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This paper positions American libraries within a global ecology of resource consumption and waste. With regard to environmental sustainability, the provision of information in print and electronic formats represents a drain on natural resources, and this paper explores various ways of measuring it. Using a mixed methods approach, the author calculates an Ecological Footprint of an average American public library, synthesizes primary and secondary sources to describe key areas of the American library's global supply chain, and reviews available resources, which can assist librarians and information professionals in addressing their institutions' environmental sustainability. This exploratory study finds that although the goods and services provided by libraries and information centers do carry environmental impacts, there are a growing number of options for institutions to eliminate wastes at their source, recycle, and practice socially responsible purchasing.

Headings:

Librarians/Social Responsibility

Environment

Book Production

Microcomputers/Equipment

Recycling

AMERICAN LIBRARIES IN A GLOBAL CONTEXT: AN ECOLOGICAL PERSPECTIVE

by
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Introduction

Consider this collection management metaphor and basic charge to library and information professionals: that institutional collections, whether print or electronic, require "care and feeding."[1] As organisms of growth, collections are subject to the Second Law of Thermodynamics—or the "entropy law"—which states that all complex systems grow at the expense of generating disorder at higher levels of the system (Georgescu-Roegen, 1971).[2] One could also say that for growth to occur, the system must take in outside resources, or energy, which in the case of institutional collections is mediated by librarians and information professionals. The benefits of this collection ecology in the library and information science world are directed towards patrons and comprise a potentially unquantifiable good for the immediate community it serves.

This paper, however, is concerned with the ecological costs of information provision, some of which can be measured. As of yet, little has been written about how much higher-level disorder might result from our collection management practices and how much farther these costs might extend beyond our immediate communities. This is not simply a geographical consideration, as important as that may be, for "beyond" also encompasses the concept of time. In short, are our current practices sustainable? Can

[1] "Care and feeding" was a recurring theme in Christopher Lee's Spring 2006 course, INLS 153: "Resource Selection and Evaluation," in the School of Information and Library Science, UNC-Chapel Hill. Although we did not specifically discuss ecological sustainability, many of the themes of that course fed my interest in this master's paper topic.

[2] The entropy law and other guiding theories from an international development perspective are discussed in *The Development Dictionary* (1992), edited by Wolfgang Sachs. I was first introduced to this powerful work in an equally powerful class, Lucila Vargas' Spring 2006 course, JOMC 347: "Communication for Social Change," in the School of Journalism and Mass Communication, UNC-Chapel Hill.

our present level of information consumption continue without serious strains on resource availability to future generations?[3] This study is an introductory assessment of the flip side of information consumption in America and implications for the professionals charged with managing it.

Specifically, the purpose of this exploratory paper is to better understand the global impact of an average American library's consumption and waste practices through a mixed methods approach.[4] The first section employs a quantitative measure known as the Ecological Footprint, using previously published data on American public libraries and an online Footprint calculator. Given the availability of an online tool, this section also encompasses a degree of resource evaluation and assessment. The second section could be characterized as an historical approach, synthesizing descriptive primary and secondary source accounts of supply chain issues. The final section of this paper describes and evaluates resources and is organized as an annotated bibliography-best practices hybrid. Taken as a whole, this mixed method reflects an interdisciplinary approach to an area that remains relatively uncharted in the information and library science literature. Thus, a majority of the paper's sources and measures come from other disciplines, such as the environmental sciences.

In practice, these issues might be of greater importance to the field of information and library science than that which the current literature alone reflects. A 2004 case study of recycling efforts at the University of Utah libraries may represent a rare

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[3] This "future generations" idea reflects language in the American Library Association (ALA) Code of Ethics. Specifically: "We have a special obligation to ensure the free flow of information and ideas to present and future generations." See http://www.ala.org/alaorg/oif/ethics.html.

