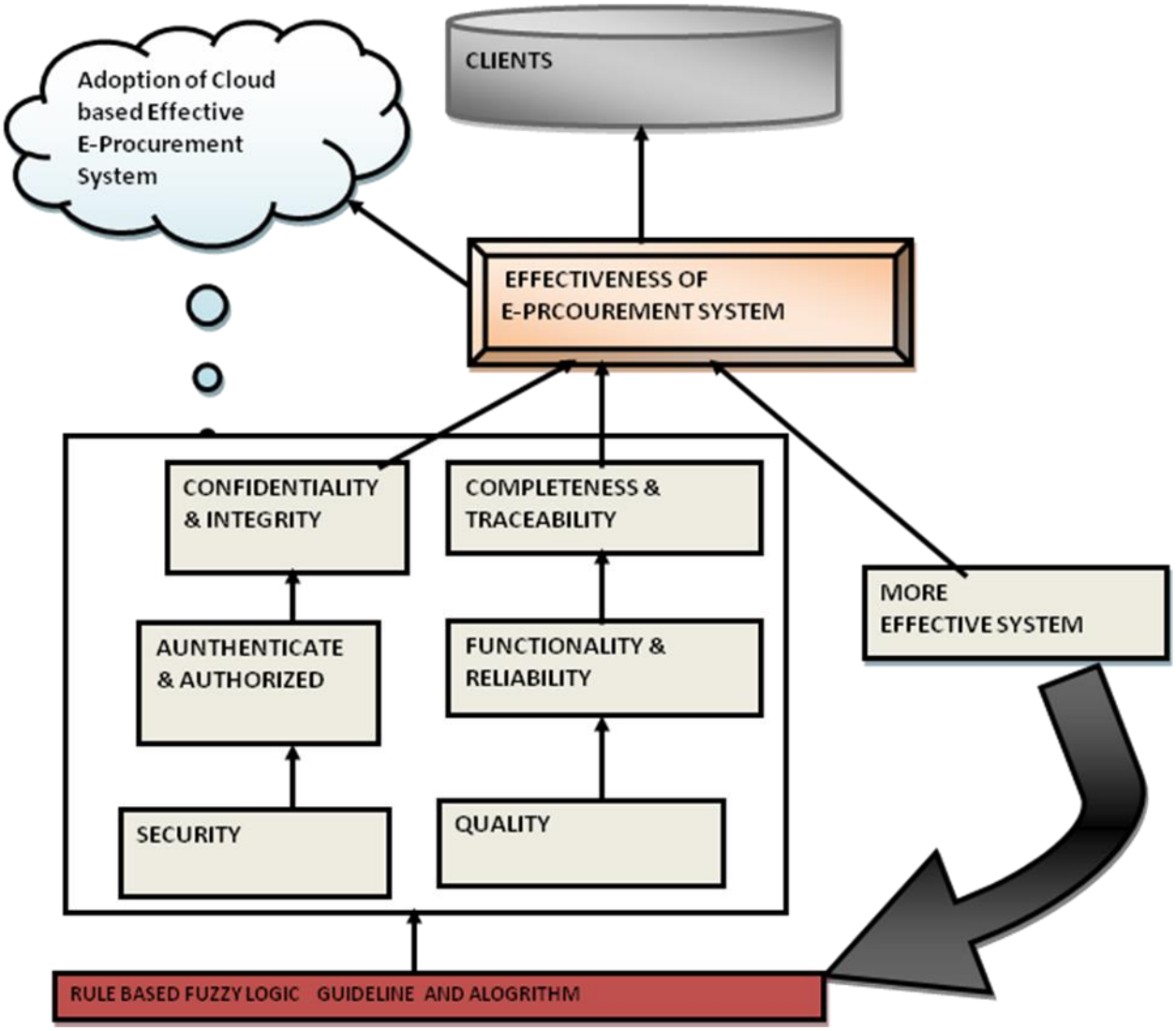

Figure 4 – Adoption of Cloud Based Effective E-Procurement System Architecture

VIII. FCATORS AFFECTING CLOUD BASED ON THE E-PROCUREMENT ADOPTION

There are many factors that influence the adoption of new systems and processes by individuals and organization [20]. The following table highlights some key factors by the domains of Psychology, IT Implementation and Innovation: Relating to the IT Implementation there are additional factors that include perceived ease of use, perceived usefulness, performance expectancy, effort expectancy, vendor support, senior management support, user training in addition to user involvement [20][21]. IT Implementation is as well affected by the preceding experience of users of new systems introduced into an organization. Poor experience of such implementations will of course collision on any new implementations. Finally we encompass the Innovation. Here the factors are having the relative advantage seen by bringing innovative solution, and the process compatibility of these innovation when it was allied with other type of processes within an organizational setup, the difficulty of the on the whole system, the aptitude to be able to scrutinize the probable collision of the innovation on what I do and the capability to with no trouble trial the solution. It would be supposed to be noted, that in context of all of these, that characteristically within an organization it is not full time purchasing of the professionals that will be using the e-procurement system for making the Indirect purchases: It is the users all the way through the organization who require to compose the purchases. Consequently a lot of these factors are applying to users all through the organization, not to procurement professionals..

IX. METHODOLOGY FOR RULE BASED FUZZY LOGIC MODEL

Fuzz logic based algorithm and guidelines for e-procurement system in public Cloud environment has been developed in this article. Firstly an adoption is done on the cloud environment with the help of associated effective e-procurement system [33] [; this relationship is based on our two quality most important factors named as security assessment model [28]and independent factors confidentiality assessment model [24], integrity assessment model [25],authentication quantification model [26], authorization quantification model [27] and after that quality of correctness assessment model [33] which depends on these independent factors completeness assessment model[29] ,traceability assessment model [30],reliability assessment model [31] and functionality assessment model [32] and we get effectiveness assessment model [33].

In this algorithm and fuzziness rules are used to predict the outcome of effective e-procurement platform for the cloud based environment system. This algorithm and rules will helps to provide high quality and security to the effective e-procurement system. Secondly the rule based Fuzzy logic models provide effective e-procurement system and implemented in the MATLAB software by Mamdani Fuzzifier. We have used Mamdani Fuzzifier Fuzzy Logic toolbox to propose technique for cloud based effective e-procurement system because it is more reliable and efficient for any types of decision making.

According to the author [21]. Fuzzy Logic is a branch of Artificial Intelligence that has been proposed by Zadeh in 1965. The basic following steps of the cloud based framework are input / output variables, building fuzzy base rule and collection of the membership functions and rules that support multivariate value for decision making for design phase for the adoption of the cloud based effective e-procurement system [33]which can be illustrate in Table 1. In the below table1 three categories of projects are chosen and predicted for Correctness and subsequent Golden Rules are also given. In this validation is also done for project category A, B & C, in each category three to four projects are selected and their final output are predicated.

