Framework to Support Cloud Service Selection Based on Service Measurement Index

Songkran Totiya and Twittie Senivongse

***Abstract*—Cloud service customers, both individual and corporate customers often face problems when choosing the right cloud services, given a substantial number of cloud services avaliable today. It is also difficult to determine which cloud service is the best for a customer since different customers have different requirements with regard to functionality and quality of the cloud services, quality of the cloud providers, and price requirements. A top-ranked service may not necessarily be the best choice for a customer as it might perform better than required by the customer and that might come with high price. In addition, there are several technical quality attributes that a customer should consider. This paper aims to assist prospective customers in choosing a cloud service. Based on the Service Measurement Index (SMI) which is a hierarchical model of critical quality attributes and measures of cloud services, the paper proposes a framework for a customer to follow to specify service quality requirements and target candidate services. Using the proposed service quality requirement questionnaire and a cloud services catalog, the customer can create a requirement vector and cloud service vector and use a similarity measure to identify the service that best matches the requirements. The paper discusses an application of this framework to the case of an air freight business in Thailand.**

***Index Terms*—cloud computing, service selection, quality of service, Service Measurement Index**

I. Introduction

CLOUD computing has been widely adopted by individual and corporate users as a cost effective and flexible computing model. The pay-as-you-go model means users can pay for, rather than own, computing services and can configure the services to fit their current needs. A substantial number of infrastructure, platform, and software services are available today, and hence it can be difficult to determine which cloud service is the best for a customer. General decision criteria for cloud service selection include functionality and quality of the cloud services, quality of the cloud providers, and price. Since different customers have different service requirements, a service that satisfies one cloud customer may not suit another customer's requirements. A top-ranked service may not necessarily be the best choice for a customer as it might perform better than required by the customer and that might come with high price. Another cloud customer might be interested in good value for money rather than minimum purchase price. A prospective cloud customer often faces problems when choosing the right service, especially when there are various service offerings as well as several technical quality attributes to be considered in a service.

It is often the case that an individual customer has to go through service specifications from different providers and compare them. Likewise, a corporate customer may not know where to start to acquire a cloud service and has to set up a team to study and compare services in a cloud project. The motivation of this paper is how to make it convenient and practical for a prospective customer to identify the right cloud service that best fits customer requirements. A framework is proposed to guide prospective customers, both individuals and cloud project team, through service characteristics that should be considered as service selection criteria. To accompany the framework, we adapt from the Service Measurement Index (SMI) model of critical service attributes [1] and introduce a requirement questionnaire and cloud service catalog to enable service selection. The customer can create vector representations of the requirements and service characteristics and use a similarity measure to identify the service that best matches the requirements. The case of an air freight business acquiring a cloud service is given as an example.

The organization of this paper is as follows. Section II discusses related work. Section III introduces the framework while section IV presents an application of the framework to a case study. The paper concludes in section V.

II. Related Work

Selecting the right cloud services can be seen as a multi-criteria decision making problem as there are many factors to consider. Different quality attributes are often the focus of many researches because usually, functional capabilities are commonly provided. An example is the work by Garg et al. [2], [3] which follows the service measurement index model (SMI) [1] that defines a holistic view of QoS and comprises seven quailty categories: accountability, agility, assurance, financial, performance, security and privacy, and usability. The work proposes quantitative metrics for those quality categories which are based on historical measurements as well as information in the service level agreement (SLA). The metrics include response time, sustainability, suitability, accuracy, transparency, interoperability, reliability, stability, cost, adaptability, elasticity, and usability. The work uses the

Manuscript received July 10, 2017; revised August 1, 2017.