[4] I credit Ruth Palmquist for encouraging me in this mixed methodological approach, which is far messier than any of the quantitative or qualitative methods we discussed in her Summer 2006 course, INLS 201: "Research Methods," in The School of Information and Library Science, UNC-Chapel Hill. Her general encouragement and feedback on this topic also meant a lot to me.

published example of a much larger trend toward self-assessment and creative recycling efforts (Le Ber & Gregory, 2004). With library-focused articles advocating for the proper disposal of computers and highlighting existing legislation, one also hopes that issues of compliance suggest a basic understanding of the issues (Beebe, 2002). From a pedagogical standpoint, Vivien-Elizabeth Zazzau's (2006) call for information literacy training to encompass the environmental and social justice aspects of digital information formats might reflect a growing general awareness of electronic waste issues. And historically, social responsibility has been an American Library Association (ALA) priority for several decades, since the establishment of a Social Responsibilities Round Table (SRRT) in 1969 (Social Responsibilities Round Table, nd, p. 1). Specific task forces of the SRRT include "International Responsibilities" and "Environment" among others, and recent emphases have focused on a resolution against the war in Iraq and the promotion of independent booksellers (Kagan, 2005). Overall, given the small number of related publications in the library and information science literature, as compared to much higher levels of related research in other disciplines, my goal is to begin framing the issue of ecological sustainability as a library and information science research agenda.

The Ecological Footprint of American Public Libraries

One measure of resource consumption that has been utilized for national comparisons all the way down to product-level considerations is the Ecological Footprint, developed by Mathis Wackernagel and William Rees at the University of British Columbia, and described in their 1996 publication: *Our Ecological Footprint: Reducing Human Impact on the Earth*. Ecological footprinting grew from the concept of "human carrying capacity," which describes the maximum population that can be sustained indefinitely in a given habitat, and which inspired calculations as early as the mid-Eighteenth Century (Wackernagel & Rees, 1996, pp. 46-48). By 1980, William Catton's human carrying capacity study, *Overshoot,* theorized that earth's ability to indefinitely sustain the human population had reached its limit, and the United Nations World Commission on Environment and Development's 1987 report, *Our Common Future,* popularized the idea of "sustainable development," as troubled as it may have been.[5] By then, Wackernagel and Rees found it more illustrative to turn the concept of carrying capacity on its head. In the simplest terms, their Ecological Footprint model took a specified population and calculated the amount of land and water it would take to continually sustain its consumption habits and waste disposal (Wackernagel & Rees, 1996, pp. 51-52). They compared five major human consumption categories: food,

[5] Both the authors of *The Development Dictionary* (1992) and Wackernagel & Rees (1996), for example, note that *Our Common Future* appeased both the environmental and corporate sectors, by advocating for economic growth that was better rather than bigger. Nonetheless, it describes what Wackernagel & Rees mean when they say, "the politically acceptable is ecologically disastrous" (p. 40).

housing, transportation, consumer goods, and services, against major land-use categories: energy, built environment, gardens, crops, pasture, managed forests, untouched forests, and unproductive areas, to approximate how many hectares a single population (city, nation, etc.) would need to sustain itself indefinitely at its current rate of consumption. Dividing by total population, Ecological Footprints can be reduced to the unit of person and projected worldwide. Thus, when Wackernagel and Rees first published *Our Ecological Footprint* over ten years ago, they calculated that the average American would require 5.1 hectares, as compared to the world average 1.8 (Wackernagel & Rees, 1996, p. 85). By extension, if everyone on earth shared the same resource consumption habits as Americans, it would require three planet earths to sustain these activities over time (Wackernagel & Rees, 1996, p. 89). Just ten years later, the Ecological Footprint of the average American nearly doubled to 9.6 hectares, requiring six planet earths to indefinitely sustain an entire global population practicing American-style consumption (Global Footprint Network, 2006).