1. Algorithm For Set Of Rules For Effectiveness Of E-Procurement System

START
Define Fuzzy Variables
Determine fuzzy variables,
// {Value as Security input confidentiality, Integrity, Authorization and Authenticity,
// And Values as Quality of Correctness input Completeness, Functionality, Reliability, Traceability}
Quality, Security and Effectiveness as Output
Establish fuzzy sets for these variables
Fuzzify each value in fuzzy sets using membership function
Generate knowledge Base using fuzzy rules
Build the system Execute the system
// Give input variable values
//Get rule strength
/Combine rule strength with output membership function
//Find consequence of rules
Generate output
//{Degree of Quality of Correctness, Degree of Security and Degree of Effectiveness}
Combine consequences of variant rules
Generate output distribution by conflict resolution process
// At every variation degree of Effectiveness is evaluated.
If modified i/p has maximum degree of Effectiveness
Then,
Modified i/p=Highest priority
Original i/p=Lowest priority
Else
Original i/p=Highest priority
Modified i/p=Highest priority
//At every variation degree of Quality of Correctness is evaluated.
If modified i/p has maximum degree of Quality
Then,
Modified i/p=Highest priority
Original i/p=Lowest priority
Else
Original i/p=Highest priority
Modified i/p=Highest priority
// At every variation degree of Security is evaluated.
If modified i/p has maximum degree of Security
Then, Modified i/p=Highest priority
Original i/p=Lowest priority
Else
Original i/p=Highest priority
Modified i/p=Highest priority

END

	TABLE 1 FUZZY BASED CORRECTNESS PREDICTION TABLE AND GOLDEN RULES					
PROJECT GROUP	PROJECT	RELIABILITY RAM $^{E\text{-}PROC}$	FUNCTIONALITY FAM $^{E\text{-}PROC}$	TRACEABILITY TAM $^{E\text{-}PROC}$	COMPLETENESS COMAM $^{E\text{-}PROC}$	QUALITY CORRECTNESS QCAM$^{E\text{-}PROC}$
TYPE A	P_1	LR	FF	HT	C	QC+
	P_2	HR	NF	T	C	QC-
	P_3	MR	MF	T	TC	QC
TYPE B	P_4	MR	NF	MT	TC	QC+
	P_5	HR	MF	T	C	QC-
	P_6	MR	FF	MT	TC	QC+
	P_7	MR	FF	MT	TC	QC
TYPE C	P_8	HR	MF	HT	LC	QC-
	P_9	LR	FF	T	C	QC-
	P_{10}	M	MF	HT	TC	QC

Range (0 >= Input factor <= 1)
Highest Priority HP (1.0 to 0.8 represents HP) **{RAM$^{E\text{-}PROC}$ U FAM$^{E\text{-}PROC}$ U TAM$^{E\text{-}PROC}$U ComAM$^{E\text{-}PROC}$} =QCAM$^{E\text{-}PROC}$**
RULE 1
IF Binary SUM of all inputs has at high in nature **THEN Priority QC+ (Quality of Correctness is high)**
Moderate Priority MP ().7 to 0.6 represents MP) **{RAM$^{E\text{-}PROC}$ U FAM$^{E\text{-}PROC}$ U TAM$^{E\text{-}PROC}$ U ComAM$^{E\text{-}PROC}$ } =QCAM$^{E\text{-}PROC}$**
RULE 2
IF Binary SUM of any three inputs has at high in nature **then Priority QC (Quality of Correctness is Moderate)**
Low Priority (LP) (0.5 to 0.4 represents LP) **{RAM$^{E\text{-}PROC}$ U FAM$^{E\text{-}PROC}$ U TAM$^{E\text{-}PROC}$ U ComAM$^{E\text{-}PROC}$ }=QCAM$^{E\text{-}PROC}$**
RULE 2
if Binary SUM of any two inputs has at high in nature then **Priority QC- (Quality of Correctness is Normal)**

X.RULES FOR QUALITY OF CORRECTNESS

In this section there are several set of the golden rules for predicting quality of correctness (reliability , traceability , functionality , completeness) for estimating effectiveness of e-procurement system ,where HP is highest priority , MP is Moderate Priority , LP is Low Priority , HR is high reliability , MR is Moderate Reliability , NR is Normal Reliability , FF is Full Functionality , MF is Moderate Functionality , NF is Normal Functionality,TC is Total Completeness, NC is Normal Completeness, C is Completeness, T is traceability, QC- is Quality of Correctness is less , QC+ is Quality of Correctness is high which can be discuss as below :-

XI. SIGNIFICANCE OF QUALITY OF CORRECTNESS

I. Memberships Functions of Quality of Correctness with 4 inputs (Reliability , Functionality , Traceability , Completeness

