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PARISA POUR REZAEI
USER EXPERIENCE STUDIES OF PERSONAL CLOUD
STORAGE SERVICES

Master of Science thesis

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ABSTRACT

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Nowadays, individuals' data is at their disposal in real time from any device with the assistance of cloud storage services (CSS, e.g. Dropbox, OneDrive, iCloud and Google Drive). Success of cloud computing in an enterprise ultimately depends on delivering user experience (UX) which delivers business applications anytime and anywhere, and on any device that user prefers.

CSSs empower new kind of collaborations between individuals and have fundamental impact on how we organize and share our data. Despite an increasing popularity of cloud computing among researchers and academia, and vast variety of CSSs offered to the end users by cloud computing, the literature on UX studies of these services is quite restricted.

This master's thesis studies UX of different CSSs (with focus on Dropbox, Google Drive, OneDrive, and iCloud) based on 10 interviews and 65 Web survey responses. We analysed the data qualitatively and quantitatively. The results consist of reasons for the most positive and negative experiences and descriptions of current habits and motivations of the CSS users. As the current use of CSSs is still mostly individual, we also investigated the potential of taking the UX of CSSs to the next level by integrating different social features to current CSSs. We conclude the thesis by explaining the significance of various Cloud UX aspects in the context of CSSs and proposing design implications for enhancing UX of CSSs.

PREFACE

This M.Sc. thesis work was carried out during year 2014 and spring 2015 at the Department of Pervasive Computing at Tampere University of Technology, Finland in partial fulfillment of the requirement for the Master of Science degree in User Experience.

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Tampere, September 2015

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LIST OF SYMBOLS AND ABBREVIATIONS

CSS	Cloud storage service
UX	User experience
CSP	Cloud service provider
QoS	Quality of service
QoE	Quality of experience
HCI	Human-computer interaction
UCD	User-centered design
PANAS	Positive affect negative affect schedule
SNS	Social network site

1. INTRODUCTION

Cloud computing “refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services” (Armbrust et al., 2009, p.1). In fact, in user’s perspective, the cloud is such a private information cloud that follows him/her, and alleviates information stream and user’s interaction with variety of devices which he/she utilizes daily (Hilbert & Trevor, 2004). In other words, services are offered and data are shared through a heterogeneous computer network, the cloud. (Vartiainen & Väänänen-Vainio-Mattila, 2010)

Lately, the emergence of file storage services facilitated by cloud computing technology is reaping increasing attention by researchers from multiple research domains. From an end user and market point of view, it is undeniable that the use of personal cloud storage services (CSSs) such as Dropbox, Google Drive, OneDrive and iCloud has boomed in an outstanding manner. (Amrehn et al., 2013)

Due to an increasing usage of CSSs, it is sometimes referred to as cloud-connected and multiple-device era. Among the benefits of cloud computing for users, centralizing services, computation and data in a location-transparent way has been accentuated. (Vandenbroucke et al., 2013). In addition to that, the shifting of services to the cloud is regarded with new affordances for users to share and access their own data more flexibly and to collaborate with several users (Hobfeld et al., 2012).

1.1 Background and Motivation

In today’s connected world, users access personal or shared data “in the cloud” (e.g. Dropbox, Google Drive, OneDrive, and iCloud) with multiple devices. Despite increasing popularity of CSSs, literature reviews on UX of CSSs are quite limited and majority of the work to date has been concentrated on the technical aspects of CSSs. In addition to that, majority of studies focusing on the QoE of CSSs are predominantly focusing on the pragmatic task fulfillment of UX (see e.g. Marshall & Tang, 2012; Casas et al., 2013; Vandenbroucke et al., 2014). However, based on recent models of UX (see e.g. Mahlke, 2008), UX pertains to instrumental and non-instrumental qualities as well as emotional user reactions. Despite to the emerging necessity of insight into the UX of CSSs to improve the UX design of such services, there is no such a generic UX framework covering all aspects of UX of CSSs to guide design of CSSs.

Moreover, none of the studies have measured long-term influencing factors of UX of CSSs, whereas based on Tractinsky and Zmiri (2006), users' overall assessment of a product is not a simple sum of the individual experiences. In fact, it is based on the memories of past experiences though users are not competent to recall all the details of their experiences (Norman, 2009). As a result, measuring long-term influencing factors and integrating them into UX model of CSSs is an issue of utmost significance.

Furthermore, there is a significant stress on the collaborative aspects of different CSSs during recent years. Yet there is no research to investigate the potential of enhancing social features within CSSs. Consequently, we decided to investigate the potential of refining social interactions within the CSSs by amassing feedback concerning participants' preferences pertinent to integration of different social features with their favorite CSSs. CSPs can also exploit this integration so as to tie their users to their service, as by changing to another CSS, it is apt that users lose the benefits of the social network they have catalyzed within the service.

Among all of the CSSs, Dropbox, Google Drive, Microsoft OneDrive, and iCloud are becoming more and more crowd-pleasing within the Internet community. Since the introduction of Dropbox in 2008, it has reached more than 300 million registered users before the end of May 2014. In the following we will elaborate the contrasts between these four CSSs as groundwork for the rest of the thesis.

Dropbox (<https://www.dropbox.com>) is a service that permits users to generate a local folder on each of their registered devices, stashing and synchronizing the files located in those multiple folders through a cloud storage system (Casas et al., 2013). Dropbox utilizes Amazon's S3 cloud storage system for file storing (Drago et al., 2012). It also concedes easy sharing of data with unregistered Dropbox users. Registered users can synchronize files within the elected shared subfolders with each other. In PC a Dropbox folder appears as a local file folder which is in sync with the repository in the cloud. Dropbox files can be managed also when the user is not online, and the files will be synchronized once the user is again connected to the Net. If multiple registered users work on a shared file simultaneously, they must reconcile the subsequent several copies manually. Last but not least, Dropbox advocates all type of files.

Google Drive (<https://drive.google.com>) and Google Docs (<https://docs.google.com>) are interconnected cloud services that are accessible through web browsers. The cardinal feature in Google Docs is the prospect to edit documents concurrently and avoiding most of version conflicts that may happen in services like Dropbox, if multiple users are editing same file. Moreover, file types that are not edited in Google Docs can be saved and shared through Google Drive.

OneDrive <https://onedrive.live.com> is a CSS from Microsoft which is integrated with Microsoft Office, so it is straightforward to create, edit, and share documents using this

service. In addition to docs, other files or entire folders such as photo albums can also be shared. Recently Microsoft has also offered collaborative online editing tools for some of their document types.

iCloud (<http://www.apple.com/icloud>) is a service for Apple device users who can simply drag all kind of files into the iCloud Drive or spawn a new document utilizing an iCloud-enabled app on their iOS devices. iCloud does not support sharing files with others, but it synchronizes files between all Apple devices. iCloud Drive can also be installed on PC running Windows 7 or later as long as the user has Apple ID.

1.2 Objective and Research Questions

Objective. This thesis has two principal research objectives (Table 1). The first objective is to apprehend and evaluate the overall UX of CSSs with concentration on Dropbox, Google Drive, OneDrive, and iCloud. The second objective is to scrutinize the prospect to integrate social features within CSSs so as to enhance social interaction in CSSs. The outcome is a holistic range of issues affiliated with understanding UX of CSSs, and social feature preferences as well as design guidelines for the future.

Table 1. Research questions for the thesis.

Research Question
RQ1. What factors affect user experience of CSSs?
RQ2. How to improve social interaction within CSSs

1.3 Research Methodology

This thesis is associated with the field of human-computer interaction (HCI) which refers to the studies of how individuals utilize any computational system or device and how those systems can be more useful and usable (McCarthy & Wright 2004). The research approach of the thesis is both qualitative and quantitative. The results of the studies are published in a scientific conference paper (Palviainen & Pour Rezaei, 2015).

As a design methodology, we used user-centered design (UCD) which involves active engagement of users for a clear understanding of user and task requirements, iterative design and evaluation, and a multi-disciplinary approach (Vredenburg et al., 2002). It engages different methods to conduct UCD activities of data gathering, data analysis and interpretation, designing and evaluating the design.

For the literature review, we used variety of research papers from different journals, conferences and other papers from the field of HCI, human factors and psychology. For data gathering, we interviewed 10 (semi-structured interview) CSSs users. Then based

on the results of our interviews and literature review we designed a Web survey and obtained 65 responses regarding to CSSs practices and UXs.

The user data gathered from the Web survey is analyzed, interpreted and consolidated utilizing affinity diagram which is a tool to organize ideas and data (Beyer & Holtzblatt 1998). The user data collected from interviews is analyzed using thematic analysis (Taylor & Bogdan, 1984; Boyatzis, 1998).

Based on the results of our research, we could get good insight into the current practices and motivations of the CSS users and evaluate the potential of integrating different social features into CSSs. In addition to that we could ascertain the reasons of the most positive and negative UXs in the context of CSSs. Consequently, we proposed design implications so as to enhance the UX of CSSs.

1.4 Structure of the Thesis

The thesis is divided into 6 chapters. Following a brief background introduction of the UX of CSSs and manifesting our research questions and research methodology,

Chapter 2 presents an overview of key concepts and models related to UX predominantly from the field of HCI. It also discusses UX evaluation methods applied in this thesis.

Chapter 3 illustrates the key concepts and theoretical background related to UX of cloud computing and notably UX of CSSs. It also illuminates theoretical background regarding to human psychological needs, and ends with a short summary of the most fundamental concepts from the literature review which are applicable in the context of the thesis.

Chapter 4 includes a summary of our empirical research and research method applied during the thesis which consists of interviews and Web survey as data collection methods. Respectively, data analysis and interpretation is performed utilizing thematic analysis and affinity diagram.

Chapter 5 presents the qualitative and quantitative results of our research based on interviews and Web survey answering to the research questions presented in this chapter (Chapter 1).

Chapter 6 deals with the overall summary and conclusion of the thesis work. It also discusses design implications of our research to improve the UX of CSSs, and conclude the thesis with the limitations of our study and future work.

2. THE KEY CONCEPTS AND USER EXPERIENCE RELATED MODELS AND EVALUATION METHODS

This chapter presents the theoretical background on UX by manifesting an overview and a synthesis of the key concepts, UX related models, and UX related evaluation methods from the field of HCI which are relevant to this thesis work. The primary emphasis is on the concepts and models concentrating on the descriptive qualities as components of UX models. The presented concepts have been utilized in the various phases of the thesis work.

2.1 Key Concepts

This chapter presents the key concepts utilized in this thesis associated with quality-based approach to UX. We first present definitions of UX and usability. Second, we define concepts associated with quality as components of UX models. Third, we manifest the consequences of UX, and last but not least, we illuminate the concept of “wow” experience.

2.1.1 User Experience and Usability

User experience is a relatively new field within the larger scope of HCI. Based on the candidate definitions of UX originating from the HCI society, it is “*a person’s perceptions and responses that result from the use or anticipated use of a product, system or service*” (ISO 9241 – 210:2010). “*UX is about technology that fulfills more than just instrumental (pragmatic) needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. UX is a consequence of a user’s internal state--, the characteristics of designed system--, and the context-- within which the interaction occurs*” (Hassenzahl & Tractinsky, 2006, p. 95). In fact, these fundamentally affecting factors of UX are also reflected in the definition of usability. Usability is demonstrated as “*the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*” (ISO 9241-11:1998). Until now usability evaluations have predominantly concentrated on task oriented issues like efficiency and effectiveness claiming that a product with such attributes assists users to solve the required tasks, to achieve their goals, and to make them satisfied. Despite the fact that usability is one of the determinants of UX (ISO 9241-210:2010), it is not adequate to have merely satisfied users (Hassenzahl & Sandweg, 2004). Indeed, user needs to experience more than

satisfaction with the service for it to be significant (Isleifsdottir & Larusdottir, 2008). As a result, different UX models have been created to measure UX for different products. In the section 2.2, some of the UX models have been discussed.

2.1.2 User Experience from ISO Standard

One of the definitions of UX according to the ISO 9241-210:2010 standard is: “*A person’s perceptions and responses that result from the use or anticipated use of a product, system or service.*” This definition indicates a holistic perspective to UX. Moreover, it emphasizes on the temporal aspect pertinent to expectations prior to usage accompanying the experience based on the usage. The definition consists of some notes discussed in the following:

Note 1 presents the experiential aspects as: “*User experience includes all the users’ emotions, beliefs, preferences, physical and psychological responses, behaviors and accomplishments that occur before, during and after use*”. This note put emphasis on the temporal aspects and multiple facets of UX. In addition to that, it contemplates accomplishments as a component of UX.

Note 2 illustrates the influencing factors: “*User experience is a consequence of brand image, presentation, functionality, system performance, interactive behavior and assistive capabilities of the interactive system, the user’s internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use.*” This note reflects the features of the interactive system, characteristics of the user, and the context of use as main affectors of UX. These factors have also been mentioned in model of UX by Hassenzahl and Tractinsky (2006).

Note 3 manifests the role of usability in association with UX: “*Usability, when interpreted from the perspective of the users’ personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience. Usability criteria can be used to assess aspects of user experience.*” However, it does not investigate further how usability and UX are associated. Moreover, it is ambiguous what is definitely meant by goals and whether they merely point to instrumental goals in this case. Some of the quality-based UX models consist of usability-relevant system qualities in the models (Hassenzahl, 2003, 2004; Mahlke, 2008; Mahlke et al. 2007; Thüning & Mahlke, 2007).

To sum up, this UX definition focuses on the experiential components (all users’ perceptions and responses that result from the use or anticipated use of a product, system or service); temporal aspect of experience (the temporal facet of the UX, before, during and after the usage of system or product); influencing factors (all factors affecting UX consisting of the characteristics of the user, the features of interactive system, and context of use); and usability as system attribute which may affect UX. (Väättäjä, 2014)

2.1.3 Quality

As the focus of the thesis is on the quality-based models of UX, this subsection illuminates the concept of quality and then indicates two pivotal categories of qualities which are manifested in many of the UX models: the instrumental (pragmatic) and non-instrumental (hedonic) quality.

2.1.3.1 Definition of Quality

The quality management systems standard defines quality as the “*degree to which a set of inherent characteristics fulfils requirements*” (ISO 9000:2005). Characteristic is a “distinguishing feature” which can be a) inherent or assigned, and b) qualitative or quantitative, and there are different classes of characteristics like physical, sensory, behavioral, temporal, ergonomic and functional characteristics. A quality characteristic is further manifested as an inherent characteristic of a product, process or system. (ISO 9000:2005).

Based on standard for software and systems engineering, quality of system is defined as “[...] *the degree to which the system satisfies the stated and implied needs of its various stakeholders, and thus provides value*” (ISO/IEC 25010:2011). Moreover, based on (Le Callet et al., 2012), QoE is defined as the degree of annoyance or delight of the user of a service which results from the fulfillment of expectations that the user has about the utility and/or enjoyment of the service, considering the user’s current state and personality.

2.1.3.2 Instrumental or Pragmatic Quality

In the quality-based approach to UX in the field of HCI, there are two main categories of system or UX qualities (attributes). The first category consists of pragmatic, utilitarian, or instrumental attributes (Hassenzahl, 2003, 2004; Mahlke, 2008; Mahlke et al. 2007; Thüring & Mahlke, 2007).

Pragmatic qualities are “*connected to users’ need to achieve behavioral goals which requires utility and usability*” (Haseenzahl, 2004, p. 322). Mahlke (2008) manifests that “*the instrumental value of an interactive system is related to the tasks and goals that the user wants to accomplish with a system*” (P.43). He postulates that instrumental value of an interactive system is determined by both “*utility* (defined as usefulness by Davis, 1989) *and usability* (defined as ease of use by Davis, 1989)”

In this thesis work, instrumental, i.e. pragmatic quality is associated with the CSSs qualities that are pertinent to the interaction, activities such as sharing, synchronization, and collaboration with tangible outcomes that user desires to accomplish with the CSS while utilizing it.

2.1.3.3 Non-instrumental or Hedonic Quality

Hassenzahl (2004) states that hedonic qualities are mainly associated with user's self. He categorized hedonic qualities into stimulation and identification. Stimulation is pertinent to personal growth (associated with knowledge and skills) and identification is related to human's need to express himself/herself through objects. Mahlke (2008, p.45-46) indicates that *“non-instrumental qualities of an interactive system satisfy user needs which go beyond the instrumental value of the product.”*

In this thesis, we approached non-instrumental qualities based on the definition presented by Mahlke (2008), as descriptive attributes of the system which satisfy user needs beyond the instrumental qualities of the system with components for the quality of stimulation and identification.

2.1.3.4 The Consequences of User Experience

It is of utmost significance to perceive the consequences of UX. Frameworks for UX concentrating on the user-centered quality of interactive systems postulate that the subjective perception of product qualities (Hassenzahl, 2003; Mahlke & Thüring, 2007) as well as emotional responses (Mahlke & Thüring, 2007) affect future usage behavior (Hassenzahl, 2003; Mahlke & Thüring, 2007) and overall judgement, preference, and satisfaction (Hartmann et al., 2008; Hassenzahl, 2003; Mahlke & Thüring, 2007).

Mahlke (2008) mentioned that perceptions of instrumental and non-instrumental qualities as well as emotional user reactions specify the consequences of UX and they influence the acceptance of the system and usage behavior.

2.1.4 Wow Experience

As technology market is being overwhelmed by vast variety of services, it is a crucial need to distinguish them by positive UX. Wow as conspicuously positive UX is a prominent design target which can tie users strongly to the product (Väänänen-Vainio-Mattila et al., 2011). Based on Hudson and Viswanadha (2009), a Wow product is one that (in addition to meeting the user needs) also 1) generates unexpected needs and 2) promotes a greater sense of control over the external world. In fact, as also cited in (Väänänen-Vainio-Mattila et al., 2011) it points to the component of surprise or surpassing the expectations that is also identified in the definition by Desmet et al. (2005). However, as Wow is comprised of a component of surprise, it is plausible that a product or feature containing Wow, will not do it after a certain amount of time has passed (Desmet et al., 2005; Hudson & Viswanadha, 2009).

Schauer (2008) emphasizes that there has to be long-term Wow so as to make customer loyalty. Schauer postulates four general guidelines to create long-term Wow including 1) dealing with a wide area of unmet customer needs or 2) creating a pipeline of Wow

moments that can be emerged through your platform of touchpoints over the long haul. Hudson and Viswanadha (2009) postulates that to acquire Wow, the designer should purvey appropriate feedback, invite user to play with the interface, and make novel forms of interaction. Playfulness may contradict usability in some scenarios. For novel interaction, designer does not have to create new interaction techniques, but apply them in enhanced or unexpected ways.

Väänänen-Vainio-Mattila et al. (2011) suggested that with good usability and aesthetic experience as well as constant feeling of trust, Wow experience may also be accomplished in prolonged usage. They also summarized the elements of Wow as the following: (Väänänen-Vainio-Mattila et al., 2011)

- Wow is surprising, positive and often emotional experience.
- Wow is sudden, but it may also happen in long-term usage, when everything proceeds pleasantly and securely.
- Wow is one kind of a “*peak experience*”- it is personal, subjective, meaningful and memorable.
- Wow is a pleasurable emotional reaction happened by product interaction which exceeds the user’s expectations.

Similar to any other experience, Wow experience is also related to characteristics of the product or service, characteristics of users and context of use (Hassenzahl & Tractinsky, 2006). Affecting factors of the product or service leading to Wow experience are identified in the literature. For instance, Steen et al. (2003) demonstrated the following factors leading to Wow experiences: nostalgia, fantasy, sensorial experience, amazement, surprise, beauty, exclusivity, budget, comfort, mastery, connectedness, own world, care, competition and inspiration. Recent studies manifest that playfulness can also contribute in forming positive UX (Arrasvuori et al., 2010). Playful Experiences model is a categorization and design tool which can be utilized as a design inspiration for certain types of playful experiences like competition, challenge, nurture, thrill, and fantasy.

2.2 User Experience Models

This section indicates an overview of descriptive quality models associated with UX from the field of HCI. The objective is to ascertain from the models the components of UX. Perceived quality is pertinent to the user’s subjective perception on an object’s quality whether the object is a system, an application, or an outcome of usage of the system.

Models picked for review have as prevalent components of UX 1) descriptive system or service related qualities, and 2) other experiential aspects like emotional user reactions.

Moreover, they consist of 3) influencing factors of the experience and/or 4) the consequences or outcomes of UX. (Vääätäjä, 2014)

2.2.1 Hassenzahl & Tractinsky's Model of User Experience

One of the classical definition for UX in the field of HCI is manifested by Hassenzahl and Tractinsky (2006, p. 95): “UX is a consequence of a user’s internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organizational/social setting, meaningfulness of the activity, voluntariness of use, etc.)”. User’s perceived hedonic quality and perceived pragmatic quality are the pivotal experiential attributes which can be evaluated through beauty and goodness respectively (Hassenzahl, 2004). This definition stresses that the characteristics of the user, the system, and the context of use are parameters of utmost significance which affect UX, and the outcome of interaction (as broadly perceived), is illuminated by the different experiential qualities. The model is user-centric, and purveys a general frame for the factors of UX. However, the details of experienced quality have not been articulated in this model.

2.2.2 Hassenzahl's Model of User Experience

In UX model by Hassenzahl (2003, 2004), product attributes have been contemplated as components of UX (see Figure1). Based on Hassenzahl, product character can be split into two attribute groups, named pragmatic and hedonic attributes (Hassenzahl, 2003).

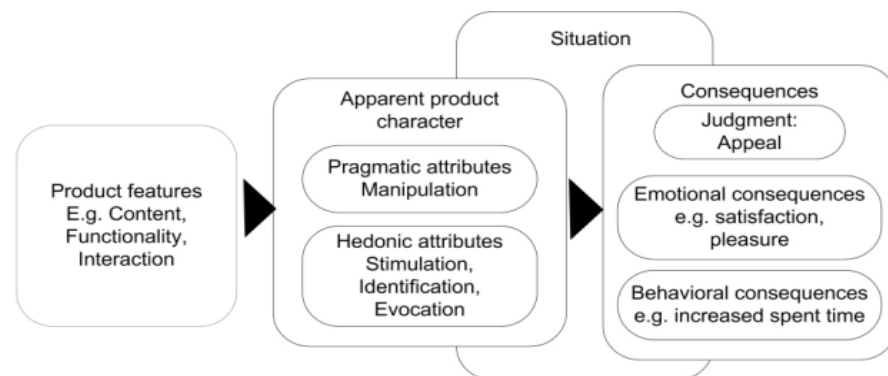


Figure 1. Key components of UX based on UX model by Hassenzahl (2003).

The hedonic/pragmatic model of UX assumes that users perceive interactive products along two various dimensions. Pragmatics is related to the product’s perceived ability to advocate the achievement of “do-goals”, like “making a telephone call”. In fact, pragmatic qualities are regarded to the product’s usability and utility when product is utilized for instrumental tasks. However, hedonic is associated with the product’s perceived ability to support the achievement of “be-goals”, like “being competent”, “being related to others”, and “being special”. (Hassenzahl, 2007)

The hedonic/pragmatic model apparently categorizes three distinct facets of hedonics (Hassenzahl, 2003): *Stimulation* associates with novelty, change and personal growth, *identification* illuminates the relatedness and communication of identity to relevant others through objects, and is social. *Evocation* addresses product ability to provoke memories, like important past events.

Each user builds his/her own personal version of the product character in accordance with the product features and his/her personal expectations (Hassenzahl, 2003, 2004). As a result, the subjective perception of the product character brings about consequences like judgements regarding to the product's appeal, goodness, and beauty (Hassenzahl 2003, 2004), as well as emotional and behavioral consequences. As an illustration for emotional repercussions Hassenzahl demonstrates satisfaction and pleasure.

2.2.3 Mahlke's Components of User Experience

The model (Figure 2) postulated by Mahlke (2008), Mahlke and Thüring (2007), and Thüring and Mahlke (2007) (as cited in Jumisko-Pyykkö, 2011) illuminates the UX components, influencing factors and consequences. The UX has three pivotal central components as: 1) instrumental quality, 2) non-instrumental quality and 3) emotional user reactions.

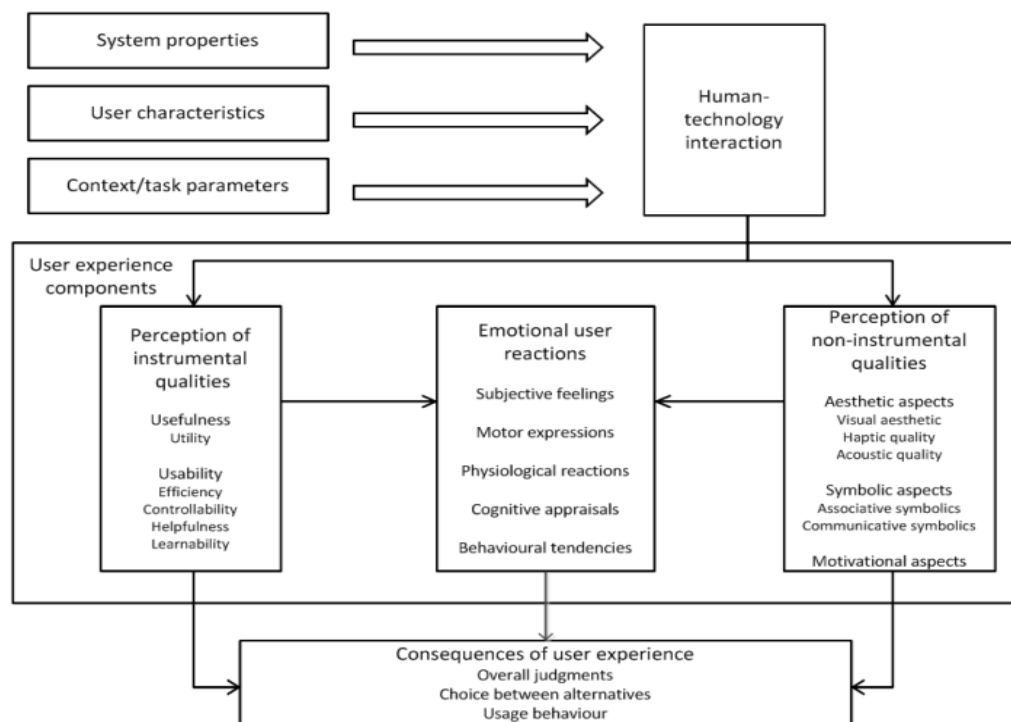


Figure 2. Components of UX by Mahlke (2008).

The instrumental quality of an interactive system addresses usefulness and usability, and is associated with the task and goals which user desires to accomplish with a

system. Non-instrumental quality consists of sensorial aesthetics, communicative and associative facets of symbolism and motivational qualities. Emotional user reactions encompasses several aspects, like subjective feelings, psychological reactions, motor expressions, cognitive appraisals and behavioral tendencies. Moreover, system properties, user characteristics and context and task parameters affect these experiences. Overall judgments of a system, choice between current alternatives or usage behaviour are the consequences of UX.

This model purveys a holistic framework for UX components. It concentrates on the perception of instrumental and non-instrumental qualities, and emotional user reactions as UX components. Unlike UX model manifested by Hassenzahl (2003) in which emotional consequences are a repercussion of the perception of the product character. Mahlke's (2008) model also differentiates between components of UX and consequences of UX.

2.2.4 Summary

This chapter indicated key concepts associated with quality-based models of UX from HCI. In this thesis, we utilized UX model by Mahlke (2008) jointly with the model by Hassenzahl (2003) as an initial conceptual framework to evaluate UX in the context of CSSs which in turn evaluate overall judgment and usage behavior of CSSs as consequences of UX.