The reality underlying this scenario, of course, is that we only have one planet earth, and the consumption habits of Americans are not practiced the world over. Millions in developing countries maintain an Ecological Footprint that is much smaller than the 2006 worldwide average of 2.2 hectares (Global Footprint Network, 2006). The costs of American consumption may not have yet depleted the earth's resources, but they are costs, nonetheless.

When Wackernagel and Rees first published *Our Ecological Footprint* they described the measure as a consciousness-raising tool and proposed a range of applications from national profiles to product labels. In a few short years, the Ecological

Footprint had gained worldwide notoriety as a public awareness and self-assessment measure and warranted inclusion in publications by multilateral organizations such as the United Nations and the Intergovernmental Panel on Climate Change. Today Wackernagel heads the Global Footprint Network, which is tracking national Ecological Footprints over time and setting the agenda for future Ecological Footprint research. Not surprisingly, the discussion has turned to standards and reliable datasets so that Ecological Footprints calculated independently of each other can eventually be used for comparative purposes (Global Footprint Network, 2006a).[6] Already in 2004, Monfreda, Wackernagel and Deumling noted that of the two distinct approaches to footprint calculation, the top-down, *compound* method was much more reliable than the erratic results of the bottom-up, *component-based* approach (Monfreda et al., 2004). Despite the individualizing richness that a component-based approach might bring to the study of a small population, such as a single office or school, the calculation of Ecological Footprints has generally migrated to compound studies utilizing national aggregate data. Product or Life Cycle Assessment (LCA), which falls into the component-based camp, still draws from Ecological Footprint language (see, for example, The WEEE Directive, 2006), but has also inspired alternative, and more precise measures, such as the "Ecological Rucksack" (Schmidt-Bleek, 2001).

Ecological Footprints in a Library Context

[6] One weakness to this comparative agenda is what Lenzen, Murray, Sack, and Weidmann (2007) call "double-counting." If all Ecological Footprints were added together over the whole of the United States, for example, they would account for larger-than-actual total resource consumption and waste, since the same data are used for per person and organizational calculations. In the end, per-person calculations are more holistic and do not extract the personal share allocated to a work environment, whereas organizational footprints do claim the personal share that contributes to its consumption and waste habits.

Although libraries and their resource needs are not exactly on par with cities, particularly with regard to the Ecological Footprint's food and housing categories, they do encompass significant resource drains for transportation, goods, and services, which have been successfully calculated for other similar environments using the compound method. As interesting as it might be to compare the Ecological Footprint of various library goods and services, such as a print book versus an e-book, I wish to begin this exploratory study using a more holistic, compound approach that compares average American library footprints over time. Both for the sake of simplicity, and in the interest of promoting comparable data, I will use an online Ecological Footprint calculator that reflects the standards of the Global Footprint Network. Previous scholarly studies have employed such calculators at the institutional level. For example, Onn, Dale-Hallett, Grant, and Othman undertook an Ecological Footprint assessment of the Melbourne Museum in Australia using the Victorian Environmental Protection Authority's online "Office Eco-footprint Calculator," which was developed from aggregate national data about Australian consumption habits (Onn et al., 2006). As this study is concerned with American libraries, in particular, I have chosen The Office Footprint Calculator™, which is a joint project of TheGreenOffice.com and Redefining Progress and is freely available online at http://www.officefootprint.org. Redefining Progress, whose Sustainability Program Mathis Wackernagel directed until 2003, produced an Ecological Footprint calculator for individuals in 2002, so the organization has some authority in this area.[7]

[7] With regard to the Global Footprint Network-Redefining Progress relationship, it is worth mentioning the Ecological Footprint Modeler for the Global Footprint Network, which was a 2005 student project of the Information Systems Program at Carnegie Mellon University (see: http://is.hss.cmu.edu/studentprojects-2005_team05.htm). These undergraduate projects tackle information solutions for real-life clients, and in the Team 5: Ecological Footprint Modeler write-up, several problems were outlined. Among them, the Global Footprint Network's online Footprint Calculator from 2002 was felt to lack impact, relevance, and educational value, and the write-up also noted a break between the Global Footprint Network and the 2002

There is some indication that the Global Footprint Network may be developing new online calculators, which would likely set the bar in this arena, but at the present moment, The Office Footprint Calculator™ is the best alternative for an American research context.

