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In this issue:

- 4. The Effects of Perceived Functionality and Usability on Privacy and Security Concerns about Cloud Application Adoptions**
Makoto Nakayama, DePaul University
Charlie Chen, Appalachian State University
Christopher Taylor, Appalachian State University

- 12. Finding the “Radicalness” in Radical Innovation Adoption**
Aditya Sharma, North Carolina Central University
Dominic Thomas, Suffolk University
Benn Konsynski, Emory University

- 21. A Multi-Criteria Network Assessment Model of IT Offshoring Risks from Service Provider’s Perspective**
Doncho Petkov, Eastern Connecticut State University
Olga Petkova, Central Connecticut State University

- 35. Downloading Mobile Applications – Are Students Protecting Themselves?**
Adnan A. Chawdhry, California University of Pennsylvania
Karen Poullet, Robert Morris University
David M. Douglas, Robert Morris University
Joseph Compimizzi, Florida Atlanta University

- 43. Proposal for Kelly Criterion-Inspired Lossy Network Compression for Network Intrusion Applications**
Sidney C. Smith, U. S. Army Research Laboratory
Robert J. Hammell II, Towson University

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The Effects of Perceived Functionality and Usability on Privacy and Security Concerns about Cloud Application Adoptions

Makoto Nakayama
mnakayam@depaul.edu
College of Computing and Digital Media
DePaul University
Chicago, IL 60604, USA

Charlie Chen
chench@appstate.edu

Christopher Taylor
taylorcw@appstate.edu

Computer Information Systems and Supply Chain Management
Appalachian State University
Boone, NC 28608, USA

Abstract

Privacy and security risk are two primary concerns for end-users to consider when adopting cloud applications. This study investigates two potential antecedents for these two concerns: functionality expectation and usability. In addition, this study tries to understand whether their relationships exist and are correlated positively or negatively. An online survey was sent to 211 college users asking about their experiences using Google Docs. Statistical tests were conducted and showed that functionality expectation and usability improve as the length of use increases. Improved usability perception has negative effect on privacy and security concerns, indicating that privacy and security concerns could be reduced over time. On the other hand, increased functionality expectation raises more privacy concerns but does not affect security concern. Academic and practical implications are drawn from the findings to conclude this study.

Keywords: Cloud Computing, Privacy, Security, Risk, Google Docs

1. INTRODUCTION

Cloud applications were initially not considered reliable and practical, as users had doubt and skepticism. A recent survey shows that 93% of its respondents are adopting cloud applications (Weins, 2015). The rapid adoption of cloud applications could be caused by the applications' improved features or users' improved perception.

What changes the users' perceptions of cloud applications depends on many factors. However, it is worth asking how end-user perceptions change over time on the functionality and usability of cloud-based applications.

The end-user perception changes about different non-standard cloud applications would be difficult to examine, given that the details of each cloud application vary. However, it is more feasible to

assess a standardized, common cloud application than a non-standard, customized one. In this study, we focus on Google Docs as one example of end-user oriented popular cloud applications. Google Docs is "a cloud productivity suite and it is designed to make computer-mediated collaboration easy and natural so that users can access any document they own or that has been shared with them anywhere, any time and on any device" (Sun, Lambert, Uchida, & Remy, 2014, p. 234). Google Docs is easy to use for a wide range of students in different educational settings. A study (Moonen, 2015) reports its successful incorporation even into an elementary school curriculum. At the university level, professors would consider integrating Google Applications into their instructional strategies, provided the appropriate professional development and training (Cahill, 2014). These professors agreed that collaborative technology was an effective teaching tool and assisted students when working on group and individual projects (*ibid.*). However, Google Docs is not limited to educational uses. In fact, it is suited to facilitate collaborations between workers using word processor, spreadsheet, and presentation applications. A recent survey (BetterCloud, 2016) notes that more than 40% of cost savings are seen at small to large firms due to adoption of Google applications, including Google Docs. Given the interest and possible business impact, our main research question is twofold: How do functionality expectation and usability of cloud computing affect privacy and risk concerns of users?

The plan of the paper is as follows: We hypothesize that functionality expectation and usability perception differently affect privacy and security concerns of these cloud applications. After describing method and results, we discuss the implications and future research agenda.

2. THEORETICAL BACKGROUND AND HYPOTHESES

Google Docs is "a free Web-based office suite that allows users to collaborate and facilitate conversations as they create and edit live documents" (Woodard & Babcock, 2014, p. 2). Users of Google Docs may have concerns about intentional or unintentional disclosure of personal information, as well as the inconveniences or costs due to the temporary or permanent unavailability of documents. This means that users have concerns over privacy and risk.

