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Analysis of Cloud Service Selection Using WASPAS method

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Abstract

In the business model of cloud computing, a relationship between service providers and customers is created. Nowadays, a lot of technology-based services are not installed or run on local machines. Instead, they are operated on distant servers or the "cloud," and the results are made available to its users as a premium service. The price of cloud services is typically stated in the service level agreement (SLA) and is determined based on the amount and quality of service (SLA). In terms of choosing on-demand services on a subscription basis, cloud service selection is essential. Since there are numerous cloud services with comparable functions available, it is essential to identify which one best meets the needs and goals of the customer. The identification and selection of hosted Web services are evolving into a highly challenging undertaking as a result of the exponential development in their number. In fact, a lot of services with related functions might be taken into account while responding to user requests. To address this problem, quality of service (QoS) standards that describe the non-functional aspects of web services are taken into account in addition to promoting the best services. In this study, WASPAS is utilized to analyze the selection criteria while using MCDM approaches to choose web services. The Quote of the Day, Xignite Quotes, Stock Quotes, Real Time Quotes, Delayed Stock Quotes, and Historical Stock Quotes are available as alternative parameters here. Response time, throughput, dependability, and portability are the evaluation criteria. As a result of the analysis, the quote of the day is ranked first, followed by Xignite Quotes in fourth place, Stock Quotes in second place, Real-Time Quotes in third place, Delayed Stock Quotes in sixth place, and Historical Stock Quotes values in fifth place. According to the result, Stock Quotes, Real Time Quotes, and Xignite Quotes are the leading services.

Keywords: Cloud computing technology, Response time, throughput, MCDM.

Introduction

Cloud computing technology (CCT) applications are a popular study Area too. This technology provides access anywhere information on Technology (IT) industries Infrastructure and utilities Online Subscriptions to next generation Services based. Nowadays, a lot of technology Based services are not installed on machines or are not enabled. Instead, they are remote servers or Powered by "the cloud", and The results are premium for its users Available as a service. Service providers are being compelled by this revolutionary technical advancement to modify their offerings and make them available to clients via the cloud [1]. The performance of the services is primarily impacted by variables including accessibility, accessibility, security, and distance. Service accessibility is reliant on connectivity. Service interruptions in network-based services are regrettable. As a result, each network failure lowers the availability (i.e., performance) of the cloud service [2]. A lot of work is being done in academia and industry to create the next generation of open, interoperable, and federated cloud environments in addition to the current cloud computing environment. These new ideas create a situation where consumers can move their virtual machines across multiple cloud service providers, but they need the right tools to make the best choice. These changes highlight the importance of creating a thorough cloud service selection mechanism [3]. There has already been a lot of focus in the literature on methodologies for testing, comparing, and monitoring cloud service performance. On the basis of a predesigned set of benchmark tools, comparative approaches are often assessed [4]. However, the outcomes of these testing tools do not always reflect how the cloud services are actually used. This is primarily due to the many testing conditions, which are distinct from the duties performed by regular users. With the help of this framework, customers can quickly compare the different cloud service offers depending on their preferences as well as a few other factors [5]. Because of this, the selection and discovery of web services in huge data repositories may produce a lot of pieces that cannot be separated by their functional characteristics. [6]. The following steps are typically followed when using MCDM-based techniques for web service selection: First, using ontologies or other traditional methodologies, the online services that are candidates for the selection are compared to the functional requirements indicated in the user requests. Then the user's request is handled, including the nonfunctional requirements (QoS parameters). The weights of the QoS parameters expressed in the user request must be processed and normalized [7]. Response time, throughput, dependability, and portability were the four QoS criteria we took into account. A cloud service's response time clearly indicates its overall performance. Here is an example of how rapidly a cloud service may be implemented. The throughput shows how many tasks the cloud service completed in a given amount of time. In a system used for transaction processing, throughput is measured in transactions per second [8,9]. "Reliability" in the context of the cloud refers to how long a cloud service continues to operate uninterrupted under a particular set of operational circumstances. The mean time to failure promised by the cloud service provider and the chance of service interruption for a specific amount of time is used to estimate it. A portable item can be transported from one system to another and continue to work on the new one. In the context of the cloud, there are two distinct areas of portability: data portability and application portability [10]. Alternative parameters include Quote of the Day, Xignite Quotes, Stock Quotes, Real Time Quotes, Delayed Stock Quotes, and Historical Stock Quotes.