Methodology

The Office Footprint Calculator™ is a four-part online form that asks for information about an office's workers, their transportation methods, the facility and its energy/waste, and the products and services offered. The full list of questions is reproduced in Appendix A. Once values are input into each of these categories, the calculator computes an Ecological Footprint at both the office and worker levels. For the purpose of this exploratory study, I used this online calculator to determine the Footprint of an average American public library. Though libraries are increasingly moving beyond the confines of a building, this exercise was most feasible from a structural perspective, given the calculator's questions. Average, aggregate data about American libraries were culled from the annual public library survey of the National Center for Educational Statistics (NCES), a division of the U.S. Department of Education. Data from the latest available, 2004 survey (published in 2006) and from the 1994 survey (published in 1997), which include data from thousands of public libraries across the United States, were used to calculate two sets of Ecological Footprints, ten years apart. The NCES data were used to answer a majority of the calculator's questions, including number of workers/visitors,

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calculator developer. Although not specified by name, that developer is Redefining Progress (see: http://www.footprintnetwork.org/gfn_sub.php?content=myfootprint), so the same criticisms might apply to The Office Footprint Calculator™, which they developed jointly with TheGreenOffice.com after Mathis Wackernagel left the organization. For the purpose of this study, however, an online calculator lacking in these particular critiqued areas is more acceptable than a calculator lacking with regard to its data or calculation values, and even if Redefining Progress no longer has relations with the Global Footprint Network, it does not necessarily reflect diminished value in terms of the newer, office-focused calculator.

weekly service hours, computers, materials, and square footage. Additional data was gathered from sources such as the U.S. Bureau of Transportation Statistics, the U.S. Department of Energy, and recent library building and space planning guides. Finally, the online calculator provides U.S. averages that were used in some cases, such as water usage, break-room habits, and recycling rates. Each question in Appendix A includes a detailed explanation of how each item was calculated and the data source(s) used.

There are certain weaknesses to this approach, particularly with regard to the accuracy of a 1994 public library Footprint. Since the online calculator is based on more or less current consumption habits and current national aggregate data, it does not accurately reflect an Ecological Footprint from ten years ago. At the same time, Wackernagel and Rees described Ecological Footprint results as most interesting and useful in a comparative context (Wackernagel & Rees, 1996, p. 80), and certain trends are worth tracking from a library standpoint. The main differences between the relevant NCES public library data from 1994 to 2004 appear to be an increase in technological equipment, audio/video acquisitions, weekly service hours, and total visits, all of which could have a potential impact on the average library's Ecological Footprint. It might also be illustrative to compare public libraries with academic libraries or other library types, but surveys administered by the NCES to these institutions did not collect the same information, and important factors, such as the number of computers, would be too difficult to estimate. The most eye-opening comparison might pair an average American public library with an average library in a developing country, but this would depend on both the availability of comparable survey data and the availability of a comparable online calculator based on that country's national aggregate data. The comparison

chosen here, a current and historical profile of an average American public library, may not be the most accurate or illuminating, but considering the available tools, it is, nonetheless, a feasible calculation and a potentially illustrative one.

