Longterm Storage of Digital Photographs

A study of digital photographers' backup practices

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a n d P A T R I K S A N D B E R G

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ABSTRACT

In this bachelor thesis we process difficulties concerning longterm storage of digital photographs for consumer photographers. The subject is looked upon from an interdisciplinary point of view with both technical and anthropological aspects taken into consideration. The study included a literature review, a quantitative survey, a qualitative survey and interviews; All data gathered are displayed and analyzed in this paper. The aim with the thesis is to clarify the major difficulties concerning longterm digital storage and consumer photographers' practices of the former. In this paper we give a thorough review of the methods used and we also describe the implementation of them. Based on the results and the analysis, criteria for a product to ease the backup issues are suggested.

Our conclusion is that consumer photographers are not interested in actively doing backups of their digital photo collections. Therefore a product that takes care of this monotone procedure may be of interest to them. The user experience is crucial and cannot be compromised; A potential backup device must not add any extra transferring steps or procedures. The device should also be able to automatically gather, filter and index all available metadata, attached to an image file. The storage components should be independent and self-checking, to minimize the risk of data loss. However, regardless of precautions taken, no digital storage medium today can compete with the life-span of photo paper.

SAMMANFATTNING

I denna kandidatuppsats behandlas svårigheter beträffande långsiktig förvaring av amatörfotografers digitala fotografier. Ämnet är granskat ur ett tvärvetenskapligt perspektiv med både de tekniska och de antropologiska aspekterna beaktade. Studien omfattade en litteraturstudie, en kvantitativ- och en kvalitativenkät samt intervjuer; All insamlad data är återgiven och analyserad i denna rapport. Målet med den här uppsatsen är att kartlägga och klargöra huvudsvårigheterna kring långsiktig digital förvaring och amatörfotografers vanor av dessa. I uppsatsen ges en grundlig genomgång av metoderna som använts samt en beskrivning av hur dessa implementerats. Baserat på resultaten och analysen, föreslås kriterier för en produkt ämnad att underlätta säkerhetskopieringsproblemen.

Vår slutsats är att amatörfotografer inte är intresserade av att aktivt sköta säkerhetskopieringssysslor rörande deras digitala fotosamlingar. På grund av detta skulle en produkt som tog hand om denna monotona syssla troligtvis vara av intresse för dem. Användarupplevelsen är avgörande och kan inte kompromissas med; En potentiell säkerhetskopieringsenhet får därför inte addera något extra överföringssteg eller moment. Enheten borde också ha egenskapen att automatiskt samla in, filtrera och indexera all tillgänglig metadata inkluderad i en bildfil. Lagringskomponenterna borde vara oberoende och självkontrollerande, för att minimera risken att förlora data. Likväl, oavsett vilka försiktighetsåtgärder som vidtagits, kan inget digitalt lagringsmedium idag tävla med livslängden hos fotopapper.

1 INTRODUCTION

Throughout history information and stories have been stored through pictures in the shape of rock carvings, paintings and in modern times photographs. It has been, and still is, of great meaning to society and individuals to preserve depictions for the posterity. According to Baker, et al., (2006), preserving information for decades or even centuries has proved important. In an information society, information is consumed at a high phase and focus is on broadcasting and sharing rather than on storing and saving.

1.1 Background

Today's generation, year 2010, has in broad extent been able to make historical flashbacks with help of stored and saved analog photographs and negatives. These flashbacks have been made possible thanks to the media's shelf life and the analog process itself. The analog process denotes that you have to develop the negatives and make photo prints in order to see the photographs. Because of the digital revolution the former natural way of transferring analog negatives onto the next generation has almost vanished. As for digital photography you are now able to see the photograph right after the exposure in the camera display. The change in the processing step and the change of capturing techniques has led to an increased mass of photos taken. You no longer have to think about saving space on the camera roll or worry about your economical situation when developing negatives and photocopies. People who are using digital cameras seem to be more trigger happy and frivolous, as found by Lehtimäki & Rajanti (2008).

Since the amount of photographs captured has accumulated, it is easy to draw a hasty conclusion that the amount of pictures printed has accumulated as well; That is not the case. When only analog cameras were used a very high percentage of the photographs captured also got printed. Many people saved their good pictures in albums and frames; The not so good were kept in shoe boxes. Today most of the digital photographs never get printed; They simply remain on memory cards and hard disk drives (HDD). The storage of photographs has transformed from analog paper copies to digital representations in the shape of ones and zeros.

1.2 Framework

This bachelor thesis is written under the discipline of media technology studies at the Royal Institute of Technology (KTH), Stockholm, Sweden. The media technology program is provided by the School of Computer Science and Communication (CSC) at KTH. The discipline is not only technical but it is also interdisciplinary. The main focus is on media, information, communication and interaction, based on the latest information technologies. In this thesis we cover creation, storing and sharing of digital files in terms of digital photography.

1.3 Problem

A problem with the storage of digital photographs, as with any digital file, is the erratic life span of their storage media. Techniques used for digital storage and digital media in general has a very high obsolescence, which makes safe longterm storage complicated. "*No affordable digital storage media are completely reliable over long periods of time*" as Baker, et al., (2006) came up to. Newly developed storage media often relay on new techniques and are seldom totally backwards compatible. This trait complicates the process of transferring digital material onto newer media.

Since the beginning of consumer digital photography, in the middle of the 1990's, different storing formats of digital photographs has been introduced, used and become outdated. Some formats that have passed over the years are: the 2.5" diskette, the 3.5" diskette and the LaserDisc (LD). Figure 1 shows a comparsion between a LaserDisc and a DVD.

Figure 1: *Comparison between a LaserDisc and a Digital Versatile Disc. To the left: Laser Disc from the early 1980's. To the right: Digital Versatile Disc from the early 2000's.*

Figure 1: http://sv.wikipedia.org/wiki/Fil:LDDVDComparison-mod.png [Accessed 13 June 2010]

GNU Public License

If you want to preserve your digital photographs as an individual and do not possess knowledge, experience or interest in computers it can be hard to know what to do to keep your digital photo collection intact and stored safe.

1.4 Objective

Our objective was to investigate how individuals store and backup their digital photo collections and to find criteria for a backup product to ease longterm storage of digital photographs. A secondary objective was to investigate how individuals show and share their digital photographs. We also wanted to analyze how future generations will be affected by the risk that their documentation probably only will be available in digital format.

1.5 Delimitations

As mentioned earlier the target group for our study consisted of individuals and hobby photographers that take pictures to perpetuate events in their lives. A difference between individuals, professionals and corporations is the economical aspect. While corporations most often have the economical muscles needed to invest in various devices to ease and secure storage of their data, individuals most of the time do not have this possibility. Another vital difference, between the earlier mentioned groups, is that professionals do backups as a part of their work while individuals do it on their spare time. Above are some of the reasons why we chose individuals as our target group. As we see it, they have the biggest problems when it comes to longterm digital storage.

Since there are different storage devices and services available for backup, focus was on the devices and services that may be of interest to our target group. That was why expensive and technically demanding backup solutions were not part of our study.

Regarding the preliminary investigation of products and services only those commonly used by the people who took part in our study where looked into.

