CHAPTER – 4

ECONOMIC PERFORMANCE AUDIT TRAIL ASSESSMENT (EPAT)-ALGORITHM

4.1 Inception

As the part of auditor assessment task in finding potential service provider and evaluating the economy attribute is a burdensome issue in SaaS environment. The evaluating economics for a potential service provider by an auditor exhibit the concept in minimization of cost of resources utilization which includes the variables of time, quality and quantity. Auditor assessment task carried with impartial, transparent constructive applicative approach which delivers the assessment report of the specific active stake holders. The inception of this EPAT under take cloud consumer preferences and potential service provider service offerings with their mutual concern and encompasses the ethical, technical and conditional analyses towards generation of assessment report. The construction part of this EPAT encounters many research scripts expecting solution for our research problem. The EPAT constructive modules are segmented as assortment, assimilation phases, algorithm is illustrated mathematically, and the working condition algorithm was outlined.

4.1.1 EPAT Design Background

The design background of EPAT encounters proximity of different service provider attributes from important research scripts. Service oriented architectures enhance data usage with some classifications techniques. Most of the software systems are customised for a specific application needs. Data provenance enables the features of security, integrity, and reliability of data. Data provenance can be used for different cloud services to evaluate quality of service utilization. The web services encompasses with data processing where provenance exhibits the features of scalability, accountability, verifiability for audit trails. The real time data can be reusable by studying data life cycle, service volume of data with the concept of reusability for data integrity. Data service monitoring with data integrity checking gives out reliability analysis. The role of provenance manager classifies the data for

the type of participants with messages is addressed. A distinguished table of data provenance legacy and provenance for service oriented was tabulated.[65]

Current day web application need internet as medium in sharing of data and resources in a distributed cloud environments. Many web applications encounter the task of sharing data, modifying intermediate data for some computations are noticed. The diplomatic role of provenance can help for the above stated issues through audit trail where the lineage of actions, process and workflows are recorded. Provenance can be used in scientific, distributed and network environments. The provenance can also be used in social networking in capturing the data as primary need which can be analyzed basing on different provenance models.[66]

Many service oriented architecture operations and tasks are tagged with multi versions and multi functionalities in justifying the quality of service. Provenance adoption is one of the solutions in achieving better outcomes in the concept of dependability and recoverability. Dependability issue show case different services and their workflow for most of the instances in failure state. The recording of history of data in a provenance is a better aware solution in many fault tolerance schemes.[67] Cloud platform services can also be enabled by mobile devices where brokering architectures promotes different utility mechanisms that help for consumer and provider. Quality of service parameters like response time, availability, and reputations are aggregated with utility equation. Cloud brokering services intermediate between consumer and provider with four signalling flags like attribute mapping, analysis, scheduling and monitoring.[68]

4.2 Design Assumptions of EPAT Algorithm

The SaaS services in cloud environment are assessed by auditor for independent assessment to ensure the predefined quality of service utilization. To our resource we undertake a scenario based provenance as a coarse grained approach which was limited to store the data of service providers provisioning and cloud consumer's preferences rather than their intermediate computations. Our research problem targets auditor assessment on service providers provisioning of services towards consume preferences. The acquired data from the provenance was handover to the auditor with the mutual concern of provider and consumer for this assessment task.

4.2.1 Allotment phase

Basing on earlier studies, efforts and principles our investigation towards research problem was elevated in this allotment phase. In the process of SaaS provisioning the task of identifying quality of service attributes decides a prominent role in judging the potential service provider. This complex task is overcome by deploying Grey system theory and its approach in deciding and distinguishing quality of service attributes in minimizing the uncertainty levels as a first step. The snap shot table from chapter 3.4.1 is taken as a baseline support and transform the value of attributes in a normalized consistency manner for computations. By taking the support of Grey scale system theory service provider table which contains the quality of service attributes are identified for the applicative demonstration of Grey scale approach [69]. From the chapter table 3.4.2 the quality of service attributes are differentiated as utility driven and cost driven attributes.

4.2.2 Assimilation phase

In the line of aggregating attributes for computation a strong mathematical formulations are endorsed for the allotment attributes. It is considered that each service provider was identified with SaaS_ID as SP1, SP2.....so on up to SPk. Every service provider provisions his list of services as availability, reliability, cost and response time. The identification of utility driven attributes are noted as availability and reliability. The identification of cost driven attributes are noticed as cost and response time. In the way of finding utility score of each service provider computations are done for utility driven attributes and cost driven attributes separately basing on specific mathematical formulas. Grade assessment was acquired basing on utility score prioritizing highest value of obtained utility score that shows the potential service provider as the best.