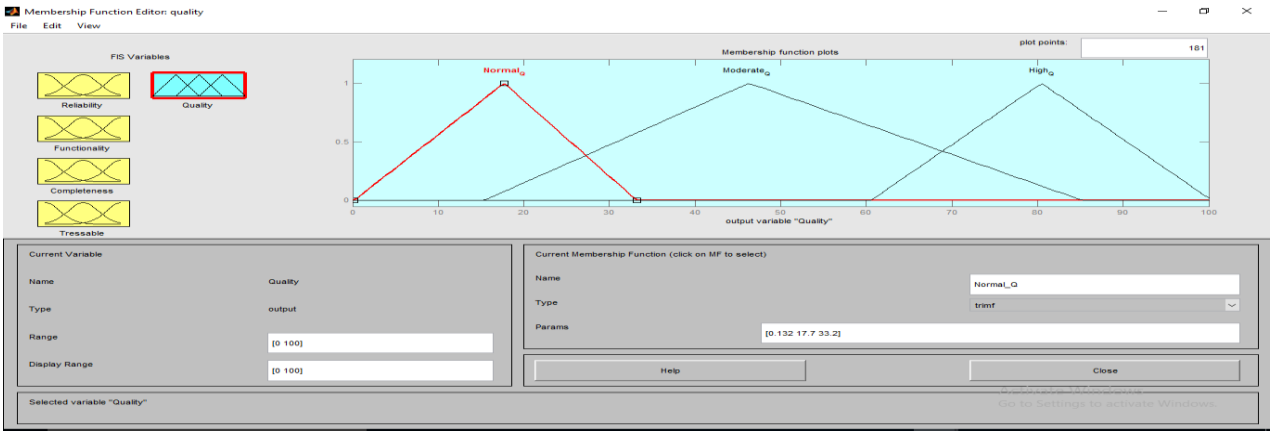

Figure 5 Membership Function of Quality of Correctness

II. Memberships Functions of Reliability

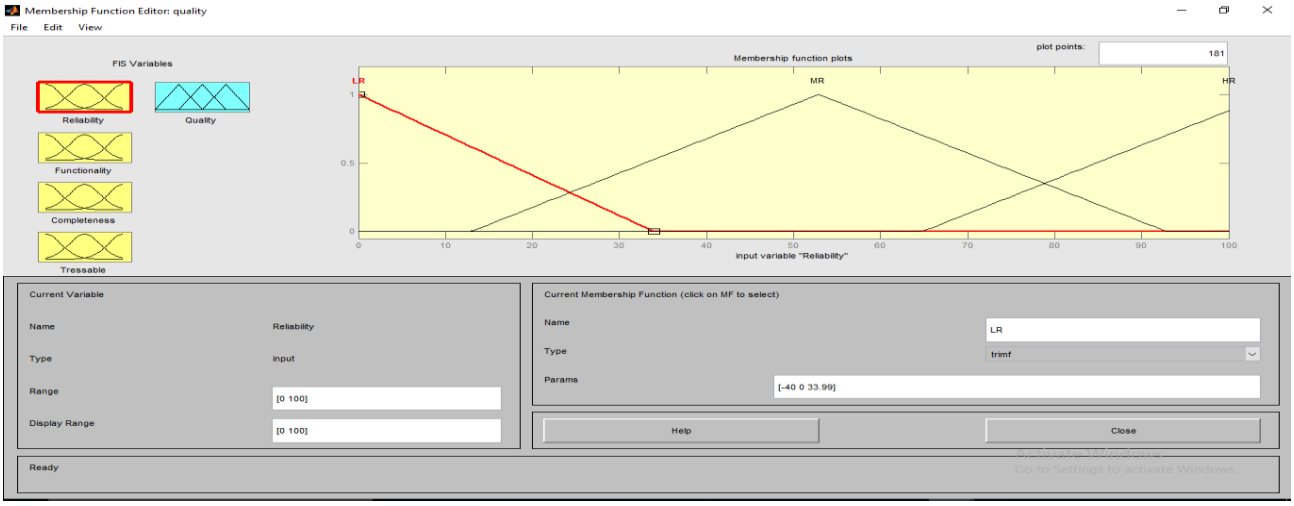

Figure 6 Membership Function of Reliability

III. Memberships Functions of Functionality

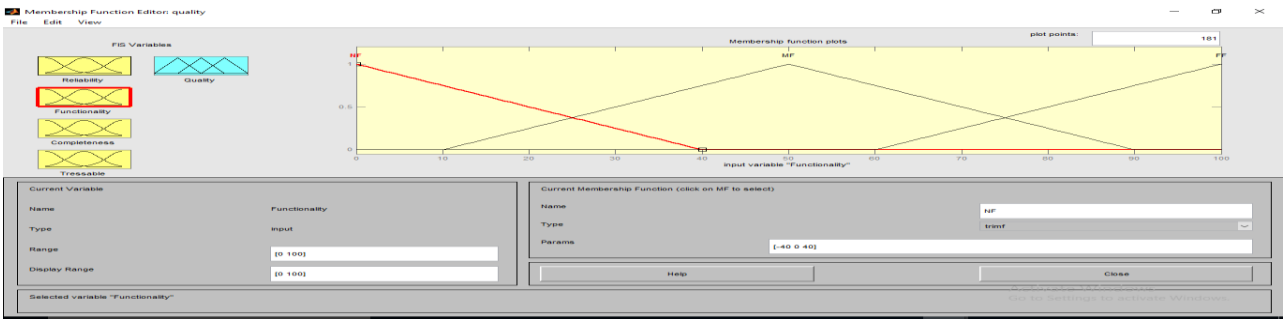

Figure 7 Membership Function of Functionality

IV. Memberships Functions of Traceability

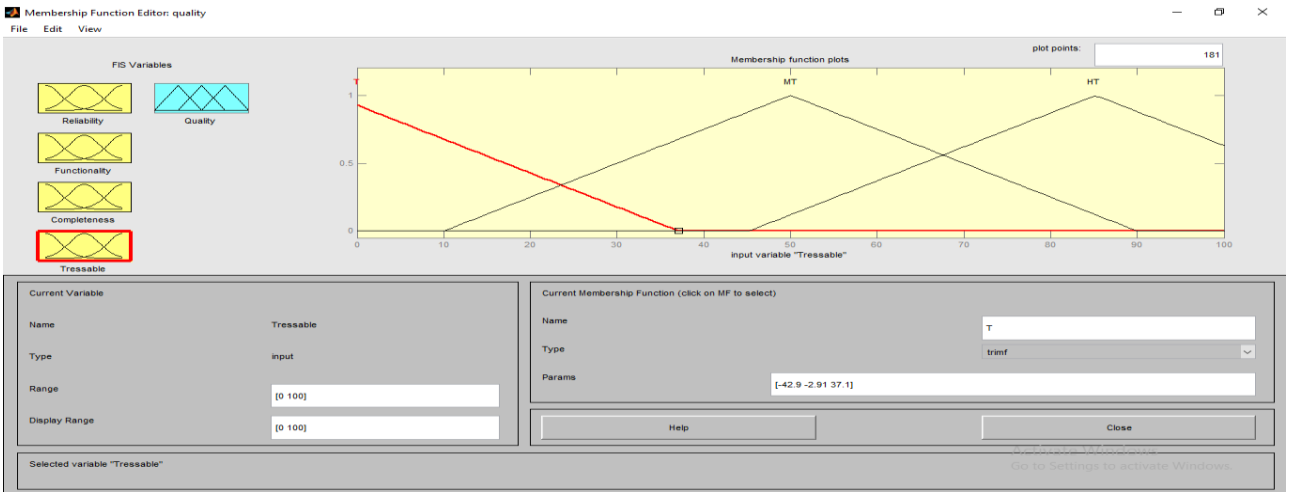

Figure 8 Membership Function of Traceability

V. Memberships Functions of Completeness

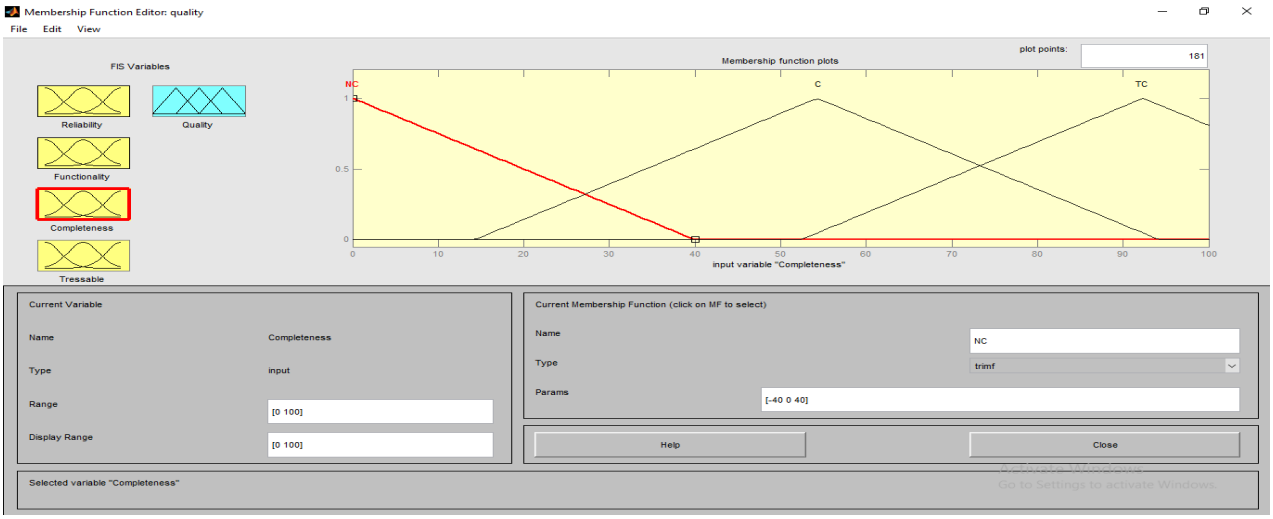

Figure 9 Membership Function of Completeness

VI. Rules 1 shows that the significance of Functionality and Completeness

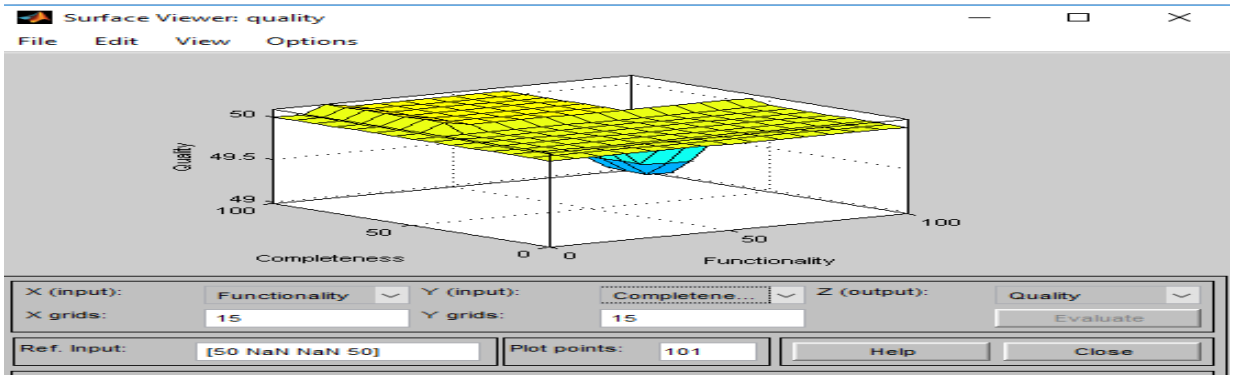

Figure10 Rule 1 significance

VII. Rules 2 shows that the significance of Reliability and Functionality

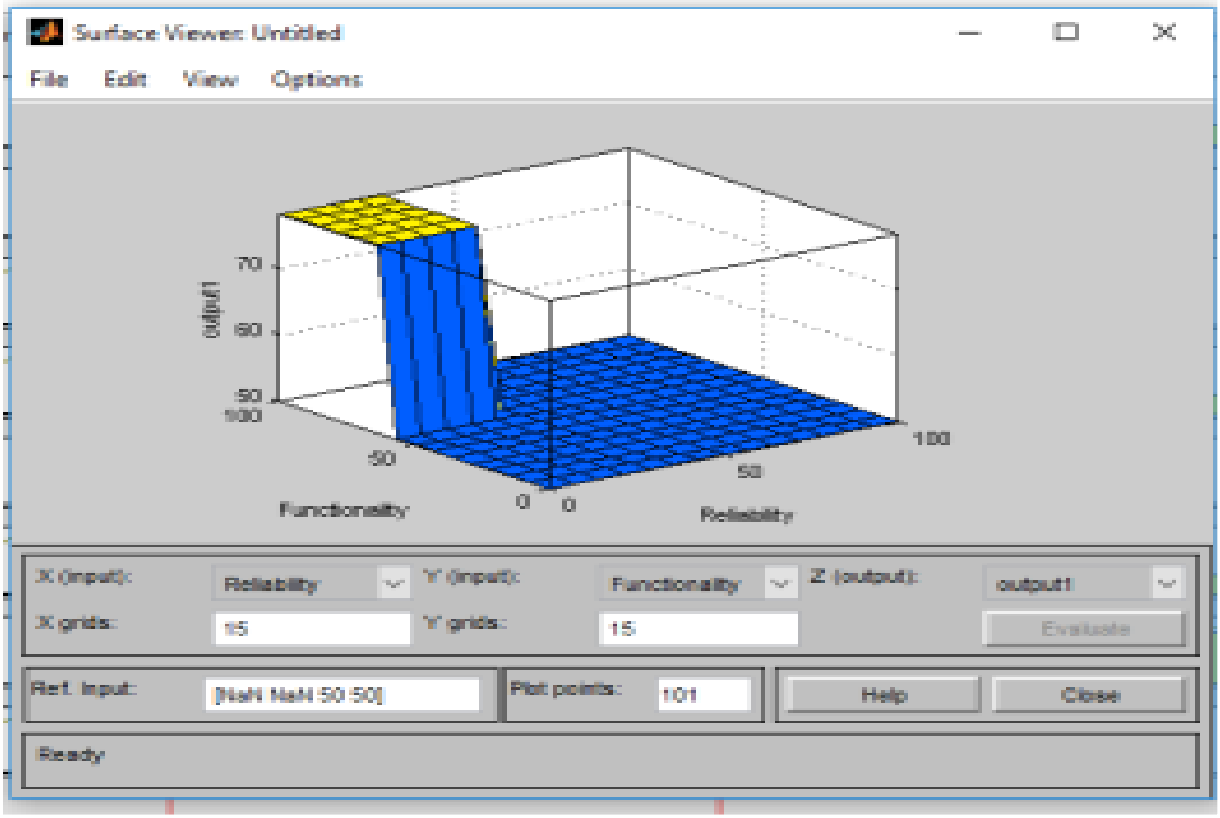

Figure 11 Rule 2 significance

VIII. Rules 3 shows that the significance of Traceability and Completeness

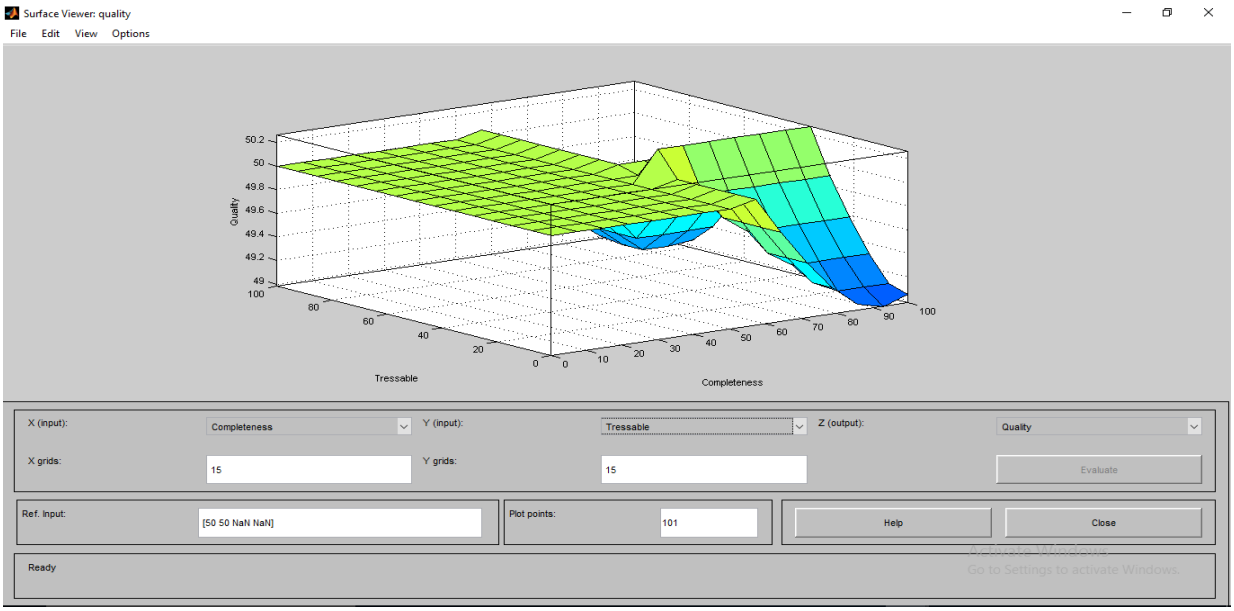

Figure 12 Rule 3 Significance

XII. RULES FOR SECURITY