1.6 Method

The methods used in this study are methods from the area of media technology studies. The two main methods used are online surveys and personal face-to-face interviews. Known methods for data analysis are

also used. We present further information concerning the methods in chapter three named “Study”.

We conducted two online surveys, one quantitative and one qualitative. The total amount of respondents for the quantitative survey was 43, 44 % of them were women and 56 % were men, with an age span from 13 to 74. In the qualitative survey there were sixteen respondents participating, 44 % of them were women and 56 % of them where men. The age span was almost the same as for the quantitative survey. Five face-to-face interviews were performed with three respondents picked from the qualitative survey and two photo dealers.

2 THEORY

2.1 Photography

The word “photo” comes from the greek word “phos” which means light. “Graphi'a” which also is greek means script. Therefore photography means light script.

Photography is the representation of pictures on materials that are affected chemically or physically by light. This includes both analog photography and digital photography with acetate or celluloid film and sensors as photosensitive material.

2.1.1 Analog Photography

A standard analog camera uses a 35 mm photosensitive film made of acetate or celluloid covered in photographic emulsion as photosensitive material. The film is inserted into the camera and usually holds 24 or 36 frames available for exposure. After capturing pictures onto the film the next step is to develop it to get negatives and then develop photocopies from the negatives.

2.1.2 Digital Photography

A digital camera or electronic camera is a camera that uses a sensor with photosensitive silicon cells. There are two major types of sensors, Charge-Coupled Device (CCD) and Complementary Metal Oxide Semiconductor (CMOS). Digital cameras have, in connection with the sensor, an Analog-to-Digital-converter (A/D-converter) that converts the analog signals from the sensor to digital information. The information is then stored onto a memory card. A memory card manufactured in the year 2010 can hold a significantly larger amount of photos than an analog film.

The size of sensors in digital consumer cameras varies. As opposed to photosensitive film, which is of fixed size, the size of a sensor is highly dependent on the manufacturer and the model. Despite this, there is one clear distinction that can be made. The sensor is either full format, which means that the size of the sensor is the same as conventional 35 mm photosensitive film, or else the size is smaller for ordinary consumer cameras.

2.2 Definition of Digital Photographs

In this thesis we define and refer to digital photographs as all kind of photographs stored digitally, including photos captured analog and then converted to a digital format.

2.3 Digital Storage

Digital storage can be divided into two main categories, volatile and non-volatile. Volatile storage lose the information stored when the power is cut why they are not used for longterm digital storage. We will focus on non-volatile storage that can store data without any power consumption. Non-volatile storage is built up of three main groups: magnetic-based, optical-based and electrical-based storage.

2.3.1 Magnetic-based Storage

When it comes to magnetic-based storage, the most common type is the hard disk drive (HDD); It is mainly used as secondary storage for computers. Other well-known magnetic-based storage platforms are the tape and the floppy disk. Mutually for all of them is the technique where a magnetizable medium is used to store the information. The bits are represented by either a negative or positive polarity written to the media. The access time for this type of storage is usually between ten to 100 milliseconds depending on the media.

As for longterm storage HDD:s are common. A more reliable way of storing data on HDD:s are via Redundant Arrays of Inexpensive (or Independent) Discs (RAID). RAID is an umbrella term for hard disk drives connected to each other to increase performance or reliability depending on which type of RAID used. RAID 1 is one of the most commonly used types where the disks connected function as mirror images of each other.

2.3.2 Optical-based Storage

Two of the most commonly used optical storage methods for digital files are Compact Disc (CD) and Digital Versatile Disc or Digital Video Disc (DVD). These methods are based on light reflections in a thin layer of metal wrapped in plastic that the disc is made of. A CD or DVD player spin the disc and use a laser beam to create reflections from it. The reflections are converted into bits and the player reads out the data stored on the disc. There are many different types of CD:s and DVD:s. There are both CD:s and DVD:s that are read only, writable

once and rewritable multiple times. There are also different standard formats for storing data onto the discs. A typical CD is able to store between 650 and 800 megabyte (MB) of data. A single-sided DVD is able to store 4.7 gigabyte (GB) of data. A DVD can be double-sided and also have dual-layers, which expands the storage capability to 18 GB total.

As for any removable optical-based storage media, CD:s and DVD:s are a bit vulnerable. Therefore the management and storage of CD:s and DVD:s are important. For example scratches or moisture in the disc may disturb the lasers reflections during readout of data and can make the disc impossible to read.

2.3.3 Electrical-based Storage

Electrical-based storage like Electrically Erasable Programmable Read Only Memory (EEPROM) is both read and writable. The EEPROM storage method is transistor based. A transistor stores its current value (i.e. 1 or 0) even when the power is shut. Flash memory, a popular type of EEPROM, is used mainly in digital cameras, mobile phones and mp3-players. There are different kinds of flash memory based storage, the following are the most commonly used: USB-stick, Solid State drive (SSD) and different kinds of memory cards. The access time of flash memories are often very short, it can be as short as ten micro-seconds while the writing speed is much slower. During the year 2009 the flash-based SSD became an alternative to HDD:s in laptops.

Electrical-based storage has none to a limited amount of moving parts, which means that they are more tolerant to physical violence, than for example optical- and magnetic-based storage.

2.4 Known Problems Concerning Digital Storage

This entire section is mainly based on Baker, et al., (2006) and Sproull, et al., (2005). To get deeper knowledge about problems regarding digital storage, we propose reading the previous mentioned works.

Digital storage has the advantage of a never fading structure when it comes down to the bits stored. A bit, either a 1 or 0, is always represented in the same way. It is either readable or not readable, it can never be half or partly broken and still represent something (e.g. 0,5 or 0,7). The biggest problem with digital storage is the preservation of the medium the bits are stored on in order to keep them readable.

There are many different threats to preservation. The most common, relevant to consumers, are:

- Human errors
- Component faults
- Media faults
- Media/Hardware obsolescence
- Software/Format obsolescence
- Attacks (worms and viruses)
- Large-scale/Natural disasters

The most troublesome one, but not very probable, to anticipate and protect digital storage against is large-scale disasters. In the event of a disaster with great magnitude, multiple systems are likely to be affected; Wide geographical spread is one solution to this problem. Media and component faults are also hard to anticipate. Components not directly part of the medium may cause system failure due to for example a power surge. The storage medium itself is also vital, it is subject to gradual accumulation of irrecoverable bit errors caused by for example broken sectors or disk crashes. Regarding the obsolescence of media/hardware and software/formats, developers of preservation techniques need to bare in mind that components or formats used might no longer be supported in the near future. This may appear in terms of removable media outliving any suitable reader device. Another example is if a company ceases to exist and a provided format stops being supported. Then loss of valuable data due to format obsolescence may occur.

One example of storage media outliving any suitable reader devices is the "*BBC Domesday Project*", illustrated by Tessella Inc. For the 900 th anniversary of "*The Domesday Book*", William the Conqueror's survey of England in the year 1086, a modern version of the book was created. Children were invited to submit digital material about their community, which was stored on the latest technology; 12-inch LaserDiscs (LD), supposed to guard against obsolescence. Just 15 years later, serious action had to be taken to save these records from being lost; Fortunately a few LaserDisc readers still existed, but great effort were put in to extract the data. William the Conqueror's original book was of course still readable at the library.

