Evaluating Service Customizability of SaaS on the Cloud Computing Environment

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ABSTRACT
Cloud computing is an important Technology that has become an essential component of the of an IT Industry. Cloud computing is offering everything as a service. The usage of services provided by the cloud is growing drastically. Even though it is a critical issue in order to select and use the potential service on the cloud. SaaS delivery model is used more attractive by many users due to its benefits. To realize these benefits, it demands a standard quality model which helps service users to select software services. In this paper, a new quality model is proposed to evaluate the service customizability of SaaS on the cloud which is a key attribute of SaaS.

Keywords
Software-As-A-Service, Cloud Computing, Classification, Decision Tree.

1 INTRODUCTION
Cloud computing is an attractive and a key computing platform within many organizations and various application domains. The major benefit of cloud computing is that it provides resources as a service via the Internet. There are 3 major service models are available: Infrastructure as a service (IaaS), Platform as a Service (PaaS), Software as a service (SaaS). Each service model is having some specific characteristics and it more suitable for particular situations or cases. In fact on the cloud computing, everything as a service (XaaS) is available like data as service, network as a service, etc. Out of all these service models, Application or Software as a service is software model that allows the users to use the software online without being installed on their local computer. So that there are no need for service users to invest any capital for infrastructure or to purchase software licenses and maintenance. The end user is charged by the service provider for using services and they can adopt pay for use concept. For service provides the cost of installation and maintenance are much optimized because many users access to the same application.

In recent years, Software as a Service (SaaS) has changed that economy of scale to decrease total cost of ownership compared to on-premises solutions. SaaS have been attracting interest among practitioners and researchers to know more and understand better usages. At the present day, there is a lot of growth for service providers as well as service users. Many end users are shifting their business needs towards SaaS model. Many SaaS models are available in the cloud computing environment. The growth of the service users and service providers increasing proportionately. But still service users have been facing difficulty while selecting software services on the cloud that which software service is suitable to their business needs. Thus, selecting a SaaS model became a critical issue for cloud users. To address this issue, a new quality model is required to evaluate software as a service. That could be more helpful for the service users to select the services that meet their preferences. Although, SaaS is derived from the Application Service Provider (ASP) model, SaaS background and architecture are different and therefore also SaaS quality management should be based on different concepts. Initially, this paper is describing existing quality models. Secondly, it explains about the proposed model and its architecture. Thirdly, it's focusing on implementation work and its results analysis. Finally, it concludes, based on the result analysis.

2 RELATED WORK
The work has been done by many researchers towards SaaS evaluation is comparatively very less till the year 2005, afterward, work have been contributed towards SaaS evaluation. Till today, many quality models were introduced to evaluate various services on the cloud in general. But there are only very few quality models were proposed for SaaS. In this paper around 20 research papers were studied thoroughly and analyzed properly based on basic quality attributes.

In the year 2008, the author Si Won Choi and Soo Dong Kim work [1] proposes the broad quality model for evaluating reusability of services published over Service Oriented Architecture. Mainly they targeted reusability as a key factor to evaluate the quality of any service either Atomic or composite. But traditional frameworks have not successfully helped SaaS-specific quality aspects such as reusability and accessibility.

In the year 2009 the work towards SaaS usage have been increased, thus led to implementing some quality models to evaluate the quality of SaaS on the cloud computing environment. Manish Godse and Shrikant Mulik research work [3] presented an approach that has used Analytic Hierarchy Process (AHP) procedure intended for the ranking the product features. So that users of SaaS, can provide ranking to each product. Author's work suggested the use of AHP as quantitative techniques for selection of some particular parameters of a product like Architecture, Vendor Reputation, Cost, Functionality and Usability. Jae Yoo Lee, Jung Woo Lee, Du Wan Chen and Soo Dong Kim's research work [2] demonstrated a complete model for evaluating quality of SaaS thus key features of SaaS have been identified as Reusability, Data Managed by Providers, Customizability, Availability, Scalability, and Pay per Use. And then derived quality attributes from the key features and defined metrics to evaluate the quality attributes.