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ISBN: 978-988-14047-5-6
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

Analytic Hierarchy Process (AHP) [4] as a method for solving this multi-criteria decision making problem. Another work by Baranwal and Vidyarthi [5] compiles a number of existing and newly introduced quality of service metrics that are either quantitative or qualitative. Some metrics are application-dependent, e.g. reliability, availability, platform support, pricing, customer support facility, response time, throughput and effciency, capacity, scalability, elasticity. Some metrics are user-dependent, e.g. reputation, monitoring, free trial, API, certification, sustainability. Based on these metrics, customers define expected QoS values and providers define offered values. In this way, cloud services are sorted by each quality aspects and a variant of ranked voting method is used to identify the service with the highest score as the best one. Rehman et al. [6] formalize a conceptual framework for multi-criteria cloud service selection in the form of service descriptor vectors, a decision matrix which combines service descriptor vectors, user requirement vector, and user priority weights vector. They introduce the weighted difference and exponential weighted difference as the measures to determine similarity scores between a user requirement vector and service descriptor vectors. However, the framework is generic as no particular quality criteria that should be considered are identified.

We are motivated by the related researches above and adopt the SMI model but, unlike them, we specially aim to assist cloud customers in identifying user requirements and cloud providers in identifying service offerings. Our proposed framework is therefore based on the development of a service quality requirement questionnaire and a cloud services catalog, both of which are associated with service quality attributes and allow a cloud customer to easily identify information necessary for decision making. Apart from the technical quality that is mainly the focus of the related researches, we follow our previous work [7] to incorporate the trusting beliefs factor (or trust in specific others) in Social Psychology and Economics together with its pricing model into our quality attribute model.

III. Cloud Service Selection Framework

This section describes the cloud service selection framework which an individual customer as well as a cloud service acquisition team of an enterprise can follow.

A. Cloud Service Quality Model

The Cloud Services Measurement Initiative Consortium (CSMIC) develops a hierarchical Sevice Measurement Index model (SMI) as a standard method to measure any cloud service based on customers' technical and business requirements [1]. As mentioned previously, the model comprises seven quality categories. Each category is refined into a number of quality attributes, some of which have measures define. Due to a large number of quality attributes in the SMI model (51 in total), we consider only some attributes that, based on the survey by Monteiro and Vasconcelos [8], are important and of interest by cloud customers. Our model is called XSMI as it considers only 12 SMI attributes and adds to the original SMI model three more attributes, i.e. integrity, benevolence, and value for money, which we adopt from the previous work [7]. Fig. 1 depicts the XSMI model which is targeted for infrastructure services (IaaS) although most attributes are applicable to other kinds of cloud services also.

Service Quality Categories

The seven quality categories are defined as follows [1].

1) *Accountability:* Can we count on the provider organization?
2) *Agility:* Can it be changed and how quickly can it be changed?
3) *Assurance:* How likely is it that the service will work as expected?
4) *Financial:* How much is it?
5) *Performance:* Does it do what we need?
6) *Security and Privacy:* Is the service safe and privacy-protected?
7) *Usability:* Is it easy to learn and to use?

Service Quality Attributes

Our matchmaking between a customer's requirement and a cloud service is based on matching between the service quality requirement questionnaire and the cloud services catalog which are developed to associate with the 15 quality attributes of XSMI (see the next sections III.B and III.C). These attributes are either qualitative or quantitative. For qualitative attributes of a service, prospective customers can look for the information from the provider web site or SLA. For quantitative attributes such as those performance-related, we suggest the customers obtain the information from a cloud benchmark web site that measures and maintains history of the service's objective performance, e.g. CloudHarmony [9]. The following lists the definitions of all attributes in the order of importance as seen by cloud customers [8].

1) *Ongoing Cost*

Most cloud customers pay most attention to the cost they have to pay to operate a service. It is not easy to compare the costs of different cloud services due to various features and dimensions of offerings [3]. In our framework, the general guideline is to compare the cost per unit.

2) *Auditability*

This attribute is about the ability of a service to provide a means for a customer to audit or verify that the service adheres to standards, processes, and policies that it follows.