Faults caused by human errors and attacks are problems of higher dignity, meaning that they are of a more advanced type. Unintentional deletion of data or swapping of wrong disks, are two examples of human errors difficult to prevent. As for attacks, malicious worms and viruses are often created with the single purpose to penetrate and destroy well functioning systems.

Even though the previous stated threats to preservation has been known for a long time, archives still loose data due to those causes. One explanation for this is potentially dangerous assumptions connected to data preservation and longterm storage. The three main assumptions are:

- The fault visibility assumption
- The independence assumption
- The unlimited budget assumption

Among these assumptions faults are both latent and visible. Visible faults makes themselves known as they happen, while latent faults gets known only when the particular data set are being read. The fault visibility assumption suggests that silent, latent, errors occur more frequently than commonly assumed. Figure 2 shows a latent fault in a digital photograph.

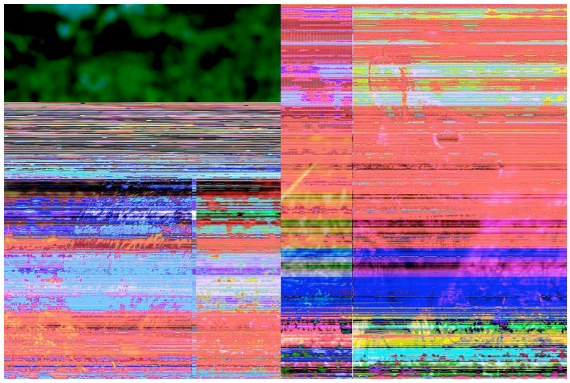

Figure 2: *A corrupt digital photograph due to a latent fault. The fault only gets know when the file is accessed.*

Regarding the independence assumption, analysis of replication schemes is often based on the assumption that replicas fail independently. However, faults are not as independent as we might hope. "*Latent sector errors are not independent of each other. A disk with latent sector errors is more likely to develop additional latent sector errors than a disk without a latent sector error*" as stated by Bairavasundaram, et al., (2007).

Figure 2: http://thekuipers.org/images/IMG_2279.jpg [Accessed 13 June 2010]

They also found that, "*A total of 3.45 % of 1.53 million disks develop latent sectors errors over a period of 32 months.*". The risk of getting latent sector errors on an HDD increases with the age of the drive, as concluded by the former authors. They also state that the risk "*...varies significantly across manufacturers and disk models.*". Another thing they observed was that "*...as disk size increases, the fraction of disks with latent sector errors increases across all disk models.*". Worth mentioning is also that "*The amount of probable data loss due to latent sector errors per Gigabyte does not increase or decrease consistently as a disk size increases.*".

Last but not least, the limited budget assumption constitutes that information people would like to see live-forever is not in the hands of organizations with unlimited budgets. For example companies committed to longterm digital storage, offering these kinds of services, might cease to exist without any further notice and data might be lost forever.

Considering digital longterm storage, earlier mentioned, visible and latent faults need attention. Figure 3 below shows that the time span from failure to complete recovery is significant, when comparing the two different types of faults. For visible faults the time span is negligible, but for latent faults the time span is substantial.

Figure 3: *Types of replica faults. A sad face illustrates a fault and a happy face a successful recovery. The sad face with sunglasses illustrates a latent fault before detection. Noticeable is the difference in the time elapsed to complete recovery between the different faults.*

2.5 Cultural-Anthropological Perspective

When it comes to usage of digital photo collections, people want to show and share their digital photographs rather than administrate their collections.

Research conducted from a cultural-anthropological point of view, about digital photo administration, shows that "*People want to tell*

Figure 3: Baker, et al., 2006, p.225

stories with their pictures, and are not interested in complicated organizing- or rating systems." as found by Lehtimäki & Rajanti (2008). Therefore it would be preferable to have an automatic organization system, as suggested by Rodden & Wood (2003), where the system for example can tag pictures with keywords indicating the presence of recognized objects, faces and locations. Lehtimäki & Rajanti (2008) also concluded that "*...it is very important that all possible metadata that can be attached to the images automatically, should be automatically received by any photo storage and sharing service.*".

When uploading or transferring digital photographs a user stated that "*The task at hand, which was uploading images, was not a moment when the images were organized and categorized.*" As Lehtimäki & Rajanti (2008) and Miller & Edwards (2007) have both shown. When administrating digital photo collections users tend to not use the advanced media features of a program at all as concluded by Rodden & Wood (2003). Another interesting point regarding the administration of photos was the finding that users "*...had no time or patience for annotating and naming the pictures, much less 'writing novels' about the situations.*" as stated by Lehtimäki & Rajanti (2008).

The parts above show that users of a photo collection program do not want to organize and tag their digital photographs by themselves. An automatic alternative that holds no advanced features seems to be the kind of service that the users would like to use.

3 STUDY

In order to achieve the objective, parallel with a theoretical exploration, different types of procedures regarding data collection were browsed. Personal interviews, focus groups, surveys and field studies all related to social science and human centered studies were considered. A decision was made to go through with a quantitative survey followed by a more niched qualitative survey based on the former. Parallel with the creation of the surveys an investigation of available photo backup services and products were conducted. To finalize and top the data collection, personal interviews were conducted with respondents from the qualitative survey.

3.1 Literature Review

A literature review was made with focus on digital storage and digital photography in order to cover the main parts of this thesis. The review is reflected in the theory section where it constitutes the major part. Digital storage is a broad subject why that part in the theory has been narrowed off to keep focus on the objective. The part concerning digital photography is describing differences between analog and digit-al photography, though from a more educational point of view.

3.2 Surveys

When designing a survey the first thing to consider is what type of information to collect, whether it is regarding attitude, knowledge or behaviour. Secondly the type of questions need to be determined, open-ended or closed-ended questions. For open-ended questions respondents answer in their own words and for closed-ended questions respondents choose from a list of answers provided. If the survey includes a lot of open-ended questions, mail or e-mail is not preferable; People do not tend to answer these kinds of questions, why other survey alternatives are more preferable. Two other important factors to consider are time and money. Web surveys are the fastest and cheapest, followed by mail surveys and then telephone surveys; Face-to-face surveys are the most expensive, as stated by Czaja & Blair (2005). Finally the respondents' proficiencies need to be considered, for example basic computer skills are needed in order to complete a web survey.

In the beginning of a survey, a good idea is to have close-ended questions that are straightforward to make answering easy. By choosing this type of objective questions respondents get to feel comfortable, as

found by Gaddis (1998), and are more likely to complete the survey.

Surveys conducted online makes, time, space and distance irrelevant. They also increase the convenience for respondents as well as for distributors, as stated by Evans & Mathur (2005). No additional costs for postage, papers and envelopes are obtained. Questions can be posted with a restriction that they need to be answered, in order for the respondents to be able to continue with the survey. Easy submission also increases the convenience for the respondents. Another strength with online surveys is the ability to prompt different questions in a questionnaire during a session, depending on the respondent's previous answers.

Compared to analog surveys, it is in online surveys important to set all default answers to "*no response*". By doing this, the risk of getting unwanted and/or corrupt data in the statistics is minimized. The former was concluded by Gaddis (1998).

