UBC Social Ecological Economic Development Studies (SEEDS) Student Report

The Long-Term Sustainability of Paper and Electronic Records. Sumeyye Cakal

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Executive Summary

In the interest of encouraging sustainability and cost effectiveness, there has been a shift from paper means of storage to electronic ones. The “going paperless” trend may seem like it is in line with sustainability initiatives on the surface, but in the long-run it may not live up to such a reputation. In this study, the environmental and financial sustainability of both paper and electronic records was investigated with the interest of determining the better method of storage over an extended period. This was done through a review of existing literature on the topic with an emphasis on finding information related to the positives and negatives of each type of record. A special focus was placed on material regarding the environmental and financial costs of each, as well as on solutions to problems associated with the two. Since both were found to have their benefits and limitations, the results were split into two segments: short-term and long-term. **Records that need to be stored for short periods, or that need to be accessed frequently should be stored in electronic form; while records that need to be stored for long periods, and that don’t need to be accessed frequently should be stored as paper.** The uncertainty with electronic records in the long-term has to do with the issue of migration: keeping old records accessible as new technologies are produced. Though there are projects underway to deal with the problem, there is currently no definitive sustainable solution. Thus in the long-run, paper records have a more certain future and should be preferred despite the ongoing shift to electronic records storage.

Introduction

As electronic means of creating and storing records have become widespread, a move from the prevalence of paper records to electronic ones has occurred. Concerns over sustainability and cost effectiveness have further contributed to this phenomenon and the emergence of the "going paperless" trend. Many believe this trend is in line with sustainability initiatives, but over the course of time it may not live up to such a reputation. This study examines the overall advantage or disadvantage of both paper and electronic records storage. The environmental and financial costs of both methods will be evaluated in order to determine which the more efficient option is over the course of time.

Method

A literature review was conducted; mainly of academic literature, but of a few non-academic sources as well, such as websites, surveys, and pricing for storage. In reviewing the literature, much focus was placed on information highlighting the benefits and limitations of paper and electronic records storage. More specifically, emphasis was placed on information regarding the environmental and financial costs of both, as well as on solutions to the problems associated with the two types of records.

Records and Records Management

Defining records and records management is necessary before moving forward with a discussion on paper and electronic records. According to Association of Records Managers and Administrators International's (ARMA) publication, records management is the systematic control of records throughout their life cycle (ARMA International, 2009b). It typically deals with deciding which records are to be destroyed and which are to be kept for archiving. Records managers also determine the lifespan of a record according to legislation, best practices, and business need in order to decide how long a record should be stored before it is destroyed.

Records, according to this publication, are defined as evidence of what an organization does and include things like personnel files, contracts, emails, website content, and information found in an organization's various databases. They can also be classed into three different groups: ephemera, general records, and archival/vital records (see table 1 below). It is ultimately the organization that defines what they think a record is, and it is their responsibility to make sure that clear guidelines are set to describe what should be kept, and for how long. This will help facilitate the security and authenticity of records.

Table 1
Types of Records

RECORD	DISPOSITION	EXAMPLES
Ephemera	• Can be destroyed without referencing a records schedule as the employee sees fit.	• Spam • Letters of transmittal (fax cover page, cover letters) • Routine correspondence • Telephone messages • Other non-policy informational messages.
General Records	• Must be destroyed according to a records schedule.	• Email • Correspondence • Employee and student records
Archival and Vital Records	• Sent to University Archives for permanent preservation.	• Pension records • Payroll records • Student transcripts • Other records with essential information

Adapted from: University Archives, *Records Management Manual*. Sept. 2007. Manual. Web.

Records managers help to define a records retention schedule, and make sure that all records are sent to appropriate locations. Records management saves money on the costs of both electronic and paper records storage by saving only what is necessary for the appropriate period of time; freeing up valuable space in filing cabinets, closets, basements, and data storage units (University Archives, 2007).