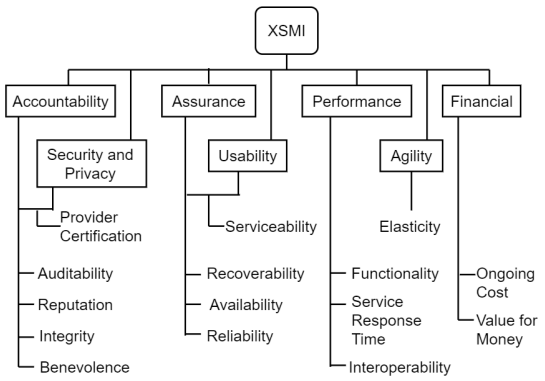

Fig. 1. XSMI model.

3) Provider Certification

This attribute is concerned with the certifications that the service maintains for different standards, such as ISO27001, PCI, SOC 3, CSA STAR, HAPP which are security-related.

4) Elasticity

This attribute is about the ability of a service to allow a customer to adjust resource consumption to meet varying demand. The support for scaling out by adding new instances that are operable with existing resources and support for managing the instances are desirable quality.

5) Recoverability

This attribute is about the ability of a service to resume its normal operation after failure.

6) Availability

This attribute is about the ability of a service to stay available for a customer to use and is usually determined as the percentage of time the service is operating, out of the total time it should be operating. A cloud benchmark web site like CloudHarmony [9] provides this information by running test applications and measuring availability of services in different regions.

7) Reliability

This attribute is about the ability of a service to operate without failure during a given time period. A cloud benchmark web site like CloudHarmony [9] provides the number of times the services in different regions fail to operate.

8) Serviceability

This attribute is about the ability of a service to provide easy and efficient maintenance and handling of problems that occur with the service. Support for 24/7 through phones, online support centers, support forums, documentation, white papers, best practice guides, and notification in the event of problems are desirable. Customers also expect the ability to control and manage the service through the web.

9) Functionality

This attribute is about functional features provided by a service such as operating systems and platforms that are supported. The service that offers various operating systems and platforms is advantageous since certain customer applications may need to run on specific platforms.

10) Service Response Time

This attribute is about the time between when the service is requested and when the response is available. A cloud benchmark web site like CloudHarmony [9] also provides this information.

11) Interoperability

This attribute is about the ability of a service to interact with other services. This can be determined by the number of different APIs which a customer might require such as Managed Instance, Customer Gateways (VPC), Dynamic Host Configuration Protocol (DHCP), Managed Snapshot/Volume, VM Import/Export.

12) Reputation

This attribute is about the reputation that is built on service capability and trust a customer has on the service. Examples of factors that reflect experience, stability, and hence reputation of the service are

- Years in business
- Market share
- Number of current customers
- Reference customers
- Number of data centers
- Number of service regions, e.g. North America, South America, Europe, Asia

13) Integrity

This is an attribute that is added to the XSMI model. A customer expects the provider of a service to act with honesty and promise keeping [7]. Integrity can be determined by checking the promised service level in the SLA with the actual service level. The latter can be obtained from the cloud benchmark web site such as CloudHarmony [9].

14) Benevolence

This is an attribute that is added to the XSMI model. A customer expects the provider of a service to express motivation to act in the customer's interests (even though it is not required to do so) [7]. Benevolence can be determined, for example, by the provision of free-tier service for a time period.

15) Value for Money

This is an attribute that is added to the XSMI model. A customer may not require a service with the cheapest price but rather the fair price with value for money [7]. This attribute can be determined based on the price per unit of CPU, memory, and storage.

B. Service Quality Requirement Questionnaire

A service quality requirement questionnaire is developed as a template of XSMI attributes that prospective customers are considered in general and is compiled based on the published cloud service specifications on different providers' web sites. As an example, we propose a questionnaire that has three parts, i.e. quality of service, provider trustworthiness, and value for money. Each XSMI attribute (a_i) in each part is associated with one or more questions for the customer to specify quality requirements. The customer can, for some questions, specify if such quality is not of interest and if it is the case, such quality will not be considered during service selection. The customer can also specify if the selected requirements are the must-have and if it is the case, the services that cannot meet such requirement will not be considered during service selection. An individual customer or a cloud service acquisition team of an enterprise can use the proposed questionnaire below to specify the requirements of expected service quality (and may adjust the questionnaire if needed).