3.2.1 Quantitative Survey

The quantitative survey was created and distributed online and the respondents were contacted through different private channels such as various instant messaging systems, email or face-to-face meetings. All the respondents were handpicked by us in order to be sure to only get people from our target group; The answers of the survey was kept completely anonymous. The survey was formed to be completed within a few minutes, in order to increase the completion rate and the amount of answers. To make the survey easy to complete it mostly consisted of multiple-choice questions. The questions where formulated with two main question in mind: "*What do a typical digital photo session look like?*" and "*How do individuals manage their digital photo collections?*". Focus was on collecting general data about the target group's photo habits and how they administrate their digital photo collections. The quantitative survey questions are attached in appendix A.

3.2.2 Qualitative Survey

The design of the qualitative survey and the questions were based on and excerpted from the results of the quantitative survey. Our aim was to dig deeper into the two main questions, formulated for the quantitative survey, to retrieve data with sharper edge. To achieve this, the questions were formulated in a more suitable and niched way.

Throughout the survey the concept of mostly multiple choice questions were kept. "*The go to capabilities*", forwarding the respondents only to the questions relevant to them, were implemented. The survey consisted of three sections: one general, one for individuals that do backups and one for individuals not doing backups. All the respondents were prompted the general section and were later forwarded to one of the two remaining sections relevant to them. The qualitative survey questions are attached in appendix B.

In the general section respondents were asked subjective questions about their attitude regarding storing digital photographs online. An attempt was also made to crystallize whether or not the respondents were willing to pay for online server storage. To be able to contact the respondents for further correspondents they were asked to supply contact information, if they wanted to. This was primary made to get the data needed for us to be able to enquire particular individuals for personal interviews, as was not possible with the first survey.

The aim of the backup section was to determine what kind of backup storage the respondents used and how they used it. The most common alternatives, as found by the first survey, were stated as multiple-choice questions with the limitation to select only one answer. When the respondents do their backup was another key question. The intention with the qualitative survey was to in detail pinpoint the procedures found in the quantitative survey.

The section directed to the respondents who did not do any backups aimed to provide data about why they did not do it. Potential changes needed for them to start doing backups were also investigated.

3.3 Interviews

People interact through face-to-face conversations in everyday life. Their experiences, feelings and hopes of the world they live in are most commonly communicated through direct conversations. Kvale (1996) conducts that "*The research interview is based on the conversations of daily life and is a professional conversation.*". The interview methodology invites to different kinds of structures, the simplicity of the structure and conversation can vary from open to more directed. An issue with guided interviews though is the risk of forcing the interviewees to answers, not shaped nor represented by themselves. An exploratory interview is essentially heuristic: to develop ideas and research hypo-

theses rather than to gather facts and statistics, as described by Oppenheim (2005).

3.3.1 Interviews with Individuals and Photo Dealers

After the surveys personal interviews were performed with specific respondents fitting the arithmetic average of the results from the qualitative survey. The interviews were of semi structured nature to keep the respondents comfortable and creative, but a line of argument where kept to keep focus on the subject. The intention with the interviews was to get a more personal contact with the individuals in our target group and also to interpret criteria for a potential backup product or service. Focus was on discussing habits, bad habits, advantages and disadvantages concerning management of the interviewee's digital photographs. It emphasized on services to ease the previously mentioned management. All questions were created after analysis foremost of the qualitative survey but also with the results from the quantitative survey in mind.

Each interview lasted for about 20 minutes and was conducted one on one. The individuals were asked to elaborate as much as they like and additional questions were asked depending on the elaboration.

The interviews with the photo dealers had the same kind of structure and approach as the consumer interviews, but started off with a brief introduction to the subject. Another difference between the two interviews was the kind of questions asked. The dealers' questions were sale oriented with the aim to find answers on how a potential product concept for backup would look like in order to be easy to sell. The questions emphasized on price and features.

3.4 Current Digital Storage/Photo Services online

Since we were interested in how individuals store, show and share their digital photographs a sample study of Internet services that possess features for those tasks was of interest. First services free of charge were investigated. In the end of the study of each service the specification of features added when using the charged alternative of the service was examined. This was done to ideate how the charged alter natives of the services work.

The investigation of the services started off with a registration of a user account. Basic functions and storage space were examined first. A typical user scenario, of basic characteristics, was staged including: uploading, sorting, tagging and sharing of some digital photographs. Special features of specific services were looked into after the research of the basic characteristics mutual to all services investigated.

3.5 Methods for Analysis

When analyzing collected information and facts from surveys and interviews different kinds of approaches are available. In our case statistics needed evaluation, pure facts and possible limitations needed attention and interview statements needed deciphering.

Three main strategies of data analysis, concluded by Tukey & Wilk (1966), are:

- Graphical presentation
- Provision of flexibility in viewpoint and in facilities
- Intensive search for parsimony and simplicity, including careful reformation of variables and bending the data to fit simple techniques

As for large-scale data representation, an effective way of making numerical information rapidly available to people is by graphical representation.

When concluding our analysis the previous strategies where used. The result of the analysis can be seen in the conclusion.

4 RESULTS

4.1 Data Collection

The main data was collected via the two online surveys. The interviews conducted after the completion of the surveys functioned as a secondary data source.

4.1.1 Quantitative Survey

Of the respondents 42 % used more than one camera, for example a digital single lens reflex (DSLR) camera and a cell phone with camera; Of the respondents 14 % used three different kinds of cameras. The amount of memory cards used varied but 47 % of the respondents said that they were in possess of more than one memory card.

When removing or copying digital photographs from memory cards, all of the respondents claimed that they initially saved the digital files at home. Of those, 86 % copied the digital photographs to a computer.

More than two-thirds of the respondents, 69 %, claimed that they only printed none to a few digital pictures as illustrated in Figure 4. As for showing and sharing, 84 % said that they used some kind of online service to distribute and share their photographs.

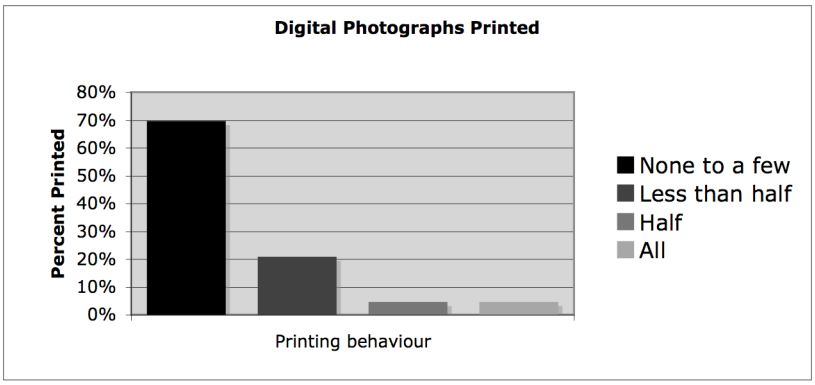

Figure 4: *The table above illustrates the digital photographs printed by the respondents.*

Regarding backup, 93 % of the respondents had at some point bestowed a thought to the possibility that their digital picture archive might vanish without a warning. Despite this, 30 % said that they had not done anything to minimize the risk. As for the rest, the most common way to do backup was to copy the files to a separate HDD, either an internal or an external. Only 9 % claimed that they used some kind of backup service or product.

