I write, erase, rewrite,
erase again, and then
a poppy blooms.
-Hokushi, 1718[1]

This presentation is purposefully titled "The Measurable Impact of Recordkeeping on the Environment" to highlight a couple things. The first is that sustainable practices are based on the ability to *measure* processes and techniques, or changes to them, in order to accurately identify their impact on the environment. The title is somewhat tongue in cheek. Not only is there a lack of substantial information about recordkeeping's relationship to the environment, but environmental information in general is subject to varying interpretations – as the recent exchange between the *Skeptical Environmentalist* and *Scientific American* can attest.[2]

The second highlight is the idea that recordkeeping actually has some relationship to or impact on the environment at large. Archivists and records managers often view their tasks in a BASF way: "We don't make the records. We make them better."[3] The deference of responsibility to the originating agency clouds the responsibility to act sustainably in two areas. The first of these is the responsibility to deal with the records in our care in a sustainable manner. The second is the responsibility as record policy makers to promote recordkeeping practices that are sustainable.

So perhaps the title really should be "My Best Attempt to Identify Recordkeeping Impacts on the Environment that Are or Could be Measured in Order to Provide Both Technical and Policy Direction." But that wouldn't have fit in the program guide very neatly, would it?

Sustainability isn't just about environmentalism and ecology. Sustainability "focuses on improving the quality of life for all of the Earth's citizens without increasing the use of natural resources beyond the capacity of the environment to supply them indefinitely. It requires an understanding that inaction has consequences and that we must find innovative ways to change institutional structures and influence individual behaviour." The 1987 World Commission on Environment and Development report *Our Common Future*, also known as the Brundtland Report, initiated the modern sustainability movement by expanding what had been traditionally an ecological framework to include both social and economic responsibility.[4]

Sustainable systems contain these four conditions (overhead):

> 1. In order for a society to be sustainable, nature's functions and diversity are not systematically subject to increasing concentrations of substances from the Earth's crust.
>
> 2. Substances produced by society must not systematically increase in nature.
>
> 3. In order for a society to be sustainable, nature's functions and diversity are not systematically impoverished by physical displacement, overharvesting or other forms of ecosystem manipulation.
>
> 4. In order for a society to be sustainable, resources are used fairly and efficiently in order to meet human needs globally.[5]

I'm going to discuss the first three conditions and how recordkeeping affects them. Roy has some thoughts on the fourth condition which he will share in a little while.

Records are a combination of processes and products, many of which are transparent to their creators and custodians. There's no way to present all of the facts and figures associated with recordkeeping, but I'm going to start with what goes into the creation of the archival base unit: a one cubic foot box of paper records. Now we *are* modern archivists, too, concerned with all of the electronic archives created today. But we'll get to that momentarily.

As for the cubic foot of records.

If it's full, it contains about 3000 sheets of paper, maybe 50 folders, and a box. Now that's in one of our fully processed, finding-aided, climate-controlled archives. Who knows what might be in that box out in some office – binders, fasteners, hanging folders, maybe even rodents! But that's a *records management* problem.

This box of records weighs about 40 pounds (more or less, depending on your position descriptions). For paper that doesn't have recycled content, or "virgin" paper, you get about a pound of paper for every two pounds of tree.[6] That means

that this box of records has consumed 74 pounds of wood. It also took nearly 164 kilowatt hours of power and 480 gallons of water to make the paper it contains.[7] The production of this box of records will also create 1.7 pounds of air pollutants, .75 pounds of water pollutants (primarily chlorine), and 3.5 pounds of solid waste. These amounts don't take into account the various types of energy, materials, and machines that were used to turn that material into records.

Goodness! Looking back at the conditions of a sustainable system it seems like an awful lot of natural resources are being consumed by this simple box of records. And not just any resources – trees, energy, and water are particularly *northwest* resources. Perhaps we'd be better off just "going paperless." There aren't any trees cut down to make a compact disk, right?