Materials and Methods

The WASPAS method, one of the newest and most accurate MCDM approaches that can improve the ranking accuracy of alternatives, combines the Weighted Product Model (WPM) with the Weighted Sum Model. The MCDM techniques are the most well-known approaches to decision-making problems (WSM) [11]. The WSM approach calculates an alternative's overall score as a weighted sum of the criteria values, whereas the WPM method calculates an alternative's score as a result of scaling each criterion to a power equal to that criterion's weight [12]. The weighted aggregate function is optimized by WASPAS in addition to these other methods in an effort to achieve the best estimation accuracy [13].

Step 1 The decision matrix X, which displays how various alternatives perform in relation to certain criteria, is created.

$$D = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & x\cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Weight vector may be expressed as

$$w_j = [w_1 \cdots w_n], \quad (2)$$

where ,$\sum_{j=1}^{n}(w_1 \ \cdots \ w_n) = 1$

Step 2: The decision matrix is normalized. Beneficial and non-beneficial criteria are normalized

$$n_{ij} = \{\frac{x_{ij}}{max.x_{ij}} \mid j \in B \ \frac{min.x_{ij}}{x_{ij}} \mid j \in C \quad (3)$$

Where $max.x_{ij}$ and $min.x_{ij}$ are the maximum and minimum value of x_{ij} in the jth column for benefit (B) and cost criteria (C) respectively

Step 3 Weighted normalized decision matrix is calculated as follows:

$$w_{ij} = w_i n_{ij} \quad (4)$$

Step 4: The preference score for the given alternative, based on WSM, is calculated as follows:

$$S_i^{WSM} = \sum_{j=1}^{n} w_j n_{ij} \quad (5)$$

Step 5: The preference score for the given alternative, based on WSM, is calculated as follows:

$$S_i^{WPM} = \prod_{j=1}^{n}(n_{ij})^{w_j} \quad (6)$$

Step The preference score for the WASPAS method is calculated using equations (5) and (6),

$$S_i^{WASPAS} = \lambda S_i^{WSM} + (1-\lambda)S_i^{WPM}$$

$$S_i^{WASPAS} = \lambda \sum_{j=1}^{n} w_j n_{ij} + (1-\lambda)\prod_{j=1}^{n}(n_{ij})^{w_j}$$

where λ is between 0 and 1.

Finally, the alternatives are ranked based on the S_i^{WASPAS} values. The best alternative has the highest S_i^{WASPAS} value. If the value of λ is 0, the WASPAS method is transformed to WPM and if λ is 1, it becomes WSM. Alternative parameters include Quote of the Day, Xignite Quotes, Stock Quotes, Real Time Quotes, Delayed Stock Quotes, and Historical Stock Quotes. Response time, throughput, dependability, and portability were the four QoS criteria we took into account. A cloud service's response time clearly indicates its overall performance. Response time:A cloud service's response time more succinctly demonstrates its overall performance. It demonstrates how quickly a cloud service may be made accessible for use. Therefore, the duration between submitting a request message and receiving a response message is known as the response time [14].Throughput:The amount of jobs finished by the cloud service in a specific amount of time is indicated by the throughput. The throughput of a system used for transaction processing is expressed in transactions per second. The data rate is used to determine the throughput for systems that process large amounts of data, such as audio and video servers (in Megabytes per second) [15]. Additionally, a task's performance may occasionally be impacted by the throughput due to factors such as the number of tasks and machines, inter-task communication delays, and service initiation delays [16].Reliability:The usage of trust is necessary since traditional methods using a central source ensure the dependability of users and resources are impractical in many distributed systems, especially those that are open and dynamic [17]. The majority of trust mechanisms in distributed systems either rely on certificates as a guarantee or a reputation built on the actions of other system entities. [18]. Portability:When something is portable, it can be moved from one system to another and still function on the new system. Data portability and application portability are the two distinct categories of portability in the context of the cloud. Data portability is the capacity to move data easily between cloud services without having to enter it again [19]. The essential component of data portability is the simplicity of data movement. The ability to move an application or its components from one cloud provider to another that offers a similar cloud service is known as application portability. Additionally, it makes the target cloud service's application run more efficiently. The key to application portability is how simple it is to move an application or its constituent parts. [20].

