Cloud Service Selection as a Fuzzy Multi-criteria Problem

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***Abstract* – Cloud adoption is an attractive technological innovation due to the capital cost reduction and fast quality improvements it provides. In this paper, we present a new fuzzy methodology for cloud service selection. Product features and functionalities, customer support, customer rating, and security options are just a few of the factors influencing cloud platforms evaluation. A practical example for ordering cloud storage systems is calculated by using fuzzy measurement of alternatives and ranking according to the compromise solution (MARCOS) method. After establishing the relevant indicators for cloud technologies' assessment and their relative weights, crisp values and linguistic terms are transformed into triangular fuzzy numbers and then multi-criteria analysis is employed. The obtained ranking helps managers make an informed and well-grounded decision for cloud platform selection.**

***Keywords* – Digital transformation, Cloud service ranking, Big Data, Multi-criteria decision-making, Fuzzy sets.**

1. Introduction

Cloud computing and Big data are the cornerstones of the digital transition of modern business and nonprofit organizations.

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Contemporary computer clouds and their services foster new business models by reengineering workflows, operations, and data exchange, both at intra- and at inter-organizational level. Dynamic changes in virtualized resources, high availability, and automated fault tolerance are some of the many benefits of cloud technology over traditional IT environments. This is the reason more and more organizations are streamlining their operations and facilitating consumer access to cloud architecture [1], [2], [3].

Cloud services are not just tools for operational activities, but also a complete solution for reaching the company's business goals. Increased demand logically leads to intensive expansion of the cloud services market. Providers have to constantly monitor cloud development trends in order to be competitive. On the other hand, customers face the problem for finding the optimal cloud proposal [4], [5].

The problem of cloud service selection is particularly important to small and medium-sized enterprises (SMEs), as deploying cloud applications would improve their productivity and allow optimal business management with guaranteed data security. Often, however, small business network administrators are busy with routine tasks and do not have enough time to upgrade their skills. Choosing the right cloud technology would provide SMEs with fast and convenient access to varied resources (IT infrastructure, business intelligence, machine learning and Internet of Things) and increase their competitiveness [6].

Deploying the right cloud technology, especially in a SME, is an IT innovation for sustainable development. Cloud services will reduce capital cost and time for acquiring and maintaining their own servers, but will also prevent some additional complications and inconveniences.

According to a survey about cloud services adoption in Bulgaria conducted in 2019, small business is falling behind medium and large enterprises in the country - with deployments in 7%, 15% and 30% of companies in the three segments, respectively. The lagging of Bulgarian enterprises is also significant in comparison with enterprises in the EU, with deployment rates there being 23%, 36% and 56%, respectively, for small, medium and large companies [7].

This study proposes and implements a set of four recently developed fuzzy multi-criteria models for preferred cloud platform selection. The main contribution of this paper is the development of a fuzzy methodology that evaluates cloud platforms' performance based on multi-criteria analysis.

The advantages of the proposed fuzzy decision-making are the following:

- Taking into account subjectivism in the decision makers' assessments (according to Zadeh's fuzzy set theory).
- Applicability to even a small number of objects or observations (the alternative probabilistic approach is only suitable for a large number of homogeneous objects).

The rest of this paper is organized in the following way: the study continues with a literature review of existing approaches for cloud platforms evaluation. The third section introduces the new fuzzy multi-criteria methodology for cloud platforms' assessment. The proposed methodology is applied to a practical example for cloud platforms performance ranking in fourth section. Finally, the last section concludes the paper and presents the limitations and future research plans.

2. Literature Review

The recent research topics on cloud services comparison and assessment can be categorized in four main areas: 1) ISO/IEC 25010 standard specifications; 2) cloud service metrics; 3) financial models; and 4) multi-criteria decision-making (MCDM) methods.

2.1. ISO/IEC 25010 Quality Models

ISO/IEC 25010 (former ISO/IEC 9126) is a family of quality models, defining requirements and evaluation criteria for software systems. Although this standard's models identify relevant quality characteristics, they have limited application – only in Software-as-a-Service (SaaS) evaluation process [8].