4.3 Formulating the Algorithm

The evaluation of our research problem is accomplished with depicting of flow chart and algorithm process clearly. The working illustration of EPAT Algorithm was outlined for some service providers with mathematical formulations

4.3.1 Flowchart for the Algorithm-(EPAT)

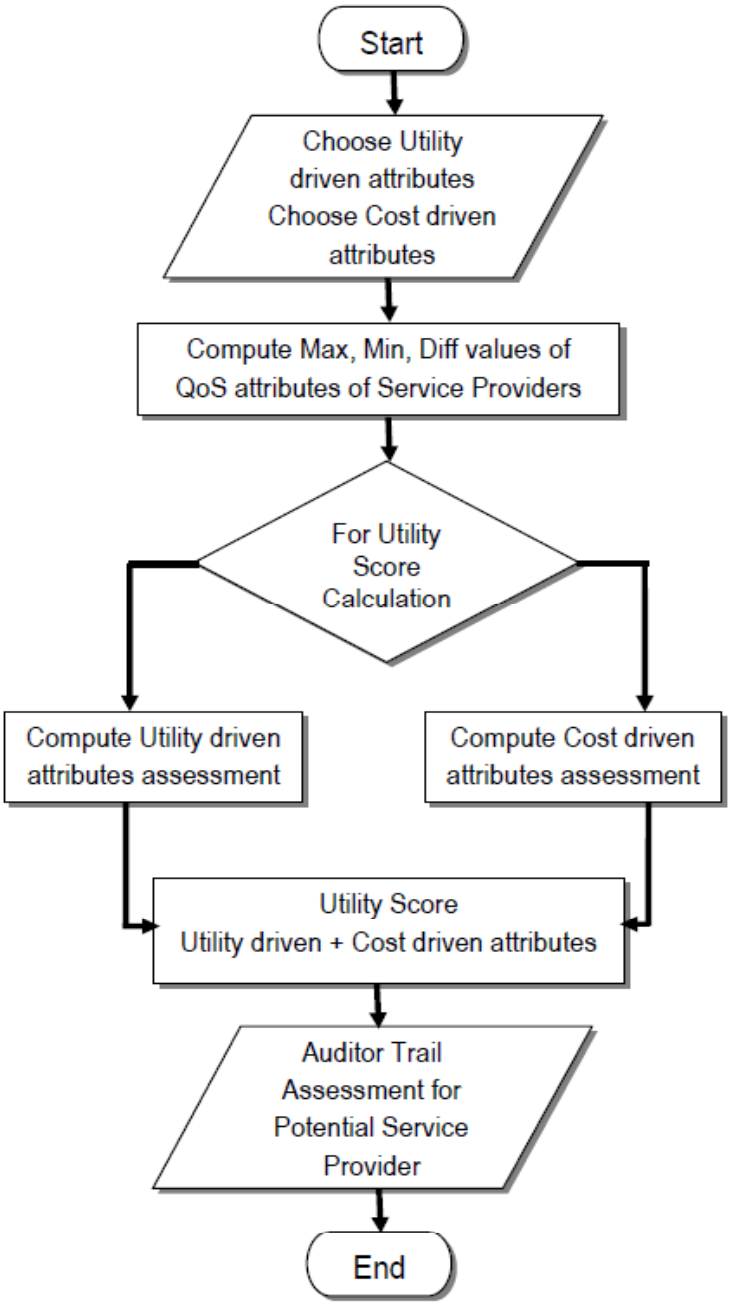


Fig 4.3.1 Flowchart of EPAT Algorithm

4.3.2 Algorithm-(EPAT) process

Step1: Let Quality of Service attributes defined as Q= {q_1, q_2 ....q_n}

ie., q_1 be the Quality of Service attribute... may be
[Availability, Reliability, Response time and Cost]
Where Q is normalized for the consistency of computations,
So that, the values lie between [0 and 1]

Step2: Let Potential Service Provider list with their service offerings is denoted as

SP= {SP1, SP2 ....SPk}
Where SP1= Q{q_1,q_2,....q_n}
Where SP2= Q{q_1,q_2,....q_n}
....
....
Where SPk= Q{q_1,q_2,....q_n}

ie., q_1 be the Quality of Service attribute... may be
[Availability, Reliability, Response time and Cost]