Well, not so quick. While the trees are generally safe in an electronic world, there are other things to consider. A standard desktop computer – CPU, monitor, mouse, and keyboard – weighs about 60 pounds and contains all sorts of things. The most prominent is plastic, comprising nearly 14 pounds. Each pound of plastic requires 2 cups of crude oil and 50 cubic feet of natural gas to manufacture. So each new computer system manufactured requires 1.75 gallons of crude oil and 700 cubic feet of natural gas. Other big contributors are silica at 15 pounds, iron at 12.3 pounds, aluminum at 8.5 pounds, copper at 4.2 pounds, lead at 3.8 pounds, and zinc at 1.5 pounds. There are numerous trace elements (occupying as much as a half pound in our generic desktop computer) as well: some benign, some toxic.[8]

There is also a variety of storage media – floppy disks, magnetic tape, and optical disks being the most common – which are made with a lot of plastic and a little bit of metal. The chart below (show overhead) compares some of the most common types.

Media	Weight (lb)	Composition	Storage
Tape Cartridge	0.1	plastic, metal	4-40 GB
ZIP	0.25	plastic, metal	100-250 MB
CD/DVD	0.25	plastic or glass	650 MB-4.7 GB
3.5 Floppy	0.05	plastic, metal	1.44 MB

[9]

This same computer will use nearly 420 kWh per year. This is in addition to the energy and water used in computer manufacture. Comprehensive manufacturing figures are difficult to obtain, but it takes about 800 kWh of power and 3000

gallons of water to produce one silicon wafer, from which about 500 chips are made. [10]

Looking back at the sustainable system conditions, this doesn't look like a much better bargain. No trees are being used, but oil, water, energy, and mineral resources are being consumed and toxic wastes are being released on a fairly large scale.

But surely, you're saying, this isn't a result of anything *we* do. Recordkeeping is a necessary function of civilized life. Without records, and the archivists, records managers, and librarians who maintain them for present and future use, the world would lose its evidential base. You can't just stop making and preserving records, right?

There is no reason to think that recordskeepers cannot make positive changes in the way that they use natural resources and still maintain adequate documentation. When looking at recordkeeping practices and their impact on the environment, we can view them through the lens of that old environmentalist chestnut: "Reduce, Reuse, and Recycle."

Reducing the tsunami of records created is one of the most beneficial and difficult to achieve actions recordskeepers can take.

The average office worker uses 12,000 sheets of paper during a year. That's about 4 cubic feet of paper records per worker per year.[11] Much of this paper is simply unnecessary. It ranges from copies of paper records to unrequested and unwanted reports to printed copies of electronic records. By some accounts each original record is the source of 19 copies. Now that seems like one of those apocryphal statistics dredged out of alt.urbanlegends, but the following case study was cited in the City of Portland's *Green Office Guide*:

> The Multnomah County Circuit Court evaluated the printing of dockets—the daily listing and schedule of Court hearings. They were photocopying approximately one million pages of dockets per year before they eliminated unnecessary data and changed the font size. That allowed them to double the number of cases per page. They found that not everyone they were sending dockets to needed them and others preferred to view them on-line (and only print out the relevant pages). They also copied some dockets using both sides of the page. Combined, this cut their paper use by almost 70% and significantly reduced staff time required to copy and distribute dockets.[12]

So it looks like the elimination of unnecessary copies could significantly reduce paper use in a given office. This has concurrent benefits. The need for file cabinets, folders, labels, heated and lighted office space, climate controlled warehouse space, shelving units, and distribution costs are all reduced when storage requirements decrease.

But why stop with a 70% reduction? Why not eliminate all paper use and usher in the much anticipated but unrealized paperless office? While it sounds enticing, you might want to double-check that particular apple. Shifting records storage from paper to some sort of electronic storage will definitely save trees. But it also requires a significant investment in computer hardware and storage media.