In order to measure the performance of cloud computing-based applications, Ravanello et al. used a performance measurement framework on log data from an actual data center to map and statistically analyze one of the ISO quality indicators: time behavior. This initial research has helped identify the relevant derived measures for statistical analysis of ISO quality characteristics in cloud computing applications [9].

2.2. Cloud Service Metrics

In order to select the most suitable among several cloud services, customers have to recognize and evaluate crucial performance characteristics. The problem here is that there are lots of cloud providers that supply various cloud solutions, and it is tough to construct the complete set of metrics for evaluating totally different cloud services.

Bardsiri and Mohsen suggested various QoS metrics for service vendors' selection. The authors started a systematic discussion regarding the evaluation metrics of cloud services. They also provided a metrics list (performance, economic and security features) to help assessment within the field of cloud service's evaluation [10].

2.3. Financial Models

The evaluation of a cloud deployment project can be done by financial models based on return or gain from an investment. The main methods of capital budgeting for assessing the economic aspects of migration to cloud architecture are the following: Payback Period (PP), Return on Investment (ROI), Net Present Value (NPV) and Internal Rate of Return (IRR). Some financial models are considered static since they are more focused on the cash benefits without taking into account risk or time changes (Average Annual Rate), while other metrics are dynamic (NPV, PP or IRR).

Misra and Mondal created a new cloud computing ROI model, which can be customized to user's specifications. Various intangible benefits have been included in the model to give a much broader picture of cloud services to its potential adopters. To determine whether cloud computing is appropriate for deployment in a company, the authors consider the following four sets of key criteria: size of IT resources; utilization pattern of resources; sensitivity of the data they are handling, and criticality of the work done by the company. [11].

Unfortunately, quality-based models and financial models for cloud technologies evaluation have their limitations. Traditional focus on technical and financial aspects of cloud services leads to the neglect of their social and organizational dimensions, which can affect the real impact of investment [12].

2.4. Multi-criteria Decision Making

The idea for multi-criteria choice of cloud computing service is not new. Z. u. Rehman et al. presented an overview of existing cloud service selection approaches. They have formalized the cloud service selection problem creating a conceptual framework and proposed an approach to determine the similarities between a requirement vector and all candidates' capability vectors to recommend the most suitable candidate [4].

Sun et al. surveyed state-of-the-art cloud service selection approaches, which were analyzed from the following five perspectives: decision-making techniques; data representation models; parameters and characteristics of cloud services; contexts, purposes [13].

Alabool et al. presented a systematic literature review based on evaluation theory via six evaluation components: target, criteria, yardstick, data gathering techniques, synthesis techniques, and evaluation process. These evaluation components and the cloud service evaluation methods validation approach are the seven dimensions that have been used to assess and analyze 77 papers published from 2006 to 2016 [14].

Kumar et al. designed a new cloud service selection model under the fuzzy environment by utilizing the analytical hierarchy process (AHP) and fuzzy technique for order preference by similarity to ideal solution (TOPSIS). The drawback of the proposed model is that it relies on only one method for multi-criteria analysis [15].

According to Şener et al., the majority of existing studies generally provide solutions incorporating a single method for making such decisions. Therefore, their study proposes a more comprehensive solution in the form of a decision support system named ClouDSS, which employs various MCDM methods with the aim of optimizing cloud service selection decisions [16].

Ilieva created three MCDM models employing fuzzy VIKOR, TOPSIS and EDAS methods. The proposed methods have handled qualitative and quantitative data for big data platform selection based on 17 QoS attributes and two sets of user requirements [5].

Farshidi et al. presented a decision support system to help decision-makers in choosing the most suitable Infrastructure-as-a-Service cloud providers. The novelty of the created new DSS lies in utilizing the MoSCoW prioritization technique to assess criteria weights and reduce uncertainty, in introducing assessment models to measure the values of non-boolean criteria, and in using ISO quality aspects to indicate the relationship among criteria according to domain experts' knowledge [17].

Despite the large number of publications on cloud platform selection, there is insufficient research on the problem of fuzzy multi-criteria cloud platform decision-making.