Step3: Let Quality of Service attributes are classified as Utility driven attributes (UD) and Cost driven attributes (CD)

ie., Condition : Utility driven attributes (UD) should maximized
and Cost driven attributes (CD) should minimized

Step4: Find the Max value for each Quality of Service attribute of SP

ie., Let MaxQ={Maxq_1,Maxq_2....Maxq_n}

Step5: Find the Min value for each Quality of Service attribute of SP

ie., Let MinQ={Minq_1,Minq_2....Minq_n}

Step6: Compute the Difference value using Step4 & Step5 of Quality of Service attribute

ie., Let Dv={(Maxq_1- Minq_1), (Maxq_2- Minq_2),..... (Maxq_n- Minq_n)}

Step7: Auditor Assessment of Quality of Service attributes of SP offering list for Utility driven attributes (UD) computed as

ie., $UD=q_n\text{-}Minq_n / Dv(q_n)$

Step8: Auditor Assessment of Quality of Service attributes of SP offering list for Cost driven attributes (CD) computed as

ie., $CD=Maxq_n\text{-}q_n / Dv(q_n)$

Step9: Auditor computes the Utility score SP offerings basing on Step7 & Step8 computed as

ie., $Us=SPk\{UD_n+CD_n\}$

Step10: Auditor computes the Grade of each Service provider of SP basing on Step9 Utility score Us

ie., Condition if Us is Maximum, treated as 1 which show highest priority Grade

4.3.3 Working Illustration of (EPAT) Algorithm

The complexity arises in identification of quality of service attributes as they exhibit numerical values with slight differences. More over the undertaken availability and reliability values are in between 0 and 1 based on the Table 3.4.2 where as cost and response time numerical values show major differences. To overcome this problem we incorporate the above said values to a common scale structure ie., general normalization was used. As we said availability and reliability values are consistent between 0 and 1 as normalized. The values of cost and response time may not be consistent between 0 and 1. We normalized this cost and response time attributes by taking the highest value from that specified column and divided to that individual service provider offering. Finally the reorganized Table 3.4.2 was constituted for EPAT algorithm computations.

In establishing computations for this EPAT Algorithm we take four service providers impartially and randomly from the dataset Table 3.4.2.

SaaS_ID	Availability	Reliability	Cost($)	Response Time(ms)
SP3	0.99935	0.99962	0.168	0.3
SP10	0.99958	0.99956	0.484	0.3
SP17	0.99952	0.99967	0.638	0.5
SP24	0.99999	0.99992	0.508	0.5

Table 4.3.3.1 Service Providers with QoS attributes for offering

For SaaS_ID SP3

Choosing Utility driven attributes are Availability and Reliablity

Availability = 0.99935

Reliability=0.99962

Choosing Cost driven attributes are Cost and Response Time

Cost = 0.168

Response Time=0.3

Compute Max Value of QoS attributes Availability MaxQ=0.99999

Compute Min Value of QoS attributes Availability MinQ=0.99911

Compute Max Value of QoS attributes Reliability MaxQ=0.99992

Compute Min Value of QoS attributes Reliability MinQ=0.9995

Compute Max Value of QoS attributes Cost MaxQ=0.804

Compute Min Value of QoS attributes Cost MinQ=0.134

Compute Max Value of QoS attributes Response Time MaxQ=0.7

Compute Min Value of QoS attributes Response Time MinQ=0.2

Compute Difference Values of QoS attributes Availability Dv=0.00088

Compute Difference Values of QoS attributes Reliability Dv=0.00042

Compute Difference Values of QoS attributes Cost Dv=0.67

Compute Difference Values of QoS attributes Response Time Dv=0.5

Audit Trail in Calculation Utility driven attributes Availability

$$UD=q_n\text{-}Minq_n / Dv(q_n)$$

$$UD = \frac{0.99935 - 0.99911}{0.00088}$$

$$UD=0.272727273$$

Audit Trail in Calculation Utility driven attributes Reliability UD=0.285714286

Audit Trail in Calculation Cost driven attributes Cost

$$CD=Maxq_n\text{-}q_n / Dv(q_n)$$

$$CD=\frac{0.804 - 0.168}{0.67}$$

$$CD=0.949253731$$

Audit Trail in Calculation Cost driven attributes Response Time CD=0.8

Audit Trail for Summative Assessment of Utility driven attributes UDn

UDn=SPk(Availability)+SPk(Reliablity)