Another difficulty in using The Office Footprint Calculator™ to calculate library consumption habits stems from the fact that an office operates differently from a public institution. Thus, some of the online calculator's questions require creative interpretation for the chosen context. Problem areas include equating library visitors with workers, accounting for per person transport with children as patrons, calculating book acquisitions in terms of reams of paper used, and calculating audio/video acquisitions in terms of CDs/floppy discs used. Also, some of the library-specific services that were not accounted for in the office calculator include shipping for interlibrary loan items, bookmobile fuel needs and upkeep, catalog retro-conversion, and digitization projects, among others. Similar mismatches were noted by the Melbourne Museum in its Ecological Footprint study using an online office-focused calculator (Onn et al., 2006). One final methodological weakness is the lack of a technical background resource, explaining how The Office Footprint Calculator's™ data is gathered or calculated. As noted earlier, this online tool appears to be the best option for an office-focused calculator in an American context, but it would carry more authority with published background information, as is available for the Victorian EPA's calculator, mentioned above.

Findings and Discussion

Using The Office Footprint Calculator™ and available data for American public libraries, it was calculated that the average institutional Ecological Footprint grew from

3,749 global acres in 1994 to 4,502 global acres in 2004. On the other hand, the per person Ecological Footprints hardly changed from 1994 to 2004—58.6 to 58.5 global acres/person respectively. In other words, the total institutional resource consumption might have grown in ten years' time, but it was increasingly distributed over a larger population. To better contextualize this consumption, the calculator illustrates it as such: "If all organizations operated like yours, we would need 0.95 planets to sustain the *workforce alone*. This does NOT include the vast amount of natural resources and ecosystem services consumed by individuals" (TheGreenOffice.com, 2006). This is not a terribly heartening statement, and there are certainly efforts that can reduce the average library impact on an ecological level. On the other hand, libraries may be shown to practice greater-than-average sustainability over time than the average office, which might be worth promoting to constituents. This would require additional comparisons using similar tools, but it seems both feasible and illustrative.

For the time being, the Ecological Footprint calculated here for American public libraries may serve as a useful benchmark for individual institutional audits until a more accurate average profile can be calculated. Ideally, this will require more transparent online calculators that are better suited for institutional or service-oriented entities. It would be useful, for example, to break from the structural constraints inherent in the current office calculator model to include digital libraries and other less-traditional repositories. If nothing else, this study illustrates the need for authoritative Ecological Footprint calculators that are better suited to such institutional environments. The current lack of such online tools may, in fact, be a contributing factor in the dearth of published

or publicized Ecological Footprint studies in a library environment.[8] Results might also be more telling and educational if presented resource by resource. Using the present method, it is impossible to know if the largest share of resource consumption by libraries, as determined by the chosen Ecological Footprint calculator, is in the category of energy use, or forests, or something else entirely.

One thing is certain: the Ecological Footprinting method is gaining worldwide attention, and libraries have an opportunity to get on board and help shape the discussion. After all, they are in the business of educating the public, and the ecology of resource management is only going to becoming more pressing over time. As a public awareness tool, the Ecological Footprint is a simple illustration of the underside of consumption. Through calculations such as these, librarians and information professionals can begin to increase their own understanding of the issues and become active agents of change through green management initiatives and community awareness building. This certainly must reflect what Ecological Footprint creator Mathis Wackernagel had in mind when he said, in 2001, "Libraries have the potential to become the strongest engines for community initiatives leading to a sustainable future" (Wackernagel, 2001). The fact that more has not been published on this library-sustainability intersection since that time may be disheartening, but with the emergence of better tools and resources, this topic has the potential for greater receptivity in the field. The following sections of this paper will further explore the ecological impact of specific library materials through a supply chain

[8] There is some evidence of library sustainability assessment that falls under larger reporting agencies. Although it is an academic setting, the University of North Carolina's Sustainability Office, for example, recently undertook an "energy intensity" building type study that placed campus libraries midway between high-energy-intensity labs and relatively low-energy-intensity residence halls (UNC Sustainability Office, 2005, p. 12). These reports do not surface in typical library research literature channels, but may represent a large portion of self-assessment efforts.

approach and highlight best practices that can assist in bringing our awareness up while bringing the size of our collective Footprint down.