As a result, in this thesis we determined to evaluate three components for UX of CSSs based on Mahlke (2008) as:

- Instrumental (pragmatic) qualities of CSSs which are associated with internally generated or externally given behavioral goals of CSSs such as abilities to share data, synchronize data, back up data etc.
- For non-instrumental (hedonic) qualities of CSSs, we constrained our definition for hedonic qualities of CSSs to definition by Hassenzahl (2003) which presents three distinct facets of hedonics: *Stimulation* which provides users with opportunity to improve their skills and knowledge through the usage of CSSs. *Identification* which investigates how the CSS is applied in a social context, and *Evocation* which reflect CSSs abilities to provoke memories.
- We also implicitly evaluated emotional user reactions in the context of CSSs as third component of UX (Mahlke, 2008).

In fact, emotional user reactions are incorporated into the HCI models both as experiential components (Mahlke, 2008) and as the consequences of UX (Hassenzahl, 2003). However, in this study we merely considered it as a component of UX.

2.3 User Experience Evaluation Methods

“To measure is to know”

“If you cannot measure it, you cannot improve it” (Lord Kelvin, a.k.a. Sir William Thomson, n.d.).

Recently, there has been variety of debates regarding to the scope of UX, and its definition. ISO 9241-210:2010 defines UX as: “a person’s perceptions and responses that result from the use and/or anticipated use of a product, system or service”. So this definition postulates that UX can be measured during or after use of a product, system or service. In fact, UX evaluation methods aim to enhance user satisfaction with achieving both pragmatic and hedonic goals. (Bevan, 2009)

A multitude of methods for UX evaluation exist. However, in the following we go through the most related methods in the context of this thesis work which are: Web survey, AttrakDiff2 questionnaire, and UX curve.

2.3.1 Web Survey

Web surveys are a common tool for user-driven assessment of software quality and usability. In general, Web surveys are usually combined with other quality assessment methods to acquire interpretable results. In any case, the results have to be interpreted by a trained usability expert, considering also the results from other used assessment methods. (Laugwitz et al., 2008). One of the most significant reasons for conducting an online survey is to facilitate recruitment of respondents with deviant or covert behaviors. The anonymity feasible on the Internet has made it possible to access to respondents normally difficult to reach, and it may facilitate the sharing of their experiences and opinions. Web surveys have also economic benefit as they are inexpensive in comparison with conventional paper-and-pencil surveys (Van Selm & Jankowski, 2006).

To sum up, Web surveys are the most effective method to gather data from international real users in a short time. The number of respondents participating in a survey can be much bigger than in any other methods. Van Selm and Jankowski (2006) presented the advantages of using online surveys. Among them, the following has been listed: 1) Global reach to the respondents 2) It is flexible and can be managed in a time-efficient manner 3) Respondents can take an online survey in a convenient time for him/her (Hogg, 2003). Moreover, respondents can take as much time as they require to answer each question 4) Online surveys consist of variety of questions including dichotomous questions, multiple-choice questions, scales, questions in multimedia format, likert and semantic differential questions, and even open-ended questions 5) By online surveys large samples are easy and cheap to achieve 6) Online surveys can require the respondents to answer questions in the order intended by the study designer.

2.3.2 AttrakDiff2 Questionnaire

To assess the user's emotion, different kind of questionnaires can be applied in HCI. However emotion evaluation is not the only way to assess UX. In order to get insight of UX and improve a system, we should study user's perceptions of the product's qualities and their overall evaluative judgements of it. To go beyond instrumental aspects, practical tools which advocate the evaluation of UX are required. One method is to incorporate hedonic aspects in the measurement like in the AttrakDiff questionnaire (Hassenzahl et al., 2003; Hassenzahl et al., 2000) so as to evaluate users' perceptions of the product or system qualities.

AttrakDiff questionnaire stem from the UX model illuminated by Hassenzahl (2003), which is manifested in Figure 1. We chose this model as the basis for UX evaluation in the context of CSSs, since the model consists of not only pragmatic aspects, but also hedonic aspects. For professionals not only the functional dimensions of the used system are of utmost significance, but also how it is associated with stimulating, advocating and facilitating creativity, and what kind of symbolic value it includes. Hassenzahl's model follows the assumption that product characters can be split into two categories, namely pragmatic and hedonic (Hassenzahl, 2003). Each user forms his/her own personal version of the product character depending on the product features and on his/her personal expectations and standards. The subjective perception of the product character brings about consequences like judgments about the product's appeal, goodness and beauty (Hassenzahl, 2003, 2004), as well as emotional (for example user's satisfaction and pleasure) and behavioral consequences. Based on the model, Hassenzahl demonstrates two versions of AttrakDiff questionnaire to evaluate attractiveness of products (Hassenzahl et al., 2000; Hassenzahl et al., 2003). The first version, AttrakDiff consists of two attribute groups. One group for pragmatic and another for hedonic, as well as one group for the judgment of appeal (Hassenzahl et al., 2000). The second version, AttrakDiff2 split the hedonic attribute group into two groups, one for stimulation, and the other for identification (Hassenzahl, 2004; Hassenzahl et al., 2003). Moreover, evaluative constructs such as goodness and beauty have been incorporated into subsequent studies (Hassenzahl, 2004).

AttrakDiff2 questionnaire was originally made in German but has been translated into English. The questionnaire contains 28 items, including a seven-point rating scale with two bipolar anchors to mark the opposing ends of the scale ranging from 1 to 7, where 4 indicates the neutral value between the two anchors of the scale (e.g. confusing–clear, ugly–beautiful). The questionnaire is comprised of four 7-item subscales, each measuring a different quality of the evaluated system. The first quality is pragmatic quality; does a system fulfil what it is supposed to do, how successful are the users in achieving their goals using the system? is it easy to perceive and utilize the system? In our case studies, for example, is it easy for users to interact with CSSs, and does it fulfil users' expectancies? Examples of items are Technical-Human, Complicated-Simple.

The second quality is Hedonic Stimulation; does the product assist the user with growing new skills or obtaining knowledge? People desire to enhance their skills and knowledge more and there are the attributes of the system or product that make it possible. In our case studies, for example, does Dropbox make people conscious of the stopped synchronization and assist them to take other actions in case synchronization can not be completed due to any reason. Examples of items are Typical-Original, Easy-Challenging. Third quality is Hedonic Identification that points out how the system is applied in a social context and how it contributes to one's identity. In particular, for instance, what does one communicate to others by utilizing Dropbox. Examples of items are Isolating-Integrating, Cheap-Valuable. Fourth quality, Attractiveness is related to the global appeal of the CSSs which usually summarizes the whole experience of CSS. For instance, regarding to Dropbox, do people find the application as a whole appealing or attractive? Examples of items are Ugly-Beautiful, Bad-Good. The combination of the four qualities determines whether the concept is practical, meaningful and pleasant to use. High scores on all qualities are important for a prolonged usage of a system. Mahlke and Thüring (2007) also deciphered empirical evidence that both of the two aspects of quality (pragmatic vs. hedonic) affect emotional reactions and the appraisal of interactive systems.

2.3.3 UX Curve

UX curve is a pen-and-paper method to evaluate long-term UX. It is a face-to-face technique where researcher can investigate participants' reasoning and thoughts. In this method participants will be provided with a template (see Figure 3) so as to users could sketch by themselves one or more curves manifesting how their experiences about a product had changed over time, and report all types of positive/negative experiences that they found meaningful and the reasons for them in the context of their desired CSS. In this template, the horizontal axis presents the time from the start of usage until the current moment, and the vertical axis illuminates the intensity of the UX.

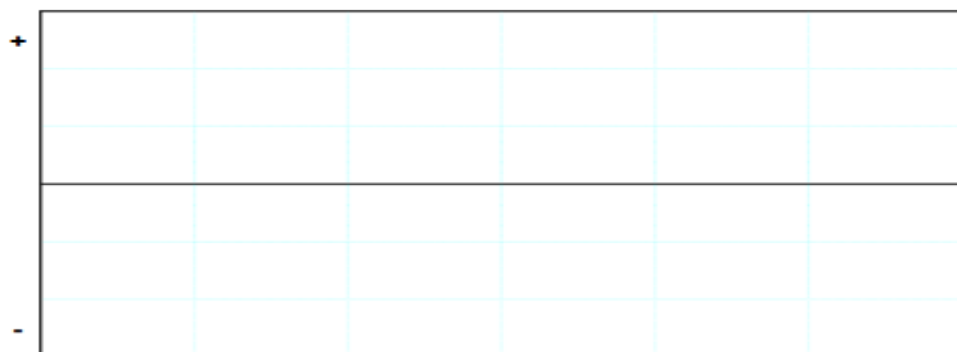


Figure 3. UX curve template by Kujala et al. (2011).

The objective of UX curve is to help users to recall retrospectively their longitudinal UX with a product by “sketching” a curve over time. In fact, users are supposed to

sketch how their opinion had altered from the moment they commenced utilizing the CSS until the present. As a result, users can easily sketch their UX and annotate their sketches. UX curve provides two types of data: a recalled pattern of change of UX and self-reports of personal experiences that lead to the change in their perceptions. In addition, UX curve minimizes the retrospection bias. (Kujala et al., 2011)

Based on Tractinsky and Zmiri (2006), users' overall assessment of a product is not a simple sum of the individual experiences. In fact, it is based on the memories of past experiences though users are not competent to recall all the details of their experiences (Norman, 2009). In addition to details lost, memory applies systematic biases into assessments (Hsee & Hastie, 2006). Psychological reviews by Fredrickson (2000) demonstrated that peak and final intensity of the experience, plays a role of utmost significance in peoples' interpretation of overall evaluations. Moreover, the chronological order of the component events and the trend of the experience affect the overall assessments (Fredrickson, 2000). More specifically, individuals advocate happy endings and experiences that improve rather than those which deteriorate (Ross & Simonson, 1991). Furthermore, Norman (2009) and Karapanos et al. (2010) illuminate that these memories of experiences will be brought to others and lead the future behavior of the person. Consequently, the reconstructed memories are very relevant even though there is a feasible bias to remember them.

3. RELATED WORK

Software products are converting to software services with the assistance of cloud computing paradigm, since cloud services require less setup installation, support, and maintenance of software, infrastructure and platforms (Oza et al., 2010). In fact, cloud can be used as a new paradigm for service design and delivery in which the services are presented and data shared between users through heterogeneous computer networks, the cloud (Miller, 2008; Vouk, 2008).

Technology markets have got saturated by various range of cloud products and services which indicates a growing need to distinguish them by positive UX. In other words, there is a need to design cloud services in ways to make them noticeable among vast variety of service offerings. UX expands the notion of product usability by incorporating additional goals like emotional accomplishment, enjoyability, aesthetic pleasure, entertainment, and fun (Jordan, 2002; Preece et al., 2015).

Cloud computing provides new business service mode to users which guarantee the storage of important data in a network storage space (Yang & Jia, 2012). Conventionally, all users' data must be stored in their hardware devices and users might utilize their computers or mobile devices to edit documents, play audio/video files and share data with others. Storing files in this way could limit accessibility and possibility of sharing in urgent situations. In addition to that, inconsistency of data was a prevalent problem as users have to edit their files on various computer devices (Wang et al., 2012). Nowadays, the above-mentioned problems have been mitigated by assistance of CSSs.

The growing popularity of CSSs such as Dropbox, Google Drive, iCloud, and OneDrive has made it crucial to measure UX of these services as it is highly connected to revenue and market success. As a result, practitioners and academics are also seeking new approaches to the design of interactive products, which accommodate experiential qualities of technology use rather than product qualities (Hassenzahl et al., 2010). The conception of UX was evolved in the early 2000's to broaden the aspect of usability with notions of users' emotional and contextual needs, and the effect of users' previous experiences to current experiences (Kujala & Väänänen-Vainio-Mattila, 2009). Experiences are subjective, individual and highly complex and therefore it is essential to investigate them from a multi-disciplinary perspective and through the participation of actual users (Vandenbroucke et al., 2014)

Despite the extreme importance of UX of CSSs, the literature on the UX of these services is quite limited, and much of the work on cloud computing to date has concentrated on technical infrastructure, like optimizing by boosting CSSs' capacity, and maximizing uptime. As a result, the influencing factors of UX in CSSs are to date poorly perceived. Moreover, there is no such a generic UX framework or model to guide the design of CSSs. There are several studies concentrating on various UX aspects in the cloud. In this section we will review the most related works that have been done so far in the domain of the UX of CSSs.

3.1 User Experience of the Cloud

Users may benefit from cloud computing in different ways (Armbrust et al., 2009; Hayes, 2008; & Mei et al., 2008). Users' data is in their access through all of their devices and they do not need to be concerned about plausible limitations of data storage or back ups as all the data is in the cloud. Consequently, if users have lost their devices, they can retrieve all of their personal data from the cloud. Moreover, users can acquire the latest and personalized versions of related services in their devices without extra updating or installation processes.

In one of the prior works handling UX related topics in cloud computing Miller (2008) mentioned multiple user benefits of cloud computing such as: lower-cost computers, improved performance, lower IT infrastructure and software costs, instant software updates, increased computing power, unlimited storage capacity, increased data safety, improved compatibility between operating systems and document formats, easier collaboration, universal access to documents, latest version availability, and finally more independence from particular devices and softwares

There are also challenges regarding to cloud computing and notably when accessing the cloud from a mobile device (Miller, 2008; Hayes, 2008). There might be problem with network availability or slowness. There may also be problems about network configuration, for instance, in cellular and WiFi networks. Privacy and security are also issues of utmost significance as the users' data is saved in the cloud, Trust is also important to ensure that users are eager to save their data in the cloud. (Vartiainen & Väänänen-Vainio-Mattila, 2010)

Miller (2008) also summarized cloud concerns from the users' perspectives as the following:

- Dependence on fast internet connections.
- Security threats when user does not know where the data is stored, and who has access to it.
- Forced version updates.
- Problems related to data ownership.

- User behavior monitoring and combining collected user data.

Miller's work is further elaborated by Väänänen-Vainio-Mattila et al. (2011) reflecting the challenges of cloud computing from the UX perspective, establishing an introduction to UX in the cloud. While all general frameworks and definitions illuminating UX are still valid in cloud computing context, certain issues reap significance due to the nature of cloud computing. Based on (Väänänen-Vainio-Mattila et al., 2011) pivotal issues consist of:

- Access to user data which might be a privacy threat,
- Multi-device access, referring to the fact that cloud services are often accessed by multiple various devices running on different platforms, making it more difficult to maintain coherence between different user interfaces, and requiring seamless transfer of task flow between devices,
- Social features of cloud services, allowing users to effectively communicate, share content and collaborate with others,
- Reliability, security and trust associated with CSP and the internet connection, including also access rights management.

In discussion section of this thesis, we have discussed the abovementioned four items in more details and have associated them specifically with CSSs.

3.1.1 Privacy, Trust and Security of Cloud Services

In 2010, Oza et al. conducted an empirical study of security and UX issues in the cloud computing using open-ended thematic interviews with eleven experts from *Finnish Cloud Software Program Consortium*. Based on the interviews, the key UX effectors in the cloud are as: the concept of trust, and how do users opt between variety of CSPs. Moreover, the liability issue between the CSP and user was of utmost significance. Finally, user's overall comprehension of cloud environment as well as general security were discussed in the interviews. We further illuminate the first two UX effectors in the following:

- **Trust**

Interviewees from oza et al.'s study mentioned that their initial confidence in the cloud services of their choice may be established by different factors such as social networking, referral by a friend, critical mass of the service users, search engine's hit count of the cloud service, localization (specifically the language of the cloud service), and established brand which is behind that service. Moreover, name and nationality of the company brand and cost of the cloud service (expensive is usually prejudiced to be more trustworthy) can affect the trust in the cloud service which confirms the results of paper by Marshall and Tang (2012), regarding to trust in the security of the cloud. However, the study by Oza et al. (2010) emphasized that the functionality of the cloud

service, which means conducting and finishing the intended task in the most efficient way, will lead to real UX in the end.

- **Liability between cloud user and provider**

Based on Oza et al. (2010), liability denotes “*who has what responsibilities in the cloud environment*”(p. 524). Based on the interview data, Oza et al. (2010) concluded that responsibilities are massively dependent on the particular situation. “*the responsible party can be either the user, the network operator, the CSP or any combination of these three. The network operator should ensure that connections are up and running, the CSP should guarantee that the data is safe and kept private, and the user should always maintain some degree of common sense*” (Oza et al., 2010. p. 624).

Oza et al. (2010) also emphasized on the significance of an accurate balance between security and UX which brings about superior UX in the cloud environment. However, reaching to the precise balance can be challenging. On the one hand, security can consolidate good UX by adding trust to the cloud service. On the other hand, it can diminish the UX by requesting more resources. For instance, in Facebook a powerful authentication could diminish the request for its services though a good UX can compensate for some security threats. To elaborate more on this issue, Oza et al. (2010) categorized cloud security threats as the following in a decreasing order of their significance in the interviewees’ notions:

- **Profiling, identity thefts:** with a huge amount of personal data in the cloud, the identity theft by a third party has got very easy and effortless. In addition to that, profiling and conceivable exploitation of user information by CSP was a principal concern between interviewees.
- **Privacy threats:** cloud extends the ventures and consequences of mishaps when everything is correlated together in the cloud. “It is not only the threat of your information but also the people who is in your network.”
- **Availability breaches:** lack of availability of the data stored in the cloud was contemplated as another potential threat. This threat can easily ensue due to a fault in the network service provider’s service, since in cloud computing a smooth internet connection is essential.
- **Liability, data ownership and copyright:** another potential security threat is liability and data ownership. Notably data is more exposed when the responsibilities are outsourced. The question is who owns the data; there are many liability, privacy legislation and copyright issues to be solved.
- **Data sanitation and access rights problems:** how can users be certain that their data is really removed when the user asks for that?
- **Backward compatibility:** this problem may happen as time passes. When the whole user’s data is handled within the cloud utilizing the updated present software in the cloud, What ensues when user desires to handle his old data that

was stashed in an old format that the updated software does not support anymore?

Kamara and Lauter (2010) also emphasized on security threats both from outside and inside the cloud. However, they stated that this responsibility is divided among several parties, including the cloud user, the cloud vendor, and any third-party vendors that users trust on for configurations.

3.1.2 Wow Experience of Cloud Services

Another research concerning cloud UX has been conducted by Vartiainen and Väänänen-Vainio-Mattila (2010). They conveyed that pivotal concepts of cloud UX are, for instance, dynamic service offering through the cloud, user's data storage and access anytime and anywhere, feeling of trust in CSPs, social interaction with other users and smooth multi-device access to the services. Later Väänänen-Vainio-Mattila et al. (2011) stated that the developed services require to be both useful and visually attractive and inspiring. In fact, they should provide users with some sort of adventures. When users use the system for the first time, they should exclaim Wow. Moreover, they should stay engaged also in long-term interaction with the system.

To acquire a more through insight of Wow as a design target, Väänänen-Vainio-Mattila et al. (2011) performed an online survey so as to obtain through understanding of general user perceptions of Wow in terms of interaction with products and services. Then, they investigated two particular cloud application domains—personal contact management and information security services- by performing two rounds of interviews pertinent to users' perceptions of Wow in these domains. Then based on the result of their studies, they proposed design implications for Wow in cloud services. The foremost design implications consist of offering positive surprises to the users by applying dynamic service features through the cloud which means offering something new in the cloud service to make the user stimulated. Advocating automated data integration of and universal access to user's personal data. Designing for personalized multi-device service access as cloud services may be accessed through multiple mobile devices, and moderating the level and types of Wow for “serious” application domains.

3.2 User Experience of Cloud Storage Services

The increasing usage of cloud services and applications in various contexts and on variety of devices also leads to technical challenges. To handle the available resources and deal with particular network conditions in the most efficient way in order to minimize the related costs, while providing user satisfaction simultaneously, it is essential to decipher aspects of CSSs which might have a significant effect on UX of CSSs. (Vandenbroucke et al., 2013).

In 2014, the survey conducted by Gartner Group demonstrated that approximately 19% of organizations are utilizing the cloud for production computing, while 20% are utilizing CSSs (Gartner Group, 2014). It indeed manifests the availability of good potential market for the CSSs. However, on the academic side, majority of work have focused on the theoretical discussion (Marston et al., 2011) or technological development (Tsai & Hung, 2014) of CSSs and merely few studies have investigated CSSs from end user's perspective so as to decipher key factors influencing UX of CSSs.

3.2.1 Privacy, Trust and Security of Cloud Storage Services

TwinStrata (2014) performed a survey regarding to cloud storage adoption, and asked participants about their objection to utilizing CSSs. Privacy security and loss of control has been picked by more than 62% of participants as major concerns for adopting CSSs. The result of another survey by InformationWeek (2014) also indicated that more than 86% of the respondents were concerned about the private security problem, and 52% of the respondents suspected the reliability and availability of CSSs.

Savola et al. (2010) also emphasized that main concerns for cloud service users are not sufficient transparency of security and the deployed controls during the usage of CSSs. Furthermore, in a study by Marshall and Tang (2012), they proved that users' usage of the CSS is not only subsequent to their conceptual model of the cloud but also on their understanding of privacy and security concerns. This result is in line with the assumption in a paper by Oza et al. (2010) which suggests that *“superior user experience and user-centric security are the two crucial issues that assist to build an overall experience for the cloud service user”* (p. 621). Then again most of the participants in the survey by Marshall and Tang (2012) had made a trade-off between security and convenience of these services which is not a marvel as their study participants were early adopters of CSSs by definition. However, their participants articulated that they would not store their critical information which would harm them in case of revealing. More sophisticated users added pre-file encryption in order to make up the lack of particular security provisions.

In Marshall and Tang (2012) 's study participants also mentioned some factors affecting their trust in the security of the cloud subconsciously. These factors can be categorized as “the name of company” such as Google with a good public figure, “cost of the service” which was contemplated by some participants as extra security provisions even without knowledge if such provisions exist. Last but not least, ad-free services were assumed more secure in the participants' perspectives. Sometimes users' files are analyzed legally based on the cloud service provide's terms and conditions. This analysis can serve various purposes such as ads, profiling customers etc. In contrast, if users paid for the service, it is envisaged to be as ad-free.

3.2.2 Data Synchronization and Sharing

Some of the interface complications regarding file sharing were enhanced via a prior research by Rader (2009). His study associated to group information repositories revealed some conflicting conceptual models of how to share files, since on the one hand individuals were averse to delete others' files in a shared repository, but on the other hand they bear animosity towards the consequent clutter which declined the value of the shared repository for everyone. However, these user's needs determined by preceding research are being contemplated by current CSSs such as Dropbox, Google Drive, OneDrive, and iCloud. (Marshall & Tang, 2012)

In a study by Marshall and Tang (2012) which is by far the most related work in our perspective, the current use of syncing and sharing services was investigated. They performed two-phase studies (106-person survey and 19 in-depth semi-structured interviews) with focus on Dropbox, Google Docs, and iCloud so as to decipher how early adopters utilizes these services and what are the conceptualizations or misconceptions that accelerate or prevent people's use of these services. In order to discover the conceptual models which users were creating via their usage, the interviewees were asked to view their synced folder or cloud document repository. Moreover, the interviewees articulated various ways they utilized cloud-based file sync and sharing services in both their professional and personal lives.

As a result of their survey, the ways that users make sense of the cloud are conceptualized into five fundamental categories in order of rising complexity. These 5 use cases established a basic conceptual framework represented in Table 2.

Table 2. Conceptual framework for CSSs by Marshall and Tang (2012).

Use cases	Concepts	User actions
Cloud repository	Ubiquitous access	Transfers files to the cloud and accesses them from any device
Shared cloud repository	Synchronization access	Edits shared content in the cloud
Personal replicated store	Disconnected access	Edits content on any device, even offline
Shared replicated store	Deletion	Understands how own actions affect content on others' devices
Synchronization mechanism	Sync triggers; resolving conflict	Ensures sync completion, avoids conflicts

Perceiving the elements of the abovementioned framework assists a user to have an absolutely strong comprehension of file sync and sharing tools, and the certainty to utilize them in the case of defective bandwidth availability, and collaborators with less complete understandings of the underlying processes.

In this framework, "concepts" are underlying principles that users must perceive about the use cases, and "user actions" indicates that participants know how to apply use

cases. They also differentiated between “Replicated storage” and “Synchronization”. In fact “Replicated store” refers to the notion that “local folders” and “the cloud” hold same copies of a set of files while “Synchronization” is the mechanism by which the replication is accomplished, versions are built, and conflicts are reflected to the users.

At the end of their papers, they proposed some design implications in terms of Process transparency, Interface Scaffolding, and Reconciling Conceptual Models to get users into the concepts presented in the framework (Table 2). Consequently, these design implications assist users to catalyze better conceptual models and make the most of features provided by the CSSs.

Process Transparency refers to having apparent transparency pertinent to the syncing process. For instance, accurate and sufficient usage of cues and notifications regarding to the process of syncing, since many of their study participants had uncertainty about exactly when syncing process was completed or what triggered it (closing or saving a file? On a scheduled basis? etc.).

Interface Scaffolding is about the role of user interface interactions which can direct users towards either a more accurate mental model of the cloud or confusion. For instance, if user wants to delete a shared file in the cloud, the concept of ownership has been clearly specified through the user interface interaction in Google Docs. In other words, in Google Docs if a user wants to delete a shared file that someone else owns, the confirmation presented is “Remove from my Documents list?” This wording accurately demonstrates that the user will not see this file anymore, while others still have access to it. However, in Dropbox, there is no clue about what ensues when a file is eliminated, rather than the standard feedback provided in the file browser.

Reconciling Conceptual Models elicited the fact that CSSs (Dropbox, Google Docs, and iCloud) strive to take advantage of familiar local folder model. Nevertheless, breakdowns occurs when real-world conditions and others’ interactions in the folder leads to surprises. For instance, Dropbox applies a familiar local model. However, when real world conditions inhibit that folder from syncing precisely, then breakdowns happen which undermines the development of a robust conceptual model of the cloud. As a result, the paper recommends the cloud services to offer an UX assisting users to perceive its capabilities and constraints on its own terms without trying to match to a pre-existing metaphor so that failure from wrong expectations can be inhibited.

3.2.3 Identifiers

In another cloud UX-related research by Volda et al. (2013), a qualitative study of the UX of cloud-based information work has been reported. They found three pivotal constructs which form the UX of information management in the cloud:

- Individuals usually utilize several digital identifiers, each pertinent to a different facet of one's real world identity,
- Individual commonly utilize several various cloud-based services offering different features for personal and group information management,
- Individuals take part in several different collaborations, each with various work practices.

In fact, based on Volda et al. (2013) majority of users coped with the challenge of managing multiple, mainly 2-4 different CSSs. In addition to that, individuals commonly associated different digital identifiers with different cloud-based services. Occasionally, individuals utilized various digital identifiers to build different several accounts on a single CSS so as to segment their information more apparently. This is pertinent to different approaches on group information management studied by Volda et al. (2013): segmenting and aggregating.

Segmenting means individuals segment their digital identity, building several digital identifiers, for example strings like email addresses or unique usernames for a certain domain and utilize them in ways that align with their various real-world identities (e.g. work and hobby profiles) (Gross, 2009; Gross & Churchill, 2007; Stutzman & Hartzog, 2012; Volda et al., 2002). This variety of identifiers also advocates a more apparent, segmented presentation of self. For instance, through the suage of a prestigious alumni email address or usage of anonymous Twitter account which permit an individual to share personal political beliefs without associating those beliefs to his/her professional persona (Gross, 2009; Stutzman & Hartzog, 2012).

Aggregating means when individual does not choos to segment his/her identity across several digital identifiers, and instead aggregate different roles under one identity for multiple audience. For instance, when posting for both friends and colleagues on Facebook (DiMicco & Millen, 2007; Lampinen et al., 2009; Skeels & Grudin, 2009).