As we've seen earlier, computers take a lot of resources to make and also require significant power to keep running. Consider the fact that the average life-cycle of a computer is currently three years (and is projected to be one year by 2005[13]). Also, most magnetic media have a relatively short lifespan. Add these together and the costs of maintaining records in electronic form don't look much more sustainable than paper. Reducing records maintained in electronic form may not have a significant effect in maintaining sustainable systems, however. The storage component of computers is relatively small compared with other components, especially the display and the circuitboards. But given the huge number of computers and storage media in place (43 million new computers were shipped in 1999) even small reductions in use would be significant.

Reusing objects is usually thought of in the context of the object itself. You have a mayonnaise jar and when it's empty you store nails in it. But recordskeepers have the ability to provide reusable content **and** objects.

Besides the records themselves, the most common reusable items related to paper records are folders and boxes. At some point, these items will break down to a point where they are no longer useful, but many of them are recycled long before their useful life is over. Other records related items include binders, fasteners, and cabinets and other storage systems. Some of these items can be reused within an organization. Even if they cannot, there may be others who would find them useful. In some cases, duplicate records or records that are not wanted by the organization that holds them may have an effective second life in another organization. The key is to squeeze whatever useful life an object has before recycling it or sending it to the landfill.

Electronic records also have reusable components. Computers and their associated drives, monitors, printers, modems, and cabling may have much longer useable lifespans than their original organization may recognize. The average replacement cycle for computers in an organization is three years. But many of these components can be used for much longer. Maximizing the useful lifespan of these items is especially important. Computer components do not recycle well and often just end up in landfills. Electronic media are highly reusable for their intended lifespan – magnetic drives, rewriteable optical drives, audio and videotape – but that lifespan is fairly short. Jewel cases, cassette holders, and other packaging should be reused, too.

The records themselves also can provide multiple uses for the information they contain. We all work with records that have probably long exceeded the lifespan their original use warranted. But they have become valuable for other uses or for other uses. The ability to use this information repeatedly reduces the need for people to recreate it.

Paper recycling has been one of the most successful sustainable practices related to recordkeeping. Many record programs regularly recycle paper records that have either exceeded their legal retention period or have been removed from archival collection due to processing. Compared with producing virgin paper, producing recycled paper requires 70% less energy and 55% less water, produces 35% less water pollution, and reduces the amount of paper entering landfills (which currently totals over 40 percent of total used paper). That means that a medium-sized Records Center and Archives like Multnomah County's, which recycles 47 tons of paper per year, can provide annual savings of 86.5 tons of wood, 620,000 gallons of water, 263,000kWH of power, and 47 tons of landfill waste. Based on the figures for my small house, that would provide enough resources to build 9 houses, give all of them water for nearly 5 years and power for 18 months. And I have *two* teenagers in my house![14]

True recycling requires the **use** of post-consumer recycled paper as well. The most common type of paper used contains 30% post-consumer content and 70% virgin paper. While pulp trees are sustainable in the long term, paper can only be usefully recycled about 5 times before its fibers become too shortened for office quality paper. An interesting corollary is the fact that shredded paper is actually much less recyclable than sheet paper because it shortens the paper fibers prematurely.

In the United States, since 1975, the volume of paper that is recycled has tripled to 43%. But the use of paper has expanded so much that more total paper is sent to landfills now than was sent 25 years ago. So even with the increased awareness of and commitment to

recycling, a combination of better recycling and reduction in use must occur to reduce actual waste.

The use of recycled paper for records intended for permanent storage has met with some resistance. The archives and library communities have recommended (and in some jurisdictions, required) the use of “permanent paper” for publications and records that have an expected long term lifespan. Permanence is defined in ANSI/NISO standard Z39.48-1992 as “the ability of paper to last at least several hundred years without significant deterioration under normal use and storage conditions in libraries and archives."[15] In general, most recycled papers meet the acidity requirements for permanent paper, but fail some durability tests. While there may be some items – publications and some archival records – that might warrant the use of permanent paper, recycled paper is generally acceptable for most records, including archival records.