Yet the management of records appears to be a problem with many organizations, especially when it comes to the destruction of electronic records. In a survey conducted by ARMA International on the management of records destruction in highly regulated industries, the shortcomings many of them have with document destruction policies were exposed (ARMA International, 2008). More respondents said that physical records were being destroyed than did those saying that electronic records were *also* being destroyed. Another survey conducted by the same association showed that there is a disconnect between the creation of policies meant to improve information management, and the adherence of employees to those policies (ARMA International, 2009a).

The cost of storage can also increase if more information is being stored than needed. This is especially true in the case of electronic records, which are not managed as well as paper records and are stored in energy consuming data centers that have finite storage space. Accordingly, the management practices required by each type of record are not the same, and can be a factor in determining the overall benefit of using one record type over the other. When it comes to management, paper records are better handled than electronic ones and are therefore more favorable (ARMA International, 2008).

Benefits and Limitations of Paper Records

Paper records are not only managed better than electronic ones, unlike their contemporary counterparts they have a good history of more or less standing the test of time. The invention of what's called true paper is credited to a man named Ts'ai Lun, and dates back to A.D. 105, when it was first announced to the emperor of China (Hunter, 1978). True paper refers to the use of macerated fiber to create thin sheets; where each filament of fiber is a separate unit (Hunter, 1978). Since papyrus and parchment aren't made this way, they technically don't count as paper; though they're similar and have an extensive history that proves them to be long lasting. As one article put it, "paper as the medium for the world's memory has one great advantage, it survives benign neglect well." (Rosenthal et al., 2012). Records that need to be stored for a long time can be stored as paper with the certainty of knowing that they can once again be accessed in a great number of years following.

High-quality acid neutral paper for example can last a century or longer, while microfilm is projected to last 500 years or more (Hedstrom, 1998). Though microfilm is different from paper and won't be mentioned further in this work, the commonality is that both mediums have the advantage of not necessitating the use of the kind of hardware or software needed to retrieve or view material in electronic form (Headstrom, 1998). While microfilm requires the use of a film reader, its overall stability is a feature that doesn't lead to the kind of issues surrounding long-term access to electronic records; a matter to be discussed later in this work (Bellinger, 1998). Additionally, because of their long-term durability and limited accessibility, microfilm and paper make better mediums for storage than they do access (Bellinger, 1998). This is perhaps why electronic records tend to be preferred presently: they are easy to make, store, and share.

Even so, according to research funded by a Xerox corporation in the 90's, paper is still sometimes preferred over electronic records because of its physical properties (Johnson et al, 1993). While there are limitations with conflict of interests in such reports, the authors do have a point in that there's a "tangible persistence" to paper which makes it more preferred to use in some instances. For example, contracts are often printed on paper and stored that way to ensure their security and authenticity. Watermarking and storage in a secure place can further help to guarantee the reliability of these records, especially if they are stored in a facility where handling and retrieval come at a documented cost.

On the one hand, the storage of paper records can be quite expensive, but on the other hand, this expense can be offset by the fact that once records are in storage they can stay there for quite some time with minimal expense to an organization. The expenses tend to be related more to the various services paper storage facilities provide. For example, the storage rates for the University of Pennsylvania includes pricing for things like supplies, the storage fee, fees for