Part 1 Quality of Service

a_1: Ongoing Cost

1. Outbound bandwidth charge (The price is for the region closest to Thailand.)

□ 1GB – 10 TB, $0.020/GB
10TB – 50 TB, $0.020/GB

□ 1GB – 10 TB, $0.090/GB
10TB – 50 TB, $0.080-0.085/GB

□ 1GB – 10 TB, $0.120/GB
10TB – 50 TB, $0.085/GB

□ Other ……..…… □ Not interested

□ Check this box also if the selected choice is a must-have.

ISBN: 978-988-14047-5-6
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

2. Monthly cost of the cloud instance package (The price is medium web server normalized cost.)
□ Less than $100 □ $101-150 □ $151-200
□ Not interested
□ Check this box also if the selected choice is a must-have.

a_2: Auditability

3. A means to audit or verify that the service adheres to standards, processes, and policies that it follows.
□ Yes □ No
□ Check this box also if the selected choice is a must-have.

a_3: Provider Certification

4. Certifications that the service holds.
□ ISO 27001 □ PCI □ SOC 3 □ CSA STAR
□ HAPP □ Other …….. □ Not interested
□ Check this box also if the selected choice is a must-have.

a_4: Elasticity

5. Auto scaling to add new instances that are operable with existing resources.
□ Yes □ No
□ Check this box also if the selected choice is a must-have.

a_5: Recoverability

6. Hot standby for disaster recovery.
□ Yes □ No
□ Check this box also if the selected choice is a must-have.

a_6: Availability

7. Duration of service unavailability (based on the lowest availability of all service regions)
□ No unavailability – 10 minutes (99.999-100% availability)
□ Less than 30 minutes per year (99.985-99.995% availability)
□ 3-3.5 hours per year (99.950-99.980% availability)
□ Not interested
□ Check this box also if the selected choice is a must-have.

a_7: Reliability

8. Number of outages (based on the highest number of outages of all service regions)
□ None □ 1-2 □ 3-4 □ Not interested
□ Check this box also if the selected choice is a must-have.

a_8: Serviceability

9. Supports from the service.
□ Online support center □ Support forums
□ Documentation, White papers, Best practice guide
□ Problem notification
□ Support for service control and management through the web
□ Other ……..…… □ Not interested
□ Check this box also if the selected choice is a must-have.

a_9: Functionality

10. Service functions.
10.1) Operating system (You can select more than one.)
□ CentOS □ Debian □ Ubantu □ Windows Server
□ Not interested
□ Check this box also if the selected choice is a must-have.
10.2) Platform (You can select more than one.)
□ Docker □ Java □ Node.js □ Windows and .NET
□ PHP □ Python □ Ruby □ Others ……
□ Not interested
□ Check this box also if the selected choice is a must-have.

a_{10}: Service Response Time

11. Service response time.
□ Global 390-420 ms, Asia 98-99 ms
□ Global 420-450 ms, Asia 99-120 ms
□ Global 450-500 ms, Asia 120-200 ms
□ Not interested
□ Check this box also if the selected choice is a must-have.

a_{11}: Interoperability

12. APIs provided by the service (You can select more than one.)
□ Managed Instance □ Customer Gateway (VPC)
□ Dynamic Host Configuration Protocol (DHCP)
□ Managed snapshot/volume □ VM Import/Export
□ Other ……..…… □ Not interested
□ Check this box also if the selected choice is a must-have.