Analysis and Discussion

TABLE 1. Data set of web services

	Throughput	Reliability	Portability	Response time
Quote of The Day	9.556	70.800	88.560	123.000
Xignite Quotes	1.554	36.700	77.540	152.000
Stock Quotes	7.213	78.990	80.240	98.000
Real-Time Quotes	8.787	68.220	69.270	112.000
Delayed Stock Quotes	1.554	24.850	70.245	132.000
Historical Stock Quotes	2.14200	9.89000	89.56400	81.00000

The dataset for the case study using online services is displayed in Table 1. Response time, Throughput, Reliability, Portability, and Alternate Parameters Quote of the Day, Xignite Quotes, Stock Quotes, Real Time Quotes, Delayed Stock Quotes, and Historical Stock Quotes are the evaluation criteria used in this analysis.

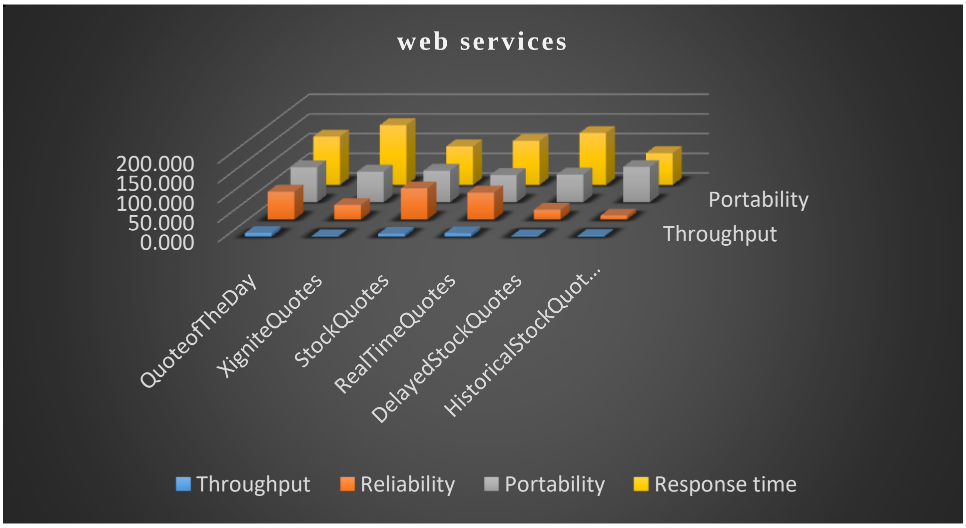

FIGURE1. Dataset for web services

Dataset values from the Case study with the most popular web services are shown in Figure 1. Response time, throughput, reliability, portability, and alternative factors such as the quotation of the day, Xignite quotes, stock quotes, real-time quotes, delayed quotes, and historical quotes are the evaluation criteria.

TABLE 2. Normalized decision matrix

1	7.408957723	9.26747593	0.658536585
0.162620343	3.840519046	8.11427375	0.532894737
0.75481373	8.266010883	8.39681875	0.826530612
0.919526999	7.13897028	7.24884889	0.723214286
0.162620343	2.600460444	7.35087903	0.613636364
0.224152365	1.034951863	9.37254081	1

Response time, throughput, reliability, portability, and alternative parameters like the quote of the day, Xignite quotes, stock quotes, real-time quotes, delayed quotes, and historical quotes are all shown in Table 2's normalized decision matrix array.

TABLE 3. Weight

0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

Table 3 shows the weight value taken for the analysis as equally distributed among the evaluation parameters.

TABLE 4. Weighted normalized decision matrix (WSM)

0.25	1.852239	2.316869	0.164634
0.040655	0.96013	2.028568	0.133224
0.188703	2.066503	2.099205	0.206633
0.229882	1.784743	1.812212	0.180804
0.040655	0.650115	1.83772	0.153409
0.056038	0.258738	2.343135	0.25

According to the evaluation criteria of response time, throughput, reliability, portability, and alternative factors such as the quote of the day, Xignite quotes, stock quotes, real-time quotes, delayed quotes, and historical quotes, Table 4 displays a weighted normalized decision matrix array.

TABLE 5. Weighted normalized decision matrix (WPM)

1	1.64983	1.744779	0.900834
0.635029	1.399902	1.687767	0.854398
0.932095	1.695602	1.702271	0.953487
0.979244	1.63459	1.640844	0.922182
0.635029	1.26988	1.646588	0.88507
0.688075	1.008626	1.749703	1

For the following evaluation criteria: response time; throughput; reliability; portability; and alternative parameters: quote of the day, Xignite quotes, stock quotes, real-time quotes, delayed quotes, and historical quotes, Table 5 displays a weighted normalized decision matrix array calculated by using WPM.