3.2.4 Interplay Between Quality of System and User Experience

In a more technical-oriented study in 2013, Casas et al. investigated the interplay between QoS and end-user QoE in Personal CSSs such as Google Drive, Dropbox, and OneDrive. In their study, 52 users, in controlled subjective lab experiments, evaluated their overall experience and acceptability of CSSs utilizing The Box, a Dropbox-like application to emulate a CSS in case of various network bandwidth and RTT to the storage servers.

From the perspective of HCI, low response time of the overall end-to-end system is of utmost significance in user satisfaction and good QoE in the cloud services (Guynes, 1988). Casas et al. (2013) presented that response time is related to the essential time to synchronize the corresponding content (i.e. the files) in the context of CSSs. This is

associated with both the responsiveness of the CSS (i.e. cloud storage servers and client application) and the performance of the network.

3.2.5 Context of Use

In 2013, Amrehn et al. also conducted four different user studies to investigate a situational QoE model for file storage services. Based on their studies, key features of CSSs are accessibility (to access data from different devices with different operating systems), sharing data and backup of data (and in wider perspective reliability). They also realized that factors such as “performance” (upload and download speed) and “synchronization speed” should be contemplated while measuring QoE of CSSs. Network conditions have an effect on performance and speed of synchronization and consequently may affect QoE. However, the relevant role of other factors like financial aspect (free of charge), privacy and security related issues (secure Internet transmission of data and protection of data against other people) should not be overlooked as well. They concluded that all influencing factors should be considered for a good QoE despite diverse use contexts. However, in (Amrehn et al., 2013) studies, measuring long-term influence factors and integrating them into QoE model remains an open question which desires further research.

In addition to that, Vandenbroucke et al. (2014) studied the use and QoE related aspects of personal CSSs such as Dropbox, Google Drive and iCloud on mobile devices from a user’s perspective. QoE has been defined as *“the degree of delight or annoyance of the user of an application or service. It results from the fulfillment of user expectations with respect to the utility and/or enjoyment of the service or application in the light of the user’s personality and current state”* (Le Callet et al., 2012, p. 6). Moreover, variety of factors placed at the human level, system level and context level may affect user’s QoE (Reiter et al., 2014).

Vandenbroucke et al. (2014) performed an online survey (N=349) between users of personal cloud services and applications so as to assimilate the use of personal cloud services (in terms of why and how), and identify possible QoE affecting factors and related features. Based on (Hobfeld et al., 2012) QoE of cloud applications is related to costs, network conditions (interpreted into waiting times), and Service Level Agreement.

As a result of the study, Vandenbroucke et al. (2014) rated the significance of particular affordances/features of personal cloud applications, as presented in Figure 4.

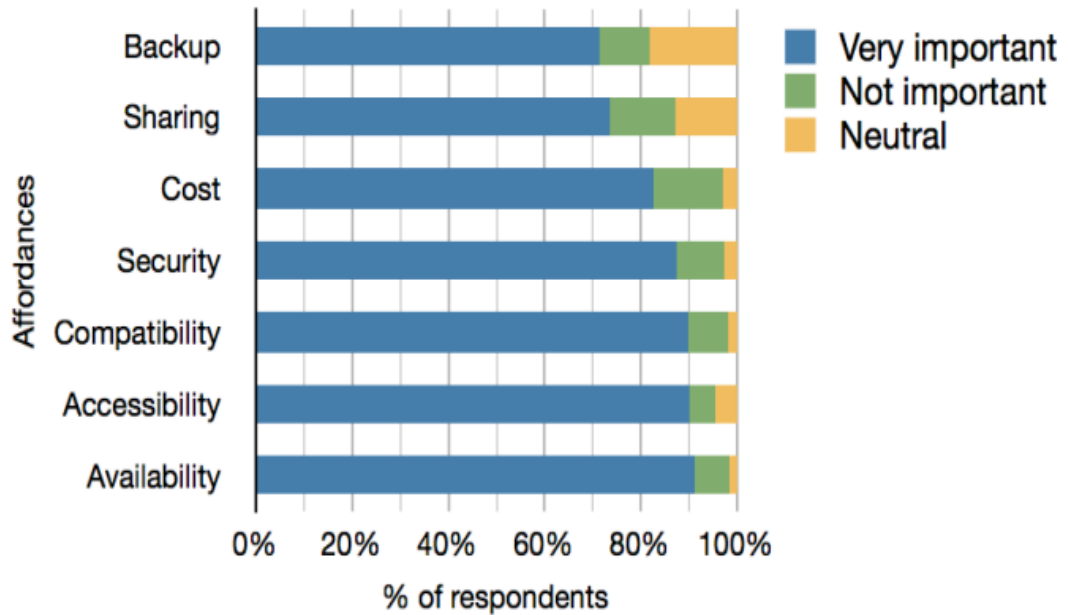


Figure 4. Rating of significance of particular affordances/features of personal cloud applications by Vandembroucke et al. (2014).

Based on Vandembroucke et al.'s survey, the most pivotal affordance of cloud computing applications is their transversal availability (to access data and media from any device and at any time), and also possibility for sharing and backing up data are also contemplated as significant affordances (see Figure 4). They also categorized possible QoE influencing factors and features as the following:

- Compatibility:**
 Different cloud computing services are both compatible with the various internet connected devices, and advocate all file extensions. Compatibility is strongly associated with availability.
- Privacy and security:**
 Privacy and security violation in the cloud are the most prevalent concern as has also mentioned in the previous research papers which can affect the QoE of cloud services. Participants of their study articulated that they will not store their confidential information in the cloud.
- Free or cost efficient:**
 Related financial cost of the cloud service is another significant QoE affecting factor in the cloud. One of the greatest advantages is that majority of CSSs are free.

Vandembroucke et al. (2014) also indicated that contextual factors (network availability, device performance (CPU, operating systems), location, and etc) seems to limit the usage of personal CSSs and affect the availability and QoE. On the one hand, they argued that most of the prior work has concentrated on factors at the system level (e.g.

network-, device-, media-, or content related) as well as human level, whereas the significant role of contextual factors on QoE is poorly discussed. On the other hand, based on (Casas et al., 2013), increasing usage of cloud-based services on mobile domain has become problematic due to dynamic and volatile network conditions on mobile devices. All in all, Vandenbroucke et al. (2014) decided to evaluate users' QoE when using CSSs on mobile devices such as tablets and smartphones and how it is affected by the users' context. By doing so, they acquired QoE relevant usage information in a natural user's mobile context (e.g. location, network connectivity, time of day, social context), while simultaneously logged network-, device-, and context related information on end-users' own devices (Vandenbroucke et al., 2014).

Following their online survey, Vandenbroucke et al. (2014) also performed a 2-week follow-up study using AWARE, an open source Android framework to infer, log and share mobile context information from participants' phones (Ferreira, 2013) as well as mobile-based Experience Sampling Method (ESM) questionnaire to acquire QoE-related usage information real time and independently of the current user's context. ESM is a research method to study what individuals do, feel and think during their daily lives. It asks people to provide systematic, self-reports at non-deterministic situations during the waking hour of their lives (Hektner et al., 2007). Vandenbroucke et al. (2014) gathered 156 responses on in-situ context of usage for Dropbox on mobile devices. The result of their paper postulated that users expect connectivity from any device, at any time and from any place. Moreover, users demand high-speed networks, collaboration amongst several users and finally, they expect security and privacy in their cloud computing services (Vandenbroucke et al., 2014).

3.3 Human Psychological Needs as Components of User Experience

In the last couple of years, the field of HCI has acquired an increasing eagerness in the experiential aspect on the design and evaluation of interactive products (see Hassenzahl, 2010). According to this trend, emotions have become a necessary part of UX and their evaluation consequently have become pivotal in the empirical research performed in the field of UX (Agarwal & Meyer, 2009).

In the field of HCI, mainly study on emotions concentrated on psychology-based dimensions for studying affective interactions (e.g. Picard, 1997; Partala & Surakka, 2003, 2004; Partala et al., 2006) using for instance, the participant's facial expressions in affective HCI. Recently, social and experiential aspects of emotions has got more attention (e.g. Boehner et al., 2005). These days, the evaluation of subjective emotional experience itself has been contemplated as a prominent task in UX evaluation and research (Partala & Kallinen, 2012).

Based on (Law et al., 2009), UX is a dynamic, highly context dependent, and subjective account of HCI. Moreover, the experiential aspects on the design and evaluation, emphasize on affects and emotions. McCarthy and Wright (2004) also stress the “emotional thread” of experience, and they emphasize that emotion and experience are inseparable. They postulate that all our actions are “*shot through with values, needs, desires and goals*” (p.85). The association of action with values and needs sets the emotional tone of experiences. With the stress on values, needs, desires and goals, (McCarthy & Wright, 2004) put emphasis on accepted psychological theories (see Carver & Scheier, 1989) which present that action is dependent on not only context and conditions on an operational level, but also on universal psychological needs. However, (McCarthy & Wright, 2004) did not specify the content of these “values, needs, and desires” explicitly.

In addition to that, based on (Hassenzahl et al., 2000; Hassenzahl, 2001, 2003; Hassenzahl & Tractinsky, 2006), perceived qualities of an interactive product can be split into the pragmatic dimension of interactive products (i.e. inextricably tied to behavioral goals) alongside hedonic dimension (i.e. tied to individual’s self and their psychological wellbeing) such as stimulation (i.e. fulfillment of the needs for stimulation, novelty and challenge, which are essential for personal growth), identification (i.e. self-expression, interaction with relevant others) and evocation (i.e. self-maintenance, memories). Consequently, the appealingness of a software system in users’ perspectives depends massively on the users’ perceptions of the quality dimensions (Hassenzahl et al., 2000).

Regarding to Hassenzahl and Tractinsky’s (2006) stress on hedonic and pragmatic aspects of interactive products which correlates product attributes with needs and values, presumably the most intriguing question is what are these needs? And how needs are prioritized?

Sheldon et al. (2001) proposed 10 universal psychological needs (autonomy, competence, relatedness, physical thriving, security, self-esteem, self-actualization, pleasure-stimulation, money-luxury, and popularity-influence) that each of them has been drawn as a need from prominent psychological theories such as self-determination theory (Ryan & Deci, 2000), Maslow’s theory of personality (1954), Epstein’s cognitive-experiential self-theory (1990 and other famous theories within the literature. Then, Sheldon et al. (2001) performed three studies in order to evaluate the significance of these 10 psychological needs. Participants depicted one recent most satisfying life experience, and then salience scores were computed for each of the 10 candidate needs within the experience using a questionnaire method consisting of 30 descriptive statements (three statements for each need in the scale of 1=not at all to 5=very much). The results of the study demonstrated that competence, autonomy, and relatedness were the most salient needs in terms of most satisfying and missing from unsatisfying life experiences.

Likewise need-related aspects, there is also an inseparable link between UX and emotion, as the emotional quality of an experience tends to summarize the experience for us; for example, as fun, exciting, or frustrating. This is how we tend to remember an experience (McCarthy & Wright, 2004). As a result, Sheldon et al. (2001) also indicated a clear relation between need fulfillment and affect (positive, negative) by applying Positive Affect Negative Affect Schedule (PANAS) questionnaire (Watson et al., 1988) to measure the affect in the reported life experience. Consequently, they demonstrated that the degree of need fulfillment was positively associated with the intensity of positive affect. Except for luxury, all needs showed correlations with positive affect. Later, in a series of studies, Hassenzahl (2008) performed a study on the structure of positive experiences with technology. He applied PANAS model to study emotions and the levels of satisfaction for self-determination associated needs consisting of autonomy, competence and relatedness. The result of his study postulated that competence was the most salient psychological need in positive user experiences with technology, followed by autonomy and relatedness. Later, Hassenzahl et al. (2010) conducted a larger study on the same topic. They proved that relatedness, stimulation and competence were the most salient psychological needs in positive UXs with technology. However, autonomy and self-esteem were omitted from their analysis. They also proved that need fulfillment and positive emotions were important factors for the perceived hedonic quality of products.

Later, Partala & Kallinen (2012) applied a holistic approach to study systematically the relative importance of different emotions and psychological needs in most satisfying and unsatisfying UXs and the effect of different contextual variables in those experiences. They utilized a three-section questionnaire to study psychological needs, emotions and context. They applied Sheldon et al.'s (2001) questionnaire to study 10 candidate psychological needs in the context of UXs. In addition to that PANAS system (Watson et al., 1988) with 10 positive and 10 negative emotions was used in analyzing emotions regarding to the user experiences. Unlike many prior UX studies, Partala and Kallinen (2012) concentrated on unsatisfying experiences and negative emotions so as to include the full range of emotions on the emotional valence scale. Eventually, a collection of 10 contextual questions was created in accordance with the context framework by Jumisko-Pyykkö and Vainio (2010) to include the most prevalent contextual variables available in present literature: physical context, temporal context, task context, social context, and the technical and information context.

3.4 Summary and Research Gap

Despite of the increasing popularity of cloud computing and its potential to grow, much of the work to date has concentrated on the technical infrastructure, like optimizing throughout scaling up in capacity, and maximizing uptime (Armbrust et al., 2009). It is important to look beyond the technical aspects in order to gain a better understanding of

the experiences and practices related to the use of CSSs. However, merely little work has focused on investigating UX of CSSs.

Much of the previous work indeed has focused on the pragmatic aspects of UX and almost none of them has evaluated user emotional reaction or hedonic aspects of UX in the context of CSSs. However, based on the UX models proposed by literature (see e.g. Hassenzahl, 2003; Mahlke, 2008), we know that user emotional reactions and hedonic dimensions are also components of UX as well as pragmatic dimensions.

Study by Marshall and Tang (2012) is one of the most relevant studies to our knowledge to understand how to improve CSS from user perspective. While our research builds on their findings, we try to investigate all components of UX suggested by UX models and strives to provide a more holistic framework for UX of CSSs, which Marshall and Tang's research lack of it.

In addition to that, the immigration of services to the cloud is related to new affordances such as sharing and accessing personal data in a flexible way and from different devices, and easy collaboration between multiple users, and others (Hobfeld et al., 2011). Nevertheless, with an increasing popularity of collaboration in CSSs, none of the studies to date have revided on evaluating individuals' social preferences regarding to CSSs. Consequently, we decided to investigate the potential of refining social interactions within the CSSs by amassing feedback concerning participants' preferences pertinent to integration of different social features with their favorite CSSs. CSPs can also exploit this integration so as to tie their users to their service, as by changing to another CSS, it is apt that users loose the benefits of the social network they have catalyzed within the service.

4. EMPIRICAL RESEARCH ON USER EXPERIENCE OF CLOUD STORAGE SERVICES

The research process of the thesis started at summer 2014. The first objective of our research was to study UX of CSSs as to our knowledge there is no generic UX study of CSSs considering all components of UX (see Mahlke, 2008; Hassenzahl, 2003). In addition to that we were interested to investigate the potential of integration of social features into CSSs. Furthermore, a practical goal was to provide implications to improve UX design of CSSs.

Theories associated with UX models as well as related literature about UX of CSSs were reviewed during summer 2014. At this stage, an initial UX framework was formed based on studied UX models to guide the UX study of CSSs. Based on the literature review on the UX of CSSs, an open-ended thematic interview was designed, and interviews were carried out at the end of summer 2014. Based on the results of the interviews, a Web survey was created and launched in autumn 2014. The empirical findings were reflected on and interpreted utilizing theory and prior literature till end of 2014 and. empirical findings were published as scientific publication as conference article in 2015.

In this section, we elaborate data gathering methods, participants and the procedures used in the study. Overall, the data was gathered from 10 interviews and 65 responses on a Web survey. We also explain the motivation for picking particular questions used in the interview and survey based on related work.

4.1 User Interviews

To investigate the usability aspects, general user perceptions, long term UX and identify the feasible new types of social interaction that might be incorporated in CSSs, we conducted 10 qualitative semi structured thematic interviews. The interview session was comprised of a consent form, an initial questionnaire, a set of interview questions, an UX curve-drawing task and a final questionnaire to investigate the participants' social features preferences within the CSS. Interviews were audio recorded for later review, and each interview lasted about an hour.

4.1.1 Participants and Procedure

We recruited 10 participants via various email lists and social networks (Facebook, LinkedIn etc.). All the participants had at least experience with their desired CSS, and half of them introduced themselves as active users of their chosen CSS. Four participants were predominantly in working life, two were students, and four were both in working life and student. We strived to invite variety of user types in order to cover all the four CSSs (Dropbox, Google Drive, OneDrive, and iCloud). Eight of the participants were male and two of them were female, all between 21 and 37 of age. The median age was 25.5, and the average age was 26.1. The participants were from 10 different nations: Estonia, Bulgaria, Romania, Brazil, Russia, China, Pakistan, Vietnam, India, and Iran.

The interview sessions with participants consisted of a consent form, an initial background questionnaire, a set of interview questions, an UX curve drawing task, and a final questionnaire that enquired into users' preferences regarding to the improvement of social interaction within participants' desired CSS. The interviews were all face-to-face communication, and each session was of a maximum length of 1 h. English language was used in materials and discussion as participants were from various nations.

After the welcoming of the participants and the filling in the consent form and an initial background questionnaire, participants were asked a set of interview questions, and then UX curve-drawing task began. At the end of the interview sessions, participants filled in a final questionnaire pertinent to participants' social feature preferences within their desired CSS.

4.1.2 Materials

Consent form- We provided participants with a consent form to inform them about the objectives of our study as well as their rights and risks. We also guaranteed that their personal information will remain confidential. The outline of the consent form is presented in APPENDIX A.

Initial questionnaire- We gathered participants' background information through an initial questionnaire. In addition to basic demographic data, we asked about variety of CSSs the participants were using on different devices (PC, mobilephone, tablet etc.) and the frequency of their usage. The initial questionnaire is manifested in APPENDIX B.

Interview questions- The interview questions were pertinent to the general usage of the CSSs, and more specifically, social interaction preferences within the CSS. We also had some questions regarding to the integration of the CSS into current social network sites (SNSs). The intention of the questions regarding to general usage of the CSSs was to uncover what CSSs are used and how frequent, the users' initial motivation to

commence utilizing them, when it happened, for how long they have been using it, and how they felt after the first experience, most satisfying and most unsatisfying experiences with the CSS. Questions also addressed the UX of security issues within the CSS. Furthermore, there were questions regarding to data sharing, and more specifically photo sharing. The outline of the interview questions is conveyed in APPENDIX C.

Curve-drawing template- In addition to focusing on short-term evaluation of UX such as initial adoption of the CSS, most satisfying and unsatisfying UX, we also applied the “UX Curve” method (Kujala et al., 2011) which provides both rich qualitative and quantitative data about identifying the main individual experiences which changed users’ attitude towards the CSS, and also the trends of UX over time respectively. We used the template discussed in (Kujala et al., 2011). First, the researcher asked the participants to remember the moment when they commenced to utilize the CSS. The researcher gave the empty template of UX curve to the participants and asked them to draw a curve indicating how their relationship towards the CSS had altered from the first-time usage till today. Participants were allowed to think aloud and illuminate the reasons verbally to the researcher, though they could also write it down by themselves if they desired to.

Final questionnaire- We had notable interest to study the social feature preferences within the CSSs. The social features evaluated are based on framework presented by (Hanrahan et al., 2011). Their framework for social features contains six distinctive groups. Each of these groups was covered in our questionnaire with one or more questions. In the following we go through Hanrahan et al’s definition for each group and present the related questions from our questionnaire.

1. **Tagging-** users annotate a specific resource like a blog post, photo, or any object with a freely selected collection of keywords (Hanrahan et al., 2011).
 - I would like to have “Photo Tagging” functionality within this service.
2. **User Profiles-** profiles purvey users’ identity on the system, and manifest common interests and relationships (Hanrahan et al., 2011).
 - I would like to acquire new virtual contacts within this service.
 - I would like to make an explicit friend list within this service.
 - I would like to send “Add Friend Request” within this service.
 - I would like to search for people within this service.
 - I would like to see other users’ profile pages within this service.
3. **Comments-** indicate social relationship and are dominant conversational methods (Ali-Hasan & Adamic, 2007)

- I would like to have a functionality to “leave comments” about friends’ files within this service.
4. **Activity Streams-** are flowing commentaries on users’ actions on various parts of the site, and are useful to probe content (Hanrahan et al., 2011).
- I would like to see the state of my contacts within this service (if they are Online, Busy, and Away)
5. **Rating and Votes-** are a paramount part of reputation systems for users of SNSs (Hanrahan et al., 2011). Reputation systems provide interaction, trust and restrictive actions (Jensen et al., 2002).
 - I would like to rate a shared file within this service.
 6. **Private Messaging-** “SNSs often have a private messaging feature similar to webmail” (Boyd & Ellison, 2008).
 - I would like to have “Private Messaging” functionality within this service. (Direct communication between you and your friends within this service)

we distributed a short questionnaire at the end of the interview session containing the above-mentioned questions and participants were supposed to evaluate 10 statements regarding to social features using 1-9 scales. (1=not at all to 9=very much)

4.1.3 Data Analysis

We used thematic analysis (Taylor & Bogdan, 1984; Boyatzis, 1998) to analyze interview data. Thematic analysis is a prevalent method for qualitative analysis of transcripts or other similar text data sources to recognize, analyze and report themes within data. After theme interviews, it is common to apply thematic analysis, since the themes discussed with the interviewees are commonly quite similar in all the interviews. After data collection, analysis is comprised of the following steps:

Data transcription and familiarization- reading the transcribed interview material multiple times.

Data division- manually and systematically searching within each transcript, copying proper citations in an excel sheet where the interviews were categorized into columns and data split into meaningful sentences categorized into rows.

Theme generation- defining and naming emerging themes and categorizing data based on them.

4.2 Web Survey

We performed an anonymous web survey based on the literature review and interviews. With the web survey, we aimed to amass feedback pertinent to the usage and UXs of CSSs. The survey consisted of multiple-choice questions as well as open-ended questions.

4.2.1 Participants and Procedure

65 individuals participated in the Web survey. One participant was under 20, thirty-three participants were into the 20–30 years age group, fourteen participants into the 31–40 years age group, and two participants into the 51–60 years age group. The median age of sample was 29 (Minimum = 19, Maximum= 52).

We developed a web based survey using Webropol tool (<http://www.webropol.com/>). A link to the survey was distributed via SNSs (Facebook, LinkedIn etc.) and various email lists in order to invite individuals to take part in the questionnaire. Survey responses were anonymous, and all materials were in English. We allowed for some missing values per participant which brought about slight variations in sample size, based on measures involved.

4.2.2 Materials

The Web survey (APPENDIX D) consist of a short instruction manifesting the goal of the survey followed by nine sections: Your Background, History of Usage, First Experience, The Most Satisfying Experience, The Most Unsatisfying Experience, General Evaluation of the Service, Improvement of Social Interaction within the Service, Evaluation of Your Feeling about the Service, and Demographic details.

In *Your Background* and *History of Usage* sections, respondents were asked to provide information on the variety and frequency of SNSs such as (Facebook, YouTube etc.) and personal CSSs that they use. They were also asked to pick one CSS that they preferred to answer the Web survey based on, as well as specifying the duration of usage of the service. They were also supposed to pick devices (Desktop, Mobile Phone, Tablet, etc.) that they usually use the CSS on. There were also questions pertinent to the current primary usage of the service.

In *The First, Most Satisfying* and *Unsatisfying Experience* sections, respondents were asked respectively about their initial motivation to start using the CSS, the single most satisfying in line with (Sheldon et al., 2001; Hassenzahl, 2008), and (Hassenzahl et al., 2010) and the single most unsatisfying experiences that they have had with the CSS in the last six months. They were also asked to describe the effect of each experience on them and whether the experiences changed their thoughts and attitudes towards the CSS in general or not as based on Kujala and Väänänen- Vainio-Mattila (2009) the overall

UX is a continuum which occurs as a result of a series of smaller UX units. Finally, participants were asked to rate their emotion using a 9-point scale Self-Assessment Manikin (SAM) model (Lang, 1980) within the reported UX.

By asking open-ended questions regarding to the first, most satisfying and unsatisfying experiences that participants may have had with CSSs, we could obtain qualitative information (i.e. on pragmatic vs. hedonic aspects of UX of CSSs) as users were asked to freely depict their UXs.

In the *General Evaluation of the Service* section, respondents were asked to assess the level of satisfaction for particular psychological needs (autonomy, competence, relatedness, stimulation) in their overall experience with the CSS as postulated by Hassenzahl and Tractinsky (2006), psychological needs are significant components of UX. We utilized a questionnaire in which an abridged definition of needs from Sheldon et al. (2001) were presented to the respondents. Participants gave their responses on a 1-9 scale ranging from 1=not at all to 9=very much.

In *Improvement of Social Interaction Within the Service* section, respondents were asked to assess 10 statements pertinent to social features using 1-9 scales (1=not at all to 9=very much). The social features evaluated are based on framework by (Hanrahan et al., 2011) which has been discussed in the interview section.

Finally, the concept of UX emphasizes that products or services require to support both users' hedonic needs like stimulation and self-expression as well as the pragmatic ones in utilizing the product or service (Hassenzahl & Tractinsky, 2006). Consequently, In the *Evaluation of Your Feeling about the Service* section, respondents were asked to fill in the AttracDiff2 (see Hassenzahl & Monk, 2010) questionnaire to evaluate perceived pragmatic quality, the hedonic quality and the attractiveness of the desired CSS.

For all three quantitative sections, *General Evaluation of the Service*, *Improvement of Social Interaction within CSS*, and *Evaluation of Your Feeling about the Service*, we used nine-point scale instead of the five point scales so as to acquire more fine grained conception of the participants' psychological needs, social feature preferences, and feelings pertinent to their UXs, and to avoid challenges regarding to response interpolation (see e.g. Finstad, 2010). We presented the outline of the whole Web survey in APPENDIX D.

4.2.3 Data Analysis

Qualitative data from the Web survey was analyzed utilizing affinity diagram. Affinity diagram is a tool that gathers large amounts of data and organizes them into groupings based on their natural relationships

The process of making affinity diagram was a bottom up approach. Each Web survey response was interpreted and affinity notes were written. These affinity notes were input to generate the affinity diagram. Each Web survey created 40-65 affinity notes. All the affinity notes were printed in A4 paper. Then the paper was cut out into small pieces, each representing affinity note. The notes were labeled according to participants so that it could be distinguished from different participants. Each affinity notes were read out loud and each were interpreted and reasoned to perceive participants' idea behind each note. Then the notes were classified under common themes or headings.

5. RESULTS

In this section, we demonstrate the findings of our research based on our data gathered from interviews and Web survey. The results are categorized based on components of UX from UX models suggested by Mahlke (2008) jointly with the model by Hossenzahl (2003). It means our findings cover both pragmatic qualities and hedonic qualities as well as emotional user reactions in the context of CSSs. We also measured long-term UX of CSSs as based on Tractinsky and Zmiri (2006), users' overall assessment of a product is not a simple sum of the individual experiences. In fact, it is based on the memories of past experiences though users are not competent to recall all the details of their experiences (Norman, 2009).

We wrote a scientific conference paper (Palviainen & Pour Rezaei, 2015) based on the results of our research which will be published in the 24th Australasian Software Engineering Conference (ASWEC 2015). The author of this thesis work is second author of the paper. You can read the paper in APPENDIX E.

In the following, we categorize and present the results of our research based on the pragmatic UX, hedonic UX, emotional UX and Long-term UX of CSSs.

5.1 Usage of Cloud Storage Services from Different Platforms

In the beginning of the survey, participants were asked to choose one of the CSSs (Dropbox, Google Drive, OneDrive, and iCloud) which they either use most or means most to them, and then they were supposed to reply the rest of the Web survey based on their chosen CSS. Distribution of participants for each distinct CSS can be found from the table 3 (considering the whole number of respondents is 65).