The studies described above provide valuable information for cloud technologies' assessment, but demonstrate some drawbacks:

1) Often criteria systems include only cloud services' performance, however, assessment should also be a function of many other variables, for example, social and organizational factors;
2) If cloud service assessment depends on qualitative factors, then their conversion into quantitative data is often subjective and should be made via linguistic terms or fuzzy numbers.

To overcome these shortcomings, in the next section we propose a new fuzzy methodology for cloud service evaluation.

3. A New Multiple Criteria Cloud Platforms' Evaluation Methodology

The previous section highlighted the importance of choosing a cloud platform tailored to the specific needs of business organizations.

The diversity in cloud architectures and number of available options has complicated the process of service and vendor selection for prospective cloud users and there is a need for a methodology for cloud service selection [4]. Given that each cloud service could be characterized using varied types of criteria, the core of our new methodology should be fuzzy MCDM approach.

This fuzzy methodology consists of five steps, described below (Figure 1).

Step 1. Exploring user cloud service needs

In the first stage of this step, in order to collect data about firm's business model, we apply the questionnaire from [11]. There are many factors listed in the form, for example, financial performance indicators, number of servers, number of countries it is spread across, amount of data handling. Next, in the second stage, suitability index is calculated as a measure of firm's readiness for cloud technology deployment. If the index value obtained for a particular organization is bigger than a given threshold, then the company could be considered as suitable for adopting cloud computing and the selection process can continue to Step 2. Otherwise, it should go to the end of the cloud selection process.

Step 2. Development of user requirements specification for a cloud service

In order to collect data about consumer requirements, the questionnaire method is used once again. The questionnaire consists of several question groups, corresponding to the various aspects of cloud storage. At the end of this step, the basic parameters of cloud storage services are defined.

Step 3. Construction of multi-criteria system for cloud service assessment

In this step, a multi-criteria index system for cloud services is established. The new index is built on user requirements and the importance of cloud specifications for the company's activity. Other evaluation measures, such as those mentioned in the previous section, may also be involved in the construction of the assessment system. The evaluation index can include social and organizational characteristics of the company.

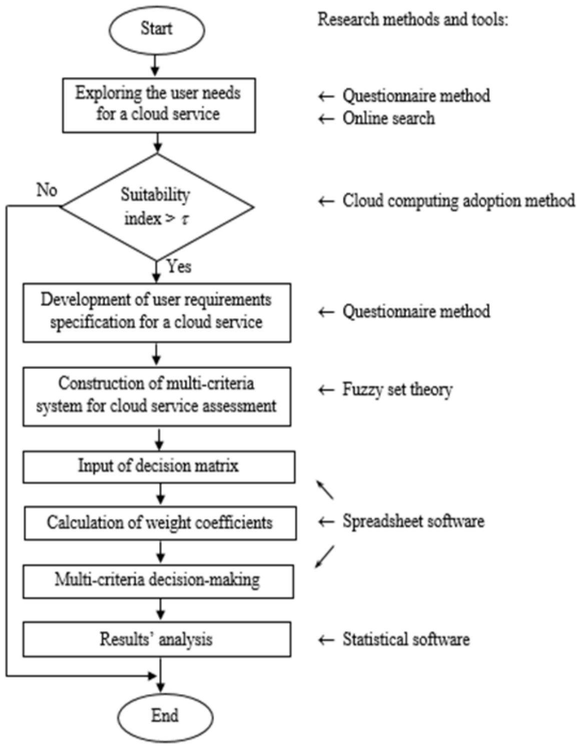

Figure 1. The flowchart of the proposed fuzzy methodology

The multi-criteria system can be expanded with additional technical specifications and economic data from cloud providers, customer reviews, demo-versions experience or cloud ratings.

Step 4. Input of decision matrix and calculation of weight coefficients

Based on data about the company's business activity, a personalized multi-criteria evaluation system, and available datasets for cloud platforms comparison, the corresponding numerical values are filled in the decision matrix. In case of categorical variables, these are converted into fuzzy numbers.

After that, the evaluations of each category group and each cloud service feature from the questionnaire are coded. The final values of weight coefficients are functions of the importance of categories and cloud features (Appendix 3).