Recycling computer components is significantly more problematic. In 1999, 24 million computers were removed from service. Of these, only 14% were recycled or donated. The remainder were either landfilled, put into storage, or shipped abroad as waste exports. Additionally, computer monitors are also notoriously difficult to recycle. 300 million monitors have been sold since 1980. In 1997, only 1.7 million were recycled, with 1 million of those being shipped abroad for precious metal salvage.[16] The primary problem with recycling is that there are few parts of a computer that can be safely and effectively recycled. Remember the composition of a computer. Many of these materials are difficult and expensive to recycle. Landfilling them is not a good solution either. Many of the toxic chemicals will leach through landfills, endangering water systems.

Even those computers and components that are “recycled” may not be benefiting the *global* environment. A report released two months ago, *Exporting Harm: The High-Tech Trashing of Asia*, notes that “[w]hile there are efforts to divert E-waste from landfills, via "recycling", electronics "recycling" is a misleading characterization of many disparate practices -- including de-manufacturing, dismantling, shredding, burning, exporting, etc. -- that is mostly unregulated and often creates additional hazards itself.”[17]

What is actually happening in many so-called takeback and recycling programs is that between 50 and 80 percent of the computers received are shipped to developing countries. This equals between 6.5 and 10 million units shipped from the United States in 2001 alone! There, workers break apart and process components. This means a variety of scraping, hammering, stripping, and acid-bathing processes to retrieve anything of use

and then burning of the remaining components. The report is sobering – especially to those who see computer recycling as an effective sustainable activity.

Recycling electronic media is equally problematic. 4.5 billion CD-R's and DVD-R's were sold worldwide in 2001. This amount is expected to grow at a rate of roughly 50% per year for the foreseeable future.[18] Including jewel case, these disks contain about 4 ounces of material, primarily plastics, a little metal, some paper, and plastic packaging. Other types of removable storage – 3.5" floppies, zip disks, and DAT tapes being the most common – are similar in composition. With an effective lifespan of less than ten years, just the optical disks will contribute over 500,000 tons of unrecyclable material to landfills annually. I suppose that uses as coasters, sun-catchers in cars, christmas tree ornaments, or mobiles might reduce that slightly, but probably not enough to make a significant difference.

The reality of computer and storage media recycling is important to recordskeepers. 84% of all original information created in the United States in 1999, about 1.7 million terabytes, was created in optical or magnetic form. This amount is estimated to grow at roughly 50% per year.[19] Recordskeepers used to maintaining paper will be faced with maintaining records in electronic formats for varying periods of time. Most strategies for maintaining these records for the medium or long term, say longer than 10 years, require the periodic migration of records to "fresh" media. What will happen to all of the discarded, "stale" media? Under current and projected disposal practices, it will be sent to landfills.

Many sustainability experts add a fourth "R" to the mix: "Rethink." In my mind, rethinking involves a look at current recordkeeping processes and impacts with the intent of altering them to better conform to a sustainable system model.

Let's look at the sustainable systems conditions again [overhead].

There are any number of recordkeeping practices that could be discussed here. I'd just like to point out three that jump out at me.

The first is the notion that paper recycling addresses the impacts of recordkeeping on the environment. While recycling is an important part of a sustainable system, it demonstrably cannot keep up with the increased paper flows created in organizations today. What is needed is some way to reduce the number of documents entering the recordkeeping stream. Many documents created are unnecessary copies – printed reports

that nobody wants, photocopies, printed versions of electronic records, and many other conveniences. Recordskeepers often sell recordkeeping efficiency in terms of effective information retrieval and storage costs. We need to couple that with sustainability, so that records creators understand the impacts of their practices on the environment.