Table 2
University of Pennsylvania Rates Schedule for Fiscal Year 2013

SERVICE TYPE	FEE
I. SUPPLIES • Standard one cubic foot box (10'' x 12'' x 15'') (price includes delivery)	$2.47 per box
II. STORAGE FEE • Per cubic foot per year	$5.64
III. SERVICE FEES	
• Deposit Services	
o Pick-up boxes for deposit……	……$3.60 per box
o Process Incoming Records……	……$3.01 per box
o Interfile Records……	……$2.89 per file
• Access Services	
o Courier delivery of files	
▪ Each file……	……$4.95
o Unscheduled or emergency delivery of files/boxes……	……$23.26 per unit
o Courier pick-up of files	
▪ Each file……	……$4.95
o Prepare requested files for pick-up by department……	……$1.85 per file
o Return of files by department courier……	……$1.85 per file
o Courier delivery of boxes……	……$4.95 per box
o Courier pick-up of boxes……	……$4.95 per box
o Prepare requested boxes for pick-up by department……	……$4.11 per box
o Return of boxes by department courier……	……$4.11 per box
o Retrieve, photocopy and re-file……	……$4.95 per file
o Lookup and telephone information……	……$3.31 per file
o Searched, but not found	
▪ Due to previous removal by customer……	……$4.95 per file
• Disposition Services	
o Office of origin disposition	
▪ Authorization requests	
• For each notification……	……NO CHARGE
o Destruction of boxes	
▪ Certified destruction and permanent removal	
• For confidential records……	……$6.86 per box
▪ Confidential destruction of computer tapes, film and fiche	……$0.52 per pound
▪ Confidential destruction of hard drives……	……$6.00 per drive
▪ Destruction of VHS tapes……	……$0.52 per tape
o Secured destruction replacement bin……	……$11.00 per bin
o Permanent removal of boxes without destruction……	……$4..95 per box
• Special Services	
o Packing boxes for storage……	……$28.99 per hour
o Preparing inventories/box lists……	……$28.99 per hour
o Data entry of departmental records	
▪ By folder heading……	……$28.99 per hour
o Photocopies ……	……$0.46 per copy
o FAX transmissions……	……$1.55 per page

Adapted from: University of Pennsylvania. "University Records Center Rate Schedule for Fiscal Year 2013." *Archives.upenn.edu. 2013.* Web.

access services, disposition services, and special services (University of Pennsylvania, 2013). Prices range from $0.46 per copy for photocopies to $28.99 for packing boxes for storage, preparing inventories/box lists, or data entry of departmental record by file folder heading. A standard one cubic foot box (10" x 12" x 15") costs $2.47 including delivery; the storage fee per cubic foot per year is $5.64 (see table 2 above for more information on pricing). While these rates are for the University of Pennsylvania, they are fairly close to what the University of British Columbia (UBC) pays with Iron Mountain, the facility UBC uses to store its paper records. It provides similar services to those provided by the University of Pennsylvania, but also includes things like document management and secure shredding (Iron Mountain, N.d.).

Recently, a new contract has been developed with Iron Mountain that will save the university money. Under this contract, all departmental accounts will be under one master account. This will provide monthly savings to all departments using Iron Mountain by eliminating monthly administration fees as well as minimum storage fees (Supply Management UBC, 2011). While this new agreement will save on costs for records to be stored and left untouched, the costs of storing paper in such a facility can be very high if the records need frequent handling.

The environmental costs of this storage must also be considered. A previous UBC SEEDS project found that UBC Supply Management sends about 80 boxes to Iron Mountain each year for storage and that each box has within it about 3,000 sheets of paper (Jackson, Shirazi, and Raad, 2009). According to the authors, all of these records sent to be stored at Iron Mountain are already stored electronically and thus don't need to be stored in the facility or to exist. The total emissions of greenhouse gasses (GHG's) related to the use of Iron Mountain were estimated at 104.05 tons of CO_2 equivalent, where 13.03 tons per year of CO_2 equivalent are directly related to UBC Supply Management's use of Iron Mountain (Jackson, Shirazi, and Raad, 2009).

The authors suggest that UBC discontinue use of Iron Mountain to achieve a total of 104.5 tons of CO_2 equivalent reduction per year, or to at least put a procedure in place to ensure that a box or set of boxes is removed after 7 years; the amount of time that they are supposed to be retained there in the first place. If UBC

Supply Management ceased using Iron Mountain not only would it save on emissions, but the total costs associated with use of Iron Mountain, which amount to $5,839.04 per year if paper costs are added in, would be eliminated (Jackson, Shirazi, and Raad, 2009). However the assumption in this report, that electronic storage of these records is sufficient and preferred, is worth challenging. Electronic records are not as sustainable as they are often made out to be and the environmental and financial costs of using this means of storage overtime are important to consider.