Yonghe Lu and Bing Sun together analyzed and proposed research work [4] based on identifying constraints of SaaS. Their work with the emphasis more on system performance and security requirement along with industry standardization, business complexity. Their model evaluates enterprise information systems from three aspects: enterprise resource, system features, and SaaS service fitness. From the year 2010 to 2012, the research work towards evaluation of cloud services had been increased vastly, but not specifically towards SaaS evaluation. Qian Tao, Huiyou Chang, Yang Yi1, Chunqin GU presented research work [5] considered different cloud services QoS parameters including time, cost, reliability, availability, reputation and security. Then a trustworthy QoS data computing model is established and trustworthy of any cloud service had been tested by applying PAM clustering. This work is more focused on general services on the cloud which may not meet the specific requirement of trust worth of SaaS, because it is different from other services. Chen Yiming and Zhu Yiwei work [6] presents that Analytic hierarchy process is used to hand pick the best SaaS vendor for enterprises. By means of creating the hierarchy model, analyzing the attributes and calculating the attribute values. With the purpose of this particular method is suitable to select the SaaS vendor but not SaaS product. Jerry Gao, Pushkala Pattabhiraman, Xiaoying Bai w. T. Tsai presented their research work [7] as a new formal graphic models and metrics to evaluate SaaS performance and scalability features. The results have shown best potential application and effectiveness of the proposed model for evaluating SaaS scalability and performance attributes only. But not on other attributes, which are also playing an important role for good quality. Zia ur Rehman proposed work [8] discussed and proposed a multi-criteria cloud service selection methodology in general. Very important parameters like reliability, trust, reputation, etc. are not given importance even though they are very critical in the cloud computing environment. Qiang He, Jun Han, etc. proposed work [9] is used to evaluate the attribute multi-tenancy cloud-based software applications with less scalability. It may not suitable if the number of end users are increasing. Tung-Hsiang Chou and Wanting Liu research work [10] presented that some of the SaaS dimensions, integrated along with service dimensions of SERVQUAL to maintain the standard of customer service. So that presented work is only benefited with very few attributes of SaaS, not applied to quality parameters.

Pang Xiong Wen and Li Dong proposed work [11] that a novel quality model to evaluate the security, quality of service, and software quality of the SaaS service, from the perspective of the service provider and service customers independently. Niyati Baliyan and Sandeep Kumar [12] presented their work in such a way that typical quality factors have been identified and used fuzzy logic to assess SaaS quality. Lukas Burkon work [13] presented the variances between traditional IT outsourcing and SaaS by introducing the set of quality attributes suitable to SaaS management. Raed Karim, Chen Ding presented their work [14] The AHP based model to facilitate the mapping procedure through few cloud layers and provided the priority to cloud services for end users perspective. Ankit Banka and Anshul Saravg etc. proposed their research work towards SaaS evaluation [15] based on the security attribute, which is used as a distinguished factor for selection of SaaS services. In general, there are many parameters involved and influencing in SaaS service quality than security like availability, reliability, etc. Jun Guo, Hao Huang, Xiaofeng Shi, Fang Liu, Bin Zhang work [16] presented only about SaaS performance. The SaaS performance prediction is influenced by SaaS resource occupancy, plus SaaS transactions.

In the year 2014, the authors Tript Kaur etc. work [17] demonstrated more about the cost attribute of the SaaS service rather than other attributes. Amid Khatami Bardsiri work [18] presented that set of service metrics to evaluate the quality of cloud services in general rather than the quality of the SaaS service. Sarbojit etc. presented in their research work [19] by introducing a new quality model for the security, quality of service, and software quality for software as a service in general theatrically rather than specific towards overall quality of SaaS. Xianrong Zheng [20] presented his work CLOUDQUAL inspired by SERVQUAL, with six quality dimensions like usability, availability, reliability, responsiveness, security, and elasticity, of which usability is independent and the others are objective.

