Cloud storage application functionalities from users' perspectives

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Abstract

Over the past years, a number of cloud storage applications have emerged claiming that they can improve IT efficiency and business agility. Cloud storage applications use the concept of Software as a Service to provide a complete solution for file storage. The applications are normally accessible through a PC web browser or as an application installed on a PC, a mobile phone, or a tablet. This paper explores some well-known cloud storage applications in the market today. The functionalities of the cloud storage applications are examined by a group of users. Limitations and recommendations from the perspectives of users are presented. User satisfaction is also measured for each function. The findings suggest that user satisfaction tends to increase if the application has more complete functionalities and capabilities.

1. Introduction

Nowadays, many organizations have started to use cloud computing with various information systems in order to achieve better organizational performance [1]. Cloud computing is a concept that uses ICTs advances such as virtualization and grid computing to deliver a variety of ICT services via virtual hardware and software [2]. These services are usually provided according to user demands and requirements by cloud providers. They are delivered remotely through public and/or private networks. Cloud service delivery models include computer applications (Software as a Service – SaaS), processing capabilities and storage facilities (Infrastructure as a Service – IaaS), and development tools and hosting facilities (Platform as a Service – PaaS). These models commonly rent the use of their computing resources to customers; however different organizations and organizations' objectives need different service types [1].

Organizations benefit from cloud computing as it improves IT efficiency and business agility [3]. IT efficiency refers to the efficient use of modern computers with highly scalable hardware and software resources and green computing concepts. Computers located in different geographical areas need to have computing power that can be remotely accessed over the Internet. Business agility shows that using IT can give a competitive advantage through use of tools such as parallel processing, rapid deployment, mobile interactive applications, and business analytics. Businesses need to be able to use rapidly deployed and scaled computational tools which can reduce substantial investments for IT infrastructure. Cloud storage applications are one of the SaaS cloud service delivery models, which are increasingly popular in today's market. At present, examples of leading cloud storage applications are Google Drive, Dropbox, Box, and OneDrive. The key functionalities of these cloud storage applications are identified based on relevant studies in the literature [4 - 9]. The cloud storage application functionalities and references are presented in Table 1.

This research aimed to explore some samples of cloud storage applications and attempted to identify if they have the functions listed above. The study also revealed limitations and recommendations of these cloud storage applications from the perspectives of users. The results of this research will benefit individuals or businesses when selecting cloud storage applications for their own use. Cloud storage applications may be extended so that they can be used as one of various tools to support capturing, storing, and sharing knowledge in organizations [10]. This research will also assist software vendors so that they can understand the users' expectations more and enhance the functionalities of cloud storage applications.

2. Materials and Methods

This research uses an exploratory approach. A sample of well-known cloud storage applications currently available in the market were selected. These were Google

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Table 1 Cloud storage application functionalities and references

Cloud Storage Application Functionalities	References
Free Storage	Varol & Underdown 2013; Malik et al. 2015; Cui et al. 2016; Su & Chang 2014; Drago et al. 2012
Expandable Storage Availability	Varol & Underdown 2013; Drago et al. 2012
File Size Limit	Varol & Underdown 2013; Su & Chang 2014
Folder Synchronization	Varol & Underdown 2013; Malik et al. 2015; Cui et al. 2016; Drago et al. 2012; Pocatilu et al. 2013
Events Tracking	Varol & Underdown 2013
Version History	Varol & Underdown 2013; Cui et al. 2016
Search	Cui et al. 2016;
Browse	Drago et al. 2012; Zeng et al.
View	Drago et al. 2012; Zeng et al.
Download	Malik et al. 2015; Drago et al. 2012
Comment	Varol & Underdown 2013
Tagging	Varol & Underdown 2013
Personal User Accounts	Malik et al. 2015; Drago et al. 2012
Edit File Online	Su & Chang 2014
Simultaneous Document Editing	Varol & Underdown 2013
Sharing/Distributing Links	Varol & Underdown 2013; Cui et al. 2016
Shared Folders	Drago et al. 2012
Permission Settings	Varol & Underdown 2013

Drive, Dropbox, Box, OneDrive, MEGA, Sync, and pCloud. They were selected because, at the time of the study, they were popular and were providing free subscriptions. This study, was therefore, conducted based on the free subscription versions of these applications. A group of fourteen senior undergraduate students from the Management Information Systems field was selected as a group of users. These users were selected as they had strong background knowledge in Information Systems and Information Technology. A pair of these users was allocated to each application for hands-on practice. They then investigated whether the application had the functions from the literature identified in the table above [4 - 9]. The applications were examined through Google's Chrome browser using PCs. After a two-week period of usage, users were interviewed in order to find out the limitations of the applications and their recommendations for improving them. The application functionalities are described in Table 2.