Table 3. Distribution of the preferred or most meaningful CSS to the survey respondents (N=65).

Dropbox	Google Drive	OneDrive	iCloud
40	16	5	4

In the Web survey, 92.30% of the participants have been utilizing personal CSSs already for longer than one year. Participants have been using different CSSs on different platforms. Percentage of usage of each particular CSS on each distinct platform can be found from the Figure 5.

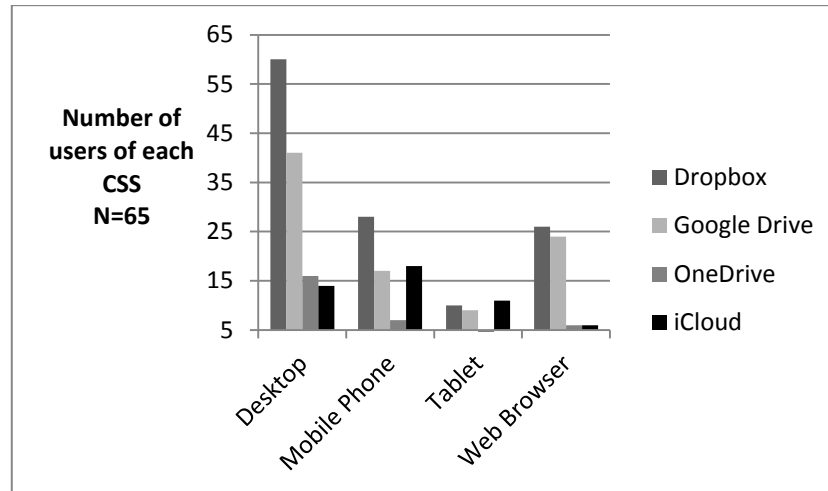


Figure 5. Distribution of number of users of each CSS from different platforms based on survey respondents (N=65).

5.2 Pragmatic Qualities of Cloud Storage Services

By asking open-ended questions pertinent to the first, most satisfying and most unsatisfying UX in the context of CSSs, we aimed to investigate both pragmatic and hedonic qualities of CSSs in both interviews and Web survey. However, the qualitative descriptions did not reveal much about hedonic qualities of CSSs. In fact, as also stated in the paper by Partala and Kallinen (2012), the qualitative results proved that majority of the participants' free-form qualitative descriptions, especially for the most unsatisfying UXs, provided significant information regarding the pragmatic aspects of the CSSs.

In general, 75 participants (65 respondents from Web survey and 10 respondents from interviews) described their first, most satisfying and most unsatisfying recent UXs with CSSs. We then analyzed those qualitative descriptions based on UX model by Hassenzahl (2003). In the following, we will discuss users' motivations to start using a certain CSS, the reasons of the most positive UX with CSSs, and the reasons of the most negative UX with CSSs.

5.2.1 Motivations to Start Using a Certain Cloud Storage Service

Based on our analysis, there are nine categories motivating the participants to adopt utilizing a CSS which are as the following in a descending order of their significance:

- Need to share files,
- Need to synchronize files,
- Need for a backup service or safe storage,
- Friend suggesting the use,

- Work or school related practices requiring, recommending or forcing to use a certain CSS,
- Device, system or purchase integration: the service was included into the purchasing of a device or the CSS is integrated into a certain operating system or service,
- Stimulation, for example trying out the system out of curiosity,
- Free storage,
- Collaboration (editing files together).

Table 4 reports the motivations for adopting a CSS. Although there were substantially more Dropbox users than any other CSS users, none of those participants reported *free storage* as the primary reason for starting to use the CSS. None of the 10 interviewees mentioned this either. Instead, the interviewees often reported *sharing* and *synchronizing* their files as their primary motivation. The visual representation of the Table 4 can also be found from Figure 6.

Table 4. *Motivations for adoption of each CSS (N=57).*

Service Motivation	Dropbox N= 35	Google Drive N=13	OneDrive N=5	iCloud N=4	Total N=57
Sharing	17	5	0	0	22
Synchronizing	9	1	2	2	14
Backup	3	1	2	4	10
Friend	7	0	0	0	7
Work or school	7	0	0	0	7
Integration	1	2	1	1	5
Stimulation	2	1	0	2	5
Free storage	0	3	1	1	4
Collaboration	1	1	0	0	2

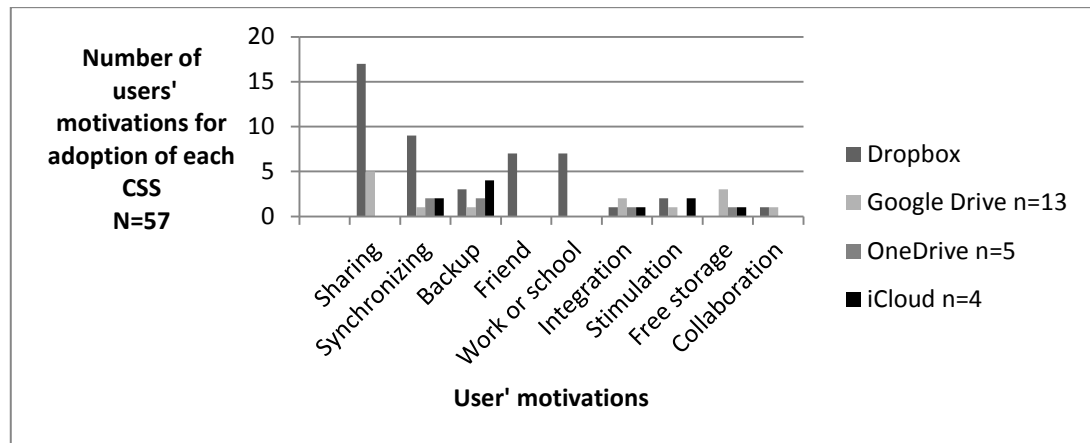


Figure 6. Motivations for adoption of each CSS (N=57).

Depending on the exact expressions used, we have categorized the answers with either one or several labels, for instance, we labeled the following quote as both *sharing* and *collaboration*.

“Too large files to share with multiple users on email and needed the possibility that all users to modify” (P63, Google Drive).

As the question regarding the motivations for adoption of a CSS was not obligatory to reply in the Web survey, so some of Web respondents skipped answering it. All in all, 57 respondents out of 65 Web respondents answered this question. From the data analysis, we realized that the most significant motivations for users to start using of CSSs stem from task-related goals which are associated with pragmatic aspects of CSSs.

5.2.2 Reasons for the Most Positive User Experience with Cloud

The survey participants were asked to denote their most satisfying experiences with their chosen CSS during the last six months. In comparison with prior data set, the responses were considerably more diverse. 50 out of 65 survey participants filled in the questions associated with the most satisfying experiences that they have had in the last 6 months. The result is manifested in table 5.

We made a nuanced distinction between accessibility *“to access data from different devices with different operating systems”* (Amrehn et al., 2013, p. 186) and synchronization, *“the mechanism by which the replication takes place, versions are created, and conflicts are reconciled (or reflected to the users)”* (Marshall & Tang, 2012, p. 548). For instance, the following descriptions were categorized into *synchronization* category:

“My most satisfying experience regarding to dropbox, when I changed my primary laptop and I did not have to move the backup, only cloud sync!” (P38, Dropbox)

“Sync works in real time if you have dropbox application.” (P39, Dropbox)

However, the following descriptions went into *accessibility* category:

“My most satisfying experience with dropbox is related to the fact that my information was always in access.” (P1, Dropbox)

“Take screenshots with my desktop and save them automatically in dropbox so that I can check them later in my mobile phone.” (P50, Dropbox)

Table 5. Reasons for the most satisfying experience with the CSS in the last 6 months.

	Dropbox N=32	Google Drive N=10	OneDrive N= 5	iCloud N= 3	Total N=50
Sharing	14	3	1	0	18
Ease of use	11	3	0	0	14
Accessibility	4	3	1	3	11
Backing up	7	2	0	0	9
Work/ school related	4	2	1	0	7
None	4	1	1	0	6
Synchronization	4	0	0	0	4
Collaboration	2	0	1	0	3
Free/cheap storage	1	1	1	0	3
Recovery	2	0	0	0	2

In the interview, the most satisfying experience varied for each specific CSS. In Dropbox the most satisfying experience was associated with *sharing* :

“What I like most was the possibility of sharing. The thing that I can share with more friends and not all of them need to have Dropbox. Actually, there is the same idea in Google Drive as well. You do not have to have a Gmail account to be able to access it, but the same goes here. As long as you have the link and you can put it into your browser, and see the content on only that directory. I mainly use this for photography and I think I rarely use it for anything else. (maybe if there was a very funny video that I want to share with my friends)” (A2, Dropbox)

For One Drive and iCloud, the reasons for the most satisfying experience lie behind *backup*.

“I needed to backup my pictures because I had to reinstall my system on my computer and in One Drive there was enough space,so I just copied them there. Hence, I had all of my pictures without deleting some of them.” (P6, OneDrive)

“I got really happy when I got all of my “contacts” back , so I did not need to ask my friends once again to send me their contact number, and I got it from my iCloud service. In addition to it, I got my applicatios back, so I did not need to pay for them again, because if

you have paid for any application once, it will stay in your iCloud service and you can download it again for free.” (P7, iCloud)

Considering responses from both interview and Web survey, the most paramount affordance of CSSs, which can lead to positive UX of CSSs, is *sharing* following with *ease of use, accessibility and backup*. Based on Gong et al. (2010), *“The ease user experience characteristic hides the complexity of CSPs and supply cloud users with very simple interfaces”* (p. 275)

5.2.3 Reasons for the Most Negative User Experience

During the Web survey, respondents were supposed to chronicle the most unsatisfying experience that they have had with their desired CSS in the last 6 month. Our broad picture of the most unsatisfying experiences based on descending order of their importance encompass:

- Lack of visibility (Nielsen, 1994) of the CSSs as well as lack of user’s control,
- Ambiguous usage of terminology and dialogue messages by CSSs,
- Lack of feeling of security and trust in CSPs,
- Lack of appropriate content management,
- Slow functioning of the CSSs,
- Running out of free storage offered by CSSs, and
- Lack of sufficient instructions and tutorials notably in Google Drive.

Understanding the most negative UXs and the conditions on which they may occur, provides an opportunity for designers to improve design of CSSs iteratively based on the UX evaluations.

5.2.3.1 Lack of User’s Control and Lack of Appropriate Visibility

Some participants pointed out issues which reveals lack of user’s control within their chosen CSS. This implicates that the CSS should let the user feel that he/she is in control. In addition to that, as mentioned by Nielsen (1994), a system should always maintain users aware of what is happening in the system, through appropriate feedback within reasonable time which indicates which process is occurring.

For instance, in the following there are mentions from responses demonstrating unwanted deletion of files and unwanted transmission of photos to the cloud. However, the CSS should let the user feel that he/she is in control and manifest clearly what is being deleted or transferred within the CSS.

“I did not understand why, but I almost lost all of my previous school work from Dropbox. However, with a little work I found a way to recover them.” (P4, Dropbox)

“My most unsatisfying experience is related to transferring all the pictures on the cloud. I just noticed this later.” (P6, Dropbox)

“The desktop client deleted one shared folder with years of work while trying not to synchronize it.” (P19, Google Drive)

“Some contacts had vanished.” (P8, OneDrive)

In the following there are some quotes conveying lack of proper visibility in *synchronization* process:

“I recently deleted files from the folder that belongs to cloud service. On the following day I noticed these files are reappeared in my computer. I do not know why but I assume that the client program was not running when I deleted the files and therefore did not register the deletion and then downloaded them from the cloud when they were missing.” (P26, Dropbox)

“Starting to upload a big file, waiting for it to get it upload, and after 15 minutes the web told me that I did not have enough space to upload it (without telling me how much too big it was).” (P48, Dropbox)

“The first OneDrive sync with OS X takes too much time , and you are not able to see how the sync progress.” (P52, OneDrive)

In the interview, respondents were also revealing lack of visibility of *synchronization* process:

“I was waiting for my files to get synchronized, but after 2-3 days I noticed that it still says that you have to wait, and I noticed that mostly everything has green check, and I had made the “system hidden files” to be shown, and Dropbox has failed to upload them! So, after deleting that, it got ok. I think not every normal user can recognize this fault!” (A1, Dropbox)

There are some other difficulties regarding to *sharing* action which convey lack of appropriate visibility in *sharing* functionality as well:

“Some minor difficulty to know how to share the link of one folder with some of my friends.” (P8, Dropbox)

“Sharing direct links to files using the web interface does not seem possible, Images are shown through a html page and other files are delivered with a download link.” (P60, Dropbox)

5.2.3.2 Ambiguous Usage of Terminology and Dialogue Messages

Some of the most unsatisfying experiences were pertinent to losing one's data accidentally. In the following there is a quote from one of the participants:

“When I was moving files around, I found out that I accidentally deleted all my files and I had to go into the web version to recover all my deleted files, no way to do this in batches! And I had to go into each folder and undelete each file. So, I want them to give more flexibilities to a user when it comes to recovering deleted files, especially multiple deleted files.” (P44, Dropbox)

Several similar cases were reported. We mention another example due to the severity of the problem:

“A guy in my former office erased everything from all the team, because he did it from desktop version. As he was seeing it in his computer, he thought that would erase the files only in

his computer, but he erased them in Dropbox, and many people did not have a copy on their local. We could save many of them because of history tool, but then again many other went lost! Because there were thousands of them and also because the files were mixed up with older versions with same names. So, since there I have to keep a copy on my Desktop!”. (P41, Dropbox)

This concept has well discussed by Marshal and Tang (2012). In fact they discussed *“how specific user interface interactions can either provide mental scaffolding that helps nudge users towards a more accurate model or cause uncertainty or confusion in the user's mental model”* (P. 552) about the CSS. They also claimed that interface scaffolding of Google Docs has assisted its users to form accurate mental model about it.

In contrast with the case mentioned by P41, in Gooegle Docs, if a user wants to delete a file owned by someone else, the confirmation presented is *“Remove from my Documents list?”* This accurate wording of the message manifests that the user will not see the file anymore, though others with whom the file is shared still have access to it. In fact, if user desires to delete a file owned by him/her, a timely user feedback purveys adequate scaffolding so as to user forms an accurate mental model when deleting shared file. (Marshal & Tang, 2012)

Our survey findings put emphasis on findings by Marshal and Tang (2012) in this regard as there were no complain and amibiguity regarding to Google Drive interface scaffolding, while most of unsatisfying experiences were associated with Dropbox.

Apparently, in the case reported by P41, participant's colleague had not comprehended the concept of "shared replicated file store" as elaborated by Marshal and Tang (2012). Some CSSs (such as Dropbox) have not been prosperous to convey this concept well enough for their users. Good solution for this problem is showing explicit information using well-formed terminologies (e.g. in dialogs when trying to remove files) about the consequences of deleting one's personal or shared files, as also postulated by Marshal and Tang (2012).

Another confusing terminology utilized by Dropbox is usage of the word "Sharing" for two different concepts which can mislead users. In a local copy of Dropbox, there are two options to share a file as *share this folder* and *share Dropbox link*. By the second option, recipient gets a downloadable link. If the recipient decides to save the shared folder, there are two options for him/her to save it as either *Zip* or *save it to his/her Dropbox folder*. Selecting the second option provides fake impression for the recipient that sharing has been done as all the files will be saved in his/her Dropbox folder which in turn leads to the wrong expectation of reaping all future updates from the sender. However, better terminology utilized by Dropbox (particularly for *share Dropbox link*) would hamper this confusion.

5.2.3.3 Lack of Feeling of Security and Trust in Cloud Service Providers

Security is a matter of utmost importance in order to provide a good UX. Due to variety of researchs on the security of CSSs from technical perspective, we focused on the security of CSSs from UX perspective. In both our interviews and Web survey, there were some reports regarding to the most negative UX of CSSs indicating lack of trust in the CSP.

"My most unsatisfying experience is related to my concern about safety" (P1, Dropbox)

"When I discovered that all your files are probably read to fill your customer's profile, especially with Google Drive and the documents you can create inside the platform." (P7, Google Drive)

"When I was working for a public company, I could not offer Google Drive in front of security team, that they were so picky about that." (P35, Google Drive)

"Easy for security abuse."(P42, Dropbox)

"I am kind of critical about it, and I do not really approve all of these privacy issues and laws that some of the corporations are trying to push thorough. What really bothered me, I know Google is probably kind of Skynet and my work and files could be compromised at some points, so I am usually not adding very important stuff there." (A4, Google Drive)

“About privacy issue. I remember a few months ago with Dropbox someone with a bad reputation in political field became a board member, so that was published badly for Dropbox. I suppose nobody would like that to have that kind of a person to be in charge of this data storage. So, such a move, left a bad impression on Dropbox.” (A4, Dropbox)

“I think Dropbox is not secure enough! For example, if my friends visit me, they can open my files on Dropbox (if you share device with people). Maybe, it is better that if someone needs to access my Dropbox folder, you can put a PIN code for Dropbox folder like the phone.” (A10, Dropbox)

5.2.3.4 Lack of Appropriate Content Management

Some participants were complaining that file system is messy, and they were looking forward to finding better ways for content management and organizing files in their both replicated store as well as the cloud repository. In the following there are some quotes reported by responses:

“My most unsatisfying experience is related to folder/subfolder presentation.” (P9, Google Drive)

“Too many files from which I could not remember the content.” (P29, Google Drive)

“I have too many documents in the main folder, hard to find what I am looking for.” (P62, Dropbox)

5.2.3.5 Slow Functioning of the Cloud Storage Services

Slow functioning of the CSS could be due to different reasons such as slowness of the network, device or the client application. In the following there are some quotes in this regard:

“It has some lags with my net speed in uploading large files.” (P3, Google Drive)

“Sometimes it has lag because of low internet speed.” (P2, OneDrive)

“Data takes lots of time to upload and the data corruption.” (P12, Dropbox)

“Time to upload the documents, it is a problem of the internet, not really of problem of dropbox.” (P21, Dropbox)

“Slowness of the application on mobile device, but I think it is due to the device, not due to the application itself.” (P64, Dropbox)

“Desktop application has problems such as synchronizing. When it is synchronizing lots of stuff, sometimes it slows down the computer.” (A4, Dropbox)

5.2.3.6 Running Out of Free Storage Offered by the Cloud Storage Services

Running out of free storage was one of the reasons of the most unsatisfying experiences reported by responses. A few quotes are illuminated in the following:

“My most unsatisfying experience is to realize that the storage is running out and I need to clean old files.” (P13, Dropbox)

“Low amount of storage.” (P34, iCloud)

“My girlfriend lost her phone, and her Dropbox was full, so the pictures from the last four months she shot, is lost!” (P49, Dropbox)

“It was when I filled all my available space and if I wanted more I had to pay.” (P56, Google Drive)

5.2.3.7 Lack of Sufficient Instructions and Tutorials

In the interview one of the reasons of the most unsatisfying experience is associated with lack of enough instructions and tutorials, notably in the context of Google Drive. In the following there are some quotes from participants in this regard:

“We had like a workshop from some guys who were dealing with Google applications (developing them), so they showed some pro tips about how to use it better because I suppose some of the options and the workflow is sort of hidden and you need to really know that they exist. I guess there is not enough tutorials in Google Drive itself to show those, but those scheduling, short, really nice tricks about how to improve the workflow with Google Drive, and some other Google products as well, really helped.” (A4, Google Drive)

“When I started using Google Drive, it was not really easy how to use it, unless you go for the whole explanation how to use it. I just saw folders with different names and I did not know how to find the needed folder, and how to get an access. I did not know whether I need to send an email and ask to put myself in the list of people who get an access with this folder or what! It was complicated, and I did not have these wonderful details and instructions saying click here, do that.” (A5, Google Drive)

5.3 Hedonic Qualities of Cloud Storage Services

Hassenzahl (2003) divided hedonic aspects of a product into three categories: stimulation, identification and evocation. In this section we focus on the identification and discuss other aspects of hedonic UX in section 5.4.2. Based on Hassenzahl (2003) identification hedonic is entirely social, and illuminates the relatedness and

communication of identity to relevant others through the product. In fact users of a product desire to be seen in particular ways by others. For instance, a CSS user might desire to customize his/her profile page to be viewed by other users in a specific way. Another example can be about receiving “Add Friend Request” from other users of the CSS which can make user to feel he/she is a popular person.

In addition to that, the immigration of services to the cloud is related to new affordances such as sharing and accessing personal data in a flexible way and from different devices, easy collaboration between multiple users, and others (Hobfeld et al., 2011). However, with an increasing popularity of collaboration in CSSs, and the significance of improving hedonic identification as a component of hedonic UX, none of the studies to date has revisited on evaluating individuals’ social preferences regarding to CSSs.

In the Web survey we asked about participants’ preferences of integrating various social features into CSSs. The mean value for each statement is shown in Figure 7 consisting of the statement and the overall mean value on a scale from 1 to 9 (1=not at all to 9=very much) calculated for Dropbox users (N=40), Google Drive users (N=16), and then for the whole group of Web survey participants (65 survey respondents). The exact mean value for each statement can also be found in APPENDIX F.

In general, the responses were slightly more negative than positive as the mean value of each single statement (when N=65) is usually under 5 which is the neutral value. Dropbox users assessed the social features more negatively than the Google Drive users. We believe this is due to the fact that Google Docs is already strongly integrated with other Google services containing many social features, making it easier for the users to anticipate the potential of the social features.

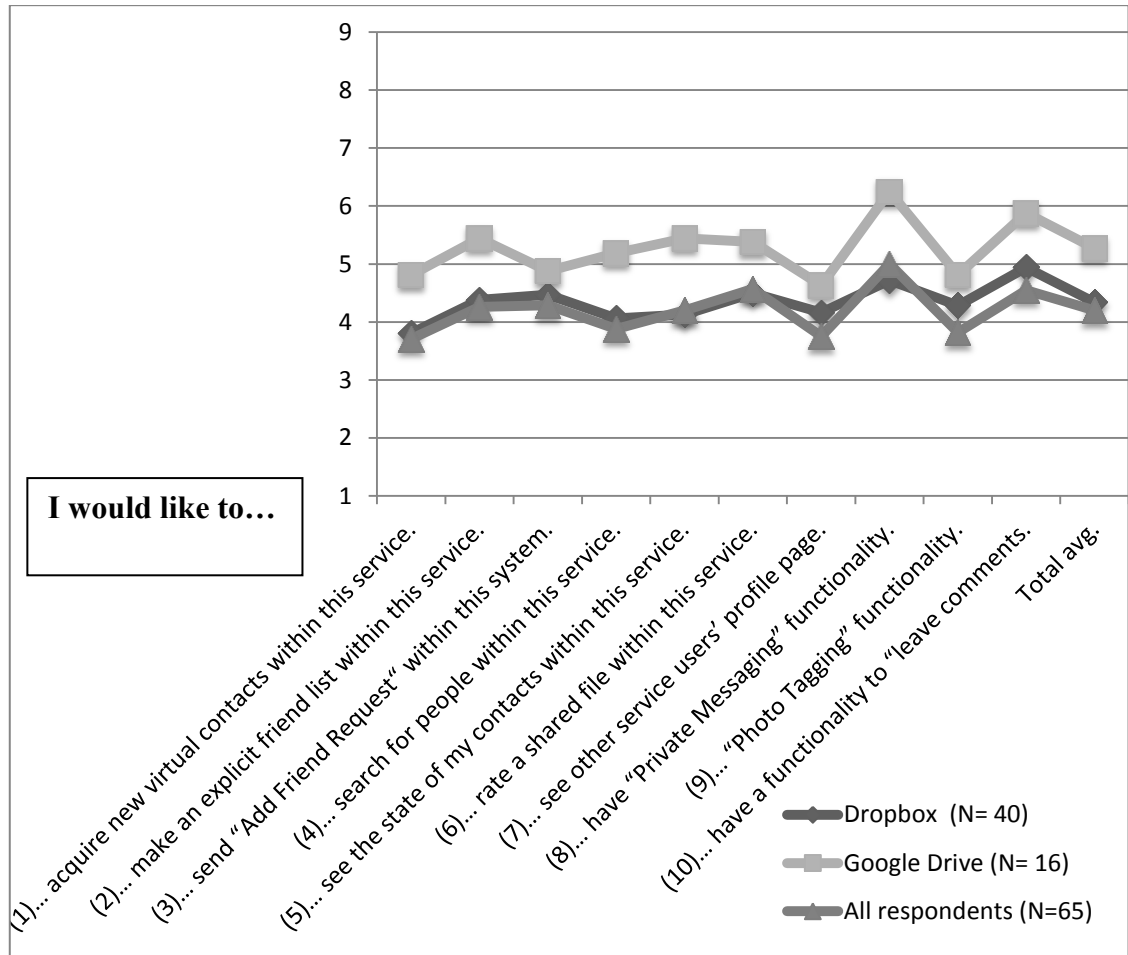


Figure 7. Preferences of social features by respondents, mean values.

Based on related work conveying that individuals have segregative and aggregative approaches towards data management (Vaida et al., 2013), we envisaged that the attitudes towards integrating social features (such as contacts, messaging, status, tags) would be somewhat polarized, which was the case. The results prove that the majority of the participants manifested segregative strategy towards managing their identity separately from social media, such as Facebook. For example, from 40 participants utilizing Dropbox, for each of the questions on the average 14.6 (37%) were responding 1="not at all", while the rest of the values were evenly receiving 4-10% share of the responses, including the other extreme 9="very much" with 7%. We can say that the result for Dropbox users is strongly biased towards negative end of the scale. For Google Drive users, the responses were more evenly spread, and the negative end acquired solely 0-3 responses (0-19%) from 16 participants for each of the questions. The mean value for all 10 statements for Google Drive users was 5.27.

Those participants, who were competent to articulate why they would neglect integration of social features, explained that they already contented themselves with their current social networking services. Those who valued the integration more reasoned their choices with pragmatic advantages:

“(integration between Facebook and One Drive) will be very beneficial, for example if you are taking pictures and you are going to put it straight away on OneDrive, it means it will be straight away on Facebook and you just need to make them public. Then this Photo Sharing would be most beneficial to me.”(A7)

All in all, integrating social features to CSSs can potentially add value to users, but the design of this integration requires to be done carefully. Knowing the multitude of different services and digital identities that common people need to manage, it is not a marvel that majority of the participants in the study rejected the notion. Special attention should be given to users having choices over which existing social networks they would integrate and how tight this integration is.

5.4 Emotional User Experience of Cloud Storage Services

Emotions are an integral part of UX, and their measurement becomes significant in the empirical research in the field of UX (Agarwal & Meyer, 2009). In a study by (Hassenzahl et al., 2010), they found an apparent relationship between psychological need fulfillment and positive affect. They also proved that relatedness, stimulation and competence were the most salient psychological needs in positive UXs with technology. However, autonomy and self-esteem were omitted from their analysis. They also proved that need fulfillment and positive emotions were significant factors for the perceived hedonic quality of products. Based on these finding, we decided to measure the fulfillment of meaningful psychological needs as an indicator of users’ emotional experiences in the context of CSSs.

In addition to that, we asked responses to fill in an AttrakDiff2 questionnaire (Hassenzahl & Monk, 2010) to assess user perceived pragmatic quality, and the hedonic quality of CSSs so as to evaluate the user’s feelings about the CSSs. In the following sections we have reported our findings.

5.4.1 Evaluation of Fulfillment of Psychological Needs within Cloud Storage Services

As postulated by Hassenzahl and Tractinsky (2006), psychological needs are a significant component of UX. As a result, understanding the level of satisfaction of users’ psychological needs systematically with regard to the UX of their chosen CSS can provide designers with valuable feedback which is tough to acquire utilizing other methods. In addition to that, comprehending needs and the level of their satisfaction contribute to the general understanding of UX beyond traditional measures of usability. (Partala & Kallinen, 2012).