In this section there are several set of the golden rules for predicting security (Authentication, Authorization Confidentiality , Integrity) for estimating effectiveness of e-procurement system ,where US is Ultra Sensitive , S is Sensitive , MS is Moderate Sensitive , LS is Less Sensitive in A, B, C project type where each element of X is mapped to a value between 0 and 1 which can be discuss in table2 as below:-

	Table 2 Fuzzy based Golden Rules and Prediction for Security models					
Project Group	**Project**	**Authentication AQM $^{E\text{-}PROC}$**	**Authorization AUQM $^{E\text{-}PROC}$**	**Integrity IQM $^{E\text{-}PROC}$**	**Confidentiality CAM $^{E\text{-}PROC}$**	**Security SAM $^{E\text{-}Proc}$**
Group A	P_{tyoeA}	S	S	LS	LS	MS
	P_{typeA}	LS	S	MS	S	S
	P_{typeA}	S	S	MS	S	US
	P_{typeA}	S	MS	LS	S	US
	P_{typeA}	MS	S	LS	LS	MS
Group B	P_{typeB}	MS	S	MS	MS	MS
	P_{typeB}	US	S	S	S	US
	P_{typeB}	US	S	S	S	US
	P_{typeB}	LS	S	US	US	US
	P_{typeB}	S	S	MS	MS	US
Group C	P_{typeC}	S	S	S	US	US
	P_{typeC}	S	S	LS	MS	MS
	P_{typeC}	S	S	US	MS	US
	P_{typeC}	MS	MS	S	S	MS