2.1 Address Challenges And Concerns Of Saas

1. Based on the previously presented related work following observations have been summarized.
2. All quality models are not considering all quality attributes and quality metrics of the software.
3. No single quality model is fully considering all quality attributes of software, which are must to ensure the quality of any software.
4. All ISO 9126 standard for quality attributes of conventional software are not considered for SaaS, Efficiency, and Portability, Maintainability is not given much focused.
5. It is also, has been observed that quality attributes of conventional software are only not enough to evaluate but also extra attributes related to service should consider because software is delivered as a service on the cloud.
6. Key features of SaaS on the cloud have been identified as an important parameters and very critical to evaluate quality, but many quality models are not considered at all.
7. Many other attributes like security, performance, etc. are also involved in the process of evaluating the quality of SaaS but not taken into consideration for many quality models.
8. No standard set of quality metrics is identified to measure the quality of SaaS on the cloud and quality of service.

3 PROPOSED MODEL

There are many challenges are involved in order to evaluate SaaS cloud. In this paper a new quality model is proposed purely based on key attributes of SaaS, even though other factors like software quality attributes and service attribute are involved in the process of complete quality evaluation of the SaaS on the cloud This method is presenting about key attributes how they are influencing each other for selection of SaaS, specifically service customizability. For that data mining, the classification method is used to find out the degree of the association of each key attribute with other key attributes. A decision tree is a supervised learning method of data mining. It is a decision support tool and is a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. It is a method to exhibit an algorithm, usually used in particular for decisions.