When asked the question about which storage method they thought was the safest for longterm storage, online server storage topped the list comfortably, followed by optical storage (CD/DVD) and at third place external HDD.

4.1.2 Qualitative Survey

Of the respondents, 81 % stated that they used a program for importing their pictures to their computers the rest did it manually. When we tried to map picture transferring practices, from camera to computer, the results showed that 63 % most often emptied their memory cards when they were full or nearly full; This often resulted in more than one event or photo session stored on the memory card. Regarding backups, 92 % of the respondents that do backups use the internal computer storage as primary storage for their digital photographs. Regarding the backups, 75 % were made on external HDD:s, the rest used CD:s/DVD:s, online server storage or flash memories.

When asked when they do their backups most of the respondents, 75 %, said that they do it sporadically. Of the respondents, 83 % do their backups manually by transferring files and folders onto other storage media. An interesting coincidence is that three out of four respondents, not doing backups, claim that if they were to do backups they would like to do it manually as well. Three out of four, that does not do backups, does not bother to do it; The fourth one said that the thought of doing backups never occurred.

Half of the respondents, 50 %, do not trust server storage. The main reason to this was the integrity issues. On the other hand 56 % stated that they would consider using server storage if it became free of charge even if some of the respondents claimed that they do not trust it.

Of the respondents, 100 % were willing to use a product or service for automatic backup when transferring their digital photographs to their computers, if it would not result in any extra work for them; The economical aspect was disregarded.

4.1.3 Interviews

All interviewed persons, both photo dealers and individuals, concluded that some kind of backup device or service, particularly for digital photographs, could be useful; The dealers made this clear by accentuating on the lack of such a device today; An individual stated that such a product would be great.

Regarding the functionality of the product the photo dealers established that in order to be future-safe the product would probably need to have wireless access. Their argument was that cameras in the near future probably would be equipped with wireless communication. By enabling this feature the transferring process would be much more convenient. The dealers also clarified that the product needs to be simple to setup and use; The out of the box experience is important.

Another idea from one dealer was the ability to sell the product as part of a camera insurance. The idea was not completely elaborated, but suggested that a smaller monthly fee could be paid instead of a bigger once-for-all cost. The product could also be leased with an ongoing service contract included. One dealer stated the following regarding the price, "*The price of a backup product can not exceed the price of a compact consumer camera. I personally believe that the maximum price is somewhere around 1000 SEK, in order to be relatively easy to sell and attractive to ordinary people.*". The same dealer also emphasized on the quality of the product, "*...important is also that the quality not is compromised in favor of the price.*".

In the dealer interview the market were also contemplated and the following was declared, "*Today every additional components, such as memory cards and bags, are hard to persuade consumers to buy. To be able to sell a backup product, together with a camera, it probably needs to be included in some kind of package deal.*"

For the individuals the price was a key issue. The preferable payment method was a once-for-all cost. An interviewee also stated that if the would-be product where to be interchanged for a new updated version at predefined intervals, a lease contract would be of interest. Regarding sharing, one interviewee's interest for accessing pictures and uploading photographs via the Internet was doubtful. The reason for this was the substantial amount of existing online sharing possibilities.

Regarding the backup process one interviewee stated that she did not do any backups and on the following question "*Why?*", the answer was "*Cause I've never lost any data.*". The same person also declared that she only printed some pictures, in order to make collages; The most common practice was to make slideshows and share pictures through Facebook.

4.2 Summary of Online Storage/Photo Services

The following section includes a brief summary of the online services that have been examined. They are not completely equal in their functionality or purpose, but they all possess topical features that can be compared and evaluated. An objective standpoint has been taken when analyzing the services. The services has been selected according to what respondents from the quantitative survey claimed that they used.

4.2.1 Bilddagboken.se

Bilddagboken (The picture diary) is a digital photo sharing service. Users in posses of a valid e-mail can register and start to upload digital photographs. All uploaded digital photographs get compressed to a size of about 25 kilobytes (kB). No editing possibility is available but the pictures can be sent via a Multimedia Messaging Service (MMS) from cell phones. A batch upload of digital photographs is available in a web browser based application. Each digital photograph can also get dated automatically through the metadata.

4.2.2 Dropbox.com

Dropbox is a service primary for storage and backup of digital files, but with some sharing possibilities included. All file formats relevant to digital photography are supported. To get started users only need a valid e-mail in order to sign up. Once registered an application needs to be downloaded, installed and configured once. As soon as the application is running it takes care of all uploads automatically, the user only needs to put the desired files in a predetermined folder on the computer. Multiple picture upload is available.

For the free version a storage quota is given of two gigabytes. The quota can be extended either by recruiting new users (250 MB/user) or by paying for more storage (50 GB - $ 99/year, 100 GB - $ 199/year). Files uploaded are not modified, as for digital photos no compression is made. Dropbox allows sharing to all people, both registered and non-registered.

4.2.3 Facebook.com

Facebook is primarily an online community but it also has a photo album feature. Users in posses of a valid e-mail can register to Facebook. The photo album feature allows users to upload, organize and sort their digital photographs into albums. All the uploaded digital photographs get compressed into low-resolution files. To be able to upload

multiple pictures a batch uploader is available for download. Pictures can also be uploaded via smart phones.

4.2.4 Flickr.com

Flickr is a service mainly for sharing of digital photos but it also has some storage features. In order to sign up users need to have a Yahoo-mail or a Yahoo-ID, those can however be registered for free. No application needs to be installed in order to use Flickr. The file formats supported are the standard digital compressing picture formats, such as Joint Photographic Experts Group (JPEG), Tagged Image File Format (TIFF) and Portable Network Graphics (PNG). Multiple picture upload is partly supported in the web interface, no folder upload is possible. All uploaded digital photographs are stored in their original size but only paying users can access their originals. Non paying users can only access compressed 680x1024 pixels versions of their pictures. Non paying users has a uploading limit set to 100 MB/month.

Flickr also holds an online editing feature and an automatic feature for sorting pictures by metadata. A web-browser based manual geotagging function and a downloadable application for multiple picture upload is also available. The geotagging can also be made automatically by the metadata provided.

For paying users ($ 25/year) unlimited storage and access to their uncompressed originals are available. All advertisements on the site are removed as well.

4.2.5 Picasa.com

Picasa is a storing and sharing service only for digital picture files. Users only need a valid e-mail to sign up. The files uploaded are not compressed if not chosen to be and the standard digital compressing picture formats are supported. The total amount of available space is 1 GB but upgrading of the storage capacity is available. Paying users can upgrade to 20 GB storage capacity for $ 5/year; There are also larger capacities available up to one terabyte (TB) for $ 256/year. No editing possibilities are included but a geotagging feature, a semi-automatic face recognition feature and a slideshow function is present. A batch uploader is also available for download.

4.2.6 Storegate.com

Storegate includes both storing and sharing of digital photographs. All formats relevant to digital photography are supported. The files uploaded are not modified and a possibility to upload multiple files at the same time is included. Storegate also has an album feature where users can create, organize and share albums with their digital photographs. To register users only need to have a valid e-mail; Once registered no extra software is needed to upload pictures. Each user get 1 GB of free storage but with no automatic backup feature. Storegate also has a paying option where users obtain automatic backup and receive 25 GB of storage (25 GB - $ 8/month).