XIII. SIGNIFICANCE OF SECURITY

IX. Memberships Functions of Security with 4 inputs (Authentication , Authorization , Integrity , Confidentiality)

Range (0 >= Input factor <= 1)
Ultra-Sensitive (US) (1.0 to 0.8 represents US) **{AQM $^{E\text{-}PROC}$ *U* AUQM $^{E\text{-}PROC}$ *U* IQM $^{E\text{-}PROC}$ *U* CAM $^{E\text{-}PROC}$} =CS $^{E\text{-}PROC}$**
RULE 1
if Binary SUM of all inputs has at least 1-US AND 1-MS **then Priority High (Highly Secure)**
Sensitive(S) (0.7 to 0.6 represents S) **{AQM $^{E\text{-}PROC}$ *U* AUQM $^{E\text{-}PROC}$ *U* IQM $^{E\text{-}PROC}$ *U* CAM $^{E\text{-}PROC}$} =CS $^{E\text{-}PROC}$**
RULE 2
if Binary SUM of all inputs has at least 1-US OR 1-MS **then Priority Tends High (Highly Secure)**
Moderate Sensitive (MS) (0.5 to 0.4 represents MS) **then Priority tends to Normal (Secure)** **{AQM $^{E\text{-}PROC}$ *U* AUQM $^{E\text{-}PROC}$ *U* IQM $^{E\text{-}PROC}$ *U* CAM $^{E\text{-}PROC}$} =CS $^{E\text{-}PROC}$**
RULE 3
if Binary SUM of all inputs has at Most 1-MS AND 3-S **then Priority tends to Below expectation (Less Secure)**
Less Sensitive (LS) (0.3 to 0.0 represents LS) **{AQM $^{E\text{-}PROC}$ *U* AUQM $^{E\text{-}PROC}$ *U* IQM $^{E\text{-}PROC}$ *U* CAM $^{E\text{-}PROC}$} =CS $^{E\text{-}PROC}$**
RULE 4
if Binary SUM of all inputs has at least 1-LS or 1-MS **then Priority tends to Not as expectation (Almost Less Secure)**