Step 5. Multi-criteria decision-making

The next step determines the cloud services ranking via fuzzy multi-attribute decision-making algorithms. In order to eliminate inaccuracies of the solution due to the specifics of input data, several methods are applied.

Our proposal is employing a classic Simple Additive Weighting (SAW) method and four recently developed models: Weighted Aggregated Sum Product Assessment (WASPAS) [18], Multi-Attributive Border approximation Area Comparison (MABAC) [19], Combinative Distance-based Assessment (CODAS) [20] and Measurement of Alternatives and Ranking according to COmpromise Solution (MARCOS) [21].

The selected multi-criteria methods belong to the two basic models for MCDM – additive weighted value function (SAW, WASPAS) and similarity to the best and/or worst alternatives (MABAC, CODAS, MARCOS).

Fuzzy SAW is a classic method for multi-criteria analysis that uses a fuzzy utility function of the weight coefficients and the estimates from the decision matrix.

The WASPAS method combines two multi-criteria decision-making approaches – the weighted sum method (SAW) and the weighted product method [18].

In MABAC method, the decision makers determine the distance between the criterion function of each alternative and the border approximate area [19].

The algorithm of CODAS method relies on two distance metrics to determine the preferred alternatives [20].

The MARCOS method is based on calculating the relationship between alternatives and reference values (ideal and anti-ideal alternatives) [21].

Step 6. Results analysis

In the analysis of results, only cloud services that have been top ranked with the various fuzzy MCDM methods are left. In this step, decision makers select the most suitable cloud platforms.

At the end of the algorithm, it is proposed that the cloud service with the highest potential to improve both the individual aspects and the overall business activity of the enterprise be deployed.

In the next section, we apply the new methodology to solve the cloud storage evaluation problem via fuzzy MARCOS algorithm.

4. Illustrative Example

Most companies face a huge amount of data entering their information systems from different sources. Let F be a randomly selected firm exposed to a data storage problem. The benefits of cloud storage over local IT infrastructure are numerous. The problem is how to find the best cloud storage solution for the particular firm.

The execution of Step 1 of the proposed methodology shows that the firm's F suitability index is high.

In this illustrative example, we utilize a cloud storage dataset, collected from Cloudwards.com. The dataset consists of 10 cloud storage platforms (A_1, A_2, …, A_{10}) and 5 assessment criteria (C_1, C_2, …, C_5). The cloud based storage platforms are as follows: A_1 – sync.com, A_2 – pCloud, A_3 – tresorit, A_4 – MEGA, A_5 – OneDrive, A_6 – Google Drive, A_7 – icedrive, A_8 – KOOFR, A_9 – Dropbox, and A_{10} – wölkli. The criteria are related to the following different aspects of cloud storage technologies: C_1 – Cloud syncing, C_2 – File sharing, C_3 – Productivity, C_4 – Security, and C_5 – Support. In this case, each criterion represents a category (set) from cloud features.

In Step 2, experts from firm F fill in the questionnaire about their cloud requirements (Appendix 1). Respondents evaluate the cloud features via a five-point Likert scale ranging from "Extremely Important" (corresponding to 5) to "Unimportant" (corresponding to 1).

In Step 3, a multi-system criteria index is constructed. The evaluation index consists of variables C_i, $i = \overline{1,5}$.

The assessments of alternatives by criteria are equal to the number of available features in the respective category (Appendix 2). These values are converted into linguistic variables from seven-point scale (Table 1). For transforming every linguistic variable into its corresponding symmetric triangular fuzzy number (TFN), the correspondence table (Table 2) is applied.