TABLE 6. Preference Score (WSM) (WPM)

	Preference Score(WSM)	Preference Score(WPM)
Quote of The Day	4.583743	2.593132
Xignite Quotes	3.162577	1.281929
Stock Quotes	4.561043	2.565236
Real-Time Quotes	4.00764	2.422055
Delayed Stock Quotes	2.681899	1.175219
Historical Stock Quotes	2.907911	1.214312

Table 6 lists the preference scores for the WSM Weighted Sum Model and the WPM Weighted Product. The preference score is calculated by adding the weighted normalized choice matrix (WSM) row values of the weighted normalized choice matrix (WSM). The preference score in the WPM Weighted Product Model from equation (5) is multiplied by the row value of the weighted normalized decision matrix (6).

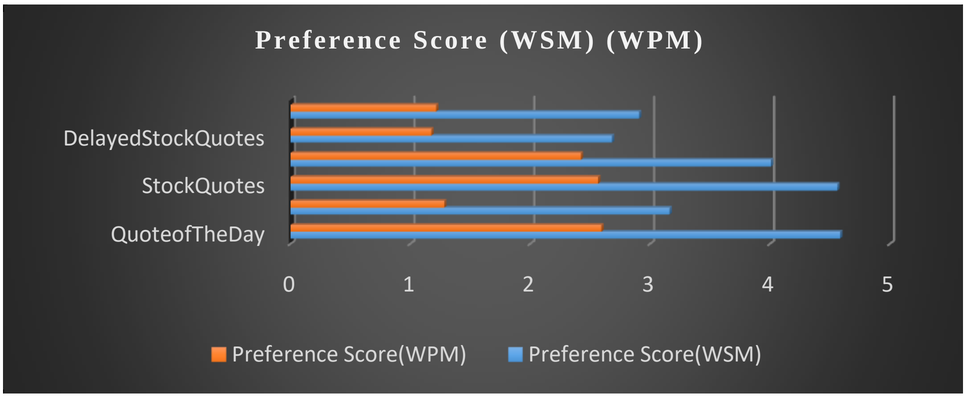

FIGURE 2. Preference Score (WSM) (WPM)

Table 6 lists the preference scores for the WSM Weighted Sum Model and the WPM Weighted Product. The preference score is calculated by adding the weighted normalized choice matrix (WSM) row values of the weighted normalized choice matrix

(WSM). The preference score in the WPM Weighted Product Model from equation (5) is multiplied by the row value of the weighted normalized decision matrix (6).

TABLE 7. WASPAS coefficient

	WASPAS Coefficient
Quote of The Day	3.588437
Xignite Quotes	2.222253
Stock Quotes	3.56314
Real-Time Quotes	3.214848
Delayed Stock Quotes	1.928559
Historical Stock Quotes	2.061112

Table 7 displays the WASPAS Coefficient value with a lambda value of 0.5. Alternative values for the parameters are 3.588437 for the quotation of the day, 2.222253 for Xignite quotes, 3.56314 for stocks, 3.214848 for real-time quotes, 1.928559 for delayed stock quotes, and 2.06112 for historical stock quotes.