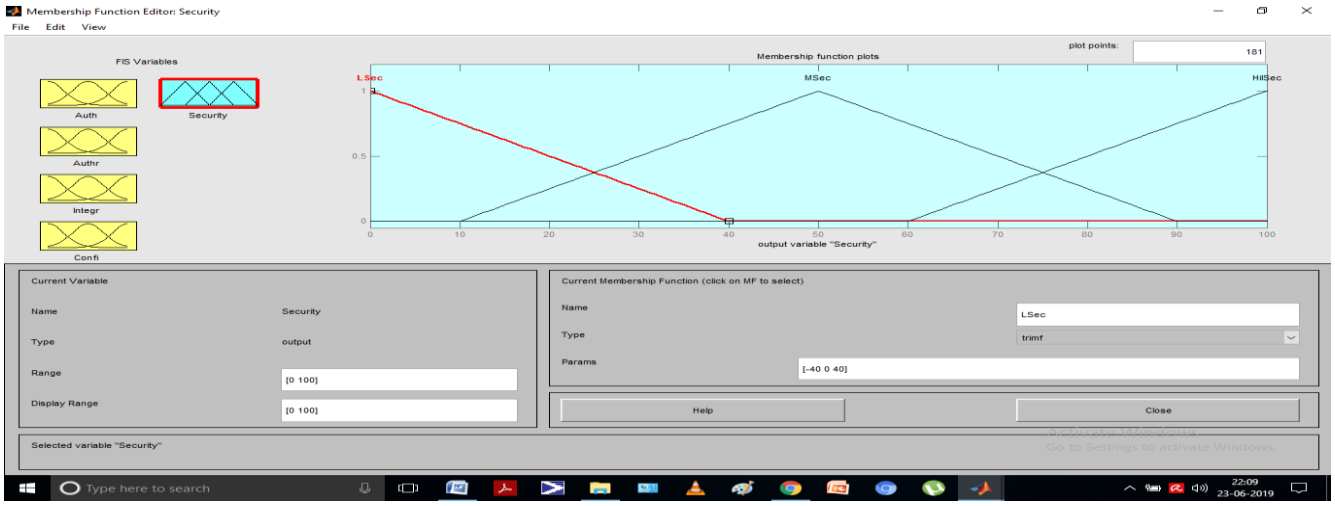

Figure 13 Membership Function of Security

X. Memberships Functions of Authentication

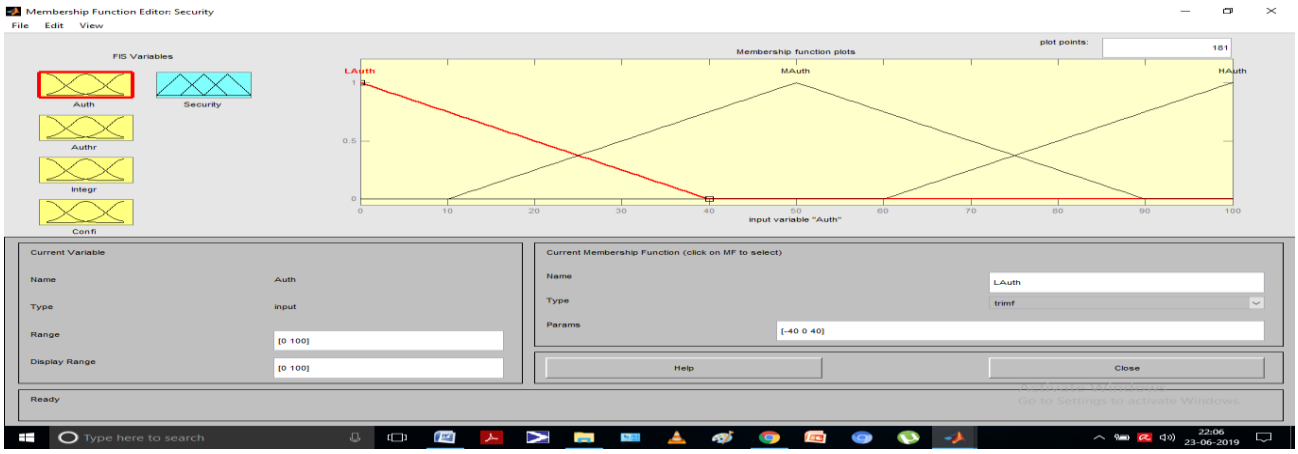

Figure 14 Membership Function of Authentication

XI. Memberships Functions of Authorization

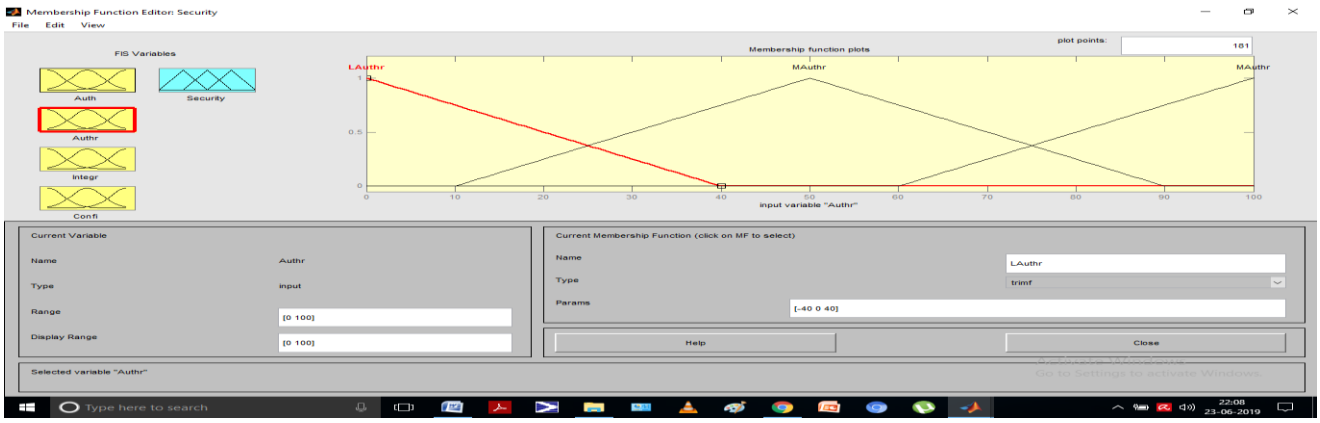

Figure 15 Membership Function of Authorization

XII. Memberships Functions of Integrity

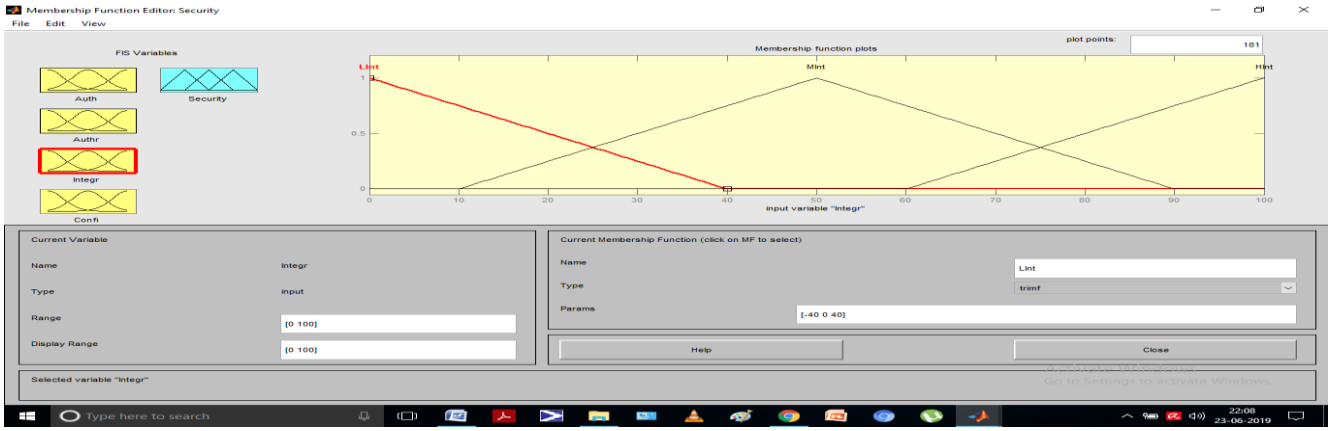

Figure 16 Membership Function of Integrity

XIII. Memberships Functions of Confidentiality

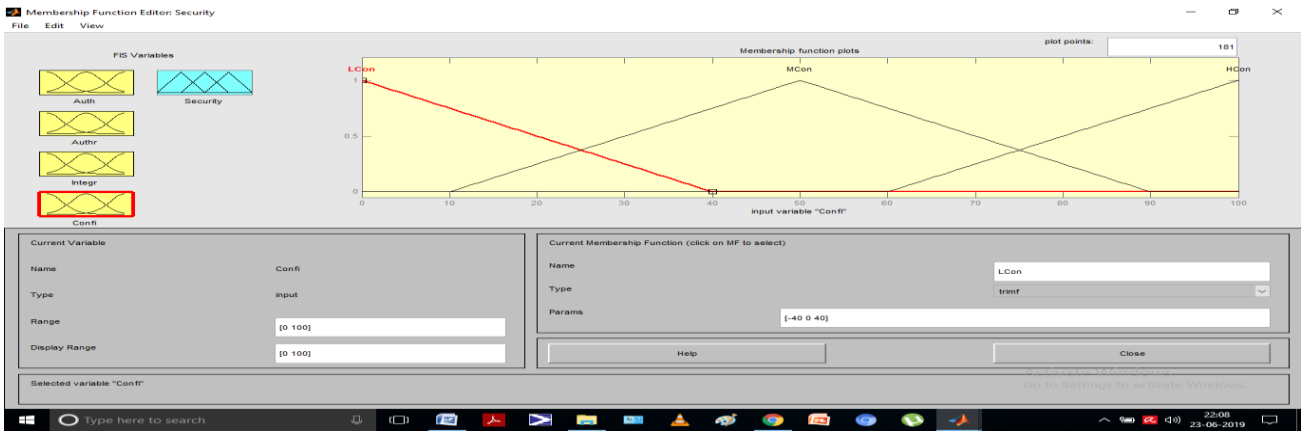

Figure 17 Membership Function of Confidentiality

XIV. Rules 1 shows that the significance of Authorization and Confidentiality

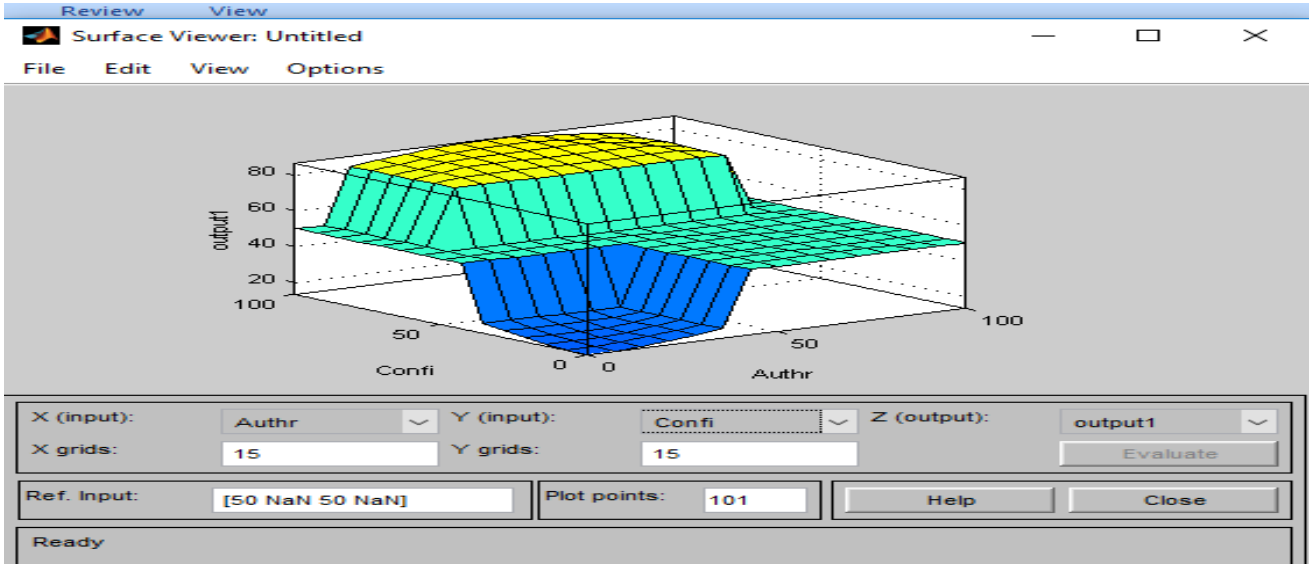

Figure 17 Rules 1 for Authorization and Confidentiality

XV. Rules 2 shows that the significance of Authentication an Authorization

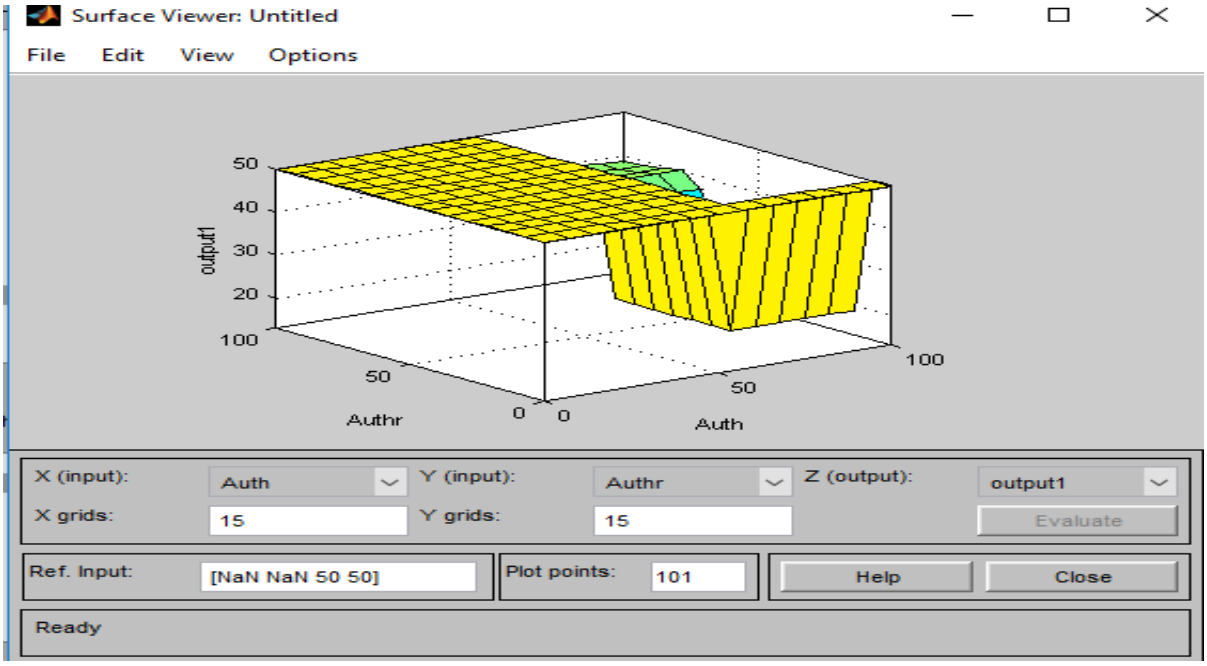

Figure 18 Rules 2 for Authorization and Authentication

XVI. Rules 3 shows that the significance of Integrity and Confidentiality