The Global Supply Chain of American Libraries

At its core, globalization is a market phenomenon that affects almost every enterprise today. While the field of information and library science seems to recognize the benefits of globalization for the enhanced services it offers local user communities, there is generally less acknowledgement of globalization's adverse effects.[9] Ecological Footprint assessment helps illustrate that even non-profit institutions, such as libraries, are tapped into the global supply chain through their consumption and waste practices. Yet, while Ecological Footprints help describe the consumer-driven inputs and outputs of a specific population, they do less to illustrate the larger global flow of resources and wastes. This, in turn, risks dislocating the impact of resource drains and waste disposal from specific places and communities. This section will give more attention to those impacts. It builds from a broad conceptualization of the problem by detailing specific industries with which the average American library has close ties. This supply chain approach moves away from the confines of a physical library space, encompassing more of the goods and services provided by a range of repositories. I have chosen to focus on industries related to print and electronic library resources, which currently represent the predominant media of information exchange. These information carrier life-cycles have also been fairly well documented, making them a logical choice for this exploratory study. There are a significant number of goods and services that fall outside of these

[9] A 2006 *Library Trends* article by Peter Webster, "Interconnected and Innovative Libraries," is one example of a generally positive outlook on the global technology tying libraries more closely together today.

areas, such as audio, video, and microform materials, the transportation aspects of interlibrary loan and bookmobile services, and outsourcing issues that have emerged with catalog retro-conversion and digitization projects. This supply chain overview is thus limited in scope.

An initial description of the relevant print and electronic industries is outlined using an historical approach. This methodology draws from primary sources, such as government reports, industry publications, and news items, which help detail trends and noteworthy changes over time. Secondary sources from related fields, particularly the environmental sciences, also provide context. I have organized this section using categories of consumption and waste—related to the first section of this paper—along with the additional category of human health and safety. In other words, it reflects a holistic, Life Cycle Assessment (LCA) approach, which considers the full range of processes in a product's "cradle-to-grave" life cycle (Erixon, 1999, p. 7).[10] Specifically, LCA accounts for raw material production, manufacture, distribution, use, and disposal of a product, including attendant processes such as transportation, energy use, and pollution.

Print Materials Sectors

Although the field of information and library science is growing in dynamic, digital directions, many still associate libraries with substantial print collections. According to a 2006 industry profile, increased library spending on digital formats has

[10] While the "cradle-to-grave" phrase encompasses a product's creation, consumption, and disposal, William McDonough and Michael Braungart proposed "cradle-to-cradle" as a more progressive concept in their 2002 publication of the same name. The idea of "cradle-to-cradle" is to eliminate waste altogether through better design practices. The phrase has been used with increasing frequency in green design circles, but since this paper reflects the reality of actual practices, the "cradle-to-grave" concept is deliberately utilized.

not diminished the attractiveness of the library market among print-material publishers (Encyclopedia of American Industries, 2006). With regard to American public libraries, for example, collection materials in electronic formats accounted for just one percent of total operating expenditures in 2004, while books accounted for 44 percent, or a collective total of over $382 million (Bogart, 2006, p. 470, pp. 460-461).[11] These print materials represent end-products in a much longer global supply chain, for which book jobbers, libraries, and individual patrons could all be regarded as consumers. Printers and publishers may determine the final content and form of these materials, but they draw from other industries, such as paper and pulp producers, who are, in turn, linked to the forestry sector. The processes that contribute to printed material production also include non-paper industries, such as binderies, chemical and ink producers, and the transportation sector. All depend on natural resources such as wood, fossil fuels, and human labor. Many employ chemical and manufacturing processes that create polluting byproducts. And the printed materials themselves go through limited cycles of use that require a means of disposal.

Print Materials Consumption

Patterns of consumption and waste can be traced along all of these levels. The current U.S. book publishing industry requires nearly one million tons of paper each year, only five percent of which is estimated as recycled content (Miller, 2004). This is the equivalent of nineteen million mature trees each year, with many originating from largely intact forests in the Canadian Boreal and from pine plantations in the southeastern United

[11] The latest Bowker library almanac, edited by Dave Bogart, summarizes the 2004 public library survey data by the National Center for Education Statistics, also used for the Ecological Footprint data in the first section of this paper.