5 ANALYSIS

5.1 Data

5.1.1 Quantitative Survey

First of all no sustainable longterm storage and backup has been prioritized by the major part of the respondents. Less than 30 % print a substantial part of the digital photographs they capture. As for longterm storage, paper copies made on proper photo paper has a lifespan between 50 and 200 years, if stored right. In comparison to photo paper an average consumer HDD gets obsolete more rapidly. On the other hand, data stored on a HDD is in higher quality and does not suffer any information fade as long as it is still intact.

Worth noticing is that 7 % of the respondents stated that they had never thought about that their digital photo collection might vanish without a warning, for example due to a HDD crash or similar. A major part also stated that they, despite the thoughts about the risk, had not done anything to prevent a loss of their digital photographs; This is remarkable for us.

Another trend that has crystallized out of the survey is that a lot of people use Internet to show and share their digital photographs. It is not that common though to use Internet and online services for backup, even though online server storage topped the list of safe longterm storage among the respondents' answers.

5.1.2 Qualitative Survey

The qualitative survey made it clear that people transfer their digital photographs from the camera to their computer for primary storage. For backup and secondary storage an external HDD is most often used. Interesting is also that a substantial share of the respondents used some kind of program when importing their digital photographs. As a contradiction to the former no one of the respondents doing backups has a systematic way of doing it. Most of the respondents do their backups manually; No program or service is used to ease the process.

An interesting contradiction to what is said about how backups are made, according to the results, is the statement where all respondents say that they would use a product or a service that would do backups automatically if it did not generate any extra work when transferring the digital photographs in the first place.

The fact that almost half of the respondents claimed that they do not trust to store digital photographs online, mainly because of integrity issues, is remarkable. The same method topped the list over reliable longterm storage in the quantitative survey. This elucidates that the integrity issue is as important as the reliability of the technology when it comes to consumer trust. These issues though, become less significant if the service is free of charge.

5.1.3 Interviews

From the interviews with the photo dealers some general points can be made. First of all the price is important, but can under no circumstances jeopardize the quality of the product. Secondly the functionality needs to be proficient and at the same time user friendly in order to make the product desirable for the consumer. Finally the payment method needs to be considered so that both customers and dealers feel that they make a good deal.

From the interviews with the individuals one interesting point can be made regarding awareness and persuasion. Apparently people do not seem to care about doing backups when they have not been victims of data loss. This is an important thing to consider and remember when it comes to promotion for a product used for backup.

5.1.4 Current Storage/Photo Services

The services investigated can be sorted into to three main categories, backup, storage and sharing. Dropbox belongs to backup, Storegate and partly Flickr to storage, and the rest including Flickr are primarily devoted to sharing. Three of the services can be used completely for free, while the other three has a free and a charged version. From an interactional point of view, Dropbox with its simple interface and seamless uploading function were very user friendly. All services that some how took use of the metadata, included in the uploaded files, allowed a convenient filtering when browsing through all uploaded files. Dropbox do not possess the former filtering feature.

A problem for all services though, was that they were kind of technically demanding. From our point of view this could perhaps restrict the use of these services for people who has not got basic computer knowledge. Some people in our target group would most certainly not be able to use any of the services evaluated.

5.2 Criteria for a Photo Backup Product

5.2.1 Technical Criteria of "The Black Box"

The technical specification of the Black Box is tailored to reach high sustainability when it comes to longterm storage. All earlier mentioned factors regarding individuals and known technical problems are taken into consideration. For starter the box could be made up of two mirrored solid-state drives (SSD), supplied from different manufacturers, and setup with RAID 1. By doing this, the fault independence assumption is taken into consideration since the drives are coming from separate manufacturers. SSD:s are chosen to minimize the media faults caused by vibrations or shocks; However, SSD:s are today, in the year 2010, more expensive than HDD:s why HDD:s could be used instead to keep the cost down; This will though decrease the reliability of the device. The RAID function makes sure that all data is duplicated and stored on the two separate drives. The box could also be equipped with self-scanning in order to detect possible disk faults on sectors or sections; This minimizes the risk of having latent faults hiding on the drive.

Regarding connectivity the Black Box is supposed to have two USB-ports, a network port and a WiFi-connection. The box can constantly be connected to a computer via one of the USB:s, while the other one can be used to hook card readers and other external interfaces to the box. External card readers are preferable since "*updates*" to new types of memories are made easier; Only the reader needs to be exchanged. The WiFi enables the box to be connected to a home network and enables cameras with wireless access to connect directly to the box.

5.2.2 Product Concept of "The Black Box"

When finding criteria for the Black Box focus was on designing a backup device that runs automatically in the background. Many parameters were considered and processed when finding the criteria. Our main conclusion is that the Black Box should be of no vexation for the user; Otherwise they will not use it. In fact the product should not even be noticed at all until it is needed to restore photographs lost for some reason.

The Black Box is supposed to be in the same price range as a digital consumer camera. The reason for that statement is that probably no one would buy a backup solution for photographs that hopefully never will

be needed, for a price exceeding the price of their camera. In comparison, why would someone pay an insurance fee exceeding the value of the item insured? Further the Black Box needs to be in the same price range and of the same capacity as an external HDD. This is necessary since the user may otherwise start to consider buying an external HDD instead, in assertion of doing the correspondent backups manually. Our study shows that the target group most certainly would not do manual backups consistently.

Regarding functionality the Black Box has to be extremely user-friendly meaning that it is to work right out of the box. The need for plug and play is essential due to the target group's computer skills. The product should not add any extra steps when transferring pictures from a camera to a computer; It is supposed to run in the background and automatically backup all pictures transferred. When connected for the first time the box should scan the entire computer and copy the digital picture files found.

The metadata of the photographs transferred to the Black Box should be examined and indexed upon together with the date of the transfer. The former is to ease a search for a specific picture if needed later on. The Black Box should also work with a camera connected directly to it, for people without computers. The need for a memory card reader is of essence and an external one may be the best pick to keep the Black Box as clean and simple as possible. Another reason is that we do not want to restrict the Black Box only to specific memory cards. It would be better to make it compatible with as many memory card readers as possible instead to ease for new card standards.

Another feature the Black Box is supposed to possess is sharing of disk space with other users thus creating geographical spread for further prevention of data loss. The sharing feature should share an eligible amount of disk space of the Black Box with another user. The meaning is to conclude a synchronization of the users boxes making all their digital photographs stored on two boxes at two different locations. The synchronization is supposed to be performed over the Internet whenever the Black Box senses that the Internet connection is not in use, or just partly in use. The point of that feature is to not interfere with the user's ordinary use of the connection. Photographs stored on someone else's box should not be accessible for that user, which is to prevent peeping on photographs you're not supposed to. The only thing a user, not owning the photographs, should be able to see regarding the sharing is

the amount of shared space to keep the sharing confidential and trustworthy. The sharing of space function is only to secure the backup, not to share photographs.