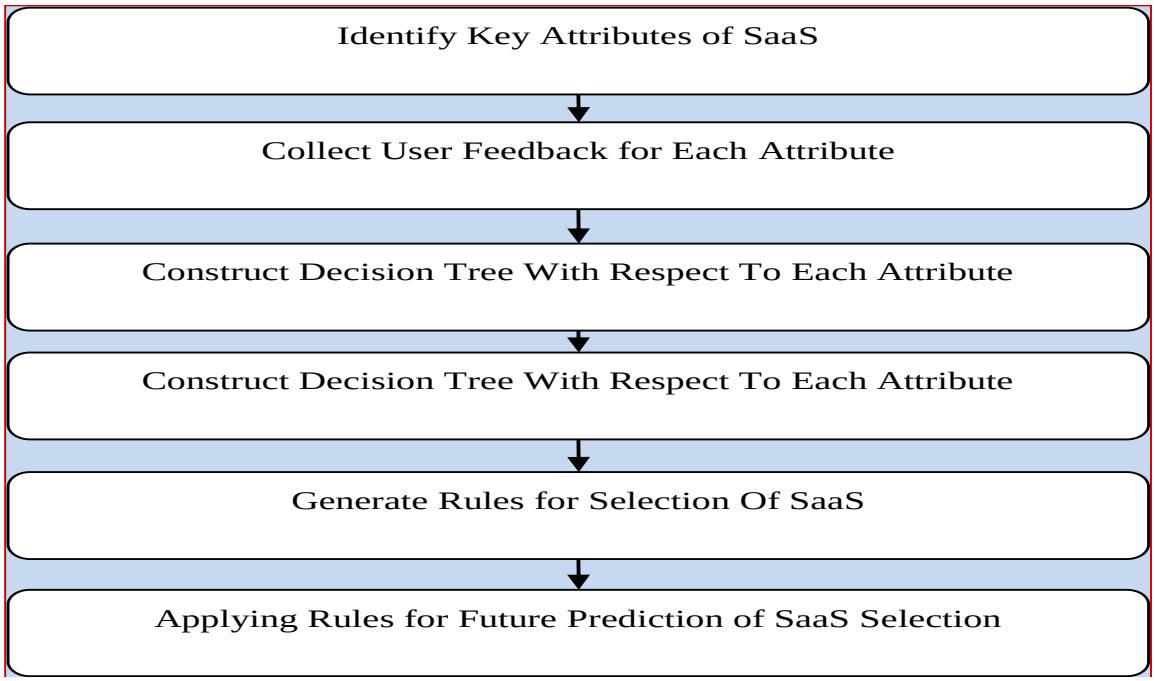

Figure 1: Working Process of Proposed model

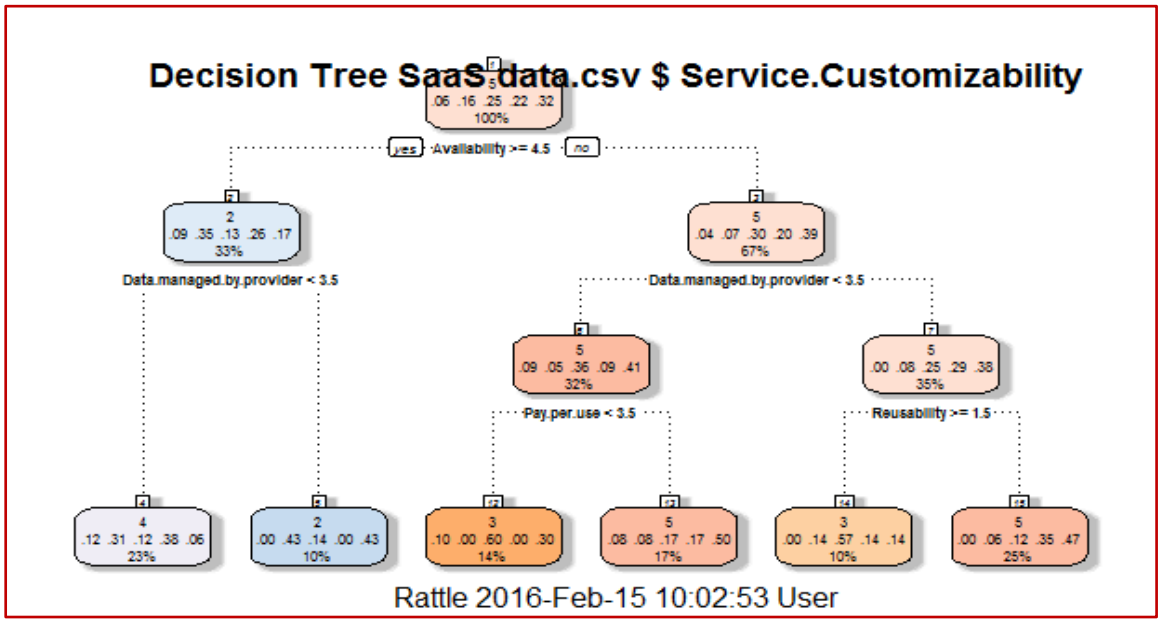

Figure 2: Decision Tree for Service Customizability Attribute Using R Tool

A decision tree demonstrates the influence of attributes with each other from a given set of attributes and the working process is shown in the above figure 1.

4 RESULT ANALYSIS AND DISCUSSION

The SaaS is a contemporary approach to providing large scalable enterprise software as a service on the Internet .The cloud platform delivers the scalability, availability, reusability, data managed by providers, customizability, and pay per use for software services on the Internet. The Sample data set is created based on user feedback as shown in below the figure 3.

There are many technical challenges have been identified in SaaS development. One of them is customization of service which permits service users to own the software in order to meet unique through configuration and customization to achieve higher maturity model. In this proposed model, customization is explored and shown how it is associated with other key attributes. Out of all key attributes, service customizability is targeted for classification as shown in the above figure 2 .in order to select service customizability, availability is the most influencing attribute.

Figure 3: SaaS Key Attributes Data

Pay-per-use	Availability	Reusability	Scalability	Data managed by provider	Service Customizability
5	4	1	3	4	3
3	5	1	3	3	5
4	3	2	5	5	5
2	5	1	5	5	5
1	4	1	3	5	4
5	3	1	4	5	5
4	2	2	2	4	3
3	2	1	1	4	4
2	2	1	5	4	5
3	3	2	4	2	3
4	5	1	3	2	4
5	5	1	2	2	2
3	5	2	4	2	1
4	4	1	4	4	5
5	3	2	3	5	4

5 CONCLUSION

In this paper a new quality model is proposed for selection of SaaS on the cloud computing environment by measuring service customizability. This the new model is also used for some trained sample data and tested by using the R Data Mining Tool. The results are analyzed and interpreted for future prediction of qualitative SaaS selection on the Cloud computing environment with respect to service customizability. In the Future it is also intended to implement a new quality model for based on other software quality attributes and SaaS key attributes like pay per use, availability, reusability, scalability and data managed by provider and service quality attributes of SaaS like reliability, assurance, tangibles, empathy and responsiveness.

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