Benefits and Limitations of Electronic Records

There is an unmistakable shift from the widespread use of paper records to the widespread use of electronic records. The present predicament with records is unique in that for the first time in 3,500 years there's too much information being produced, and much of that information is being stored in an intangible way (Cook, 2007). While the tangible properties of paper are beneficial for some things, they can be limiting for others. Electronic records are made in such a way that they are easy to create, share, and to dispose of; it is their intangible nature that makes them so. For this reason electronic records are much more practical than paper ones. Almost all the sources used in this report for example were found online and read electronically; this document was created and typed electronically, and it was saved electronically; all while saving on the burden of carrying the number of physical sheets of paper this endeavor would equate to.

One of the draws of using electronic records is that they don't take up as much physical space as paper records do. The physical space it takes to store a certain amount of information in paper form is greater than the amount of physical space it would take to store that same amount of information in electronic form. The average 8 ½ " x 11" sheet of paper requires 50 KiloBytes of electronic storage space and 20,000 letter sized pages requires 1 GigaByte (Gilheany, N.d.). Many laptops can hold several hundred gigabytes of storage which could equate to several millions of pages; all of which can be stored in approximately the same amount of physical space needed by a notebook of a few hundred physical pages. Not only does this save in the production of that many sheets of paper, but it also saves on the costs of destroying and/or recycling that paper; something paper storage facilities charge for. Assuming that the devices used to make the records are a constant that would be present and running regardless of whether a record was made, the creation, storage, and destruction of an electronic record would come at little cost, both environmentally and financially.

Even with this, however, the dependability of electronic records is a significant issue which if compromised could lead to big costs and problems for an organization. A paper by Zhu and Hsu (2005) examines the reliability of records stored electronically and the methods that can be used to keep them reliable. While the authors point out the positives of storing things electronically, they show that in order to maintain reliability these records need to be managed properly and protected from things like misconduct, such as attempts to illegally destroy or alter incriminating records. Write-Once-Read-Many (WORM) storage devices are becoming more and more inadequate for ensuring the trustworthiness of records, and relying on indexes for accessing records can add to the efficiency of altering or deleting them (Zhu and Hsu, 2005).

A fossilized index is suggested to make sure that once a record is preserved it can be accessible in its original, unaltered form (Zhu and Hsu, 2005). The authors use the term "fossilized index" to refer to an indexing method that is invulnerable to records modification, such that once the records are preserved in WORM storage they can be accessed in an unaltered form through the index. While many indexing methods fall short of the requirements set by fossilized records, the *Generalized Hash Tree* (GHT) method fulfills all of them and is thus recommended (Zhu and Hsu, 2005). With this method, inserted records can never be rehashed or relocated, and the possible locations of a record are established by a hash of the record key (Zhu and Hsu, 2005). Yet despite these measures, the overall security of electronic records can still be difficult to ensure, and this is something to consider when looking into their long-term costs and benefits.

The problem is even bigger with storage in the "cloud" according to a paper by Stuart and Bromage (2010). There are quite a few risks associated with using it and the authors call for careful decision making when thinking about whether or not an organization should store records there. Potential risk to an organizations information should be given more weight in the decision making process than the technological aspects of the cloud. It can however be beneficial to use if the lifespan of data is significantly less than the lifespan of the hardware needed to store that data (Rosenthal et al., 2012). In such circumstances, purchasing the hardware can lead to greater costs than any of the risks posed by using the "cloud". In any case, careful management of electronic records is still crucial; both to make sure that only needed records are put into storage and to assign lifespans to those records in order to make sure that they are stored and dealt with appropriately.

However, Electronic Document and Records Management Systems (EDRMS) are only useful so long as they are being adhered to (Johnston and Bowen, 2005). A survey co-sponsored by ARMA International for Cohasset Associates Inc. found that there has been progress made in some of the foundational components of records management in the form of new regulations and a growing realization of the importance of effective records management (Ashley and Williams, 2009). Despite this, the authors found that while there are improvements in things like attaining greater credibility and consistency in life cycle management of electronic records, the organizational risks associated with handling records with electronic archiving and backup media and devices still need to be worked on.