6 DISCUSSION

6.1 Data Collection

In research a major problem to deal with is the problem of getting the respondents participating to represent the entire target group. This gets typically clear when the total amount of respondents only constitutes a very small percentage of the target group. In our study we had 43 participants in the quantitative survey versus 16 in the qualitative, which aimed to represent a target group consisting of consumer and hobby photographers in Sweden. Noticeable is also the fact that a majority of the respondents had a broader technical knowledge, than an average person from the target group. These two factors need to be kept in mind when looking at the results, analysis and conclusions of the study. If a similar investigation were to be made, the amount of participants and their background could be something to consider more.

6.2 Objective of the Thesis

The part in the objective of the thesis concerning how future generations would be affected by the digital revolution is still not completely answered. The time span from the beginning of the revolution till today is yet to short for analysis; The digital revolution is still in progress. In the next five to twenty years a more reliable and clear picture will have crystallized; Then a new investigation needs to be carried out in order to answer the question.

6.3 Existing Backup Devices

In the overhaul of existing backup services, no backup devices were examined in detail. The reason for this is that most of the devices we came across were not directed to our target group or fitted the objective. The devices were either too expensive or technically demanding, did backup of entire systems or just seemed ambiguous. Since this standpoint were taken in such an early stage it might have led to that devices that could have been of interest got disregarded too early.

6.4 Economical Delimitation Contradiction

One of the demarcations drawn, in the beginning of this thesis, focused on the economical boundaries for consumers. In our proposal of the potential “Black Box”, solid-state drives are suggested as storage drives. This might look like a contradiction to what is previously stated

about the consumers' price range. Solid state drives sold in the year 2010 would exceeded the budget by far; As we see it the price of the drives will most certainly drop in the near future and the SSD:s could then be implemented in the “Black Box” without interfering with the budget.

Another budget interference, regarding the potential Black Box specification, is the suggested WiFi-connection. The WiFi-connection could cause a budget infraction, but as for the future WiFi-networks will probably constitute an even bigger proportion of the information technology infrastructure; Because of that it is likely to believe that the price of the components will drop.

7 CONCLUSION

This thesis began from the standpoint that historical flashbacks has been made possible thanks to graphical representations of events and stories stored on sustainable media. Today, year 2010, the gathering of new mementoes is most often made with digital cameras; The mementoes are stored digitally on media with erratic life-span, why preservation of the former need to be considered. The aim of this thesis was to investigate how individuals store and backup their digital photo collections and also to find criteria for a photography backup product to ease the longterm storage issues. To investigate how individuals show and share their digital photographs was also of interest.

7.1 Storage and Sharing of Digital Photographs

People seem to pay very little attention to sustainable longterm digital storage. This symptom is clearly related to lack of time, interest, economy and knowledge. Backups of digital photographs are commonly made completely manually and sporadically, while trans-fers are made more frequently and with the help of software. The diff-erence in frequency between the two tasks probably has to do with the rewards gained. Transferring digital photographs nowadays has replac-ed the former developing step, but generates the same kind of reward (i.e. you get to see your pictures). Backup on the other hand does not generate any immediate reward and can be compared to the reward gained when buying an insurance (i.e. no reward until some-thing bad happens).

Because of the enervated behaviour for backup a lot of different services are available to ease this procedure. The problem though is that they are time consuming and/or technically demanding.

When it comes to showing and sharing of digital photographs individuals like to use fast and easy online sharing services like Facebook and Flickr.

7.2 Consequences of Storing Photographs Digitally

A part of the objective was to determine how future generations would be affected by the risk that their documentation of them probably only will be available in digital format.

It is not easy to foresee how future generations will be affected by the fact that they might only be represented digitally. One can only guess that it could be fatal if no sustainable storage is used when only a few pictures are printed. In our study we conduct that people tend to print less digital photographs, but accumulate more; This is of course due to the conversion to digital photography. Because of all the previous mentioned factors concerning digital storage it is important to transfer digital information onto the latest storage technology as they come. The worst thing you can do is to store digital files on the same removable media over a long period of time.

We conclude that a safe and reliable alternative medium for longterm storage of digital photographs still is the photo paper; No digital medium can compete with its life span; Pixels in the shape of binary data are not human readable.

7.3 Contribution

After completion of our study we claim that there is need for a backup product holding criteria like the ones stated earlier in this thesis. Our suggestion is a backup device that stores extra copies of all digital photographs transferred either to a computer or directly to the product itself. Technical features that could be included are:

- Multiple storage media (from different manufacturers)
- Self-supervision of the storage medium
- Mirroring of the storage medium
- External removable media reader support
- Wireless-connection
- Fast wire transfer connection

Functional features that could be included are:

- Automatic function in the background
- Out of the box experience, plug and play
- Slim transfer (no extra steps)
- Geographical spread via sharing of storage media
- Automatic collection of metadata
- Smart filter and indexing
- No unnecessary interference with the host system

To get consumer photographers to use and enjoy a service for backup it has to have plenty of automatic features, be reliable, be simple to use and have a reasonable price. To make sure that data are protected against human errors, the user interaction with the product should be as little as possible. For deletion or advanced back-end commands a root user or super user should be needed.

Today digital photo collections are partly managed with the help of software. Computer hard disk drives are the main storage medium and backups are mainly made sporadically on external HDD:s. These are not sustainable procedures for preserving digital photographs for the future.

We hereby summarize this thesis by the following statement by Ken Parulski, chief scientist at Eastman Kodak, IS&T's PICS Conference, 2003; "*Preserve your digital memories and make your favorite photos human readable. Do not wait until it is too late.*".

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APPENDIX

A: Quantitative Survey Questions

This appendix includes the questions from the quantitative survey. The order of the questions is the same order as the original survey. The question were stated in Swedish but is here translated into English. The unnumbered sub lists represents the choices given; The questions with an "M" after are of multiple choice, the ones with an "S" are single choice questions and the ones with a "T" after are text field inputs. All the "Other:"-options are text field inputs.

1. Age? (T)
2. Gender? (S)
    - Female
    - Male
3. What type of camera/cameras do you use? (M)
    - System camera
    - Compact camera
    - Other device with camera such as mobile phone, mp3-player, web camera etc.
4. How many memory cards do you use? (T)
5. How many of your digital photographs do you print at a photo dealer or via an Internet service for photo prints? (S)
    - All of them
    - More than half
    - Half
    - Less than half
    - A few
    - None
6. How many of your digital photographs do you print yourself at home via for example a photo printer? (S)
    - All of them
    - More than half
    - Half
    - Less than half
    - A few
    - None

7. When do you empty your memory card? (S)
    - After each photo session
    - Once a month
    - Once a year
    - Never
    - Other:
8. If you save your digital photographs at home, how do you save them? (M)
    - Computer
    - External hard disk drive
    - CD/DVD
    - USB-memory
    - I do not save my photographs at home.
    - Other:
9. Do you use any online photo sharing service? (M)
    - Flickr
    - Facebook
    - I do not use any photo sharing service.
    - Other:
10. Do you use any program like the following to administrate your digital photographs? (M)
    - Adobe Lightroom
    - Aperture
    - Adobe Bridge
    - iPhoto
    - No, I do no use any program.
    - Other:
11. Do you use any separate online backup service? (S)
    - Yes
    - No
12. Which service do you use? (If the answer was “Yes” in the previous question.) (T)