UDn=0.272727273 + 0.285714286

Audit Trail for Summative Assessment of Cost driven attributes CDn=

CDn= SPk(Cost)+SPk(Response Time)

CDn= 0.949253731+ 0.8

Auditor computes the Utility score of Service Provider Us

Us= UDn + CDn

Us=0.558441559 + 1.749253737

Us= 2.307695296

QoS Attributes	Max Value	Min Value	Difference Values
Availability	0.99999	0.99911	0.00088
Reliability	0.99992	0.9995	0.00042
Cost($)	0.804	0.134	0.67
Response Time(ms)	0.7	0.2	0.5

Table 4.3.3.2 Reckoned computations of MaxValues, Min Values and Difference Values of QoS attributes of the Service Providers

SaaS_ID	Availability	Utility driven Computation of Availability
SP3	0.99935	0.272727273
SP10	0.99958	0.534090909
SP17	0.99952	0.465909091
SP24	0.99999	1

Table 4.3.3.3 Reckoned computations of Utility driven attribute Availability

SaaS_ID	Reliability	Utility driven Computation of Reliability
SP3	0.99962	0.285714286
SP10	0.99956	0.142857143
SP17	0.99967	0.404761905
SP24	0.99992	1

Table 4.3.3.4 Reckoned computations of Utility driven attribute Reliability

SaaS_ID	Cost($)	Cost driven Computation of Cost($)
SP3	0.168	0.949253731
SP10	0.484	0.47761194
SP17	0.638	0.247761194
SP24	0.508	0.441791045

Table 4.3.3.5 Reckoned computations of Cost driven attribute Cost

SaaS_ID	Response Time(ms)	Cost driven Computation of Response Time(ms)
SP3	0.3	0.8
SP10	0.3	0.8
SP17	0.5	0.4
SP24	0.5	0.4

Table 4.3.3.6 Reckoned computations of Cost driven attribute Response Time (ms)

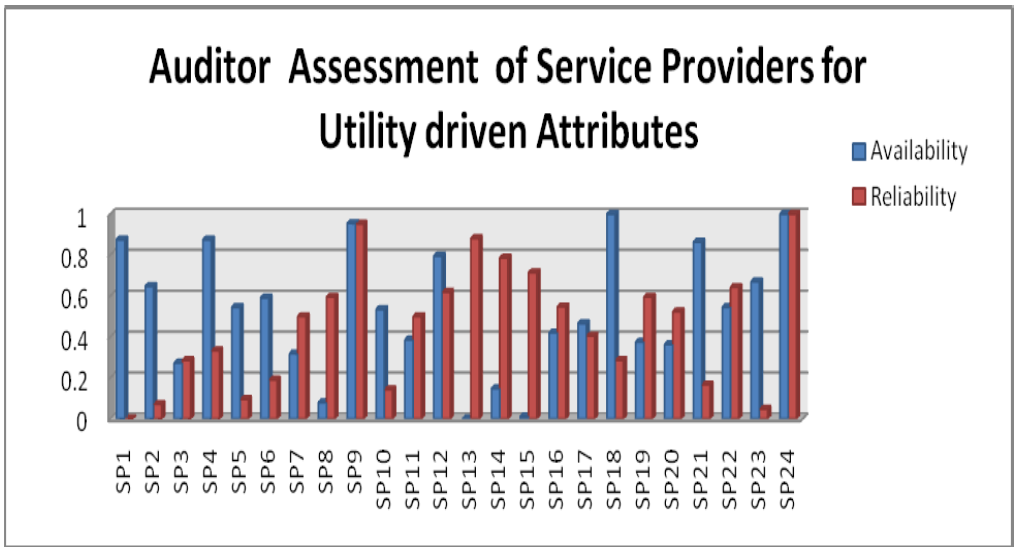
SaaS_ID	Utility Score
SP3	2.30769529
SP10	1.95455999
SP17	1.51843219
SP24	2.84179104

Table 4.3.3.7 Reckoned computations of Utility Score for QoS attributes of Service providers