Table 1. Evaluation scores and weight coefficients for cloud storage platforms

	C_1	C_2	C_3	C_4	C_5
A_1	MH	VH	M	MH	MH
A_2	VH	H	M	H	M
A_3	H	H	ML	VH	H
A_4	H	H	M	VH	ML
A_5	H	M	H	MH	M
A_6	MH	M	H	MH	VH
A_7	VL	MH	ML	MH	MH
A_8	ML	H	M	H	VL
A_9	H	H	MH	H	H
A_{10}	H	H	H	VH	MH

Source: https://www.cloudwards.net

Table 2. Linguistic variables and their corresponding triangular fuzzy numbers

Linguistic term	*Symmetric TFN*
Very low (VL)	(0, 0, 0.17)
Low (L)	(0, 0.17, 0.33)
Medium Low (ML)	(0.17, 0.33, 0.5)
Medium (M)	(0.33, 0.5, 0.67)
Medium High (MH)	(0.5, 0.67, 0.83)
High (H)	(0.67, 0.83, 1)
Very High (VH)	(0.83, 1, 1)

The importance of each category from the questionnaire about user requirements is multiplied by the average value of the features from the same category (Appendix 3). The final weights W_i, $i = \overline{1,5}$ are normalized such that

$$\sum_{i=1}^{5} W_i = 1$$

The obtained weight coefficients are as follows: $W_1 = W_2 = W_4 = W_5 = 0.1$ and $W_3 = 0.6$ (Set-1).

In order to test the sensitivity of the MCDM method we repeat the calculations with a second weight coefficients set: $W_1 = W_2 = … = W_5 = 0.2$ (Set-2).

The two sets represent different combinations of criteria importance: Set-1 emphasizes on the platform's productivity (C_i), while Set-2 demonstrates the equal importance of five criteria. The next step is the multi-criteria analysis.

The obtained scores and rankings of given cloud storage platforms by using fuzzy and crisp MARCOS method for the two sets of weight coefficients are displayed in Table 3.

The standard MARCOS method has been tested under various scenarios. The experiments have proven that the method is reliable [21]. In order to show that this method is applicable to fuzzy numbers, we compare the ranking obtained with fuzzy numbers to the one with their corresponding crips values (Table 4).

Table 3. Overall scores and their corresponding ranking – MARCOS method, TFNs

	Set-1		*Set-2*	
	Score	Rank	Score	Rank
A_1	0.649	7	0.682	6
A_2	0.664	5	0.713	5
A_3	0.605	8	0.739	3
A_4	0.649	6	0.680	7
A_5	0.792	3	0.665	8
A_6	0.806	2	0.725	4
A_7	0.489	10	0.461	10
A_8	0.578	9	0.498	9
A_9	0.776	4	0.788	2
A_{10}	0.849	1	0.821	1

Table 4. Overall scores and their corresponding ranking – MARCOS method, crisp values

	Set-1		*Set-2*	
	Score	Rank	Score	Rank
A_1	0.596	7	0.654	7
A_2	0.619	5	0.701	5
A_3	0.537	8	0.720	3
A_4	0.601	6	0.664	6
A_5	0.724	4	0.636	8
A_6	0.806	1	0.710	4
A_7	0.405	10	0.453	10
A_8	0.519	9	0.498	9
A_9	0.741	3	0.763	2
A_{10}	0.795	2	0.782	1

The final fuzzy rankings are as follows:

Set-1: $A_{10} \succ A_6 \succ A_5 \succ A_9 \succ A_2 \succ A_4 \succ A_1 \succ A_3 \succ A_8 \succ A_7$;
Set-2: $A_{10} \succ A_9 \succ A_3 \succ A_6 \succ A_2 \succ A_1 \succ A_4 \succ A_5 \succ A_8 \succ A_7$.

Spearman's rank correlation coefficient is applied as a similarity measure between fuzzy and crisp solutions. In the two cases, Spearman's coefficient indicates a high degree of closeness – 0.976 (Set-1) and 0.988 (Set-2).

Data analysis shows that three groups of cloud platforms can be distinguished in the rankings:

Set-1:
Group 1. Cloud storage products with highest assessments – A_{10}, A_6, and *A5*;
Group 2. Cloud storage products with middle to highest estimate – A_9, A_2, A_4;
Group 3. Cloud storage products with relative low assessments
by criterion C_3 (Productivity) (the maximal important feature);
Set-2:
Group 1. Cloud storage products with highest assessments – A_{10}, A_9, and A_3;
Group 2. Cloud storage products with middle to highest assessments A_6, A_2, A_1;
Group 3. Cloud storage products with relative low assessments – A_4, A_5, A_8 and A_7
on almost all criteria.