Long-term reliability is particularly important because quite a few problems can arise with the storage of electronic data over an extended period. There are issues with the long-term storage of data from web services such as email, photo sharing, and website archives because not only are there large quantities of such information, but users expect for it to be stored indefinitely and to be easily accessible (Baker et al., 2006). The needs for and threats to preservation, are not just issues for web materials but for any electronic material that needs to be stored for a long time. Though perhaps not all electronic records can be expected to last, there needs to be more clarity as to which losses are acceptable and to be expected (Mason, 2007). The problem with the feasibility of making records last in storage is coupled with that of keeping data centers running sustainably.

Unlike paper storage, much power is needed to keep data centers running and ways to reduce that power use are needed to save on the financial and environmental costs of electronic storage. The IT industry is beginning to recognize this problem and is actively trying to come up with energy conserving solutions for the rising costs and impacts of energy consumption that data centers require (Das et al., 2008). UBC is also working towards this objective with the new data center built into the Pharmaceutical Sciences Building. One of the major goals of this building is to reduce the university's overall carbon footprint (Pini, 2011). This is to be done through use of the buildings energy efficient design and its leading edge cooling technologies (Pini, 2011). The data center will be filled gradually as demand for electronic storage increases and older sites around campus are no longer used (Pini, 2011).

Table 3
Regional GHG Emissions Comparison

CATEGORY	EMISSION INTENSITY RANGE (KG CO2E/KWH)	REPRESENTATIVE PROVINCE AND EMISSION INTENSITY	ANNUAL GHG EMISSIONS FROM 2 MW DATA CENTRE
Low	0 to 0.1	B.C. (0.0172)	301
Medium	0.1 to 0.5	Ontario (0.2207)	3867
High	0.5 and above	Alberta (0.8166)	14,307

Source: Kristina Welch. *Assessing the Business Case for Data Centre Relocations.* Sauder School of Business, University of British Columbia, 2011.

Data centers account for 2% of GHG emissions worldwide and are continuing to grow as contributors (Welch, 2011). Since location can impact the intensity of emissions, a positive for data centers is that they can be located anywhere and can still provide needed services to users; affording the opportunity to take advantage of renewable energy sources to keep centers running (Welch, 2011). To the benefit of

UBC, of the provinces in Canada to have low electricity emissions factors, British Columbia is one of the cleanest (see table 3 above).

In his UBC SEEDS report, Chau (2012) assessed the sustainability of information storage techniques and provided recommendations of how to improve the costs of data storage at UBC. His findings suggest that the new data center in the Pharmaceutical Sciences building should continue to integrate the small data centers across campus in order to take advantage of the buildings sustainable design. He also recommends that a method of records management should be used to reduce the storage of unnecessary information to guarantee that servers can support as much of the demand for storage as possible before reaching full capacity.

Results

Both paper and electronic records have their share of benefits and limitations, and no definitive answer can be made for the preference of one over the other in the long-term. The main reason for this is the uncertainty surrounding the future of electronic records, especially when it comes to preserving them for long periods. For this reason, the results are split into two parts: short-term and long-term. In the short-term, records that need to be stored for brief periods, or that need to be accessed frequently should be stored in electronic form. They are easily created, shared, and disposed of, and they also require less physical space than the paper equivalent of the data they store. However, their long-term sustainability is uncertain, and old records become inaccessible if they're not updated to the newest technologies. Until effective migration strategies are created, records that need to be stored for long periods, and that don't need to be accessed frequently should be stored as paper.

In the long-run, paper is the preferred method of storage. It does not require any software to be accessed, and can thus be stored for a long time and remain accessible. Also, unlike electronic records that need running data centers for storage, paper records, once stored, can remain in storage with relatively little financial and environmental cost. However they are only low for long-term storage because the cost of services and fees accompanying storage in facilities like Iron Mountain can run high if the records need to be accessed frequently or if they only need to be kept for a short amount of time. Paper records are also better managed, which means that most of what is saved is important and is dealt with appropriately.

Conclusion

While electronic records are becoming increasingly preferred to paper, there is need for the development of better management practices and effective migration strategies to ensure that they can be kept sustainable in the long run. Paper still appears to be the more sustainable and reliable option but only for records that need long-term storage. A more definitive answer to the question of the long-term sustainability of paper and electronic records depends on the future of electronic records and whether they can be made to last in a reliable and efficient way.

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