As a result, we measured the fulfillments of four psychological needs (named as Relatedness, Competence, Autonomy and Stimulation). In the questionnaire, we did not

reveal the name of psychological needs and participants were merely provided with the following four sentences:

1. I feel connected with other people when using this service.
2. I feel capable and effective in my actions within the service rather than feeling incompetent or ineffective
3. I feel I am the cause of my own actions within the service rather than feeling that external forces or pressures are the cause of my actions.
4. I feel that I get plenty of enjoyment and pleasure rather than feeling bored and under stimulated when using this service.

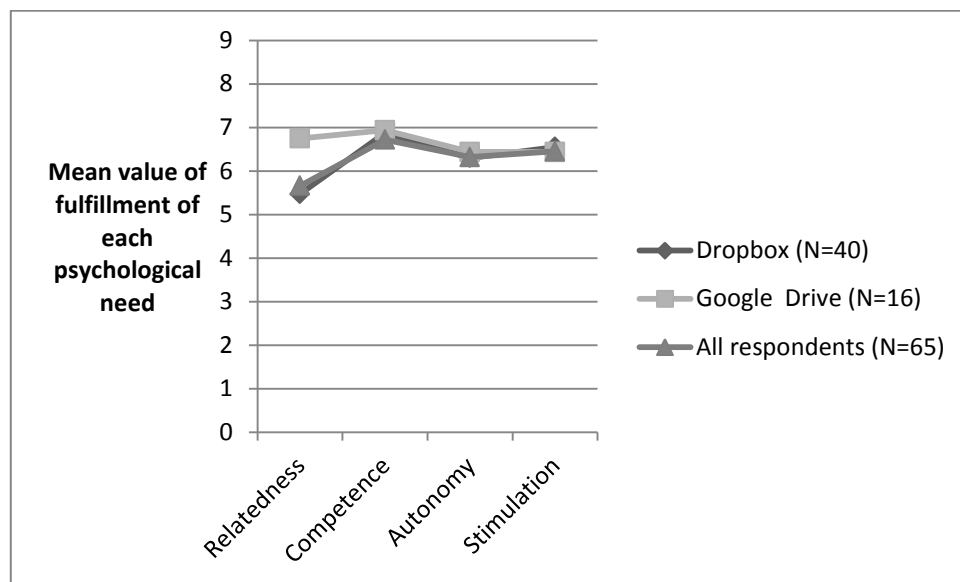


Figure 8. Fulfillment of psychological needs within CSSs for users, mean values.

Figure 8 indicates the mean value for each psychological need. APPENDIX G also demonstrates the mean value for these psychological needs in the context of CSSs. By comparing the mean values of Dropbox with Google Drive, we notice strong similarities between them except for the *relatedness*. In fact, Dropbox users were less (-1.27, P value 0.06) fulfilled in terms of relatedness compared to Google Drive. This may by far be justified by the more collaborative and social nature of Google services including the Google Docs, which allows users to simultaneously edit shared documents and exchange messages.

This finding is supported by comments of some of our interviewees as well:

“I think Dropbox is good for storing and uploading files. I do not know if it is also good for team working. I think if what a service is going to offer me is only storing and uploading that is not enough for me, because Google Drive can also support those

things, and because I work in teams frequently, and I schedule my meetings using Google Calendar, I chat with my friends using Google+, and I am also a Gmail account client. So it is easier for me to use merely one service for all of my purposes.”(A3, Google Drive)

“I think social services that I have in Google Drive at the moment they cover my needs when it comes to communication with my friends, and sharing info with them. I think more or less not only on professional level but also on a social level people can benefit from Google Drive.” (A5, Google Drive)

5.4.2 Evaluation of Users' Feelings about Cloud Storage Services

As demonstrated by Hassenzahl and Tractinsky (2006), the notion of UX strives to go beyond the task-oriented aspects of traditional HCI by uncovering dimensions such as beauty, fun, pleasure, and personal growth that satisfy general human needs but have little instrumental value. Mahlke and Thüring (2007) also deciphered empirical evidence that both of the two aspects of quality (pragmatic vs. hedonic) affect emotional reactions and the appraisal of interactive systems.

When we talk about something as being attractive to us, we are indeed summarizing the whole experience of the product. In AttrakDiff2, attraction is utilized to evaluate the global appear of a product for the user and to see how the other quality attributes influence this global judgement (Hassenzahl, 2003).

The data fo AttrakDiff2 questions for both Dropbox and Google Drive can be found from APPENDIX H. We calculated the mean value of all user answers for each quality scale (each scale includes seven questions). As indicated earlier, each answer gets a value from 1 to 7, with 4 as the neutral value between the anchors of the question.

Based on Figure 9, all the quality scales have mean values above 4. Regarding to the effects of the different qualities (PQ, HQ-I, HQ-S) on ATT, Figures 9 and 10 demonstrate that the group of questions that measure the personal growth of the user (HQ-S) within the CSSs got the lowest scores for both Dropbox and Google Drive which indicates that both CSSs have less hedonic stimulation qualities than identification and pragmatic ones. This result put emphasis on the necessity of improving hedonic stimulation UX of CSSs. Pragmatic attributes and hedonic identification got higher scores. It is not surprising that pragmatic issues got higher scores for task oriented CSSs like Dropbox and Google Drive, though it is surprising to find that both hedonic identification and pragmatic contributed almost evenly to the attraction of the CSSs.

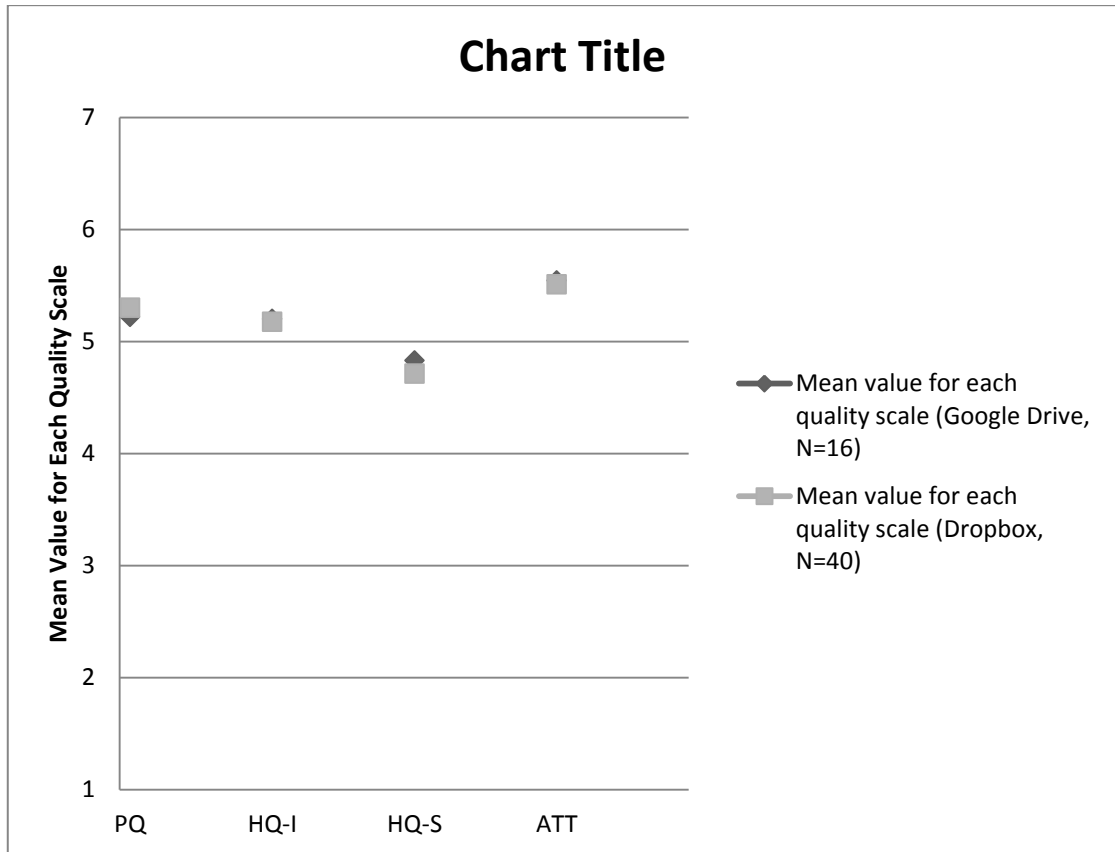


Figure 9. Mean value for each quality scale of AttrakDiff 2 questionnaire.

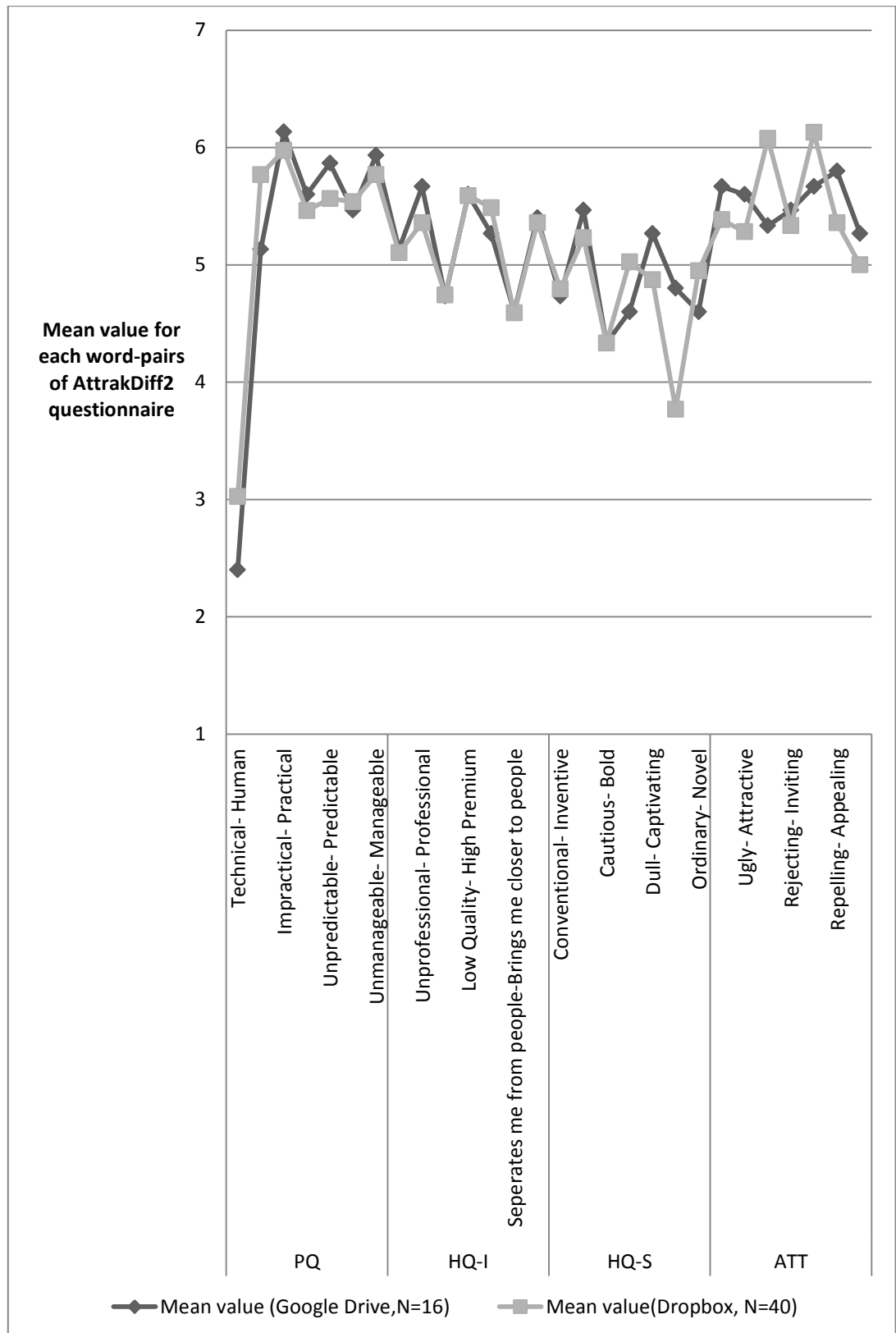


Figure 10. Comparison of mean values for word-pairs of AttrakDiff2 questionnaire between Google Drive and Dropbox.

5.5 Long-term User Experience

With the assistance of UX curve, we acquired a collection of qualitative data as participants had manifested the reasons for changes of UX in the curves. All of our participants had used their desired CSS over time. Otherwise, it would be tough to sketch a curve to illuminate UX over time. We set the usage period from start of CSS usage until present, since we were also eager to get insight about the early experiences as well as long-term UXs. The mean usage period was 2.3 years. Altogether, we gathered 13 curves, though we had 10 participants. The reason for that is some of participants have been using more than one CSS and they were asked to draw a separate UX curve for each distinct used CSS.

Our objective was to gather a large collection of long-term experiences which would assist us to analyze how results are different for distinct users and what distinguish happy users from unhappy ones. As a result, we had picked participants with different backgrounds, ages, and CSS usage periods. The reasons regarding to the changes of the UX curve trend were content analyzed. To this end, we could define some themes for them. Next, the recognized themes were classified based on UX models by Hassenzahl (2001) and Hassenzahl (2003). Based on the model, the product character can be divided into two attribute groups, named pragmatic (utility and usability) and hedonic attributes (stimulation, identification, and evocation). Utility illustrates associated functionality provided by the product to conduct tasks and manipulate environment, and usability is related to the ways to acquire access to this functionality efficiently and in convenient manner (Hassenzahl, 2001).

The curve drawings were categorized according to their trends. We classified all the curve trends into three prominent trends: improving, deteriorating, or stable. The categorization was conducted by comparing the starting point of the curve with the ending point of it. The curve was classified as stable if the starting point and ending point were at the same level. The categorization was quite straightforward with three types of trends. We also conducted qualitative content analysis on the verbal data, and analyzed the trends of the curves. For instance, the curve in APPENDIX I was classified as deteriorating, since its starting point was higher than its ending point. It also includes experiences pertinent to aspects of the CSS that have a negative effect on UX, and pleasurable aspects that enhance the UX.

5.5.1 Trends of the Curves

Most of the curves were deteriorating (8 out of 13 curves) manifesting a decrease in UX over time. In the section 5.5.2, we investigate the reasons behind decrease in UX of CSSs in long-term usage. Figures 11 and 12 indicate how the users sketched the curves and how they were classified into the improving (Figure 11) and deteriorating and

stable (Figure 12) categories. As there was merely one stable curve, we grouped it into the deteriorating curves.

Nevertheless, the classification of curves into improving and deteriorating is an approximate analysis of trends of curves, there is a strong difference between improving and deteriorating /stable curves. Both curves revealed a sharp change right at the start of usage. The mean usage time is 2.5 years for deteriorating curves and 2 years for improving ones.

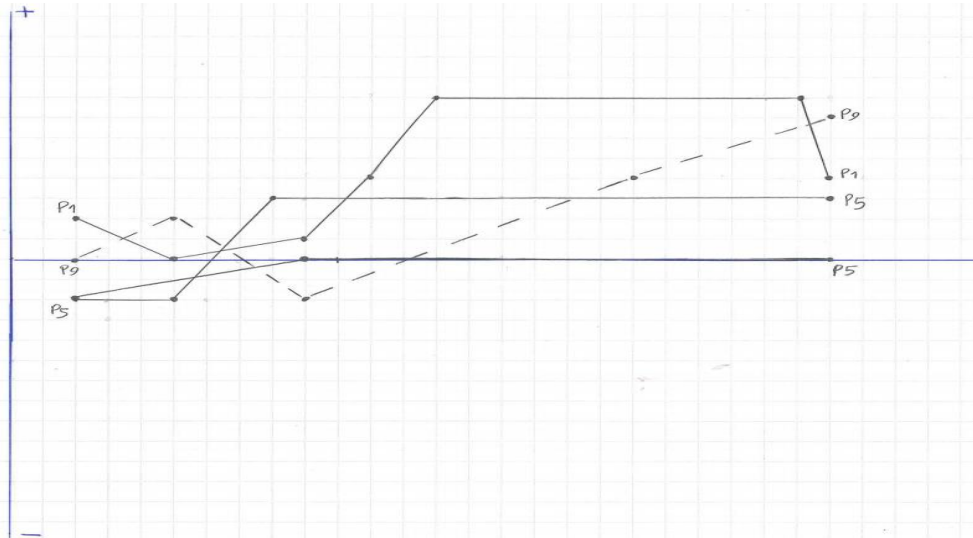


Figure 11. Improving UX curves.

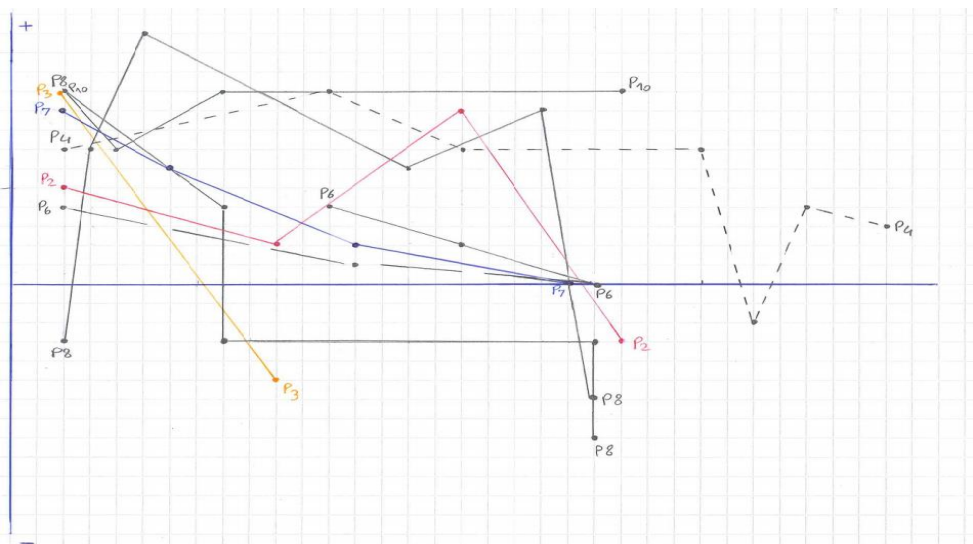


Figure 12. Deteriorating and stable UX curves.

5.5.2 Reasons for the Change of User Experience

Participants were supposed to articulate the reasons that either enhanced or deteriorated their experiences over time. The reasons were then classified into pragmatic (usability and utility) and hedonic aspects in accordance with Hassenzahl's (2003) model of UX.

All in all, each user gave an average of 4.1 reasons (2.4 positive and 1.6 negative, N=13) while sketching the UX curves.

The pragmatic utility reasons were predominantly related to functionality and practicality. There are some quotes from participants in this regard in the following:

“ Google Drive is good for the purpose of draft but it does not have as many features as Microsoft office word, so sometimes when I want to edit the word (especially its appearance), it really does not have that much features.” (A3, Google Drive)

“Then I figured how to use iCloud, and I figured out why do I need to have it, and it was actually nice that I could make a folder and put pictures and allow access only to certain people, as in when you for example put it on facebook everyone will see it. So, in this case it is quite private. Kind of private sharing .So my experience between 2012 and 2013 became positive.” (A5, iCloud)

“ Sometimes after second experience, I realized that I could not save all kind of files , only some restricted file types were saveable. I could only store photos and some specific Mac file types, and I could not for example store PDF.” (A9, iCloud)

Some other experiences classified into pragmatic usability category. For instance, consider the following quotes:

“I remember afew month after I started using desktop app of Google Drive, there was a bigger update which really made it like somehow smooth and faster to work (you could see they were developing application)” (A4, Google Drive)

“In the negative experience, I suddenly got a problem with the desktop client that it just stopped working altogether, and it gave me a lot of headache as I tried to fix it. I guess it was because of the model of my Macbook Pro which at first I was using an older model, but then I got a new computer and it started working there.” (A4, Google Drive)

“My first experience was really great because it is so easy and speed of uploading and downloading is very fast .” (A10, Dropbox)

The hedonic reasons were mainly associated with stimulation. In the following there are some quotes from interviewees:

“Quite positive, whwn I first opened the UI of iCloud, it was really impressive and still impressive.” (A7, iCloud)

“Nowadays, I am not amazed anymore, because after using something you get used to it, and there are no new features there. Everything is almost the same. They put almost the same functionality everywhere and just change the interface.” (A6, One Drive)

In general as Figure 13 demonstrates the mean value of reasons (either negative or positive) was higher for improving curves in comparison with deteriorating curves. However, the focus of reasons for both improving and deteriorating curves is on pragmatic reasons; the stable curves are not included in the figure 13. Indeed, there is not significant difference between mean values of negative reasons for improving curves compared to deteriorating curves (1.625 vs. 1.5). The quality of pragmatic reasons pertinent to the improving or deteriorating curves were almost similar.

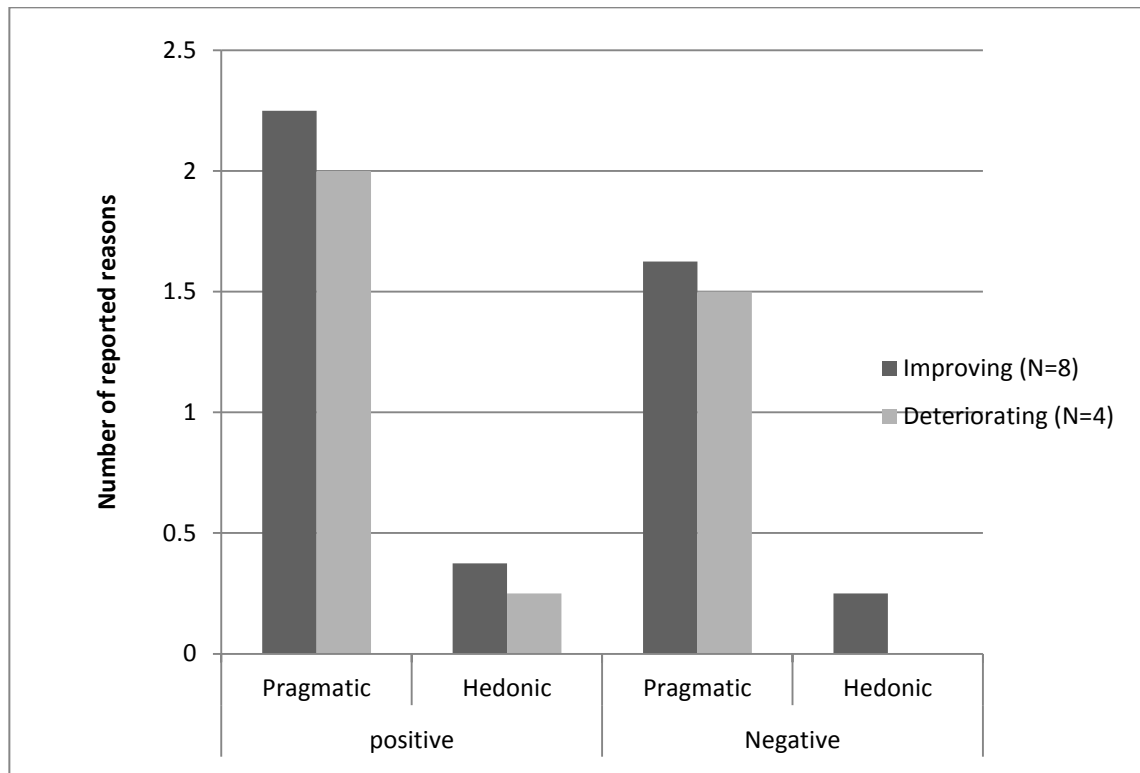


Figure 13. The mean value of reported reasons for improving and deteriorating UX curves.

6. SUMMARY AND CONCLUSION

In this section we present a summary of key findings of our research, run a short discussion about our findings, and give design implications suggesting how to improve UX and support collaboration in the context of CSSs. At the end, we discuss the limitations of our study and determine some research topics for the future researchers.

6.1 Summary of the Findings

This thesis work studies the user experience (UX) of cloud storage services (CSS) such as Dropbox, Google Drive, OneDrive, and iCloud, using 10 interviews and 65 Web survey responses. **Our first contribution during this thesis was to identify factors affecting UX of CSSs**, we measured pragmatic qualities, hedonic qualities and emotional UX as components of UX (Mahlke, 2008; Hassenzahl, 2003). **We applied UX model by Mahlke (2008) jointly with the model by Hossenzahl (2003) as an initial conceptual framework to evaluate UX in the context of CSSs** which in turn identify affecting UX factors in the context of CSSs.

The results of our study revealed the reasons of the most negative and most positive UX in the context of CSSs. **The reasons for the most negative UX of CSSs were mainly associated with pragmatic qualities of UX.** Especially, as presented by Partala and Kallinen (2012), in the field of UX, understanding the reasons of negative experiences and the conditions in which they may happen, is an issue of utmost significance to further develop design of the products iteratively. Consequently, we proposed design implications to improve the UX of CSSs based on the UX evaluations which can guide the future design of CSSs.

Based on qualitative descriptions, the most fierce problems were related to **lack of user's control and visibility of CSSs notably in the context of synchronizing files** when collaborating through a CSS. We gave multiple examples of participants' stories in the results section to illustrate the stringency of the consequences of these problems, **ambiguous usage of terminology and dialog messages by CSSs, lack of feeling of security and trust in CSPs, lack of appropriate content management in CSSs**, slow functionality of CSSs, running out of free storage offered by CSSs, and lack of obvious instructions and tutorials were mentioned among other reasons of the most negative UX with CSSs as well.

Moreover, **the main affordances of CSSs appeared to be sharing following with ease of use, accessiability and backup which can lead to positive UX in the context of CSSs.**

The qualitative descriptions did not reveal much concerning hedonic or social aspect of UX, when the participants were asked to freely articulate their UX. These results put emphasis on the result of research by Partala and Kallinen (2012) suggesting that in the context of qualitative research, structured, semi-structured, or mixed method approaches are required so as to acquire rich qualitative information about the hedonic and social aspects of UX. In our case, the majority of qualitative descriptions revealed pragmatic aspects. However, we could assess hedonic and social aspects with the assistance of AttrakDiff2 and other used quantitative questionnaires as well as semi-structured interviews.

We also measured emotional UX as third component of UX of CSSs (Mahlke, 2008). To this end, we evaluated the fulfillment of particular psychological needs (named as Relatedness, Competence, Autonomy and Stimulation) as a source of positive UX. Among the needs, **relatedness appeared as the least fulfilled need especially in the context of Dropbox in comparison with Google Drive**. This may be justified by the more collaborative and social nature of Google services including the Google Docs, which allows users to simultaneously edit shared documents and exchange messages. We also applied AttrakDiff2 questionnaire to assess overall user feelings about the CSS. **The results of AttrakDiff2 questionnaire especially put emphasis on the improvement of hedonic stimulation UX of CSSs** while showing room for the improvement of pragmatic and hedonic identification qualities of CSSs. We assume that our suggested design implications will improve both hedonic and pragmatic UX of CSSs.

Our second contribution was to investigate the potential of improving social interaction within CSSs. We applied a questionnaire containing 10 different statements to identify participants' perceptions of integrating different social features into the CSSs. The results were slightly more negative than positive especially in the context of Dropbox. We believe that the result for Dropbox users is strongly biased towards negative end of the scale in comparison with Google Drive users. This is probably due to the fact that Google Docs is already strongly integrated with other Google services containing many social features, making it easier for the users to anticipate the potential of the social features.

We conclude the thesis by explaining the importance of different Cloud UX aspects in context of CSSs and suggesting design implications improving UX for CSSs. We have also mentioned the limitations of our study as well as some research topics for future work.