The high Productivity assessments of A_6, A_5 and A_4 alternatives allow them to occupy leading positions in the ranking and vice versa, A_3 lagging causes the platform to fall into the last part of the ranking.

Therefore, it can be concluded, that the proposed methodology is reliable and properly reflects the requirements and needs of firm *F*.

5. Conclusion

The paper proposes a new methodology for ranking cloud services according to specific requirements of an organization. The methodology combines both multi-criteria and fuzzy approaches into its cloud technology selection process. Some of the preferred factors influencing cloud storage assessment are product features and functionalities, customer support, and security options.

The described methodology facilitates the choice of the most appropriate cloud service and fosters digital transformation. The methodology offers the following benefits:

- It integrates all stages of the cloud service selection process by combining varied metrics, and different data types from multiple online and offline sources;
- The methodology can employ various kinds of weight and ranking methods stepping on several types of fuzzy assessments (type-1, type-2, intuitionistic, etc.).

In the future, we plan on: 1) collecting a database of the most popular cloud storage products, and 2) applying the presented methodology to other types of cloud services.

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Appendix 1.

Business requirements for cloud storage and file sharing questionnaire

Please respond to the following questions by filling in the blanks where indicated and/or placing a check mark (√) in the answer box that corresponds to your response (one response per row).

1. Company name:
----

2. Location:

Cloud service categories

3. How important is each cloud service category for your business?

	Extremely important	Very Important	Important	Less Important	Unimportant
Sync					
File Sharing					
Productivity					
Security					
Support					

Sync category

4. How important is each sync feature for your business?

	Extremely important	Very Important	Important	Less Important	Unimportant
Sync Folder					
Block-Level Sync					
Selective Sync					
Bandwidth management					
Sync Any Folder					

File Sharing category

5. How important is each file sharing feature for your business?

	Extremely important	Very Important	Important	Less Important	Unimportant
File Link Sharing					
Link Passwords					
Link Expiry Dates					
Folder Sharing					
Folder Permissions					
Link Download Limits					
Upload Links					

Productivity category

6. How important is each productivity feature for your business?

	Extremely important	Very Important	Important	Less Important	Unimportant
File Previews					
Edit Files					
In-App Collaboration					
Office Online					
Google Docs					
Notes App					
Media Playback					
Mobile Apps					
Deleted File Retention					
Versioning					
WebDAV					

Security category

7. How important is each security feature for your business?

	Extremely important	Very Important	Important	Less Important	Unimportant
At-Rest Encryption					
In-Transit Encryption					
Encryption Protocol with high level of security					
Zero Knowledge					
Two-Factor Authentication					
Closeness to the server location					

Support category

8. How important is each support feature for your business?

	Extremely important	Very Important	Important	Less Important	Unimportant
24/7 Support					
Live Chat Support					
Telephone Support					
Email Support					
User Forum					
Knowledgebase					

Cost of cloud service

9. How important is cost of cloud service for your business?

	Extremely important	Very Important	Important	Less Important	Unimportant
Low cost					

Source: Based on https://www.cloudwards.net

Appendix 2.