States' Cumberland Plateau (McLaughlin, 2005, p. 44). The demand on the Canadian Boreal is particularly worrisome from a sustainability standpoint, because it remains one of the major planetary storehouses of biospheric carbon (Green Press Initiative et al., 2006, p. 2). Thus, high demand for paper products also has the potential to diminish one of the most important natural defenses against global warming (Intergovernmental Panel on Climate Change, 2001, p. 310). Demand for timber is also driving rapid conversion of the most intact forest ecosystem in the United States into plantation-style tree farms. In place of virgin forestland, the Cumberland Plateau has undergone a significant shift towards clear-cutting, single species cultivation, and the intensive use of fertilizers, herbicides, and water—all of which draw concern from an environmental standpoint (Knight, 1996, p. 10). Almost all of these southeastern U.S. plantations are privately owned and thus unregulated by state governments, which puts the initiative for change in the hands of the marketplace (Green Press Initiative et al., 2006, p. 4).

Beyond the wood, itself, processes that convert pulp to paper and paper to printed materials consume large amounts of energy and water. American paper-making represents one of the largest industrial consumers of energy, though its use of renewable energy—in the form of recovered wood by-products—is high compared to other sectors (Unrah, 2002). Over a few decades' time, pulp mills have also reduced significantly the volume of water used in the pulp-making process, through in-plant efforts to recycle effluents. (Knight, 1996, p. 16). Though transportation is a major fossil fuel-use category at every stage of the wood-to-materials production process, few specific data are available. It has been estimated, however, that the pulp and paper industry compares favorably with other industries, since it relies primarily on ship and rail transport as

opposed to higher environmental-impact modes of transport over land and air (Knight, 1996, p. 17).

Print Materials Waste

Both during these paper-related production processes and at the end of product life cycles, there are waste considerations that have a direct bearing on environmental sustainability and human health. The printing industry has made significant changes since the 1980s, when chlorine, a harmful dioxin, was widely used as a bleaching agent and chemical emissions to waterways were among the highest of environmental priorities for this sector (Knight, 1996, pp. 16-17). The U.S. Environmental Protection Agency began working with the printing industry in 1992 to examine the full range of printing process and suggest ecologically-minded alternatives (U.S. EPA Design for the Environment, 1995, p. 1). Regulatory policy began to take shape through the EPA's 1994 Common Sense Initiative, of which printing was one of six pilot industrial sectors (U.S. EPA Office of Compliance, 1995, p. 80). Today, most publishers choose papers that are bleached through an Elemental-Chlorine Free (ECF) process, which eliminates some water pollution, though a few have switched to Process Chlorine Free (PCF) alternatives, which eliminate a majority of pollutants (McLaughlin, 2005, p. 45). Apart from chlorine, silver in wastewater discharges from photographic fixer solutions remains a serious concern (U.S. EPA Communications Services Branch, 1998, p. 11). The increased use of computerized printing technologies have helped to eliminate the amount of such toxic by-products released to water, though it has not generated much discussion of additional toxic elements in these computers' printed circuit boards (U.S. EPA Design for the Environment, 2006).