Merriam-Webster defines privacy as "the state of being alone" or "the state of away from public attention." However, the meaning of privacy is contextual and varies among different academic disciplines (Paul A Pavlou, 2011; Smith, Dinev, & Xu, 2011). Privacy is categorized as value-based or cognate-based (Smith et al., 2011), with the former viewing privacy as a right or commodity and the latter as the state of limited information access. Since the study focuses on the perception of individual cloud-application users, we frame privacy concerns as those about "opportunistic behavior related to the personal information submitted" (Dinev & Hart, 2006, p. 64) through Google Docs.

Cloud computing has the flexibility of changing functionality and can do so at a potentially lower cost than dedicated infrastructure (Ali, Soar, & Yong, 2016). Thus, users have a higher functionality expectation for cloud computing. As the degree of functionality expectation for a cloud application becomes greater, the users essentially expect more interactions with the application. A study shows that cloud services with a transparent and adaptable interface can encourage users to spend efforts and time in provisioning privacy requirements before uploading their sensitive data into the services (Henze et al., 2016). Using a cloud application, the user may perceive a 1 in 100 chance of having a privacy violation. If the user keeps using the application in the same way more frequently, the same user would feel a higher chance of experiencing a privacy violation. The more the application delivers its functionality to the user through increased interactions, the higher the perceived chances of privacy violations. We therefore hypothesize:

H1a: The degree of functionality expectation is positively associated with the extent of privacy concerns.

Oxford Dictionary defines risk as "a situation involving exposure to danger." In our study, risk is contextual and depends on subjective perceptions similar to privacy. However, the key difference between privacy and risk relates to the fact that privacy is a perceived state of isolation, whereas risk hinges on the probability of outcomes. Adapting from Gefen and Pavlou (2012), we define security risk as the belief in a potential of suffering a loss while interacting Google Docs fellow users.

Based on this definition of security risk, we can make a parallel argument on the relation between increasing functionality expectation and security

risk, as with the hypothesized relation between increasing functionality expectation and privacy concerns (H1a). The more the user uses a cloud application, the higher the chance of some risk compromise everything else being equal. We therefore hypothesize:

H1b: The degree of functionality expectation is positively associated with the extent of risk concerns.

Advances in information technology bring tremendous benefits to society and yet they could also threaten information privacy and create security risk concerns. This digital dilemma has forced customers to think analytically about how much personal information to disclose in face of growing usability features. According to privacy calculus theory, consumers feel comfortable releasing personal information only when they feel that the benefits of doing so can outweigh potential threats (Milne, Rohm, & Bahl, 2004).

As technology acceptance grows, users realize how much they could be susceptible to privacy and security threats. For instance, as users contribute and share more personal information to Web 2.0 sites (Facebook), they are more likely to have rich user experiences (e.g. expanded personal network, relevant commercials & latest information about friends). However, the success of these rich online socializing experiences depends on the sharing of personal information (e.g. what one did with whom, what opinion one has on a sensitive subject, how one's health exam resulted). Fortunately, a growing number of usable features are easing the process of using Web 2.0 sites. Testing the password strength is now a prevalent feature to assist users in creating a new account. The single sign-on (SSO) feature enables users to access other unfamiliar Web 2.0 sites via their Facebook or Google accounts and passwords. All the contact information on Facebook and Google could be automatically released to other applications (e.g. instant messaging services). Phishing-detection applications with the built-in feature of blacklist-based and whitelist-based anti-phishing toolbars can increase perceived usability and reduce privacy and security concerns for users (Li et al., 2014). Scheduling a personal and business event can be synchronized across Google platform. All these features are integrated on a limited number of platforms with a more sophisticated SSO password. Such evidence shows that the increase of perceived usability is negating privacy and security risk concerns of users.

The perception of usability is based on how the user interacts with the application as opposed to what functions are used or how much the application is used (McNamara & Kirakowski, 2006). In online banking, better website usability leads to higher trust in the website (Casalo, Flavián, & Guinalú, 2007). Higher trust can ease risk concerns (Kim et al., 2008). A study (Hart, Ridley, Taher, Sas, & Dix, 2008) on Facebook use notes the relation between better usability and more Facebook use, while privacy concerns can discourage more Facebook use. A study compares single-factor and two-factor authentication methods in automated telephone banking and finds that users have a higher degree of perceived security with the two-factor method (Gunson et al., 2011). However, the advanced security feature is harder to use and takes longer time for users to complete. Because of its lower perceived usability, users expressed in the study that they are less likely to use the system. This finding indicates that better usability has direct impact of the intention of system use. In addition, better usability has direct impact on satisfaction and trust (Flavián, Guinalú, & Gurrea, 2006). Based on the popularity of e-commerce and Facebook, we can surmise that the impact of better usability has overall eased the privacy concerns. Thus, the last set of hypotheses are:

H2a: The degree of perceived usability is negatively associated with the extent of privacy concerns.