3. Results and Discussion

3.1 Functionality Comparison

From the study, the functionality mapping of the cloud storage applications that were studied is presented in Table 3.

3.2 Limitation and Recommendation

First, a free Google Drive account receives 15 GB of storage. This can be expanded up to 30 TB with the payment of monthly fees. There are several standard and additional functions that are convenient to use. Google Drive has all of the functions shown in Table 2. It's search function is excellent as might be expected. The application allows users to search not only from the file title but also from the full text inside the document. The file size limit seems to be very high compared to others. Overall, users were very satisfied with Google Drive and thought that it was quite perfect for their usage.

Dropbox offers only 2 GB of storage for a single-user free account. The application does not provide tagging function which most of the other cloud storage applications offer. Tagging function can be useful to assist with searching for files within the application. Another issue is that the application lacks full-text search. Therefore, users cannot perform search for the content inside the document when they access it using a web browser. Users recommend that Dropbox should include functions like adding tags and searching text in the document. Users also raised a limitation concern regarding shared folders for business accounts. The shared folder used space is counted against the team available storage. If a business user shares a folder with someone outside of the team, used space will be counted against the external individual's as well as the team's available storage.

Box offers 10 GB of storage for a free account but the file size limit is very low compared to others. Users also point out that the registration process requires them to enter personal details such as full name, email address, and phone number. Instead, the users proposed that the

Table 2 Cloud storage application functionality description

Cloud Storage Application Functionalities	Description
Free Storage	This function enables users to store files within the storage capacity registered under free subscription.
Expandable Storage Availability	This function enables users to store files within the expanded storage capacity registered under paid subscription.
File Size Limit	This function limits the maximum file size of each file stored in the applications.
Folder Synchronization	This function enables the synchronization of folders and files across multiple devices.
Events Tracking	This function enables users to keep track of all activities occurred in the applications.
Version History	This function enables users to keep track of old and current versions of files.
Search	This function enables users to search document objects including searching full text inside documents.
Browse	This function enables users to browse files in different categories.
View	This function enables users to preview the content of the file.
Download	This function allows users to download files to use or modify them locally.
Comment	This function allows users to add comments to each file.
Tagging	This function allows users to add tags to each file.
Personal User Accounts	This function enables users to create and manage their own personal accounts.
Edit File Online	This function enables users to edit file online without having to download files locally.
Simultaneous Document Editing	This function enables multiple users to edit documents at the same time.
Sharing/Distributing Links	This function enables users to share or distribute files to other users through links.
Shared Folders	This function enables users to share files through folders.
Permission Settings	This function enables users to set permission of their files and folders.

application should provide them with the link to popular accounts such as Facebook account or Google account to get information more quickly. Similar to Dropbox, the search function of Box does not allow users to search full text inside the document. Therefore, it was suggested that Box should increase the file size limit and integrate full-text search into search function. That would make the application more interesting for users.

OneDrive provides only 5 GB of storage for a free account. However, the application has all of the functions listed in Table 2 including full-text search inside documents. Therefore, OneDrive is very competitive when compared to GoogleDrive. The only drawbacks are that OneDrive has less free storage and a smaller file size limit. MEGA offers the largest amount of storage at 50 GB for free. Nevertheless, the application was found to lack several necessary functions. For example, the

application does not allow users to keep track of file versions. They can only overwrite files or keep old files as separate files with different names. Moreover, the application does not allow users to search full text inside documents. MEGA only allows users to preview some types of files such as images but not Microsoft Office documents and PDF files. Users have to download documents to their computers in order to view or modify them. Simultaneous document editing is also not allowed.