6.2 Discussion

We summarized earlier work on cloud UX in the related work section. Our results especially affirm the results of research by Väänänen-Vainio-Mattila et al. (2011) indicating three applicable issues:

1) Access to user data may lead to privacy threats

Access to data is the central reason for the CSSs to exist. In our study accessibility was also mentioned as the main affordance of CSSs, and the major reason for many reported positive UXs. However, Internet service providers are monitoring user behavior and amassing lots of user data without users' permission. Cloud then combines various data of the user which in turn uncover very sensitive and private issues of an individual user. In our study, some users were also quite cynical and thought that once information is in the Internet, it sooner or later gets manipulated or misused.

2) Many cloud services are rich on social features

As demonstrated in the study by Väänänen-Vainio-Mattila et al. (2011), cloud services are usually communication and social services where users communicate with each other either directly (e.g. email, messaging) or through media content (e.g. content sharing, social media commenting). However, CSSs have limited offering in this area. We assimilated that increasing collaboration through CSS could benefit from multiple features, but the results of our study convey that particularly Dropbox users are suspicious about the benefits of integrating such features to the CSS. Then again as the UX commonly stem from content shared by other users, and not from the service itself, designers can improve UX by enhancing synchronization processes in collaboration contexts and better content management.

3) Reliability, security and trust improve overall user experience of cloud storage services

Väänänen-Vainio-Mattila et al. (2011) demonstrated that security is an UX factor of utmost significance in users' perspectives. Even in their study, some individuals valued security of a cloud service even more than ease of use or good functionality. They indicated that user's trust in a cloud service demands ease of use, familiar brand, understandable licence agreements and professional appearance of the service.

In our study, Security threats were recognized by most of our interview participants, while there were also those who said they don't worry about it. However, 7 out of 10 interviewees restrained from saving any private or sensitive data in CSSs. In the Web survey there were only few responses directly stating concerns about security, while in the interviews the participants reported it more often when drawing the UX curve, and they considered it as privacy threat deteriorating their overall UX of CSSs and affecting

the way they use CSSs. Issues related to reliability were sometimes mentioned as a source of the most unsatisfying experiences as well.

6.3 Suggestions to Enhance User Experience of Cloud Storage Services

We propose the following design improvements for CSSs in accordance with our study and related work.

6.3.1 Make the Synchronization Process Visible

We postulate more innovative, and meaningful visualization especially for data transfer and synchronization notably in the context of Dropbox. As also illuminated by our participants, synchronization in Dropbox suffers from lack of proper visibility.

For instance, the problem of “conflicted copy” is very commonplace in the context of Dropbox. It denotes if two people alter the content of a shared file simultaneously, Dropbox will not merge changes, in lieu it will save original file as well as second version which has the same name, albeit is appended with “conflicted copy”, the name of the person or computer responsible, and the date the conflict betided. Moreover, if a file is left open on another computer, it can breed *conflicted copies* notably when utilizing applications with auto-save feature.(<https://www.dropbox.com/en/help/36>). As a result, Dropbox users collaborating on a shared file simultaneously has to manually merge changes, remove or rename a shared file which clamour for superfluous work. This might be comprehensible to experienced users in collaborating on shared files. However, the results of our study stipulate that it is challenging for novice users, and majority of our participants have experienced glitches while collaborating on shared files in Dropbox.

To prevent such problem, indeed, system should advise the user by giving a gentle warning when a shared file is already open by someone else on another computer. The user then may either bypass it or communicate with those who have the file open. Presently, the user discerns the *conflicted copy* merely once the file is saved, and there is too much work resolving the discrepancies in documents thereafter.

Conceivable solutions for the synchronization problems is comprised of apparent status indications, and an obvious, automatically created version history visible in the context of the CSS. In fact, once someone opens a shared file in Dropbox, he/she should be competent to see clearly when, where and by who the document is opened. In addition to that, there should be prospect of locking shared files explicitly if a user desires to do so.

6.3.2 Improve Hedonic User Experience of Cloud Storage Services

As demonstrated by Karapanos et al. (2009) UX is temporal and thus changes over time. Väänänen-Vainio-Mattila et al. (2011) also emphasized that hedonic product characteristics are more significant in long-term use. Given the results of AttrakDiff2 questions, there still exist areas for continued development notably in domain of hedonic qualities. To this end, we trust on the results of paper by Väänänen-Vainio-Mattila et al. (2011) regarding to general cloud-specific wow design implications and strive to customize them in the context of CSSs. The question is how to develop CSSs with good UX, and how associate UX to CSS development methods?

In other words, the developed CSSs should be both useful and visually attractive, inspiring, and they should provide users with some form of “adventures”. In fact, users should be fascinated by interacting with the CSS, and stay eager also in long-term interaction with the service (Vartiainen & Väänänen-Vainio-Mattila, 2010).

Hassenzahl (2010) has proved that basic human needs like autonomy, relatedness, stimulation, competence and security lay foundation for design of positive UX. That was the reason we measured the fulfillment of such human needs in the context of CSSs, as *“similar, or at least a subset of the basic human needs can be assumed to lie behind Wow experience as well”* (Väänänen-Vainio-Mattila et al., 2011. p. 64).

One of the design guidelines for wow experience by Väänänen-Vainio-Mattila et al. (2011) is *“design for unmet user needs, following practices of human-centered design, analyze users’ current practices and uncover needs that are not yet met, and offer novel solutions for them.”*(p. 69). We take advantage of this guideline for better content management in CSSs as “lack of appropriate content management” was reported as one the reasons for the most negative UX of CSSs by our participants.

In addition to our study, in a study by Voidsa et al. (2013) they discussed one of their case studies who was utilizing different digital identifier to manage different email accounts and CSSs each corresponding with different domain and audiences. For instance, many of her colleagues, have her personal Gmail address so as to collaborate with her in Google Docs. The challenge is when she opens Google Docs in work meetings, her personal documents are intermingles with her work documents violating the distinction she was striving to keep between audiences using multiple digital identifiers. To solve the problem of “lack of appropriate content management” deciphered in our study as well as prior researches, we propose that CSSs should provide users with more personalization options and the feasibility for distinct profiles such as office, home, work, and Miscellaneous.

Väänänen-Vainio-Mattila et al. (2011) also proposed superior usability and aesthetics for wow design implications. It means flawless usability solely is not adequate for wow experience, and CSS must surpass usability by offering some novel user interface. Our

proposition in the context of CSSs is usage of voice commands as a new interaction technique notably for most used functionalities such as *sharing*.

One crucial point which designers should scrutinize discreetly is the balance between wow experiences and CSSs as such experiences themselves may bring about feeling of suspicion and security concerns (Väänänen-Vainio-Mattila et al., 2011). In other words, designers should not aim at improved wow experience through the cost of diminished security and users' trust.

6.3.3 Improve User's Sense of Security and Privacy in Cloud Storage Services

Based on the results, users' sense of security in CSSs should be improved. However, it is a delicate issue which requires adequate attention to make most of it. On the one hand security increase trust to the CSSs, but on the other hand it can diminish UX by beseeching more resources (Oza et al., 2010). For instance, as denoted by Oza et al. (2010), public venues like Facebook usually make compromises with regard to security issues e.g. a strong authentication could diminish plea for its services. Moreover, a good UX can reconcile security ventures.

Based on our findings, security threats were identified by 7 out of 10 interviewees. However, in our survey merely 4 out of 65 participants directly mentioned security concerns as their most negative experience with their desired CSS. Then again, majority of participants both in the interviews as well as Web survey emphasized that they will not save their confidential and private data in any cloud services. As demonstrated by Jaeger et al. (2008), it is crucial for the CSSs to meet the cloud users' minimum expectations for security:

- If a CSP commence administrating "mission-critical" applications, users require apparent explanation of liability if server problems arise.
- Users require that the CSP will impede unauthorized access to both data and code. Users also require that CSP will not monitor their activities.
- Users expect freedom to access and use cloud when and where they desire without impediment from the CSP or third parties, while their intellectual property rights are kept.

Question is from where this ingrained prejudice of security concerns come from? Based on Savola et al. (2010), the lack of transparency of security and privacy practices, and the deployed controls while using the CSSs are paramount concerns for CSS users. For instance, the content of a shared folder in Dropbox can be easily and rapidly diffused.

In addition to fulfilling the cloud users' minimum expectations (Jaeger et al., 2008), one solution is the usage of data encryption to improve security in CSSs. In our study,

several participants were enthusiastic to pay for a service which postulates more trustworthy encryption services at least for opted files they mind to retain safe. Consequently, the business potential for encrypting services should be earnestly evaluated, as that kind of proposition would potentially alter users' mental model of security of CSSs and hopefully propagate trust.

Moreover, in our study *accessability* is one of the pivotal affordances of CSSs which in turn affect users' trust in CSSs as well. This finding is in line with the study by Olwig (2009), indicating that cloud computing prosperity is by far pertinent to delivering an end user experience which delivers services and applications whenever, wherever, and on any device the user desires it.

6.3.4 Improve Collaboration and Communication Support of the Cloud Storage Services

Collaboration and communication support of the CSSs, i.e. social features, should be enhanced. The social features can be utilized in both pragmatic objectives like arranging contacts and managing collaborations over social network, as well as hedonic objectives (Drago et al., 2013) like evocation and affection generated by social interaction. While, one might claim that there is no requirement for "chatting with your Dropbox friends", managing the collaborative work is required, and chat would be an apt tool for this purpose.

6.3.5 Design for the Whole Lifecycle of the Cloud Storage Service User Experience

As demonstrated by prior research, time is a foremost determinant changing the way individuals experience and evaluate products. There is a shift in users' concerns over time from ease-of-use to usefulness. In fact, usefulness is much broader than the functionality of the product, and it may not emerge apparently in the early phases of product's adoption. (Karapanos et al., 2009)

While in our study, ease-of-use of CSSs was a paramount affordance of CSSs based on the participants' responses, many participants were complaining about for instance running out of free storage after using Dropbox for a while. This is an example of issue which can jeopardize the usefulness of the CSS over time. In fact, the CSSs should be designed so as to based on users' behaviors and expectations over time, they gradually expand solutions which is both beneficial for them and increase usefulness of the service over time. For instance, Dropbox though failing in some other issues, have performed well in introducing their useful features gradually over time and persuading its users to try new proposed features by rewarding them with free extra storage space.

6.4 Reflections, Limitations and Future Work

This thesis work generally succeeded in finding the answer for research questions presented in section 1.2. Our survey data revealed that design of CSSs could be improved from a user perspective. However, we believe the findings regarding integration of social features into CSSs especially in the context of Dropbox, are strongly biased towards negative end of the scale and this is due to misunderstanding among respondents. We believe majority of respondents have assumed we are striving to use CSSs as a substitute for SNSs. We also encountered this kind of attitude during interview sessions, though after clarifying our intention, the interviewees' attitudes changed subsequently. We could design mid-fidelity prototypes of CSSs including our desired social features so as to demonstrate the concept more accurately to participants which in turn would lead to more precise UX evaluation of social features.

Despite the rich findings of this study, it bears multiple limitations that future researchers should further address. First, the empirical data for this study were predominantly gathered from male participants (merely 29.23% of survey participants (N=65) and 2 out of 10 interviewees were female). It implies that the generalization of both genders could be limited. Future study may be required to show the effect of gender on the user experience and fulfillment of user needs in interaction with CSSs. Such understanding can turn to further design suggestions.

Second, majority of Web respondents of our study were Dropbox users (40 out of 65) following by Google Drive users (16 out of 65). It leads to limitations in generalization of the results and design implications for different types of CSSs. Future study may incorporate sufficient samples from all different types of CSSs so as to generalize our findings. Moreover, our study aimed to discuss the UX of CSSs at the individual level. Future research may perform similar study at the organizational level, and further discuss the possible contrast between the organizational UX and individual UX.

We also acknowledge that not all the possible contextual dimensions have been taken into account in our study. To create a broader, more holistic vision on context and consequently user' UX, we could for instance, have considered psychological and cultural background of our respondents.

Last but not least, in the future work, we are planning to develop mid-fidelity prototypes containing all the proposed design solutions for CSSs and to perform design studies on them so as to evaluate the CSSs for users' reactions in their everyday lives, both in short and longitudinal usage. We hope that both academia and industrial organizations will benefit from our findings in this thesis.

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APPENDIX A: CONSENT FORM

Consent Form

Participant number

User Experience with Cloud Storage Service

You are invited to participate in an interview in which you will be asked some questions associated to the utilization of cloud storage services such as Dropbox, Google Drive, iCloud, and OneDrive. ISO 9241-210 defines user experience as “a person’s perceptions and responses that result from the use or anticipated use of a product, system or service.”

RISKS AND BENEFITS

Participating in the interview does not contain any risks. Because you will have to sit for a while, there may be some minor tiredness in your back. In this case, you can have a break. There are also drink and light snacks during the interview available. You may also cancel your approval to participate to the interview at any time. However, your participation will help us to enhance the design of cloud storage services in different aspects. At the end of interview, you will be granted a free movie ticket.

DURATION

The study altogether will take approximately 60 minutes.

PARTICIPANT RIGHTS

The interview will be audio recorded. All the data gathered during this interview will be analyzed anonymously and will be reported on a master thesis level.

The participation is voluntary, meaning you have the right to quit the interview any time without having to give us any specific reason.

By signing this form, you will accept the above terms.

Date and place: _____

Name: _____

Signature: _____

CONTACT INFORMATION

If you have any concerns after the interview, you can contact

Parisa Pour Rezaei, parisa.pourrezaei@tut.fi

Jarmo Palviainen, jarmo.palviainen@tut.fi

APPENDIX B: INITIAL QUESTIONNAIRE

Background Information Form

Participant number

Year of Birth _____

Gender: Female Male

Education _____

Profession _____

Mobile phone Model and its Operating System _____

Computer Operating System _____

Which of the following cloud storage services you use/ have tried on any device (mark each line P=Pc, M=Mobile phone, T=Tablet)? If you have not tried/ used the CSS, leave the line blank.

CSS	I've been using, but I do not use anymore	I've tried	Daily	A few times a week	Weekly	Less frequent
Example of CSS		M	P			T
Dropbox						
Google Drive						
OneDrive						
iCloud						

How often do you use a Pc, mobile phone or tablet with the following social services (check each line P = Pc, M = Mobile phone, T = Tablet) ? If you have not tried/ used the service, leave the line blank.

Social Service	Daily	A few times a week	Weekly	Less frequently	Never
Example of service	P	M	T		
Yahoo! Mail					
Gmail					

Facebook					
Twitter					
Skype					
Flicker					
LinkedIn					
Something else, What?					
Something else, what?					

APPENDIX C: INTERVIEW QUESTIONS

History of usage of the cloud storage service

- 1 What was your initial motivation to start using the CSS?
- 2 When did you start using it?
- 3 How long have you been using it?
- 4 For which purpose do you usually use it nowadays?
- 5 Do you remember anything about “registration process” when you started using this service?
- 6 What is your first experience with the CSS? How did you feel after that?
- 7 What is your most satisfying experience with the CSS? How did you feel after that?
- 8 What is your most unsatisfying experience with the CSS? How did you feel after that?

Sharing

- 9 What kind of data do you usually share using this service? (Photo, Document, video, music etc.)
- 10 In what kind of situations do you usually share your data?
- 11 In which way do you usually share your data within this service?
- 12 Once, you have shared your data, do you usually do something afterwards? In sense of deleting etc
- 13 What other methods do you use to share your data (email, facebook etc.). What are the positive and negative issues compared to using CSSs.

Photo sharing

- 14 Do you use your mobile phone for photography?
- 15 Have you used the “camera upload feature” in the mobile application of this service? How would you evaluate it?
- 16 In which way do you usually share a bunch of your photos (public folder versus shared folder)
- 17 Once you share your photos, do you usually do something afterwards?

Social aspects of the cloud storage service

- 18 Are there any features related to communicating with your friends that you would like to be improved within this CSS? (Commenting on files, tagging, chat etc.)
- 19 Do you encourage your friends to join to this CSS? How would you encourage them to join?
- 20 Which SNS do you use most often?
- 21 How much do you share your data using this SNS? (e.g. facebook)
- 22 Have u ever been concerned about the quality of your data especially your photos that u share on this SNS?
- 23 What about integration between the CSS and this SNS (e.g. facebook)? Have you ever noticed any kind of integration?
- 24 What kind of integration do you think would be beneficial for you?

Trust and security issues of the cloud storage service

- 25 How do you assess the available security level within this CSS?
- 26 How have you created current level of trust in the CSS? How can you rely that your data are safe from prying eyes within the CSS that you are using?
- 27 What is your suggestion to improve security within your selected CSS so that make you put more trust in the CSS?

APPENDIX D: WEB SURVEY



User Experience Study in Personal Cloud Storage Services

Dear Participant,

This questionnaire investigates the user experiences of personal cloud storage services such as Dropbox, Google Drive, OneDrive, and iCloud. This will assist us to optimize these services as efficient as possible, and possibly improve social interaction within these services.

We will ask about history of usage, first experience, most satisfying and most unsatisfying experiences that you have had with these services in the last six months. You will also be asked about your non-confidential demographic and other background information.

The questionnaire is part of master thesis work at Tampere University of Technology.

The results will be utilized in writing master thesis, and probably some research papers.

Filling this questionnaire takes about 25-35 minutes.

Your answers will be dealt with anonymously.

Please read all questions and instructions carefully. Some questions have different formats and scales for answering. Kindly familiarize yourself with the format and measurement scale carefully before answering. This will also help you answer the questions quicker.

Your participation is voluntary and anonymous but gives you a chance to win one **Amazon voucher worth 50 €!**

Thank you for your answers beforehand.

Best Regard,

Parisa Pourrezaei
Parisa.pourrezaei@tut.fi

Jarmo Palviainen
Jarmo.palviainen@tut.fi

*

I agree to the terms of the study

Next -->

User Experience Study in Personal Cloud Storage Services

1. Background Information

Specify the Operating System of the of the following devices? (If you use any of them)

Desktop

Mobile Phone

Tablet

How often do you use / have tried the following social services on any devices? (Desktop, Mobile Phone, Tablet etc)

	Daily	A few times a week	Weekly	Less frequently	I've been using, but I do not use anymore	I've tried
Facebook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Twitter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
LinkedIn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google Plus+	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you use any other social services regularly:
Please specify

Which of the following cloud storage services do you use / have tried on any devices? (you can choose more than one device for each service if applicable)

	Desktop	Mobile Phone	Tablet	Web Browser
Dropbox	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Google Drive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
OneDrive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
iCloud	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Choose one of the following services that you either use most or that means most to you personally? *

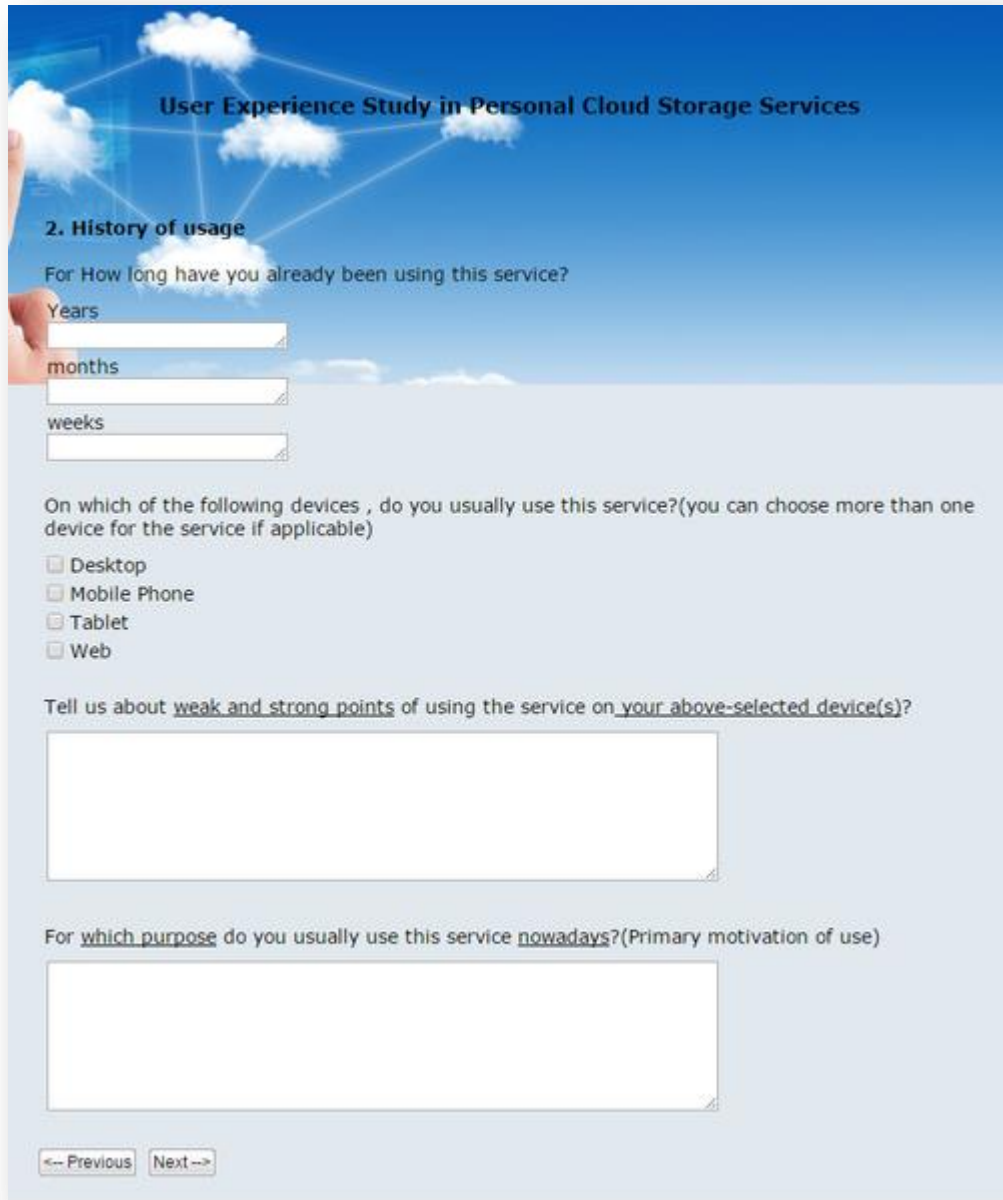
Dropbox

Google Drive

OneDrive

iCloud

You are supposed to focus on the above-chosen cloud storage service during this survey.



User Experience Study in Personal Cloud Storage Services

2. History of usage

For How long have you already been using this service?

Years

months

weeks

On which of the following devices , do you usually use this service?(you can choose more than one device for the service if applicable)

Desktop
 Mobile Phone
 Tablet
 Web

Tell us about weak and strong points of using the service on your above-selected device(s)?

For which purpose do you usually use this service nowadays?(Primary motivation of use)

User Experience Study in Personal Cloud Storage Services

3. First Experience

What was your initial motivation to start using this service?

Please describe what happened in your first experience?

3.1. Effect of First Experience


Did the first experience change your thoughts or attitudes towards the service in general? Please describe any changes in the text box below.

How you felt during the first experience?(1)

Choose a character on the scale. If you felt unhappy, dissatisfied or bored choose the far left character. If you felt happy, satisfied, or joyful choose the character on the far right side or any character in between.



The scale consists of eight square icons, each containing a stylized face. From left to right, the faces transition from a sad expression (frowny mouth) to a neutral expression (straight line for a mouth) to a happy expression (upturned mouth). The faces are arranged in a horizontal row.



User Experience Study in Personal Cloud Storage Services

4. The Most Satisfying Experience


What is the most satisfying experience that you may have had with this service in the last six months?

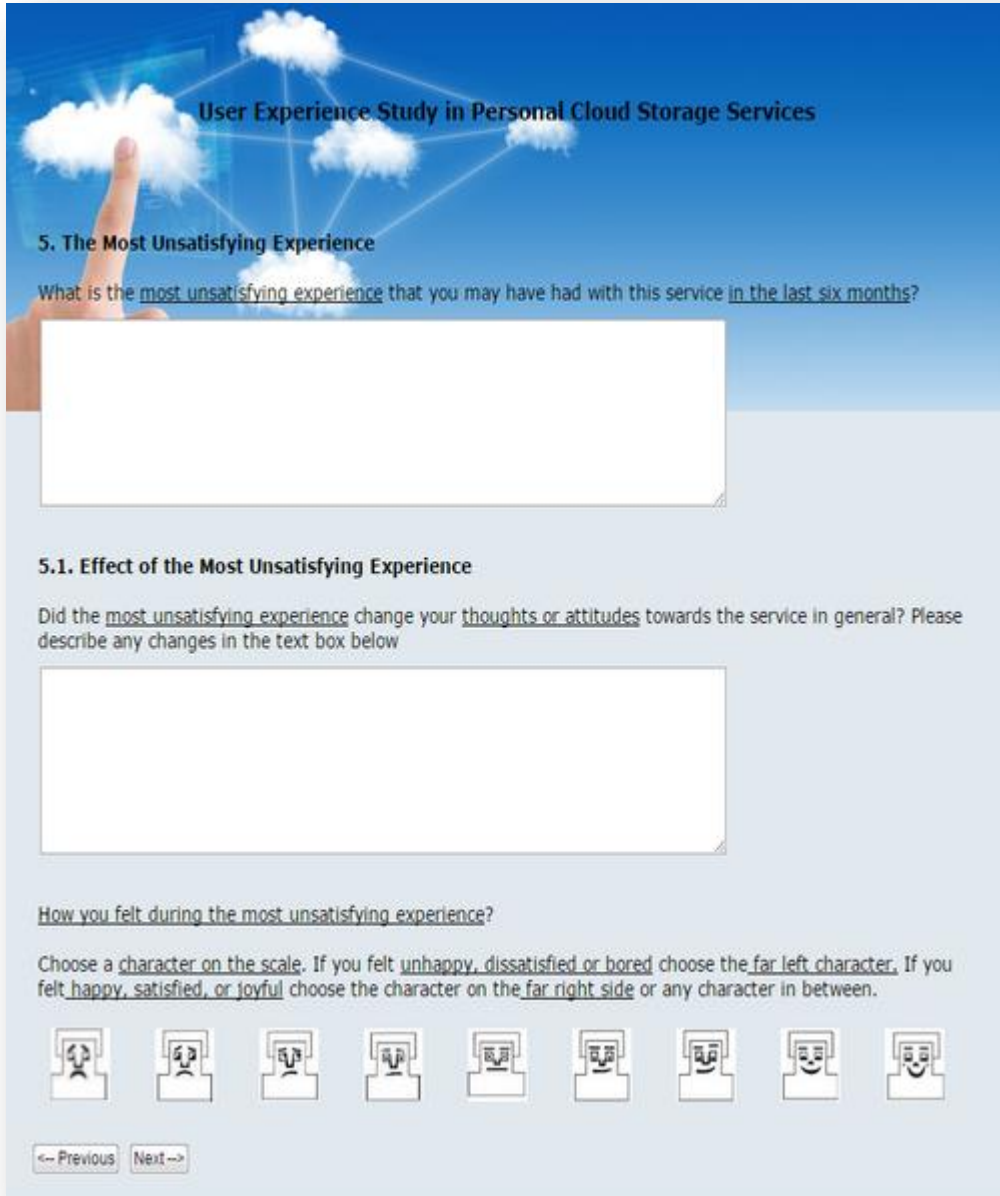
4.1. Effect of the Most satisfying Experience

Did the most satisfying experience change your thoughts or attitudes towards the service in general? Please describe any changes in the text box below

How you felt during the most satisfying experience?

Choose a character on the scale. If you felt unhappy, dissatisfied or bored choose the far left character. If you felt happy, satisfied, or joyful choose the character on the far right side or any character in between.





User Experience Study in Personal Cloud Storage Services

5. The Most Unsatisfying Experience


What is the most unsatisfying experience that you may have had with this service in the last six months?