Cloud storage platforms and their features

	sync.com	pCloud	tresorit	MEGA	OneDrive	Google Drive	icedrive	KOOFR	Dropbox	wölkli
Sync category										
Sync Folder	1	1	1	1	1	1	0	0	1	1
Block-Level Sync	0	1	0	0	1	0	0	0	1	0
Selective Sync	1	1	1	1	1	1	0	1	1	1
Bandwidth management	1	1	1	1	1	1	0	0	1	1
Sync Any Folder	0	1	1	1	0	0	0	1	0	1
Count:	**3**	**5**	**4**	**4**	**4**	**3**	**0**	**2**	**4**	**4**
File Sharing category										
File Link Sharing	1	1	1	1	1	1	1	1	1	1
Link Passwords	1	1	1	1	0	0	1	1	1	1
Link Expiry Dates	1	1	1	1	1	1	1	1	1	1
Folder Sharing	1	1	1	1	1	1	1	1	1	1
Folder Permissions	1	1	1	1	1	1	1	1	1	1
Link Download Limits	1	0	1	0	0	0	0	0	0	0
Upload Links	1	1	0	1	0	0	0	1	1	1
Count:	**7**	**6**	**6**	**6**	**4**	**4**	**5**	**6**	**6**	**6**
Productivity category										
File Previews	1	1	1	1	1	1	1	1	1	1
Edit Files	1	0	0	0	1	1	0	0	1	1
In-App Collaboration	1	0	0	0	1	1	0	0	1	1
Office Online	0	0	0	0	1	0	0	0	1	0
Google Docs	0	0	0	0	0	1	0	0	0	0
Notes App	0	0	0	0	1	1	0	0	1	1
Media Playback	0	1	0	1	1	1	1	1	0	1
Mobile Apps	1	1	1	1	1	1	1	1	1	1
Deleted File Retention	1	1	1	1	1	1	1	1	1	1
Versioning	1	1	1	1	1	1	0	1	1	1
WebDAV	0	1	0	1	0	1	0	1	0	1
Count:	**6**	**6**	**4**	**6**	**9**	**10**	**4**	**6**	**8**	**9**
Security category										
At-Rest Encryption	1	1	1	1	1	1	1	1	1	1
In-Transit Encryption	1	1	1	1	1	1	1	1	1	1
Encryption Protocol	0	1	1	1	1	1	1	1	1	1
Zero Knowledge	1	1	1	1	0	0	1	0	1	1
Two-Factor Authentication	1	1	1	1	1	1	0	1	1	1
Server Location	0	0	1	1	0	0	0	1	0	1
Count:	**4**	**5**	**6**	**6**	**4**	**4**	**4**	**5**	**5**	**6**

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Appendix 3.

Business requirements for cloud storage and file sharing

Customer: F

Location: X

Cloud service categories	Extremely important	Very Important	Important	Less Important	Unimportant
Sync					1
File Sharing					1
Productivity	5				
Security					1
Support					1

Sync category	Extremely important	Very Important	Important	Less Important	Unimportant		
Sync Folder	5						
Block-Level Sync			3				
Selective Sync		4					
Bandwidth management				2		Total sum:	Count:
Sync Any Folder		4				18	5

File sharing category	Extremely important	Very Important	Important	Less Important	Unimportant		
File Link Sharing	5						
Link Passwords		4					
Link Expiry Dates			3				
Folder Sharing	5						
Folder Permissions		4					
Link Download Limits				2		Total sum:	Count:
Upload Links			3			26	7

Productivity category	Extremely important	Very Important	Important	Less Important	Unimportant		
File Previews		4					
Edit Files			3				
In-App Collaboration			3				
Office Online				2			
Google Docs		4					
Notes App			3				
Media Playback				2			
Mobile Apps		4					
Deleted File Retention		4					
Versioning			3			Total sum:	Count:
WebDAV					1	44	11

Security category	Extremely important	Very Important	Important	Less Important	Unimportant		
At-Rest Encryption			3				
In-Transit Encryption		4					
Encryption Protocol with high level of security		4					
Zero Knowledge		4					
Two-Factor Authentication			3			Total sum:	Count:
Closeness to the server location				2		20	6

Support category	Extremely important	Very Important	Important	Less Important	Unimportant		
24/7 Support			3				
Live Chat Support				2			
Telephone Support			3				
Email Support		4					
User Forum		4				Total sum:	Count:
Knowledgebase			3			19	6

Cloud service categories:	Sync	File Sharing	Productivity	Security	Support
Extremely important	0	0	5	0	0
Very Important	0	0	0	0	0
Important	0	0	0	0	0
Less Important	0	0	0	0	0
Unimportant	1	1	0	1	1

Average value per category:	3.60	3.71	4.00	3.33	3.17	Total sum:
Weighted average value per category:	3.60	3.71	20.00	3.33	3.17	33.81
Relative category weight:	0.1	0.1	0.6	0.1	0.1	1.00