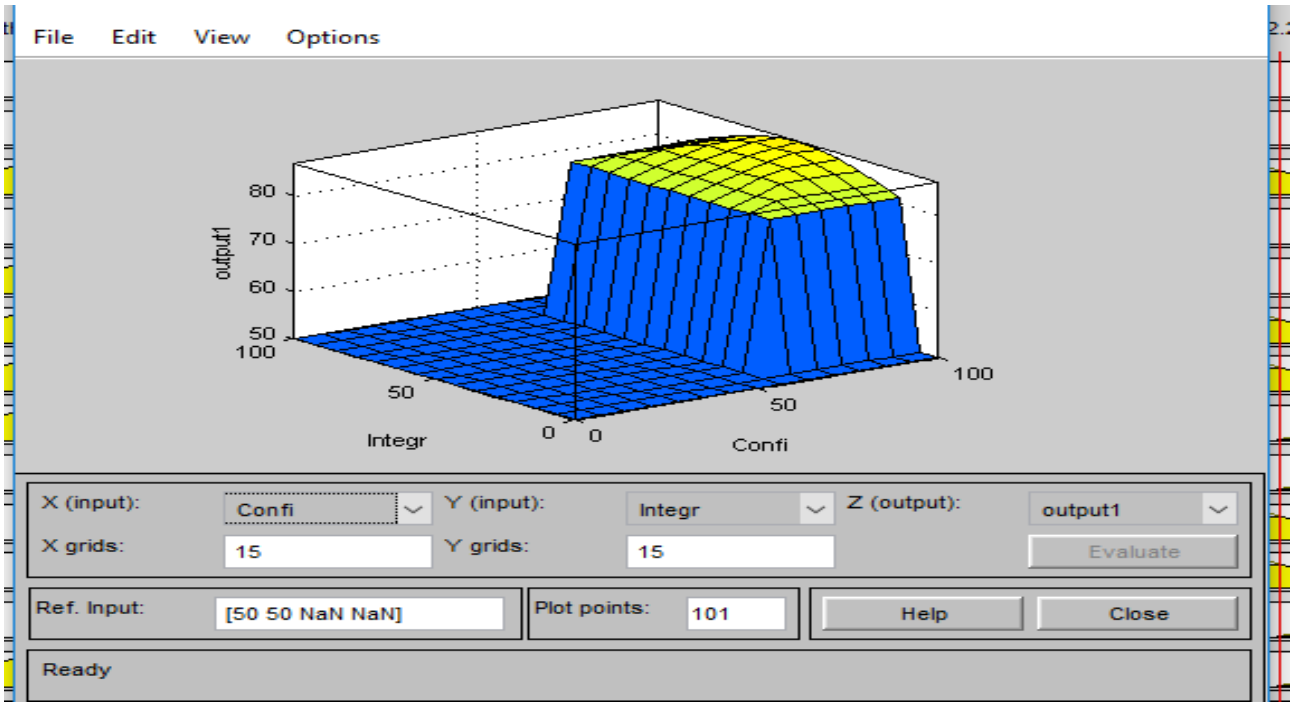

Figure 18 Rules 3 for Integrity and Confidentiality

XIV. RULES FOR EFFECTIVNESS

In this section there are several set of the golden rules for effectiveness of e-procurement system with the help of quality of Correctness and Security in A, B, C project type where each element of X is mapped to a value between 0 and 1 where E+ is a Highly Effective , E is Effective and E- is Almost Effective which can be discuss in table2 as below:-

Table 3 Fuzzy based Golden Rules and Prediction for Effectiveness models			
PROJECT	QUALITY OF CORRECTNESS (QCAM $^{E\text{-}PROC}$)	SECURITY (SAM $^{E\text{-}Proc}$)	EFFECTIVENESS (EAM $^{E\text{-}Proc}$)
P_1	MC	S	E-
P_2	MC	US	E
P_3	C	US	E-
P_4	C	US	E
P_5	C	MS	E
P_6	C	MS	E+
P_7	MC	MS	E-
P_8	C	MS	E+
P_9	MC	US	E-
P_{10}	MC	US	E-

RULE 1	Highest Priority E+ if (>=C AND <=US) Then Highly Effective
RULE 2	Moderate Priority E if (<= C AND > =MS) Then Effective
RULE 3	Less Priority E- if (>=LC AND <=LS) Then Almost Effective