5.1. Effect of the Most Unsatisfying Experience

Did the most unsatisfying experience change your thoughts or attitudes towards the service in general? Please describe any changes in the text box below

How you felt during the most unsatisfying experience?

Choose a character on the scale. If you felt unhappy, dissatisfied or bored choose the far left character. If you felt happy, satisfied, or joyful choose the character on the far right side or any character in between.



User Experience Study in Personal Cloud Storage Services

6. General Evaluation of the Service

This following question includes a series of statements about the service. Read each statement and specify the level of your agreement or disagreement for each statement.(2)

1= Strongly Disagree
9= Strongly Agree

*

	1	2	3	4	5	6	7	8	9
1.I feel connected with other people when using this service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.I feel capable and effective in my actions within the service rather than feeling incompetent or ineffective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.I feel I am the cause of my own actions within the service rather than feeling that external forces or pressures are the cause of my actions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.I feel that I get plenty of enjoyment and pleasure rather than feeling bored and understimulated when using this service.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. Improvement of social interaction within the Service

1= Strongly Disagree
9= Strongly Agree *

	1	2	3	4	5	6	7	8	9
1. I would like to acquire new virtual contacts within this service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I would like to make an explicit friend list within this service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I would like to send "Add Friend Request "within this system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I would like to search for people within this service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I would like to see the state of my contacts within this service (if they are Online, Busy, and Away...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I would like to rate a shared file within this service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I would like to see other service users' profile page	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I would like to have "Private Messaging" functionality within this service(Direct communication between you and your friends within this service)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I would like to have "Photo Tagging" functionality within this service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.I would like to have a functionality to "leave comments" about friend 's files within this service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

User Experience Study in Personal Cloud Storage Services

8. Evaluation of your feeling about the service

With the help of the word-pairs please enter what you consider the most appropriate description for service.

Following, are pairs of words to assist you in your evaluation. Each pair represents extreme contrasts.
The possibilities between the extremes enable you to describe the intensity of the quality you choose.

Do not spend time thinking about the word-pairs. Try to give aspontaneous response.

You may feel that some pairs of terms do not adequately describe the service. In this case please still be sure to give an answer. Keep in mind that there is no right or wrong answer. Your personal opinion is what counts! (3) *

	1	2	3	4	5	6	7	
Human	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Technology
Isolating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Connective
Pleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Unpleasant
Inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Conventional
Simple	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Complicated
Professional	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Unprofessional
Ugly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Attractive
Practical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Impractical
Likeable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Disagreeable
Cumbersome	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Straightforward
Stylish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Tacky
Predictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Unpredictable
Low Quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High Premium
Alienating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Integrating
Brings me closer to people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Seperates me from people
Unpresentable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Presentable
Rejecting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Inviting
Unimaginative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Creative
Good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Bad
Confusing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Clearly structured
Repelling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Appealing
Bold	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Cautious
Innovative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Conservative
Dull	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Captivating
Undemanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Challenging
Motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Discouraging
Novel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Ordinary
Unmanageable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Manageable



User Experience Study in Personal Cloud Storage Services

9. Demographic Information

Year of Birth

Nationality

Profession

E-mail

Gender *

Highest Level of Your Education

High School

Professional college degree or currently student at

University degree or currently student at

other

References:

(1) Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: computer applications

(2) Sheldon, K.M., et al.(2001). What is satisfying about satisfying events? Testing 10 candidate psychological needs.

(3) Hassenzahl, M., et al. (2003). AttrakDiff: Ein Fragebogen zur Messung wahrgenommener hedonischer und pragmatischer Qualität

APPENDIX E: SCIENTIFIC PAPER BASED ON THE RESULTS

The PDF file of paper is merged with master thesis at the end of this document.

APPENDIX F: PREFERENCES OF SOCIAL FEATURES, MEAN VALUES

I would like to...	All respondents (N=65)	Dropbox users (N= 40)	Google Drive users (N=16)
(1)... acquire new virtual contacts within this service.	3.71	3.81	4.81
(2)... make an explicit friend list within this service.	4.26	4.38	5.44
(3)... send "Add Friend Request" within this system.	4.29	4.47	4.88
(4)... search for people within this service.	3.88	4.06	5.19
(5)... see the state of my contacts within this service.	4.2	4.13	5.44
(6)... rate a shared file within this service.	4.57	4.5	5.38
(7)... see other service users' profile page.	3.75	4.16	4.63
(8)... have "Private Messaging" functionality.	5.0	4.72	6.25
(9)... "Photo Tagging" functionality.	3.82	4.28	4.81
(10)... have a functionality to "leave comments.	4.55	4.94	5.88
Total avg.	4.2	4.34	5.27

APPENDIX G: FULFILLMENT OF PSYCHOLOGICAL NEEDS

Dropbox (N=40)	1	2	3	4	5	6	7	8	9
1.I feel connected with other people when using this service	3	3	3	3	5	8	8	3	4
2.I feel capable and effective in my actions within the service rather than feeling incompetent or ineffective	1	1	0	2	4	4	10	12	6
3.I feel I am the cause of my own actions within the service rather than feeling that external forces or pressures are the cause of my actions	1	0	2	5	5	5	10	8	4
4.I feel that I get plenty of enjoyment and pleasure rather than feeling bored and understimulated when using this service	1	1	0	2	5	8	11	7	5

Google Drive (N=16)	1	2	3	4	5	6	7	8	9
1.I feel connected with other people when using this service	0	1	1	0	0	4	4	3	3
2.I feel capable and effective in my actions within the service rather than feeling incompetent or ineffective	0	0	0	3	1	3	0	5	4
3.I feel I am the cause of my own actions within the service rather than feeling that external forces or pressures are the cause of my actions	1	0	0	2	2	3	1	4	3
4.I feel that I get plenty of enjoyment and pleasure rather than feeling bored and understimulated when using this service	0	1	1	1	1	5	0	4	3

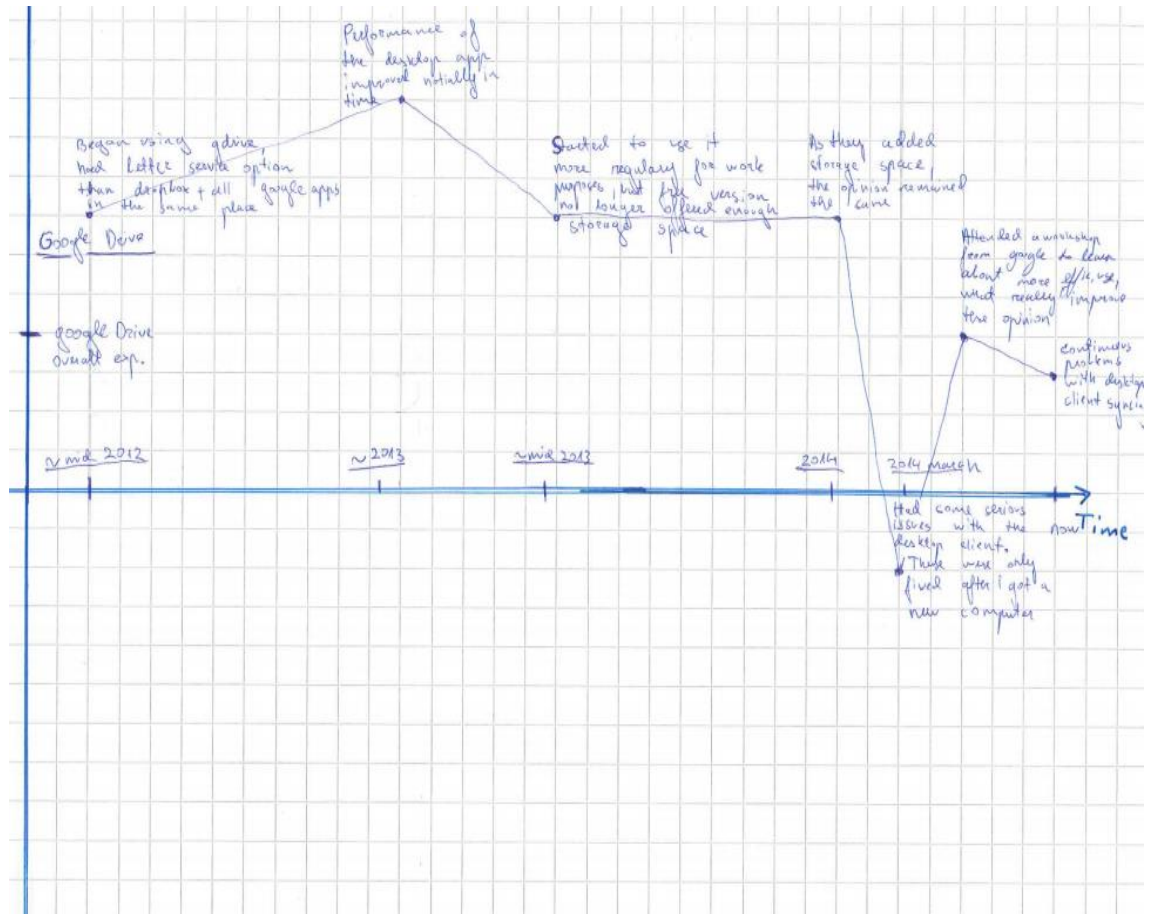
Need	All respondents (N=65)	Dropbox (N=40)	Google Drive (N=16)
1.Relatedness	5.66	5.475	6.750
2.Competence	6.72	6.875	6.9375
3.Autonomy	6.32	6.300	6.4375
4.Stimulation	6.45	6.550	6.4375

APPENDIX H: DATA OF ATTRAKDIFF2 QUESTIONNAIRE

Quality scale	Dropbox (N=40)								Mean value	Mean value for each quality scale	
		1	2	3	4	5	6	7			
PG	Technical	4	14	8	9	3	2	0	Human	3.025641026	5.3003663
	Complicated	0	1	2	4	7	14	12	Simple	5.769230769	
	Impractical	0	3	1	2	4	12	18	Practical	5.974358974	
	Cumbersome	0	2	0	6	10	17	5	Straightforward	5.461538462	
	Unredictable	0	1	1	6	9	16	7	Predictable	5.564102564	
	Confusing	0	1	3	2	13	13	8	Clearly structured	5.538461538	
HQ-I	Unmanageable	0	0	1	6	7	16	10	Manageable	5.769230769	5.175824176
	Isolating	1	1	7	4	10	9	8	Connective	5.102564103	
	Unprofessional	0	1	1	8	13	10	7	Professional	5.358974359	
	Tacky	2	0	5	12	10	6	5	Stylish	4.743589744	
	Low Quality	0	0	0	7	12	13	8	High Premium	5.58974359	
	Alienating	1	0	0	5	15	14	5	Integrating	5.487179487	
HQ-S	Seperates me from people	0	3	3	19	4	7	4	Brings me closer to people	4.58974359	4.710622711
	Unpresentable	0	1	2	6	13	12	6	Presentable	5.358974359	
	Conventional	0	5	4	8	7	12	4	Inventive	4.794871795	
	Unimaginative	1	0	2	8	12	13	4	Creative	5.230769231	
	Cautious	0	3	5	19	5	7	1	Bold	4.333333333	
	Conservative	0	3	5	4	12	11	5	Innovative	5.025641026	
ATT	Dull	0	0	1	16	15	5	3	Captivating	4.871794872	5.509157509
	Undemanding	3	7	5	14	7	3	1	Challenging	3.769230769	
	Ordinary	0	1	4	9	14	9	3	Novel	4.948717949	
	Unpleasant	2	1	2	6	3	20	6	pleasant	5.384615385	
	Ugly	0	0	4	9	4	20	3	Attractive	5.282051282	
	Disagreeable	0	0	2	2	7	12	17	Likeable	6.076923077	
ATT	Rejecting	0	1	2	9	9	12	7	Inviting	5.333333333	5.509157509
	Bad	0	0	4	2	2	12	20	Good	6.128205128	
	Repelling	0	1	1	9	12	9	8	Appealing	5.358974359	
	Discouraging	1	0	3	12	11	8	5	Motivating	5	

Quality scales	Google Drive (N=16)	1	2	3	4	5	6	7		Mean value	Mean value for each quality scale
PQ	Technical	7	0	7	1	1	0	0	Human	2.4	5.219047619
	Complicated	0	2	1	3	3	4	3	Simple	5.133333333	
	Impractical	0	0	0	2	4	2	8	Practical	6.133333333	
	Cumbersome	0	0	3	2	1	5	5	Straightforward	5.6	
	Unpredictable	0	1	1	1	3	4	6	Predictable	5.866666667	
	Confusing	0	1	2	2	2	5	4	Clearly structured	5.466666667	
	Unmanageable	1	0	0	1	3	7	4	Manageable	5.933333333	
HQ-I	Isolating	0	2	2	2	2	5	3	Connective	5.133333333	5.2
	Unprofessional	0	0	3	2	0	6	5	Professional	5.666666667	
	Tacky	1	2	2	2	3	4	2	Stylish	4.733333333	
	Low Quality	1	0	0	1	7	4	3	High Premium	5.6	
	Alienating	1	1	1	2	4	3	4	Integrating	5.266666667	
	Seperates me from people	2	1	2	4	1	3	3	Brings me closer to people	4.6	
HQ-S	Unpresentable	0	1	2	1	5	3	4	Presentable	5.4	4.828571429
	Conventional	1	2	2	2	4	2	3	Inventive	4.733333333	
	Unimaginative	0	1	1	1	7	2	4	Creative	5.466666667	
	Cautious	2	0	1	8	2	2	1	Bold	4.333333333	
	Conservative	0	3	3	2	3	2	3	Innovative	4.6	
	Dull	0	0	1	4	5	4	2	Captivating	5.266666667	
	Undemanding	1	1	1	5	2	5	1	Challenging	4.8	
	Ordinary	0	1	4	4	3	2	2	Novel	4.6	
ATT	Unpleasant	0	0	2	1	3	7	3	Pleasant	5.666666667	5.542857143
	Ugly	0	0	2	2	3	5	4	Attractive	5.6	
	Disagreeable	2	0	0	2	5	3	4	Likeable	5.333333333	
	Rejecting	0	1	2	2	3	3	5	Inviting	5.466666667	
	Bad	1	1	1	0	4	3	6	Good	5.666666667	
	Repelling	0	0	0	4	2	5	5	Appealing	5.8	
	Discouraging	0	1	1	3	4	5	2	Motivating	5.266666667	

APPENDIX I: EXAMPLE OF A DETERIORATING UX CURVE WITH REASONS



The Next Level of User Experience of Cloud Storage Services: Supporting Collaboration with Social Features

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Abstract— Nowadays, individuals’ personal data is at their disposal real-time from any device through cloud storage services (CSS). Such services enable new kinds of collaboration between individuals and have fundamental impact on how we organize and share our data. Nevertheless, only a few studies have been made on the user experience (UX) of such services. This paper reports the user experience of different CSSs (focusing on Dropbox, Google Drive, OneDrive, and iCloud) based on 19 interviews and 65 survey responses. The results include reasons for the most positive and negative experiences and descriptions of current habits and motivations of the CSS users. As the current use of CSSs is still mostly individual we investigate the potential of taking the UX of CSSs to the next level by integrating different social features to current CSSs. We conclude the paper by explaining the importance of different Cloud UX aspects in CSS context and suggesting design implications improving UX for CSSs.

Keywords— *User Experience; Design; Cloud Storage Services; CSCW (key words)*

I. INTRODUCTION

Software products are converting to software services through the *cloud computing* paradigm. Cloud enables the service providers to offer scalable and continuously evolving services to their users at remarkably low costs. From the user’s perspective, cloud services require little or no setup installation, support, and maintenance of software, infrastructure and platforms [27]. Cloud storage services (CSS), such as Dropbox and Google Drive, are businesses offering maintenance and management and making the data accessible for their customers over the network. With an overwhelming growth of personal and business CSSs, the service quality is becoming a significant differentiator for the cloud service providers. Service quality is not merely associated with network, technical and Quality of Service (QoS)-related factors. It has been demonstrated that human and contextual factors may have a significant effect [30] as well. For instance, in the context of Web Quality of Experience, memory effects, i.e., the psychological influence of past experiences, have a strong effect [16]. Consequently, it is of utmost significance to look beyond the technical aspects so as to obtain a better understanding of the experiences and

practices regarding to the utilization of personal CSSs, which in turn ensure revenue and market success [2].

The overall user experience (UX) is the most pivotal factor which can tie a user to a cloud service provider [27], and it is a central factor of the acceptance and spreading of novel services. UX refers to both pragmatic task fulfilment and to user’s emotional responses [10]. Deeper insight into the UX of CSSs is required, so that developers of CSSs can enhance the UX design of such services. We studied the UX of CSSs with particular focus on collaboration and sharing. During the recent years, the collaborative aspects of different CSSs have become more important to the users since they are increasingly collaborating through the CSSs in addition to using them as backup and personal data synchronization systems. Therefore we also investigated the potential of social interactions within the CSSs by gathering feedback about participants’ preferences regarding to integration of different social features with their favorite CSSs. Social features of a CSS can also be a mechanism to motivate users to stay loyal to a particular service, since by switching to another service the users could potentially lose the benefits of the social network they have built within the service.

Among all of the CSSs, Dropbox, Google Drive, Microsoft OneDrive, and iCloud are becoming more and more popular within the Internet community. Since the introduction of Dropbox in 2008, it had reached more than 300 million registered users before the end of May 2014. In the following, we elaborate the contrasts between these four CSSs as groundwork for the rest of the paper.

Dropbox (<https://www.Dropbox.com>) is a service enabling users to synchronize files across multiple devices. It also concedes easy sharing of data with unregistered Dropbox users. Registered users can synchronize files within the shared subfolders with each other. In a PC, a Dropbox folder appears as a local folder, which is in sync with the cloud repository. Dropbox files can be managed when the user is offline, and the files will be synchronized later online. If multiple registered users work on a shared file simultaneously, they must reconcile the subsequent several copies manually. Dropbox supports all file types.

Google Drive (<https://drive.google.com>) and Google Docs (<https://docs.google.com>) are interconnected cloud services accessible through web browsers. The key feature in Google Docs is the possibility to edit documents concurrently and avoiding most of the version conflicts that may occur with services like Dropbox. Also file types that are not edited in Google Docs can be saved and shared through Google Drive. Google Drive was launched in spring 2012. It has been possible to edit certain file types in Google Docs offline since 2012 with certain limitations.

OneDrive (<https://onedrive.live.com>) is a CSS from Microsoft which is integrated with Microsoft Office, so it is straightforward to create, edit, and share documents using this service. In addition to documents, other files or entire folders such as photo albums can also be shared. Recently Microsoft has also offered collaborative online editing tools for some of their document types.

iCloud (<http://www.apple.com/icloud>) is a service for Apple device users who can simply drag all kind of files into the iCloud Drive or create a new document utilizing an iCloud-enabled application on their iOS devices. iCloud does not support sharing files with others, but it synchronizes files between all the user's Apple devices. iCloud Drive can also be installed on PC with Apple user ID.

The structure of the rest of the paper is the following: in section II, we introduce related work; briefly presenting our perspective on user experience in general and then focusing on the context of cloud and CSSs. In section III, we explain the research methods used for conducting the study. Section IV reports the study results, which are then further discussed in section V to establish their connection to the literature and to conclude with the implications of the study for improving social interaction and UX design in CSSs.

II. RELATED WORK

There has been an increasing trend towards experience-based design in the field of Human-Computer Interaction as [25] manifested how technology can be understood in terms of experience. The concept of UX has evolved in the early 2000's to broaden the aspect of usability with notions of users' emotional and contextual needs, and the effect of users' previous experiences to current experiences [21]. Nowadays, "practitioners and academics are also looking for new approaches to the design of interactive products, which accommodate experiential qualities of technology use rather than product qualities" [14].

Hassenzahl and Monk [10] distinguished between pragmatic quality (the usability of the product) and hedonic quality, which point to quality dimensions with no apparent relation to task-related goals. Hedonic quality demonstrates, for instance, the human needs for novelty, change and social status. [10] proved that appealingness of a software product for the user is dependent on these two quality factors. Hassenzahl [9] split hedonic aspects further into three classes: stimulation, identification, and evocation. Stimulation is related to the fulfilment of the needs for stimulation, novelty, and challenge. For instance, a CSS with a new kind of visual design could purvey its users with hedonic stimulation [27]. Identification manifests the

human need for expressing oneself through objects. Identification aspect is totally social, since the users of products want to be seen in particular ways by others. For instance, user might desire to customize his profile so as to be seen in a specific way by his profile viewers. Evocation indicates the symbolic meaning of the product and the potential to arouse personal memories. We used Hassenzahl's model in this study to analyze our qualitative UX description acquired.

A. Fulfilment of Human Psychological Needs as Components of User Experience

McCarthy & Wright [25] stress the "emotional thread" of experience, and they emphasize that emotion and experience are inseparable. They postulate that all our actions are "shot through with values, needs, desires and goals" (pp.85). The association of action with values and needs sets the emotional tone of experiences. With the stress on "values, needs, desires and goals", [25] emphasize the accepted psychological theories (see [4]) demonstrating that action is dependent on not only context and conditions on an operational level, but also on universal psychological needs.

Sheldon, Elliot, Kim & Kasser [31] proposed 10 universal psychological needs (autonomy, competence, relatedness, physical thriving, security, self-esteem, self-actualization, pleasure-stimulation, money-luxury, and popularity-influence). Each of them has been drawn from prominent psychological theories within the literature (see e.g. [4]). [31] performed three studies in order to evaluate the significance of these 10 psychological needs. Participants depicted one recent most satisfying life experience, and then salience scores were computed for each of the 10 candidate needs within these experiences using a questionnaire method consisting of 30 descriptive statements. The results demonstrated that competence, autonomy, and relatedness were the most salient needs in terms of most satisfying and missing from unsatisfying life experiences.

Sheldon et al. [31] also indicated a clear relation between need fulfilment and affect (positive, negative) by applying Positive Affect Negative Affect Schedule (PANAS) questionnaire [36] to measure the affect during the experience. Consequently, they demonstrated that "the degree of need fulfilment was positively related to the intensity of positive affect. Except for luxury, all needs showed correlations with positive affect." Later, in a series of studies, [14] proved that need fulfilment was associated with hedonic quality perception.

Partala and Kallinen [28] applied a holistic approach to study the relative importance of different emotions and psychological needs in most satisfying and unsatisfying user experiences and the effect of different contextual variables in those experiences. Their result postulated that feeling of autonomy and competence emerged as highly salient in the most satisfying user experiences and missing in the unsatisfying experiences.

In the current study, an adopted version of questionnaire method by [31] is applied to measure the level of satisfaction for the psychological needs, autonomy, competence, relatedness, and stimulation. In so doing, we could also measure the emotional experience with the CSSs keeping in mind that fulfilment of particular psychological needs is the primary source

of positive (emotional) experience with interactive technologies [14]. In the current research, the selection of these four specific psychological needs is based on the results of studies by [11, 14, 28, 31]. We strived to make a simplified list of needs contemplated as the most predominant ones in the context of experience with CSSs to eschew complexity, though presumably our selection is not definitive.

B. User Experience in the Cloud

In one of the earliest publications handling UX related topics in cloud computing, Miller [26] noted several user benefits of cloud computing, including: lower-cost computers, improved performance, lower IT infrastructure and software costs, instant software updates, increased computing power, unlimited storage capacity, increased data safety, improved compatibility between operating systems and document formats, easier collaboration, universal access to documents, latest version availability, and finally more independence from specific devices and software. Miller also lists potential user concerns including: the service use requiring a constant (high-speed) Internet connection, slower response times compared to locally installed software, less features than the corresponding locally installed application, user's discomfort of not having the files and software in personally controlled and owned device as well as the potential security threats and data ownership issues [26 pp. 28-30, 35-36].

Miller's work is further elaborated by [35] reflecting the challenges of cloud computing from the UX perspective, establishing an introduction to UX in the cloud. While all general frameworks and definitions describing UX are still valid in cloud computing context, certain issues gain importance due to the nature of cloud computing. The pivotal issues include [35]: 1) access to user data, which may be a privacy threat, 2) multi-device access, referring to the fact that cloud services are often accessed by several different devices running on different platforms, making it harder to maintain coherence between different user interfaces, and requiring seamless transfer of task flow between devices, 3) social features of cloud services, allowing users to effectively communicate, share content and collaborate with others, and 4) reliability, security and trust related to the service provider and the internet connection, including also access rights management.

In the results section, we discuss the abovementioned four items in more detail and relate them specifically to CSS.

C. User Experience of Cloud Storage Services

There are few studies made specifically on UX of CSS. The most relevant study to our knowledge is by Marshall and Tang [24], which surveyed 106 CSS users and interviewed 19 of them to understand conceptual models the users have about the services. These models have a lot to do with how users understand how the system saves, copies, synchronizes and deletes files.

Synchronization. Marshall and Tang emphasize the importance of offering users hints about the processes and principles guiding file sharing and synchronization. This supports users in building correct and deep understanding of the potential and limitations of cloud based file synchronization services.

They separate five concepts describing the sophistication level of user's understanding of the service. The users can perceive their services as a 1) personal file repository, 2) shared file repository, 3) personal replicated file store, 4) shared replicated file store, and 5) synchronization mechanism coordinating treatment of file and folder replicas. These concepts are listed in a growing order of complexity, and none of the participants had problems in understanding the first concept, but varying problems in understanding the remaining four concepts were found. For example the fourth level "Shared replicated store" means that in this level, each collaborator has a copy of the files and folders on his computer(s) and shares the local content. This experience is only seamless if the collaborators are aware of what to expect from each other and perceive the effects of their actions on the shared store. Sometimes, the fact that collaborators have deletion rights over shared folders is a problem [24]. Failing to understand the fourth level concept may lead to unintentional removal of everybody's files when a user actually wants to remove only his/her copies of the files.

Rader [29] studied social influences on group information repositories and found that users manage files they own differently from the files that are shared with others. They are reluctant to remove files potentially useful to others though they are displeased with the clutter resulting from keeping these files. Often this is also connected to the problems users have with understanding the details of sharing and synchronization, as explained by [24].

Identities. In addition to striving with the logics of individual cloud service, majority of users deal with the complexities of managing several, typically 2-4 [34] different CSSs. Depending on the amount of different collaborations they are involved, some users may have several digital identifiers for one CSS. This is often related to different approaches on group information management studied by Voidsa, Olson & Olson [34]: segmenting and aggregating. This refers to users segmenting different real-life roles with different digital identities (e.g. work and hobby profiles) or sometimes aggregating different roles under one identity (e.g. Facebook status update targeted both to colleagues and friends). Moreover, Voidsa et al [34] recognized three constructs affecting the UX of information management in the cloud: 1) Individuals are maintaining multiple digital identifiers associated to different facets of their real-world identity, 2) Individuals use multiple different cloud-based services offering different features for information management; and 3) Individuals participate in multiple different collaborations with different work practices.

Our study, sharing similar focus on collaboration (and sociability) confirms these observations, but unlike [34] our primary concern was on assessing the UX during the whole history of using a CSS while their pivotal study topic was user identities orchestration with different cloud services.

Context of use. Study by Vandenbroucker, Ferreira, Goncalves, Kostakos & De Moor [33] investigates quality of experience (QoE) in mobile cloud storage context. QoE is in close relation to UX definitions explained previously. They arranged a survey with 349 respondents showing for example that only 11.8% of the respondents used (mobile) cloud services while on the move. After the survey they conducted a follow-up

study using experience sampling method with 13 users during a period of two weeks. During the period, they collected contextual data about usage episodes every time a user just had stopped using a mobile CSS. They collected and analyzed data about the effect of location and mobility, network, device and the functionality associated to the devices, the social context (number of people in proximity), the effect of time (on the frequency of use) and the effect of emotional context. To be brief, they conclude the study with noting that: “...users demand connectivity from any device, at any time and from any place. Also, users expect high-speed (mobile) networks, collaboration amongst multiple users and lastly, they demand security and privacy...” [33]

Compared to [33] our work aims to be more holistic about UX while their work explored the contextual factors in mobile use by probing episodic experiences. We expect our study and results to support enhancing UX and particularly collaboration amongst multiple users, but we do not address networking issues in this study.