Part 2 Provider Trustworthiness

a_{12}: Reputation

13. Number of years in business.
□ 5 years and over □ 3-4 years □ 1-2 years
□ Not interested
□ Check this box also if the selected choice is a must-have.
14. Market share of the provider.
□ Top 5 □ Top 10 □ Top 100 □ Not interested
□ Check this box also if the selected choice is a must-have.
15. Number of customers.
□ 200 and over □ 100 and over □ 50 and over
□ Not interested
□ Check this box also if the selected choice is a must-have.
16. Well-known reference customers.
□ Yes □ No
□ Check this box also if the selected choice is a must-have.
17. Number of data centers.
□ 20 and over □ 11-20 □ 3-10 □ Not interested
□ Check this box also if the selected choice is a must-have.
18. Regions of data centers. (You can select more than one.)
□ North America □ South America □ Europe □ Asia
□ Other ……..…… □ Not interested
□ Check this box also if the selected choice is a must-have.

a_{13}: Integrity

19. Difference between the uptime and outages within a year as specified in the SLA and the actual uptime and outages.
□ 0% □ 1-2% □ 3-5% □ Other ……..
□ Not interested
□ Check this box also if the selected choice is a must-have.

a_{14}: Benevolence

20. Duration of free-tier.
□ 1-3 months □ 2-3 weeks □ 1 week □ Not interested
□ Check this box also if the selected choice is a must-have.

Part 3 Value for Money

a_{15}: Value for Money

21. Rank the value for money that you are interested for the following hardware when comparing different services with similar monthly costs by specifying rank 1-3.
…… CPU …… Memory …… Storage
□ Not interested
□ Check this box also if the selected choice is a must-have.

C. Cloud Services Catalog

In addition to filling in the service quality requirement questionnaire, an individual customer or a cloud service acquisition team of an enterprise also compile a catalog of

ISBN: 978-988-14047-5-6
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

targeted cloud services. The catalog should contain the service information that corresponds to each question in the questionnaire to enable matching of service information with customer requirements. The information in the catalog is taken from 1) cloud providers' web sites for service specifications and SLAs and 2) cloud benchmark web sites, e.g. CloudHarmony for objective performance information.

D. Creating Requirement Vector and Service Vectors

The customer's answer to the requirement questionnaire is represented by a requirement vector $R = [ra_1, ra_2, \ldots, ra_{15}]$ where ra_i denotes the score for the XSMI attribute a_i as specified by the customer. Likewise, the information of a cloud service in the cloud services catalog is represented by a service vector $C = [ca_1, ca_2, \ldots, ca_{15}]$ where ca_i denotes the score for the attribute a_i as characterized by the service. The value of an attribute score in a vector is between 0 (lowest) and 5 (highest). (For an attribute associated with more than one questionnaire question, we use a normalized value of all question scores to represent the score for that attribute.) The score for each XSMI attribute is determined differently based on the type of the answer to the questionnaire question. There are four cases.

1) Boolean Type

The answer of the boolean type is either Yes or No. If the customer answers Yes to the question or the service exhibits such quality, the score is 5. Otherwise, the score is 0. An example is shown below:

a_4: Elasticity

5. Auto scaling to add new instances that are operable with existing resources.

(1) Yes (score = 5) (2) No (score = 0)

Customer answer: (1) (i.e. **$ra_4 = 5$**)

Google Cloud Platform: Autoscalers (i.e. (1), **$ca_4 = 5$**)

2) Range Type

The answer of the range type specifies a range of possible values. The score ranges from 1 (least desirable) to 5 (most desirable). An example is shown below:

a_1: Ongoing Cost

1. Outbound bandwidth charge (The price is for the region closest to Thailand.)

(1) 1GB – 10 TB, $0.020/GB
10TB – 50 TB, $0.020/GB (score = 5)
(2) 1GB – 10 TB, $0.090/GB
10TB – 50 TB, $0.080-0.085/GB (score = 3)
(3) 1GB – 10 TB, $0.120/GB
10TB – 50 TB, $0.085/GB (score = 1)

Customer answer: (2) (i.e. **$ra_1 = 3$**)

Google Cloud Platform:
Outbound/Same Region [USD]/ap-southeast-1: $0.010/GB
Outbound/Internet [USD]/ap-southeast-1: First 1GB: $0.120/GB, 1GB-10TB: $0.110/GB, 10TB-50TB : $0.080/GB.
(i.e. (2), **$ca_1 = 3$**)

3) Number Type

The answer of the number type specifies the number of choices that are selected. The score ranges from 1 to 5. An example is shown below:

a_3: Provider Certification

4. Certifications that the service holds.

(1) ISO 27001 (2) PCI (3) SOC 3
(4) CSA STAR (5) HAPP (Each one scores 1.)