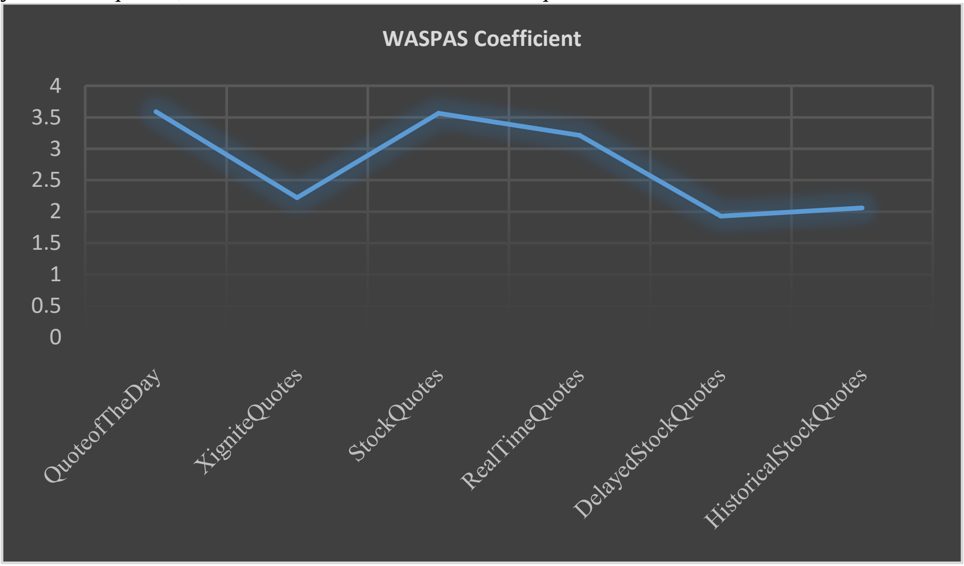

FIGURE 3. WASPAS coefficient

A graphical illustration of the WASPAS coefficient is shown in Figure 3. Alternative values for the parameters are 3.588437 for the quotation of the day, 2.222253 for Xignite quotes, 3.56314 for stocks, 3.214848 for real-time quotes, 1.928559 for delayed stock quotes, and 2.06112 for historical stock quotes.

TABLE 8. Rank

	RANK
Quote of The Day	1
Xignite Quotes	4
Stock Quotes	2
Real-Time Quotes	3
Delayed Stock Quotes	6
Historical Stock Quotes	5

The ranking of alternative WASPAS coefficient settings is displayed in Table 8. Alternative criteria: The quote of the day is ranked first, followed by Xignite Quotes in fourth place, Stock Quotes in second place, Real-Time Time Quotes in third place, Delayed Stock Quotes in sixth place, and Historical Stock Quotes values in fifth place.

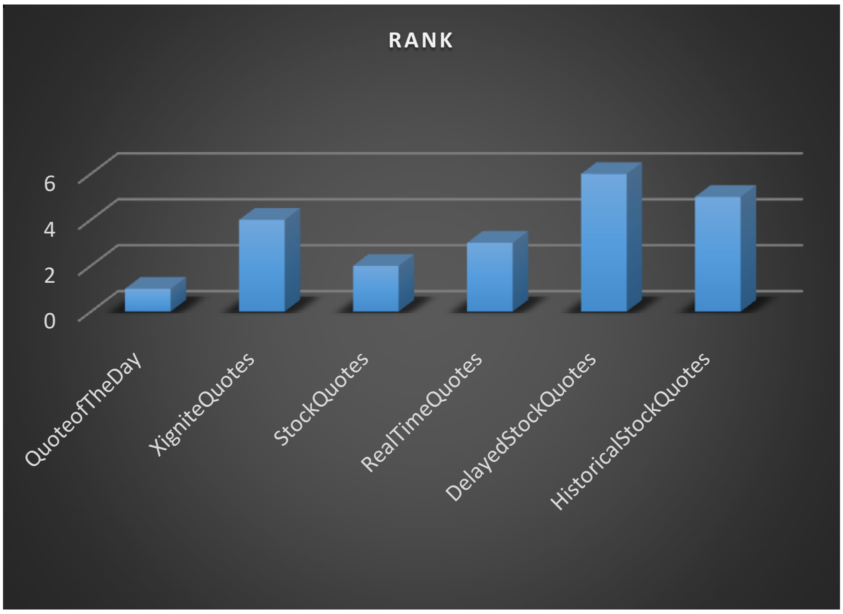

FIGURE 4. Rank

A graphical depiction of the rank of alternative WASPAS coefficient parameters is shown in Figure 4. Alternative criteria: The quote of the day is ranked first, followed by Xignite Quotes in fourth place, Stock Quotes in second place, Real-Time Quotes in third place, Delayed Stock Quotes in sixth place, and Historical Stock Quotes values in fifth place.

Conclusion

Potential cloud users are having a difficult time deciding which cloud service is best for them because of the variety and dynamic nature of cloud services. A cloud service review should be done first before choosing a cloud service. Two different methods can be employed to carry out this examination. The first category of techniques is founded on an impartial evaluation of performance using standard QoS metrics (Quality-of-Service, e.g., service response time, availability, and throughput). The identification and selection of hosted Web services are evolving into a highly challenging undertaking as a result of the exponential development in their number. In fact, a lot of services with related functions might be taken into account while responding to user requests. To address this problem, qualities of service (QoS) standards that describe the non-functional aspects of web services are taken into account in addition to promoting the best services. In this regard, there is a growing demand for user intermediation and advice throughout the consumption of cloud services, which should always refer to the optimal option based on user preferences. In this study, the WASPAS approach is utilized to analyze the chosen criteria while the Multi-Criteria Decision Making (MCDM) method is used to choose web services. According to the results, Delayed Stock Quotes received the lowest ranking, and Quote of the Day received the highest.

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