H2b: The degree of perceived usability is negatively associated with the extent of risk concerns.

Thus, our theoretical model is shown as Figure 1 below.

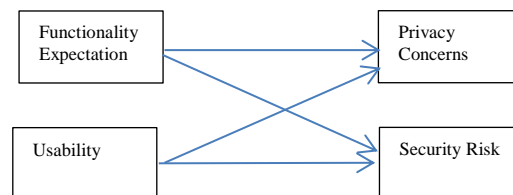


Figure 1. Theoretical model

3. METHOD AND RESULTS

Participants and Procedures

A total of 224 college students in the College of Business of a state university in the southeast region of the United States participated in the study. These students were taking an introductory management information systems course. Participation was voluntary. However, students could earn an extra credit (0.5% of their final grade) if they choose to participate. A final sample of 202 valid questionnaires was used in the present study.

Survey Instrument

We measured the functionality expectation of Google Docs users with a combination of two constructs, collaboration support (Park & Ryoo, 2013) and adoption intention (Gefen, Karahanna, & Straub, 2003). We assessed usability by testing usefulness (Burda & Teuteberg, 2015) and ease of use (Burda & Teuteberg, 2015) for cloud applications. The user's perceived privacy while using Google Docs was measured using three items adapted from Vannoy et al. (2013). To measure the perceived risk construct, we modified the original questions from Pavlou and Gefen's study (2004) into 3 items.

The partial least squares (PLS) (Fornell & Bookstein, 1982) analysis was conducted with the SmartPLS software, because it enables a small sample size. An additional benefit of conducting PLS is that it is nonparametric. Therefore, assumptions such as normality and independence are unnecessary (Chin & Newsted, 1999).

	Function	Privacy	Risk	Usability
Function	0.742			
Privacy	0.397	0.701		
Risk	-0.231	0.022	0.926	
Usability	0.594	0.144	-0.316	0.770

Table 2. Convergent and discriminant validity test results

After removing items with loadings less than 0.7, we conducted the Cronbach's alpha test. In addition, we conducted convergent and discriminant validity tests based on the average variance extracted (AVE) value for each construct reported (Yoo & Alavi, 2001). This test result indicates that all questions used to measure constructs in the model have high discriminant and convergent validities. Table 2 in the Appendix shows that the square root of these AVEs on the diagonal are larger than the correlations with other constructs. This test result indicates that all questions used to measure constructs in the

model have high discriminant and convergent validities.

After confirming acceptance of the survey instrument's reliability and validity, we entered the data into the path analysis to test our hypothesized relationships. Table 3 shows the path analysis results, including path coefficients and their respective t-statistics. H1a was supported, given that functionality expectation increases privacy concern ($\beta=-0.476$; $p<0.1$). However, H1b was not supported since there was no effect of increased functionality expectation on security risk perception ($\beta=-0.068$; not significant). We consider possible reasons in the next section. H2a was weakly supported ($\beta=-0.150$; $p<0.10$), indicating that usability has a negative influence on privacy concern in cloud computing applications. H2b was supported, indicating that usability has a negative impact on security risk ($\beta=-0.256$; $p<0.05$).

Hypothesized Relationships	Path Coefficients (Beta)	T-Statistics
H1a: Functionality expectation → Privacy Concerns	0.476	6.208***
H1b: Functionality expectation → Risk Concerns	-0.068	1.166
H2a: Usability → Privacy Concerns	-0.144	1.778*
H2b: Usability → Risk Concerns	-0.256	2.929***