The second is a related concern. Records creators should attempt to limit the number of times a record is migrated. Whether that migration is from paper to microfilm, from 5 inch floppies to DVD's, or from photographs to digital images, migration creates wasted resources and energy, both material and human. Identifying the prospective lifespan of a record is part of our work. Matching that lifespan with an appropriate medium is our work as well. Records creators should be made aware of the impact their choices have on the environment.

Third is the computer – the elephant in the living room. Recordskeepers cannot ignore the negative impact of the computer on the environment – it's cost in materials and energy, it's role in air and water pollution, it's limited recyclability – in a world where computer records creation far outstrips any other kind. I don't want to suggest some Luddite rejection of the computer as a records creation and storage device. What I *would* like to suggest is that until computer makers manufacture computers that fit into sustainable systems, recordskeepers have a duty to minimize computers' negative effects on the environment.

In "Green Archivism," our own Todd Welch suggested that "Archivists need to encourage the preservation and use of records containing information related to natural processes and events and their consequences" as a vital resource for environmental researchers.[20] It is just as vital that recordskeepers rethink the role of recordkeeping in relation to the environment and see it as a contributory process and not just a documentary one.

Thank you.

[1] In this poem, the translator notes that Hokushi is commenting on both the notion of renewal and on the triumph of nature (poppy) over technology (writing). See Yoel Hoffman (compiler), *Japanese Death Poems: Written by Zen Monks and Haiku Poets on the Verge of Death*, (Boston: Tuttle Publishing, 1998), 190

[2] See both Bjorn Lomberg, *The Skeptical Environmentalist: Measuring the Real State of the World* (Cambridge: University Press, 2001) and "Misleading Math about the Earth," *Scientific American* (January 2002), 61-71.

[3] This should not be confused with BASF's registered trademark: "We don't make a lot of the products you buy. We make a lot of the products you buy better®."

[4] "Introduction to Sustainable Development: Definitions," retrieved from http://sdgateway.net/introsd/definitions.htm on 2 April 2002..

[5] "The Natural Step Framework Workshop," presented by Oregon Natural Step Network, 24 October 2000. See also http://www.naturalstep.org/.

[6] [this and next footnote should reflect the Browning -Ferris study] What constitutes a "tree" varies greatly. The American Forest and Paper Association calculates that one hardwood tree will yield 1000-2000 pounds of paper. Other groups like Treecycle or Worldwatch argue that 17-20 trees yield a ton of paper. Accuracy varies depending on species of tree and papermaking process used. Both extremes indicate a range of 1 to 3 pounds of wood per pound of paper.

[7] Again, the numbers in these area vary. Industry figures ranges vary from 2-4 MWh of power per metric tonne of paper created and from 10 to 15 cubic meters of water per metric tonne of paper created.

[8] Life Cycle of Old Computers

[9] http://www.prov.vic.gov.au/vers/standards/pros9907/99-7-3a4.htm#2.5 for lifespan, various sources for other info.

[10] Kawamoto et al, p. 7;Energy and Water Efficiency for Semiconductor Manufacturing, p. 8, 13.

[11] "Cutting the Costs of paper."

[12] Green Office Guide, pdf version, downloaded 9 April 2002, p. 12.

[13] Get correct footnote here

[14] http://www.emagazine.com/march-april_1997/0397curr_wood.html; my electric bill, March 2002

[15] "The Nature of Permanence," Abby Publications, located on Conservation Online (http://palimpsest.stanford.edu/byorg/abbey/napp/perman.html), accessed April 12, 2002.

[16] "Life Cycle of Old Computers," http://www.epa.gov/region02/r#/problem.htm, accessed April 8, 2002.

[17] Exporting Harm: The High-Tech Trashing of Asia, get infor from pdf version.

[18] http://www.pcworld.com/news/article/0,aid,49504,00.asp

[19] "How Much Information", http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html.

[20] "Green Archivism: The Archival Response to Environmental Research," American Archivist, …