SaaS_ID	Utility driven attribute Assessment	Cost driven attribute Assessment	Utility Score	GRADE Assessment
SP1	0.875	0.919402985	1.794403	18
SP2	0.719155844	1.062686567	1.7818424	19
SP3	0.558441558	1.749253731	2.3076953	6
SP4	1.208333333	0.8	2.0083333	13
SP5	0.640692641	1.423880597	2.0645732	11
SP6	0.781385281	0.737313433	1.5186987	21
SP7	0.818181818	0.208955224	1.027137	24
SP8	0.67478355	1.444776119	2.1195597	10
SP9	1.906926407	0.280597015	2.1875234	8
SP10	0.676948052	1.27761194	1.95456	15
SP11	0.886363636	0.519402985	1.4057666	23
SP12	1.414502165	1	2.4145022	5
SP13	0.880952381	1.552238806	2.4331912	4
SP14	0.933441558	1.250746269	2.1841878	9
SP15	0.725649351	0.859701493	1.5853508	20
SP16	0.968073593	1.32238806	2.2904617	7
SP17	0.870670996	0.647761194	1.5184322	22
SP18	1.285714286	1.486567164	2.7722814	2
SP19	0.970238095	0.994029851	1.9642679	14
SP20	0.887445887	0.982089552	1.8695354	17
SP21	1.03030303	1.014925373	2.0452284	12
SP22	1.188311688	1.388059701	2.5763714	3
SP23	0.718073593	1.191044776	1.9091184	16
SP24	2	0.841791045	2.841791	1

Table 4.3.3.8 Computation of Utility Score from Utility driven and Cost driven attributes

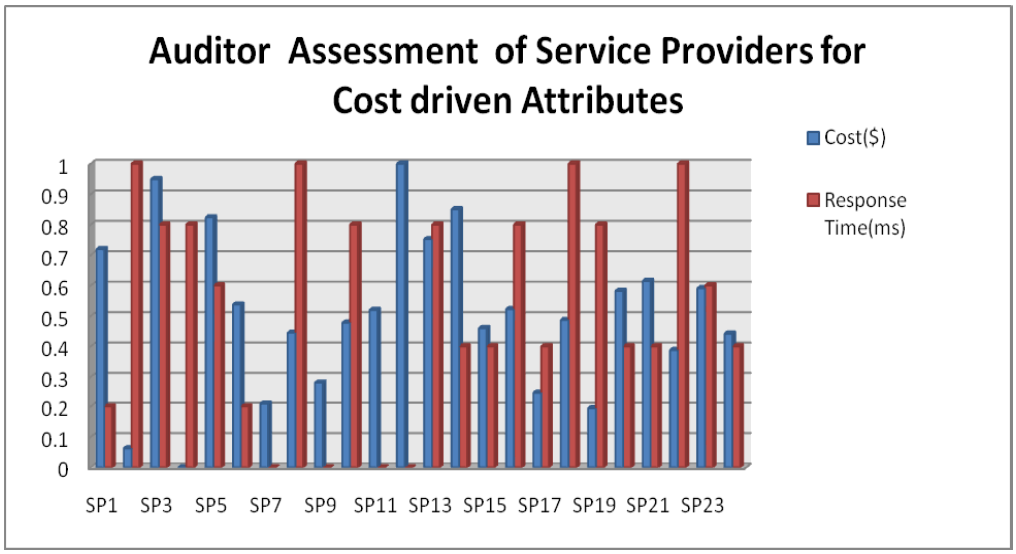
From the Reckoned Computations tables Table 4.3.3.2 discloses the calculation of Max, Min, Difference values of QoS attributes of the Table 3.4.2. The Reckoned tables 4.3.3.3, 4.3.3.4 for Utility driven attributes. The Reckoned tables 4.3.3.5, 4.3.3.6, related to Cost driven attribute computations. The Table 4.3.3.7 discloses the Utility score computation of the illustrated service provider of the algorithm. the Table 4.3.3.8 gives the clear glance about Utility driven attribute and Cost driven attribute assessments with Utility Score.



Graph 4.3.3.1 Audit Trail on Utility driven attributes Availability and Reliability

X-axis: Service Providers Availability & Reliability values

Y-axis: variations in Utility driven attributes



Graph 4.3.3.2 Audit Trail on Cost driven attributes Cost and Response Time

X-axis: Service Providers Cost and Response Time values

Y-axis: variations in Cost driven attributes

4.4 Chapter Summary

EPAT Approach commences with an inception of auditor assessment related to economy justification of each service provider. The design background of EPAT algorithm look through some important research scripts and structures some assumptions for our research problem. Segmentation process as allotment and assimilation phase trigger in formulating of algorithms with more unambiguity. The illustration of algorithm for few service providers helped to showcase the worthiness of EPAT Algorithm.