Table 3. Path analysis results

4. IMPLICATIONS

One major implication is that improved perceptions of functionality expectation and usability may change privacy and risk concerns. Security concerns will ease as the usability perceptions of standardized cloud applications improve through more frequent use of these applications. Contrary to H1b, the perceptual changes on functionality expectation do not have significant impact on security perceptions. This may be explained partly by the diminishing effect of consumer risk perception, and partly by the habituation effect (Amer & Maris, 2007) between Google Docs and its users. First, in consumer purchase decisions, risk perception generally

continues to move from the beginning of product purchase intention to post-purchase product evaluation (Mitchell & Boustani, 1994). This is because consumers use risk reduction strategy in their purchase process to minimize two types of uncertainties: knowledge uncertainty and choice uncertainty (*ibid.*). Cloud application users go through a similar process of initial application evaluation to post-adoption evaluation, just as consumers go through pre-purchase research to post-purchase evaluation. A survey in a past study shows that user experience affects trust (Beldad, de Jong, & Steehouder, 2010). Trust in turn lowers the degree of risk perception (Kim, Ferrin, & Rao, 2008). That is, as Google Docs users continue to use the application, they develop more trust on Google Docs and, in turn, have lower risk perception. These are driven by the user learning through continuous interaction with the cloud application over time.

Second, more use may increase security risks, but the habituation effect may ease security concerns at the same time. However, the model of this study posts that the usability improvement is likely to ease both privacy and risk concerns. A growing number of regulators and system developers are collaborating to develop systems by using the concept of "privacy by design" or "build in" privacy (Rubinstein and Good, 2013). This emerging concept further affirms the importance and impact of increased perceived usability on reducing security and privacy concerns.

For the developers of cloud applications, these results highlight the importance of continuous usability improvements that not only give the end-users better application experience but also accelerate the adoption of cloud applications by pacifying the concerns on privacy violations and risks. The developers should also be aware that the end-users are likely to better appreciate the functions of standardized cloud applications.

For researchers, the results of this study provide research opportunities to investigate our hypothesized relationships over time. Scholars of human computer interactions should further study how much influence habituations have on functionality expectation, usability of standardized, and non-standardized cloud applications.

One limitation is that the study is rooted in the use of Google Docs in the higher educational settings. However, the participants of the study were mostly adults. Future studies could use participants with broader profiles. Another

limitation is rooted in the nature of Google Docs. It is a productivity suite as well as a collaboration tool (Sun et al., 2014). Future studies need to focus on other types of business and consumer applications.

5. CONCLUSION

This study examines the potential effect of functionality and usability on security and privacy concerns while using Cloud applications. Based on the survey of 211 users of Google Doc., this study finds that improved usability perception eases both privacy and security concerns. In contrast, increased functionality expectation raises more privacy concerns but does not affect security concern. These findings provide implications about promoting standardized cloud applications, such as Google Docs.

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Editor's Note:

This paper was selected for inclusion in the journal as a CONISAR 2016 Distinguished Paper. The acceptance rate is typically 7% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2016.

APPENDICES

Variable	Construct	Reference
Length of Use	How long have you used Google Docs? [year]	
Functionality expectation $\alpha = 0.859$	<p>The extent of collaborative interaction among users is increased by using Google Docs. The extent of sharing information among team members is increased by using Google Docs. The openness to share data among team members is increased by using Google Docs. Overall, the extent of collaboration is increased by using Google Docs.</p> <p>I would use Google Docs to archive my class assignments. I am very likely to archive my class assignments using Google Docs. I intend to use Google Docs for archiving class assignments in the future.</p>	<p>collaboration support (Park & Ryoo, 2013)</p> <p>adoption intention (D. Gefen et al., 2003)</p>
Usability $\alpha = 0.863$	<p>Google Docs enables me to archive and retrieve my class assignments faster. Google Docs enhances my effectiveness in archiving and retrieving my class assignments. I find Google Docs useful for archiving my class assignments overall.</p> <p>Google Docs is easy to use. It is easy to get Google Docs to do what I want it to do. Learning to operate Google Docs is easy.</p>	<p>usefulness (Burda & Teuteberg, 2015)</p> <p>ease of use (Burda & Teuteberg, 2015)</p>
Privacy Concern $\alpha = 0.751$	<p>I need to think twice before providing personal information to Google Docs. It is my concern if Google Docs collects too much of my personal information. Google Docs should not disclose any personal information, unless they are explicitly given the right to do so. Google Docs should not use personal information for any reasons other than the only purpose of information sharing. Google Docs should never sell personal information from its database to any other organizations.</p>	privacy (Vannoy et al., 2013)
Security Risk $\alpha = 0.917$	<p>There is a high potential for loss involved in using Google Docs for archiving class assignments. There is a considerable risk involved in using Google Docs for archiving class assignments. A decision to use Google Docs for archiving class assignments is risky.</p>	risk (Paul A. Pavlou & Gefen, 2004)