13. How long do you expect the life span of an average hard disk drive to be? (S)
    - o Less than 1 year
    - o 1 – 3 years
    - o 3 – 6 years
    - o 6 – 9 years
    - o Longer than 9 years
14. Have you ever thought about the risk that your digital archive might vanish? (S)
    - o Yes
    - o No
15. Have you done anything to minimize the risks? (M)
    - o Done backup on a separate internal hard disk drive.
    - o Done backup on an external hard disk drive.
    - o Done backup on CD/DVD.
    - o Done backup on USB-memory.
    - o Done backup on online.
    - o No, I have not done any backup.
    - o Other:
16. Which of the following media used for backup do you think is the safest? (S)
    - o Internal hard disk drive
    - o External hard disk drive
    - o CD/DVD
    - o USB-memory
    - o Online server storage
    - o Other:

B: Qualitative Survey Questions

This appendix includes the questions from the qualitative survey. The questions are in the same order as in the original survey. The question were stated in Swedish but is here translated into English. The un-numbered sub lists represents the choices given; The questions with an "M" after are of multiple choice, the ones with an "S" are single choice questions and the ones with a "T" after are text field inputs. All the "Other:"-options are text field inputs. The survey includes three different sections, one general section for all participants, one for participants doing backups and one for participants not doing backups.

General Section

1. Age? (S)
2. Gender? (S)
    - Female
    - Male
3. Which type of camera do you use the most? (S)
    - System camera
    - Compact camera
    - Other device with camera such as mobile phone, mp3-player, web camera etc.
    - Other:
4. Which photo-session scenario fit your practice best? (S)
    - Relatives are coming over for a visit. You find your camera in the drawer, capture a few photographs and then you put it back in the drawer. You only empty the memory card when it is jam-packed.
    - You are going to an event, the camera battery is fully charged and the memory card is empty. You capture a picture series and when you come home you empty the memory card onto your computer as soon as possible.
    - You grab your camera and head off to the next event; Before you go out of the door you check that the amount of available pictures on the memory card is enough. Later when you empty your memory card there are pictures from different events stored on it.
    - After a successful photo-session you go directly to a photo dealer to get your digital photographs copied onto a CD/DVD. Since you are already there maybe you'll order photocopies of your digital photographs as well.

5. How do you import you photographs to your computer? (S)
    - I use a program (like Bridge, Lightroom, Aperture, iPhoto etc.).
    - I use the operating system's embedded function for picture transfer.
    - Nothing of the above, I do my picture transfer manually.
6. Do you perform backups of your digital photographs? (S)
    - Yes
    - No

Performing Backup Section

1. Which is your primary storage of your digital photographs? (S)
    - Computer (internal hard disk drive)
    - External hard disk drive
    - CD/DVD
    - USB-stick
    - Server storage (online)
    - Network hard disk drive (Network Access Server NAS)
2. Which is your secondary storage of your digital photographs? (S)
    - Computer (internal hard disk drive)
    - External hard disk drive
    - CD/DVD
    - USB-stick
    - Server storage (online)
    - Network hard disk drive (Network Access Server NAS)
3. Do you have any more backups than the previous mentioned storage? (S)
    - Yes
    - No

4. When do you perform your backups? (S)
    - In connection with the transfer from the memory card to the primary storage of the photographs.
    - It's an automatic backup (i.e. NAS or server storage).
    - More sporadically when I feel for it and got time for it.
    - At predefined intervals (i.e. Once every month etc.).
5. How do you perform your backups? (S)
    - I use a photo software like Lightroom or iPhoto.
    - I do it manually with the help of the operating system and copy folders/photographs to other media.
    - I use a special backup software.
6. Would you consider using a product or service that perform backups of your digital photographs automatically when you transfer your digital photographs to your computer? (S)
    - Yes
    - No
7. Do you trust server storage? (To have your digital photographs stored online) (S)
    - Yes
    - No
8. What is the reason that you do not trust server storage (if you answered "No" in the previous question)? (S)
    - I do not like to send files including personal content over the Internet.
    - I am afraid of hackers stealing my digital photographs from the server.
    - I do not trust the companies providing the online server storage services. (ie. How do I know that the company does not steal my digital photographs?).
    - I do not trust that the services deliver what the companies say.
    - Other:

9. Would you consider using online server storage? (M)
    - Yes, if it become cheaper.
    - Yes, if it become free of charge.
    - Yes, if it was easier.
    - No, it is to complicated.
    - No, it is not of interest.
    - No, it seems unsafe.

10. If we eventually want to ask you some follow up questions, would that be ok? In that case submit your email in the text field.
    - Other:

Not Performing Backup Section

1. Would you consider doing backups to minimize the risk of losing you digital photographs? (S)
    - Yes
    - No
2. If you were to do backups, how would you do it? (S)
    - Manually on external media (external hard disk drive or CD/DVD).
    - Automatically on external media (external hard disk drive or CD/DVD).
    - Manually online server storage (manual upload to server storage).
    - Automatic online server storage (the computer performs the upload automatic).
3. Why is it that you do not perform backups? (S)
    - To complicated.
    - Unnecessary, I trust my computer.
    - Do not bother to do it.
    - Economical reason, to expensive.
    - I have not even thought about it.
    - I do not know how to do it.

4. Do you trust server storage? (To have your digital photographs stored online) (S)
    - Yes
    - No
5. What is the reason that you do not trust server storage (if you answered "No" in the previous question)? (S)
    - I do not like to send personal files over the Internet.
    - I am afraid of hackers stealing my digital photographs from the server.
    - I do not trust the companies providing the online server storage services. (ie. How do I know that the company does not steal my digital photographs?).
    - I do not trust that the services deliver what the companies say they will.
    - Other:
6. Would you consider using online server storage? (M)
    - Yes, if it become cheaper.
    - Yes, if it become free of charge.
    - Yes, if it was easier.
    - No, it is to complicated.
    - No, it is not of interest.
    - No, it seems unsafe.
7. Would you consider using a product or service that perform backups of your digital photographs automatically when you transfer your digital photographs to your computer? (S)
    - Yes
    - No
8. If we eventually want to ask you some follow up questions, would that be ok? In that case submit your email in the text field. (T)
    - Other:

C: Face-to-face Interview "Questions"

This appendix includes the questions that the personal face-to-face interviews were based on. The interviews were of an unstructured nature to keep the respondents comfortable and creative, but a line of argument where kept to keep focus on the subject.

1. Has photographs of yourself, your family and/or friends ever brought you any joy?
2. Can you describe how you usually make use of your digital photographs and how you usually share them?
3. What is your attitude regarding doing backups? (tiresome, fun, etc.)
4. Backups are most often made sporadically, why do you think that is?
5. What is reason to that you do backup the way you do?
6. Could you consider having a device, large as an external HDD, that automatically would backup your digital photographs when you are transferring them to your computer?
7. How much would you be willing to pay for such a product?
8. If you were to use such a product, how would you like to pay for it?
    - Once-for-all cost
    - Monthly charge
    - Lease
9. Would it be of interest for the product to be able to share and/or publish digital photographs online? (you choose which photos you want to share or publish)
10. Would it be of interest for you to be able to upload digital photographs to the product via Internet (i.e. during travels or via the cell phone etc.).
11. If you were to use such a product, would it be interesting if it had a feature for geographical spread via sharing disk space with friends? (Positive, negative, redundant feature?)