2. SIGNIFICANCE OF EFFECTIVNESS

XVII. Memberships Functions of Quality of Correctness

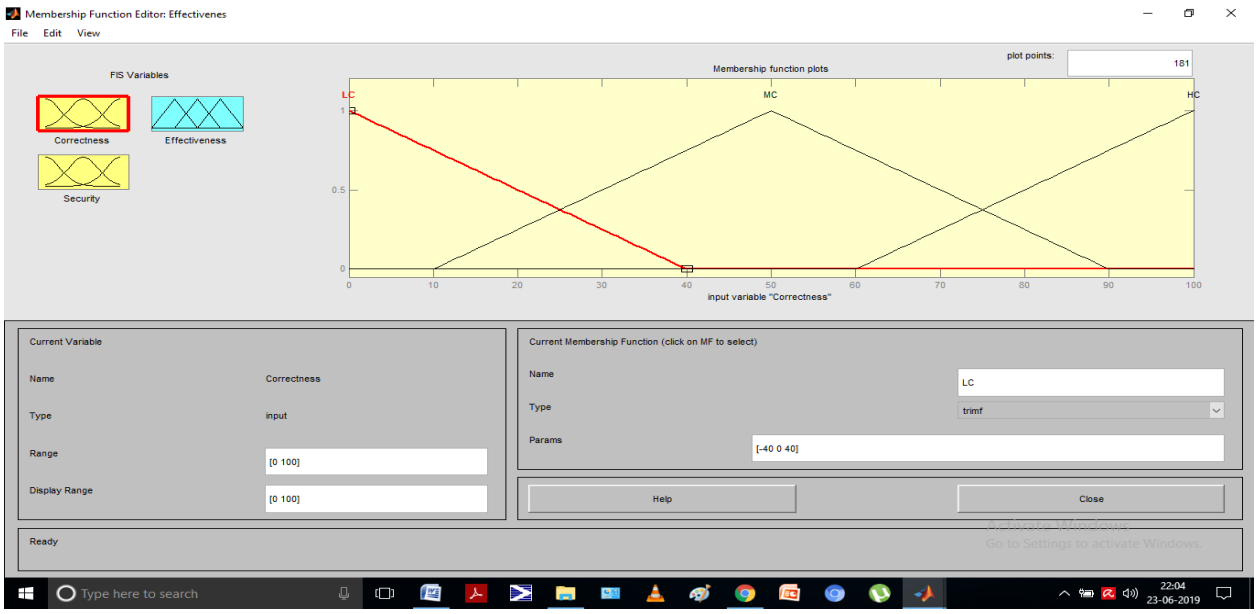

Figure 19 Membership Function of Quality of Correctness

XVIII. Memberships Functions of Quality of Security

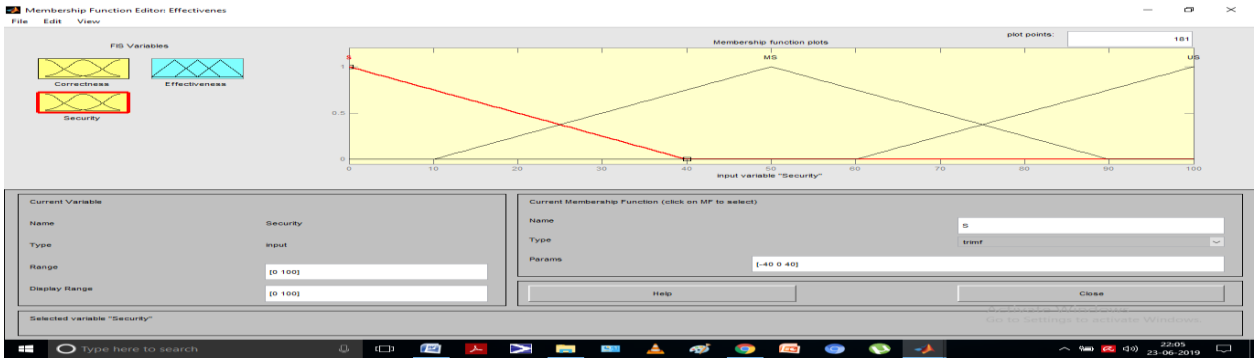

Figure 20 Membership Function of Security

XIX. Memberships Functions of Effectiveness with 2 Inputs

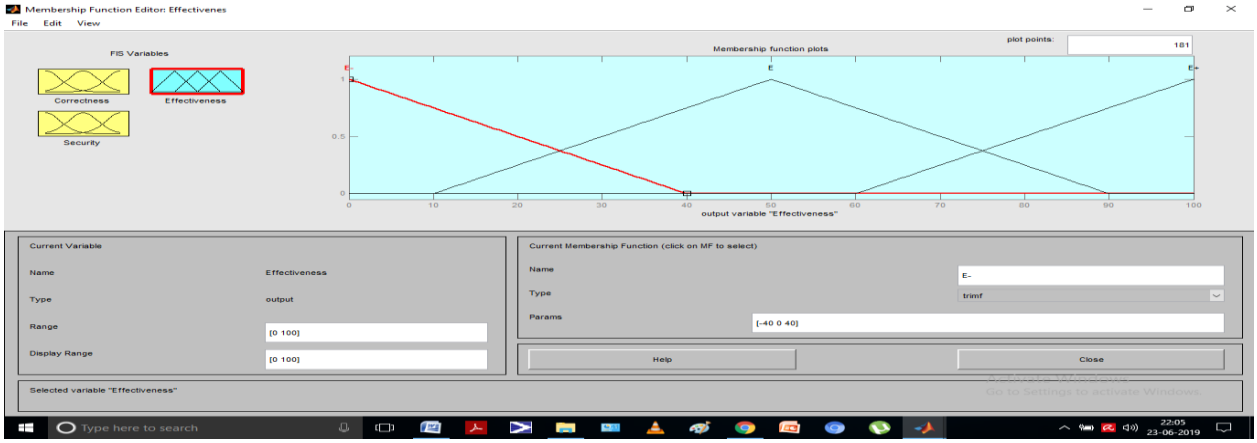

Figure 21 Membership Function of Effectiveness

XX. Rules shows that the Significance of Quality of correctness and Security

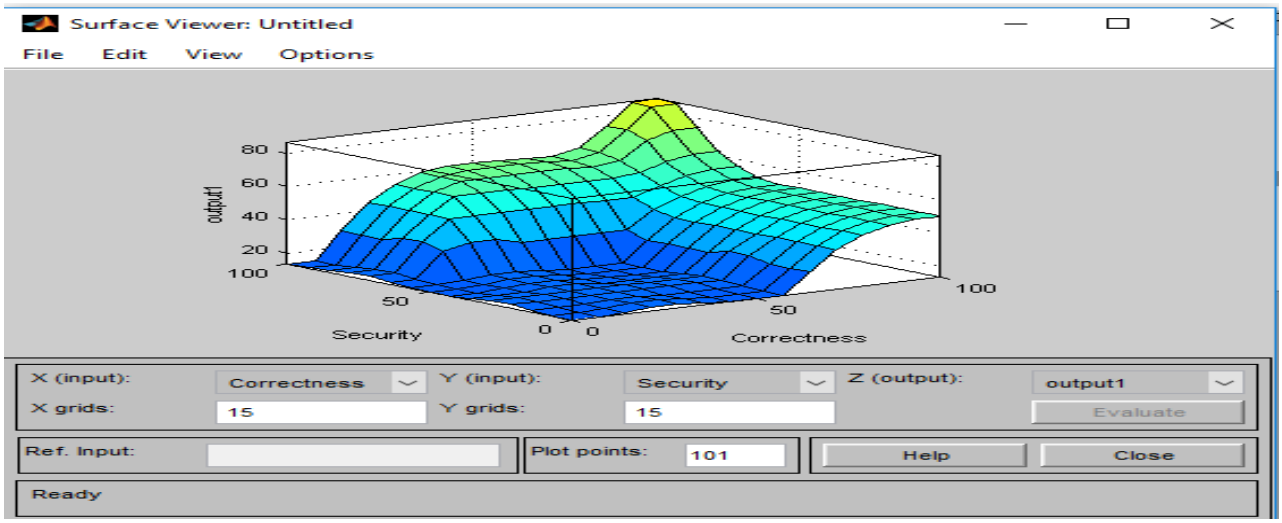

Figure 22 significance Rules of Effectiveness

XV. CONCLUSION

After selecting and predicting rule set for quality of correctness, security and effectiveness of e-procurement system on cloud, this article has set the prediction based results for the acceptance of these model models in public cloud domain. Here cloud security and correctness factors are used that are connected with user's acceptance and adoption of e-procurement systems, which include correctness issues and security issues and the support conventional from the complete environment of the e-procurement system. In this evaluation, presented Fuzzy based graph and show the impact on factors.

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