Sync provides only 5 GB of storage for a free subscription. The application also lacks several important functions. For instance, the application does not allow users to search for full text inside documents. Users can preview image files through the browser but cannot preview Microsoft Office documents and PDF files. The application does not allow users to add comments and tags to the file. Also, users cannot edit file online so

Table 3 Functionality mapping of cloud storage applications

No.	Cloud Storage Application Functionalities	Google Drive	Dropbox	Box	OneDrive	MEGA	Sync	pCloud
1	Free Storage	15 GB	2 GB	10 GB	5 GB	50 GB	5 GB	10 GB + 10 GB by referral
2	Expandable Storage Availability	/	/	/	/	/	/	/
3	File Size Limit	5 TB	20 GB	250 MB	10 GB	N/A	N/A	N/A
4	Folder Synchronization	/	/	/	/	/	/	/
5	Events Tracking	/	/	/	/	/	/	X
6	Version History	/	/	/	/	X	/	/
7	Search	/	Title only	Title only	/	Title only	Title only	Title only
8	Browse	/	/	/	/	/	/	/
9	View	/	/	/	/	/	/	/
10	Download	/	/	/	/	/	/	/
11	Comment	/	/	/	/	/	X	X
12	Tagging	/	X	/	/	/	X	X
13	Personal User Accounts	/	/	/	/	/	/	/
14	Edit File Online	/	/	/	/	X	X	X
15	Simultaneous Document Editing	/	/	/	/	X	X	X
16	Sharing/Distributing Links	/	/	/	/	/	/	/
17	Shared Folders	/	/	/	/	/	/	/
18	Permission Settings	/	/	/	/	/	/	/

Remarks:

/ = The application has the specified functions.

X = The application does not have the specified functions.

N/A = The application does not provide the information.

simultaneous document editing is therefore impossible. Another limitation is managing personal user accounts. The application allows password reset only from a device in which the application is installed.

Finally, pCloud offers 10 GB of storage for a free account plus another 10 GB as a perk if customers refer new users. Similar to Sync, pCloud lacks several necessary functions such as event tracking, full-text search, adding comments or tags to the file, and editing files online or with other users simultaneously. However, the application allows users to preview many types of file through the browser including images, Microsoft Office documents, and PDF files. The limitations of the cloud storage applications are presented in Table 4.

3.3 User Satisfaction Scores

The satisfaction of the users was measured giving the rating scores listed as follows. The score for each of the functions of cloud storage applications are presented in Table 5.

1 = Very dissatisfied

2 = Dissatisfied

3 = Neither satisfied nor dissatisfied

4 = Satisfied

5 = Very satisfied

Table 4: Limitations of cloud storage applications

Limitations	Google Drive	Dropbox	Box	OneDrive	MEGA	Sync	pCloud
Lack of event tracking							/
Lack of comment function						/	/
Lack of tagging function	/					/	/
Lack of full-text search	/	/			/	/	/
Lack of version history function					/		
Lack of editing file online					/	/	/
Lack of simultaneous document editing					/	/	/
Shared folder used space for business accounts are counted against the available storage of both the team and the external individual.	/						
Very low file size limit			/				
Difficulty of the registration process			/				
Unavailability of Microsoft Office documents and PDF files preview					/	/	
Password reset can be done only from a device in which the application is installed.						/	

It was found that the users tended to feel dissatisfied if the particular cloud storage application did not have all of the functions that the other cloud storage applications had. This aligns with the Technology Acceptance Model (TAM) which specifies that the usefulness of the systems is very important [11]. The systems will be considered useful if users can access all functionalities that help them with their job. Google Drive received the highest user satisfaction score with an average score of 4.83. Dropbox and Sync received average scores of 4.28 and 4.11 respectively. Box, OneDrive, and pCloud received average scores of 3.94, 3.83, and 3.44 respectively. MEGA has the lowest score with an average of only 3.11. It seems surprising that OneDrive has all functionalities but the average score is less than Dropbox, Box, and Sync. It is thought that this is due to user interface of OneDrive being more difficult to use than Dropbox, Box, and Sync. This issue needs to be studied further from ease of use aspect in order for firmer conclusions to be drawn. According to Davis F-D [11], a lack of user friendliness of systems is the key barrier to user acceptance.