Privacy and security. Security in the cloud has been studied extensively in recent years; see e.g. [27, 32]. Majority of the related studies have focused more on technical performance, such as the backup times and the amounts of data transferred [5, 32] and system workloads [6]. To our knowledge, our study is the first one trying to explain the overall UX of current popular CSSs.

Collaboration and social aspects in CSS context. There has not been much research focusing on this particular topic. In the larger context of computer supported co-operative work several relevant topics are covered. We motivate our focus on the CSS’s social features by referring to the findings by Mark, Gudith & Klocke [23], who state that the subjective experience of interruptions is better if the interruptions are emerging within the same context with the main task. So, if a user is editing a file from a CSS, it could be the optimal channel for possible interruptions regarding the editing of that particular file.

III. RESEARCH METHODS

In this section, we describe the participants and the procedures used in the study. Overall, the data was collected from 19 interviews and 65 responses on a survey. We also explain the motivation for selecting the methods and particular questions based on related work.

A. User Interviews: Participants and Procedure

We conducted two rounds of semi-structured user interviews to investigate the experiential aspects, and to identify the feasible new types of social interaction that might be incorporated in CSSs. The first interviews were conducted in spring 2012 with 9 participants (A1-A9 in Table I) and the second set of interviews in summer 2014 with 10 participants (B1-B10), giving us an opportunity to study the changes in participant’s views in a two years course.

The interview sessions were comprised of a consent form, a set of interview questions and an UX curve-drawing task [21], and background questionnaire probing the variety and frequency of CSSs that the participant was using on different devices

TABLE I. THE PARTICIPANTS OF THE INTERVIEW A(2012) AND B(2014). CODES USED IN THE TABLE FOR USAGE FREQUENCY: D=DAILY, F=FEW TIMES A WEEK, W=WEEKLY, M=MONTHLY

ID	Age group, gender	Primary CSS	Initial motivation	Start	Current main usage
A1	20-25	Dropbox, D	Sharing files with father	2011	Storage
A2	20-25	Dropbox, D	Syncing files btw two devices	2010	Backup, sync, sharing
A3	26-30	Mendeley, D	Mendeley	2012	Sci. articles
A4	26-30	Dropbox, D	Syncing files	2010	Backup, sync, sharing
A5	20-25	Skydrive, D	Sharing mobile photos	2011	Backup, sync, sharing
A6	26-30	Dropbox, D		2009	Backup, sync, sharing
A7	19	Dropbox, M	Sharing a file with friend	2012	Sharing
A8	20-25	Dropbox, F		2012	Sync, sharing, mobile editing
A9	20-25	Dropbox, D	Sharing	2009	Back up, sharing
B1	20-25	Dropbox, F	To access a shared file	2013	Backup, syncing
B2	35-40	Dropbox, D	To avoid carrying the memory stick	2008	Storage, sharing
B3	20-25, F	Google Drive, F	Team collaboration	2012	Collaboration
B4	25-30	Google Drive, D	Integrated with Gmail, Being used by my workplace	2012	Backup, Sharing
B5	20-25, F	Google Drive, F	Team collaboration, Sharing	2012	Sharing
B6	25-30	Google Drive, F	Storage, sharing	2012	Storage
B7	25-30	OneDrive, D	Sharing	2013	Sharing
B8	20-25	iCloud, D	Storage	2012	Auto syncing of photos
B9	20-25	iCloud, D	Syncing	2012	Storage
B10	25-30	Dropbox, D	Sharing	2010	Syncing

(PC, mobile phone, tablet etc.) The participants in the second round (B1-B10) also completed a final questionnaire reporting their preferences about social features integrated within the CSS. Table I displays the characteristics of our interviewees. The essential difference between the two groups of participants was the nationality: the first nine participants were Finns, and the participants of the second set were originally from different cultures, but staying in Finland because of their job or studies. The participants were originally from 11 different countries: Brazil, Bulgaria, China, Estonia, Finland, India, Iran, Pakistan,

Romania, Russia, and Vietnam. Eight participants were predominantly in working life, seven were students, and four were working along their studies. We strived to involve variety of user types in order to cover all four CSSs of our interest. All but two of the participants were male. The ages varied between 19 and 37 of age (median 25.5, average 26.1.) The CSS's used by the interview participants included the following: Wuala, Dropbox, One Drive, Mendeley, HTC Sence, Amazon Cloud Drive, iCloud, Kapsi server, Google Drive, Box, MyCloud, and FileZilla.

The interview questions covered the general usage of the CSS, and more specifically, social interaction preferences within the application. We asked about the initial motivation to commence utilizing the application, and the feelings after their first experience. Questions also addressed the current primary usage of the application, the UX of security issues within the application, and the UX of using the application on different devices (Desktop, Mobile Phone, and Tablet.) Furthermore, there were questions regarding data sharing, and more specifically, photo sharing and the contexts of use. Participants were also asked to elucidate the most satisfying and most unsatisfying experiences while using the CSS.

In addition to probing the episodic user experiences such as initial adoption of the CSS, most satisfying and unsatisfying user experiences, we also applied the "UX Curve" method. UX Curve method [21, 22] encourages the interviewees to share narratives about the important episodes during their history of using the services. In fact, Karapanos [20] suggests that in order to understand the dynamics of UX over time, experience narratives should be elicited and content analysis techniques should be employed "*in creating multiple levels of abstraction, from concrete idiosyncratic insights to abstracted and generalized knowledge*" [20, pp. 58]. Participants were prompted to freely report their meaningful experiences from the first time they used the CSS until today. The interviews were audio recorded for later review, and notes were taken during the sessions. Each interview lasted about an hour.

B. Web Survey: Participants and Procedure

We carried out an anonymous Web survey which was based on a literature review and the interviews. The survey investigated the usage issues of CSSs from various perspectives, i.e. what CSS the participant was using, why, and on which device(s), sharing behavior and synchronization related issues. Participants were also requested to elicit explanation about their most satisfying and unsatisfying experiences in the last 6 months with their desired CSS.

On the whole, 65 individuals (P1-P65) answered the questionnaire. Thirty participants were into the 20–30 years age group, 27 participants into the 31-40 years age group, five participants into the 41-50 years age group, and three participants into the 51-60 years age group (Minimum=20, Maximum=56).

Respondents were asked to describe the variety and frequency of social services usage and CSSs that they use. They were asked to select one CSS, based on which they preferred to answer the questionnaire. They also selected the devices (Desktop, Mobile Phone, Tablet, etc.) with which they usually access the service.

Respondents were asked about their initial motivation to start using the CSS, and about the single most satisfying and the single most unsatisfying experiences that they have had with the application in the last six months. They were also asked about their feelings during each experience and whether the experience changed their thoughts and attitudes towards the CSS in general. This probing was motivated by the concept of the overall UX being a continuum which occurs as a result of a series of smaller UX episodes [10]. By asking open-ended questions regarding the experiences that participants have had with these services, we followed two purposes. First of all, as postulated by Hassenzahl [9], we could categorize experiences based on the psychological needs that they fulfill through the use of technology, and probe qualitative differences between experiences based on emotions involved. Secondly, we could obtain qualitative information (e.g. on pragmatic vs. hedonic aspects of the UX) as users were asked to freely depict their user experiences.

Next, respondents were asked to assess the level of satisfaction for particular psychological needs (autonomy, competence, relatedness, stimulation) in their overall experience with the CSS. As postulated by [15], psychological needs are a significant component of UX. We utilized a questionnaire in which an abridged definition of needs from [31] was presented to the respondents. Participants gave their responses on a nine point scale ranging from 1=not at all to 9=very much. We used nine point scales instead of the five point scales utilized in original methods to acquire more fine grained conception of the participants' psychological needs, social feature preferences, and feelings pertinent to their user experiences, and to eschew challenges regarding to response interpolation (see e.g. [7]).

Finally the respondents were asked to assess 10 statements pertinent to social features using similar 1-9 scales. The social features evaluated are based on framework presented by Hanrahan et al [9]. Their framework for social features contains six distinctive groups. Each of these groups was covered in our questionnaire with one or more questions:

- 1) **Tagging** allows users to annotate a specific resource like a blog post, photo, or any object with a freely selected collection of keywords [9]. (Question 9 in Table V)
- 2) **User Profiles** provide users' identity on the system, and manifest common interests and relationships [9]. (Questions 1, 2, 3, 4, 7)
- 3) **Comments** indicate social relationship and are dominant conversational method [1] (Question 10)
- 4) **Activity Streams** are flowing commentaries on users' actions on various parts of the site, and are useful to probe content [9] (Question 5)
- 5) **Rating and Votes** are a paramount part of reputation systems for users of social networking services [9]. Reputation systems provide interaction, trust and restrict aversive actions [18] (Question 6)
- 6) **Private Messaging** similar to webmail are often included in social networking services. [1] (Question 8)

IV. RESULTS

In this section, we present the findings of our study based on qualitative content analysis and statistical analysis on the questionnaire data. First, we describe some of the participants' experiences. By doing this we try to draw a richer picture than what it would be if it was based just on quantitative data. After this, we present problems and the features related to negative and positive experiences in current CSSs found in this study. We also report how the services supported the fulfillment of meaningful psychological needs in the context of CSSs. Consequently, we report the results related to integrating social features to CSSs, based on user evaluation of 10 statements about new social features.

A. Motivations to Start Using a Certain Cloud Storage Service

Based on our analysis, there were seven categories motivating the participants to adopt using a CSS. These were: 1) need for a back-up service or safe storage, 2) collaborating (editing files together), 3) device, system or purchase integration: the service was included to the purchasing of a device or the CSS is integrated to a certain operating system or service, 4) friend suggesting the use, 5) need to share files, 6) need to synchronize files, 7) work or school related practices requiring, recommending or forcing to use a certain service, 8) free storage and finally 9) stimulation, for example trying out the system out of curiosity. Depending on the exact expressions used, we have categorized the answers with either one or several labels, for example (P63, Google Drive) stated: *"Too large files to share multiple user on email and needed the possibility that all user to modify"* which was labeled to sharing and collaboration. Table II reports the motivations for adopting a CSS.

Although there were substantially more Dropbox users than any other service users, none of those participants reported free storage as the primary reason for starting to use the service. None of the 19 interviewees mentioned this either. Instead, the interviewees often reported sharing and or synchronizing their files as their primary motivation.

B. Satisfying and Unsatisfying Experiences

The survey participants were asked to describe both their most satisfying and unsatisfying experience with their chosen CSS during the last six months. Compared to previous data set, the responses were substantially more diverse. 50 out of 65 survey participants filled in the question associated with the most satisfying experiences that they have had in the last 6 months with the CSS, and 17 of them was related to "sharing".

The most unsatisfying experiences were typically related to accidentally losing one's data:

P43: *"When I was moving files around, I found out that I deleted all my files and I had to go into the web version to recover all my deleted files, no way to do this in batches! And I had to go into each folder and undelete each file. So, I want them to give more flexibilities to a user when it comes to recovering deleted files, especially multiple deleted files."* (Dropbox)

Several similar cases were reported. Due to the severity of the problem, we quote another example:

TABLE II. THE MOTIVATIONS FOR ADOPTING A CLOUD STORAGE SERVICE.

Service / Motivation	Dropbox n= 35	Google Drive n=13	OneDrive n=5	iCloud n=4	Total n=57
(1) Backup	3	1	2	4	10
(2) Collaboration	1	1			2
(3) Integration	1	2	1	1	5
(4) Friend	7				7
(5) Sharing	17	5			22
(6) Synchronizing	9	1	2	2	14
(7) Work or school	7				7
(8) Free storage		3	1	1	4
(9) Stimulation	2	1		2	5

P41: *"A guy in my former office erased everything from all the team, because he did it from desktop version. As he was seeing it in his computer, he thought that would erase the files only in his computer, but he erased them in Dropbox, and many people did not have a copy on their local. We could save many of them because of history tool, but then again many other went lost! Because there were thousands of them and also because the files were mixed up with older versions with same names. So, since there I have to keep a copy on my Desktop!"*

In the abovementioned case, participant's colleague had not grasped the concept of "shared replicated file store" as explained in [24]. Some CSSs (such as Dropbox) have not been able to convey this concept well enough for their users. Good solution for this problem is showing explicit information (e.g. in dialogs when trying to remove files) about the consequences of deleting one's personal or shared files, as also suggested in [24]. For example, Google Drive currently manages to clarify the consequences of deleting a shared file, and does not let a user to permanently remove a file, originally shared by another user, from the others' repositories.

In the interviews, also other types of unsatisfying experiences were reported:

B9: *"I could not upload any kind of file (with iCloud), just specific files that are supported"*

B7: *"I could not share pictures directly from any iPhone!"*

With other CSSs, following incidents were reported:

B1: *"I was waiting for my files to get synchronized, but after 2-3 days I noticed that it still says that you have to wait, and I noticed that mostly everything has green check, and I had made the "system hidden files" to be shown, and Dropbox has failed to upload them! So, after deleting that, it got ok. I think not every normal user can recognize this fault!"* (Dropbox)

TABLE III. THE MOST SATISFYING EXPERIENCES WITH CSS IN THE LAST 6 MONTHS

	Dropbox n=32	Google Drive n=10	OneDrive n= 5	iCloud n= 3	Total n=50
Accessing files	7	4	1	1	13
Sharing files	13	3	1	0	17
Backing up	5	3	0	0	8
Collaboration	2	0	1	0	3
User preferences within CSS	3	0	0	0	3
Recovery	2	0	0	2	2
Free/cheap storage	1	0	0	0	1
Integration of CSS	0	1	0	0	1
Ease of use	6	3	0	0	9
Work/school related	2	2	0	0	4
None	4	0	1	0	5

B5: "Lack of instructions about how to follow it! I spent a lot of time to learn how to find the right folder, though it looked very familiar and I had a feeling that I know what I am doing, but I did not really!" (Google Drive)

Although Google has made thorough tutorials and instructions, users seem to need better linkage to those resources from their user interface.

The most severe problems were caused by unclear access/write/delete rights and misunderstood synchronization resulting to unintended deletion of shared files from the whole group. Synchronization has been recognized to be the most complex use case for the users [24], requiring deep understanding about the principles and processes governing the functions of the CSS. One user for example understood the caveats of the system, and was overly cautious when editing the files, causing extra work for him. Actually, he had transferred to use Mendeley for managing his work related data, although he still maintained mainly positive view over Dropbox.

A3: "Dropbox is effortless in use, but I do it harder for myself. Whenever I edit a file, I remove it from the Dropbox – folder, because I'm afraid that something goes wrong and then a corrupted file would be synced to all my devices. When I'm finished with editing, I move the file back to Dropbox -folder. I know I can restore old versions from Dropbox web pages. I haven't needed that yet, but I'm overly cautious. This causes some extra fiddling with the files. Sync can be turned off, but it's not that visible."

Several technical issues not related to user's concepts of the system were reported as well, for example the system not being able to continue the interrupted transmission of a large file. The first round of interviews in 2012 revealed many incidents of limitations on the maximum size of the files handled with the CSS, but none of the interviewees mentioned such issues two years later.

Table III shows the distribution of different categories of satisfying experiences among respondents of different CSSs. The participants reported issues falling to following categories: 1) access to their files, 2) sharing files, 3) collaboration, 4) synchronization, 5) ease of use, 6) backup and/or safe storage

for the files and 7) successful recovery of accidentally deleted files. There were also 5 participants reporting that they cannot raise any certain incident above the others.

The following categories were identified for the unsatisfying experiences: 1) problems caused by running out of (free) storage capacity, 2) slow functioning of the service (due to network, device or the client application), 3) different (sometimes unexplained) problems with synchronization, 4) clutter (file system is messy or spam from notifications), 5) accidentally deleted files and complicated, potentially imperfect recovery of accidentally deleted files and 6) security issues. None of these categories were mentioned by more than four participants.

There were three comments related to security (e.g. "safety" and "easy for security abuse"). The most specific explanation was that the employer's policy was against using the CSS. We believe that the users do not expect superior safety from their (free) CSSs, and due to their low expectations they don't have such severely disappointing experiences. The most cumbersome problems seemed to relate to recovering accidentally deleted files.

C. Fulfilment of Psychological Needs

Psychological needs are closely related to UX. We were using the following four statements to test the fulfilment of the main psychological needs (1. Relatedness, 2. Competence, 3. Autonomy and 4. Stimulation):

1. I feel connected with other people when using this service.
2. I feel capable and effective in my actions within the service rather than feeling incompetent or ineffective
3. I feel I am the cause of my own actions within the service rather than feeling that external forces or pressures are the cause of my actions.
4. I feel that I get plenty of enjoyment and pleasure rather than feeling bored and under stimulated when using this service.

Table IV shows the averages for the four needs regarding all respondents and then the Dropbox and Google Drive users respectively.

The results for Dropbox and Google Drive are similar to each other except for the relatedness. Dropbox users were less (-1.27, P value 0.06) fulfilled in terms of relatedness compared to Google Drive. This may largely be explained by the more collaborative and social nature of Google services including the Google Docs, which allows users to simultaneously edit shared documents and exchange messages.

TABLE IV. THE NEEDS FULFILMENT FOR CSS USERS, AVERAGES (SCALE 1: NOT AT ALL ... 9: VERY MUCH)

Need	All respondents (n=65)	Dropbox (n=40)	Google Drive (n=16)
1.Relatedness	5.66	5.48	6.75
2.Competence	6.72	6.88	6.94
3.Autonomy	6.32	6.3	6.44
4.Stimulation	6.45	6.55	6.44

TABLE V. THE AVERAGE RESPONSES ON SOCIAL FEATURE INTEGRATION, (SCALE 1: NOT AT ALL ... 9: VERY MUCH).

I would like to...	All (n=65)	Drop-box (n= 40)	Google Drive (n= 16)
(1)... acquire new virtual contacts within this service.	3.71	3.40	4.81
(2)... make an explicit friend list within this service.	4.26	4.00	5.43
(3)... send "Add Friend Request" within this system.	4.29	4.15	4.87
(4)... search for people within this service.	3.88	3.47	5.19
(5)... see the state of my contacts within this service.	4.2	3.60	5.44
(6)... rate a shared file within this service.	4.57	4.02	5.38
(7)... see other service users' profile page.	3.75	3.55	4.63
(8)... have "Private Messaging" functionality.	5.0	4.32	6.25
(9)... have "Photo Tagging" functionality.	3.82	3.72	4.81
(10)... have a functionality to "leave comments".	4.55	4.25	5.88
Total avg.	4.2	3.85	5.27

D. Social features

In the survey we asked about participants' perceptions of integrating different social features into CSSs. The averages for each statement are reported in Table V including the statement and the overall average on scale from 1 to 9 (not at all ... very much) calculated for the whole group of survey participants (65 survey respondents), and then for Dropbox (n=40) and Google Drive users (n=16).

In general, the responses were slightly more negative rather than positive. Dropbox users evaluated the social features more negatively than the Google Drive users. We believe this is due to the fact that Google Docs is already strongly integrated with other Google services containing many social features, making it easier for the users to see the potential of the social features.

Based on related work stating that people have segregative and aggregative approaches towards data management [34], we expected that the attitudes towards integrating social features (such as contacts, messaging, status, tags) would be somewhat polarized, which was the case. The results suggest that the majority of the participants manifested segregative strategy towards managing their identity separately from social media, such as Facebook. For example, from the 40 participants using Dropbox, for each of the questions, on the average 14.6 (37%) were responding 1 = "not at all", while the rest of the values were evenly receiving 4-10% share of the responses, including the other extreme 9 = "very much" with 7 percent. We can say that the result for Dropbox users is strongly biased towards negative end of the scale. For Google Drive users, the responses were more evenly spread, and the negative end received only 0-3 responses (0-19%) from 16 participants for each of the

questions. The mean value for all ten statements for Google Drive users was 5.27.

Those participants, who were able to articulate why they would reject social feature integration, explained that they already contented themselves with their current social networking services. Those who valued the integration more reasoned their choices with pragmatic advantages:

(B7): "(integration between Facebook and One Drive) will be very beneficial, for example if you are taking pictures and you are going to put it straight away on One Drive, it means it will be straight away on FB and you just need to make them public. Then this Photo Sharing would be most beneficial to me."

Integrating social features to CSS can potentially add value to users, but the design of this integration needs to be done with great care. Knowing the multitude of different services and digital identities that people need to manage, it is not surprising the majority of the participants in the study rejected the idea. Special attention should be given to users having choices over which existing social networks they would integrate and how tight this integration is.

V. DISCUSSION AND CONCLUSIONS

This paper reports an empirical study of collecting data from 84 CSS users, resulting in particularly qualitative descriptions of user's actions in CSS which can be found above. The most severe problems were related to synchronizing files when collaborating through a CSS. We gave several examples of participants' stories in the results section to highlight the severity of the consequences of these problems.

In this section we explain what we consider as the essential features of the UX in the context of CSS in comparison to more generic descriptions and models of the UX. We start by explaining how the UX of CSSs has changed during the last two years to recognize relevant factors describing UX of CSSs in more general level. Finally we give design implications suggesting how to support collaboration in the context of CSS.

A. Changes in Using Cloud Storage Services from 2012 to 2014

The first round of interviews for this study was done in May 2012, just few weeks before Google published their Google Docs, which is integrated with Google Drive and other Google services. Based on qualitative analysis on the interview data, two years later the major difference is the increased role of collaboration in addition to file sharing and synchronizing over personal devices. People have increasingly adopted the habit of more direct collaboration instead of e.g. editing local documents and circulating them by email. However, the issues reported in the two rounds of interviews were very similar, with the exception of fewer negative experiences when dealing with large file sizes. During the recent years, CSSs have improved by offering some more free space and functioning somewhat more securely and smoothly. Another difference was found from the user narratives collected in 2012, showing that 2 out of 9 participants were confused about the real purpose and possible benefits of the service and it took several months before they started to use for any purpose. We did not find

similar cases two years later. Although our samples are small, this may hint that now there are better tutoring processes of the service providers or peers explaining users how they could benefit from CSSs. We also repeatedly heard positive stories about Dropbox encouraging its users familiarizing to different features in the service by email reminders and rewards (more free quota), both in 2012 and in 2014.

Although the services have improved during the two years between the interview rounds A and B, the more recent interviews (B) included more negative experiences that had affected on the UX. While our interview samples are small we suggest that a possible reason for this could be the participants' improved expectations, as well as people being nowadays more dependent on the CSSs and therefore more easily irritated when the service is not functioning properly.

B. Top Level Explaining Factors of the User Experience of the Cloud Storage Services

We summarize the overall UX of CSSs by giving some more examples of the narratives the participants were sharing. Then we generalize the results to present CSS specific UX factors in comparison to the factors presented in related work.

When reflecting their usage history, the interviewees reported increase in UX due to learning to use new features as well as learning to apply the features in new ways. Receiving extra free storage space was often mentioned, but typically it had relatively small positive effect compared to other reported incidents. Reasons for decreasing UX were: serious problems with the client software and synchronization and missing features. None of our interviewees had experienced serious data losses, but among the survey respondents such cases were reported as the worst experiences. Interviewee A3 reported that he had a bad experience related to the security of Dropbox (reading about problems from the media, not experiencing problems in personal level), and therefore he had limited the usage of the service to certain selected synchronizing tasks. However he was still relatively positive about the UX of the service. In general, even those who were mainly positive about the UX of their CSS reported some problems with updates of the service or possibly loosing or almost losing data.

C. Results Related to the Generic Cloud User Experience

In the related work section we summarized earlier work on cloud UX. The authors of [35] pointed out four relevant issues:

1) Access to user data (potentially causing privacy threat). Access to data is the central reason for the CSSs to exist, and also major reason for many reported positive experiences.

2) Multi-device access making it hard to maintain coherence between user interfaces. During the first interviews in 2012 we were keen on probing this topic, but it seemed to be no concern for the users. Already by then the users had no problems with multi-device access in the sense of UI coherence, as long as some familiarity between the CSS applications on different platforms was maintained. The CSSs themselves are a crucial solution for multiplatform use, offering synchronization between different devices.

3) Many cloud services are rich on social features. Most CSSs have limited offering in this area. We understand that increasing collaboration through CSS could benefit from several features, but our results indicate that particularly Dropbox users are suspicious about the benefits of integrating such features to CSSs.

4) Reliability, security and trust. Security threats were recognized by most of our interview participants, while there were also those who said they don't worry about it. However, 17 out of 19 interviewees restrained from saving any private or sensitive data in CSSs. The two remaining interview participants (A4 and A6) encrypted the data they considered should be kept private before saving it to a CSS. In the survey there were only few responses directly stating concerns about security, while in the interviews the participants reported it often when drawing the UX curve. From this we can conclude, that privacy was primary concern only for two participants from the total of 84 respondents, A3 limiting his usage to specific cases and P42 fully discontinuing the usage of the CSS. However, we need to state that almost all of the remaining participants considered privacy threats decreasing their overall UX of CSS and affecting the way they use CSSs. Issues related to reliability were sometimes mentioned as a source of the most negative experiences as well.

D. Suggestions to Improve User Experience of a Cloud Storage Services

Based on our study and related work we suggest the following design and business improvements for CSSs:

1) Offer data encryption to enhance privacy and security. The CSSs studied don't specify clearly to their customers how they maintain the security and privacy of their users' data. Several participants were ready to pay for a service that would offer better encryption services at least for chosen parts of the data they wanted to keep safe. At the same time, majority of the users were restraining from saving any sensitive data into the CSS. The business potential of encrypting services should be seriously considered, since that kind of offering would potentially change how the majority of the users perceive CSSs.

2) Offer system transparency, referring to how well one can deduce the rules governing the functioning of the CSS as well as how transparent the system is from the perspective of the used platform (e.g. Windows). This includes letting the users to try out things first in private and supporting their understanding on what is shared and how it is visible to their contacts before they use the social features. The system should also explicitly show the status of a file, if there is a chance it is e.g. being edited by someone else.

3) Develop clear data management model and synchronization rules, referring to the model of the system being understandable for the users. Data security should be carefully considered, particularly when dealing with shared files to prevent accidental data loss.

4) Develop Collaboration and communication support of the CSS, i.e. social features. The social features can be used for pragmatic goals, such as arranging contacts and managing collaborations over social network, as well as hedonic goals

[6], such as evocation and affection produced by social interaction. Though one might suspect that there is no need for “chatting with your Dropbox friends”, managing the collaborative work is needed and indeed, chat could be an appropriate tool for this purpose.

5) Design synchronization practices that are visible and understandable to the users. For example, the Dropbox users need to manually remove or rename a shared file if they want to prevent problems from potential simultaneous edits on the file. This may be understandable for those experienced in collaborating over shared files, but our results show that most users have experienced problems with the collaboration. The system should give a warning when the file is already opened by somebody. The user may then ignore this, or communicate with those who have the file open. Currently the user notices the file conflicts only once the file is saved. Afterwards there’s too much work resolving the differences in the documents. Potential solutions for the synchronization problems include: locking files explicitly if a user wishes to do so, clear status indications, and a clear, automatically generated version history visible in the context of the CSS. This could contain pieces of information like: “Tom opened the file today at 12:30, saved 12:43, 12:55, file still open.”

6) Design for the whole length of the service experience. For example Dropbox, although failing with some other issues, have done well in introducing their features gradually and luring the users to try out new suggested features by rewarding them with free extra storage space. The service should be designed so that based on the user’s behavior it gradually expands his/her understanding about the potential of the service.

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