Customer answer: (1) (i.e. **$ra_3 = 1$**)

Google Cloud Platform: ISO 27001, PCI, SOC 3, HAPP (i.e. (1), (2), (3), (5), **$ca_3 = 4$**)

4) Rank Type

The answer of the rank type is the rank number (1-3) of each choice which is used to calculate the score. The score ranges from 0 to 5. An example is shown below. For the customer requirement, the score is 5 if the "Not interested" choice is left unchecked. Otherwise, it is 0. For each targeted cloud service, the rank numbers specified by the customer are used to determine the score by using the AHP method for multi-criteria decision making [4]:

a_{15}: Value for Money

21. Rank the value for money that you are interested for the following hardware when comparing different services with similar monthly costs by specifying rank 1-3.

…2… CPU
…1… Memory
…3… Storage

Service ranked 1st by AHP (score = 5)
Service ranked 2nd by AHP (score = 4)
Service ranked 3rd by AHP (score = 3)
Service ranked 4th by AHP (score = 2)
Service ranked 5th by AHP (score = 1)
Service ranked lower than 5th by AHP (score = 0)

Customer answer: "Not interested" choice is unchecked. (i.e. **$ra_{15} = 5$**)

Google Cloud Platform: Ranked 2nd by AHP (i.e. **$ca_{15} = 4$**)

In the example above, Google Cloud Platform is ranked 2nd by AHP with regard to value for money. To determine the ranking, the specifications and costs of all targeted services are compared. Based on AHP, the CPU, memory, and storage are modeled as the three criteria, and all targeted services in the cloud services catalog are modeled as the alternatives. The AHP method is used to determine the best alternative with regard to all criteria.

The first step is to conduct a pair-wise comparison of the criteria (i.e. CPU, memory, storage) to determine the relative importance (or weight) of each criterion. If the two criteria in comparison are of equal importance, the intensity number is 1. If a criterion is of more importance than another, the intensity number is 3. If a criterion is of less importance than another, the intensity number is 0.33 (or 1/3). Given the ranks of CPU, memory, and storage as specified by the customer (2, 1, 3 respectively), the intensity numbers are shown in Table I. Then, the intensity numbers in each column are normalized and the average of the normalized values in each row represents the weight of each criterion, as shown in Table II.

The second step is to conduct a pair-wise comparison of the alternatives to determine the relative importance (or weight) of each alternative with respect to each criterion. In this example, the specifications of a medium web server

ISBN: 978-988-14047-5-6
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

normalized costs ($150-200 per month) offered by each pair of services are compared with regard to CPU, memory, and storage. The calculation is done in the same way as for the criteria. Suppose there are five targeted services and the average of the normalized values as the weight of each services with regard to each criterion is as shown in Table III. Summation of the product of the weights in Tables II and III results in the importance weights of all alternative services, as shown in Table IV, by which their ranking with regard to value for money can be determined. Hence, Google Cloud Platform (S3), ranked 2nd, scores 4 as above.

E. Comparing Requirement Vector and Service Vectors

To compare the requirement vector R and each of the service vectors C, a similarity measure between the two vector is applied. Several similarity measures are available (e.g. Pearson's Correlation, Cosine Similarity, Euclidean Distance). Here we adapt from the Exponential Weighted Difference (EWD) [6] measure since it can distinguish between a service with higher quality than required and another service with lower quality than required. It can also restrict the effect of mutual cancellation between criteria exceeding and below the requirement. The EWD score of a service determines the degree of difference between the service provision and the customer requirement and is calculated by $\sum_{i=1}^{15} e^{-(ca_i - ra_i)}$. The service with the lowest EWD is the most suitable service. For example, given R = [4, 5, 1, 5, 5, 1, 1, 5, 2, 5, 0, 2, 5, 5, 5] and C_{S3} = [4, 5, 4, 5, 5, 1, 3, 5, 5, 5, 3, 3.17, 3, 3, 4], the EWD score of Google Cloud Platform (S3) is 25.09.