4. Conclusions

From the study, it can be concluded that Google Drive is the best cloud storage application in terms of complete functionalities and user satisfaction. Dropbox, Box, and OneDrive are currently acceptable in the term of user satisfaction. However, Dropbox and Box should improve search function to allow full-text search inside documents. MEGA, Sync, and pCloud need to improve the functionalities such as full-text search, comment, tagging, online file editing, and simultaneous document editing to enable user collaboration and increase user satisfaction. This research could be expanded further to the organizational level in cases where organizations wish to use cloud storage applications to support information and knowledge management. With research funding, the applications could be assessed based on the paid subscriptions with full access to all functionalities. This would allow researchers, organizations, and software developers understand users' satisfaction more thoroughly. It would also lead to the identification of the most important functions for organizations and the enhancement of these functions.

References

[1] Lin A, Chen N-C. Cloud computing as an innovation: Percepetion, attitude, and adoption. **International Journal of Information Management**. 2012; **32**: 533-540.

Table 5 Functionality rating score of cloud storage applications

No.	Cloud Storage Application Functionalities	Google Drive	Dropbox	Box	OneDrive	MEGA	Sync	pCloud
1	Free Storage	5	1	4	4	4	4	5
2	Expandable Storage Availability	5	4	4	3	4	4	4
3	File Size Limit	4	2	2	4	5	5	5
4	Folder Synchronization	5	5	4	4	4	5	5
5	Events Tracking	4	5	4	4	3	4	3
6	Version History	4	5	4	4	1	4	4
7	Search	5	3	4	3	4	5	2
8	Browse	5	5	5	4	3	5	4
9	View	5	5	5	4	1	5	4
10	Download	5	5	5	4	3	5	4
11	Comment	5	5	2	3	4	2	1
12	Tagging	5	3	4	4	3	4	1
13	Personal User Accounts	5	5	4	4	4	5	4
14	Edit File Online	5	5	5	4	1	1	1
15	Simultaneous Document Editing	5	4	4	4	1	1	1
16	Sharing/Distributing Links	5	5	4	4	3	5	5
17	Shared Folders	5	5	4	4	4	5	4
18	Permission Settings	5	5	3	4	4	5	5
	Average score	**4.83**	**4.28**	**3.94**	**3.83**	**3.11**	**4.11**	**3.44**

[2] Sultan N. Knowledge management in the age of cloud computing and Web 2.0: Experiencing the power of disruptive innovations. **International Journal of Information Management**. 2013; **33**: 160-165.

[3] Marston S, Li Z, Bandyopadhyay S, Zhang J, Ghalsasi A. Cloud computing — The business. **Decision Support Systems**. 2011; **51**: 176-189.

[4] Varol S, Underdown R. An analysis of mobile applications for the purpose of facilitating knowledge management. **Proceedings of The International Conference on Intellectual Capital, Knowledge Management & Organizational Learning**. 2013; 638-644.

[5] Malik R, Shashidhar N, Chen L. Cloud storage client application analysis. **International Journal of Security**. 2015; **9**(1): 1-14.

[6] Cui Y, Lai Z, Dai N. A first look at mobile cloud storage services: architecture, experimentation and challenge. **IEEE Network**. 2016; **30**(4): 16-21.

[7] Su W-C, Chang SE. Integrated cloud storage architecture for enhancing service reliability, availability and scalability. **Proceedings of The International Conference on Information Science, Electronics and Electrical Engineering**. 2014; 764-768.

[8] Drago I, Mellia M, Munafò MM. Inside dropbox: understanding personal cloud storage services. **Internet measurement conference: Proceedings of the 2012 ACM conference** (IMC'12). 2012; 481-494.

[9] Pocatilu P, Boja C, Ciurea C. Syncing mobile applications with cloud storage services. **Informatica Economica**. 2013; **17**(2): 96-108.

[10] Liophanich C. Knowledge management success factors: Human perspective. **Journal of Thai Interdisciplinary Research**. 2017; **12**(4): 32-43.

[11] Davis F-D. User acceptance of information technology: System characteristics, user perceptions, and behavioural impacts. **International Journal of Man-Machine Studies.** 1993; **38**(3): 475-487.