IV. Application of Framework to Case Study

Before the framework was applied to a case study, the service quality requirement questionnaire was reviewed by a number of cloud adoptors and adjusted according to the feedback. Then the framework was applied to a case of an air freight business in Thailand.

TABLE I
INTENSITY NUMBERS OF CRITERIA

	CPU	Memory	Storage
CPU	1	0.33	3
Memory	3	1	3
Storage	0.33	0.33	1
Sum	4.33	1.66	7

TABLE II
NORMALIZED INTENSITY NUMBERS AND WEIGHTS OF CRITERIA

	CPU	Memory	Storage	Weight (%)
CPU	0.23	0.20	0.43	28.59
Memory	0.69	0.60	0.43	57.40
Storage	0.08	0.20	0.14	14.01
Sum	1	1	1	100.00%

TABLE III
WEIGHTS OF ALTERNATIVES WITH REGARD TO CRITERIA

	CPU (%)	Memory (%)	Storage (%)
S1	14.04	25.59	13.83
S2	33.03	39.39	13.83
S3	33.03	17.69	7.54
S4	12.29	8.67	32.40
S5	7.61	8.67	32.40

TABLE IV
IMPORTANCE WEIGHTS AND RANKS OF ALTERNATIVES

	CPU (28.59%)	Memory (57.40%)	Storage (14.01%)	Importance Weight (%)	Rank
S1	(0.1404*0.2859)+(0.2559*0.5740)+(0.1383*0.1401)=			**20.64%**	**3rd**
S2	(0.3303*0.2859)+(0.3939*0.5740)+(0.1383)(0.1401)=			**33.99%**	**1st**
S3 [a]	(0.3303*0.2859)+(0.1769*0.5740)+(0.0754*0.1401)=			**20.65%**	**2nd**
S4	(0.1229*0.2859)+(0.0867*0.5740)+(0.3240*0.1401)=			**13.03%**	**4th**
S5	(0.0761*0.2859)+(0.0867*0.5740)+(0.3240*0.1401)=			**11.69%**	**5th**

[a]Google Cloud Platform

The cloud service acquisition team of the organization targeted five services (three well-known services S1, S2, and S3, and other two services S4 and S5 from local providers). The team specified the requirement and compiled a services catalog. The R and C vectors are

R = [4, 5, 1, 5, 5, 1, 1, 5, 2, 5, 0, 2, 5, 5, 5]
C_{S1} = [1, 5, 5, 5, 5, 3, 3, 5, 5, 3, 5, 5, 5, 3, 3]
C_{S2} = [5, 0, 2, 0, 5, 1, 3, 5, 4, 3, 3, 2.67, 3, 0, 5]
C_{S3} = [4, 5, 4, 5, 5, 1, 3, 5, 5, 5, 3, 3.17, 3, 3, 4]
C_{S4} = [0.5, 0, 1, 0, 0, 0, 0, 2, 3, 0, 0, 1.33, 0, 0, 2]
C_{S5} = [2.5, 0, 1, 0, 0, 0, 0, 2, 3, 0, 0, 0.83, 0, 1, 1]

The EWD scores of S1-S5 are 47.65, 465.59, **25.09**, 973.52, and 886.85. S3 (Google Cloud Platform) is the most suitable service for this customer requirement.

V. Conclusion

The proposed framework can be helpful to prospective customers as it suggests the steps for the customer to follow. The service quality requirement questionnaire is an easy-to-use tool to identify requirements and, for simplicity, focuses only on the most important service quality attributes based on the XSMI model. The customer can use the questionnaire also as a guideline to compile a cloud services catolog, and may adjust it when technology of the cloud services has changed. The EWD score can identify the right service that is closest to the customer requirement. Future work includes the development of a supporting tool and an evaluation if the service selected by the framework is really the right service after adoption. The EWD can be enhanced to consider different weights for different XSMI attributes.

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