Despite these improvements, the paper sector remains in the top tier of chemical-releasing industries, as tracked by the most recently available EPA Toxic Release Inventory (TRI) data (U.S. EPA, 2007, p. A-1). Today, available TRI data shifts the printing industry's current pollution focus to air emissions, with 99 percent of its toxic chemicals released to air, and only one percent to water and land (U.S. EPA Office of Compliance, 1995, p. 32). Of the more than 350 toxic chemicals monitored by the TRI, toluene comprises the largest share of the printing industry's releases, at seventy percent (U.S. EPA Office of Compliance, 1995, p. 32). Used as a printing solvent, toluene can cause headaches, may affect kidney and liver functions, and also contributes to the formation of ozone in the lower atmosphere, where it affects respiratory health. (U.S. EPA Office of Compliance, 1995, p. 37). Other hazardous air pollutants generated by printers include benzene, perchloroethlyne, and xylene (U.S. EPA Communications Services Branch, 1998, p. 11). Additionally, some glues and adhesives used in binding processes are problematic both because of their toxicity and because they hinder recycling efforts; this has prompted the development of alternative glues (Knight, 1996, p. 23). Yet overall, compared to other sectors, printing has one of the lowest numbers of enforcement actions taken by the EPA, which underscores a rapid industry turn-around in a relatively short amount of time (U.S. EPA Office of Compliance, 1995, p. 32). It is also promising to see that between 2001 and 2005 the paper and printing/publishing sectors reduced their overall total reported releases, reflecting composite U.S. release trends for all sectors (U.S. EPA, 2007, pp. A-3, A-5).

The largest remaining area of environmental concern in the paper industry seems to hinge upon carbon emissions, through the net loss of carbon-dioxide-absorbing trees,

through manufacturing processes that rely on fossil fuels, and through methane emissions from rotting paper.[12] There is also some debate about the environmental advantages of recycling over incinerating when it comes to printed materials; this seems largely to depend on transport considerations and the extent to which certain recycling processes consume fossil fuels (Knight, 1996, p. 27). As for printing operations, in-plant recycling efforts and the use of biofuels for energy efficiency has generally increased, which should play a positive part in reducing the industry's overall carbon emissions (Grieg-Gran, 2004, p. 6).

Print Materials Human Impacts

As one 2004 industry progress report notes, printers have invested considerable time and energy in addressing environmental concerns, but with much less attention paid to the social impacts of their production processes (Grieg-Gran, 2004, p. 7). As compared to industry-wide public relations efforts, such as forming partnerships with local communities and demonstrating contributions to development, proactive internal practices are less common than general compliance with labor standards (Grieg-Gran, 2004, p. 7). Case studies suggest that worker health and well-being have been a concern for the industry in the past and may necessitate continued efforts to improve working conditions. For example, complaints of headaches at one plant subsided after a fountain solution was switched from isopropyl alcohol to an alcohol-free solution (U.S. EPA Design for the Environment, 1996, p. 3). An historical study of mill workers in Canada's

[12] As a greenhouse gas, methane is twenty-five times more potent than carbon dioxide and has been a concern given the high levels of paper still going to landfill (Grieg-Gran, 2004, p 7). Some landfills have begun to capture methane for reuse as a fuel, and the EPA has offered financial incentives to landfills for capture-and-use projects in support of its Methane to Markets Partnership. See http://www.epa.gov/methanetomarkets/.

British Columbia also quantifies the social cost of layoffs over several decades' time due to technological change in the industry (Ostry, 1999, pp. 197-199). Indigenous groups, whose subsistence depends on land areas that border paper mills and tree farms, also raise questions about the industry's social responsibility. Among other things, these groups have contended with mercury contamination in their water and food as well as the introduction of monocultures that threaten their supply of medicinal plants (Green Press Initiative et al., 2006, p. 2). Such human costs are an important consideration in reflecting on the global supply chain for paper products, but by and large, they seem not to have been addressed in as systematic a fashion as environmental concerns.

Electronics Sector Consumption

Those who find paper product consumption statistics alarming often cite technology and digital information exchange as a solution to the problem. While the growing use of electronic information services among American libraries is probably due more to supplier-side and user-supported considerations than to ecological consciousness, the trend is undeniable. An Outsell report from 2003 found that in government, academic, and corporate settings, digital formats comprised 52 percent of all content purchased by libraries (Stratigos & Strouse, 2003, p. 74). Academic libraries have traditionally been the largest consumer of scholarly journals, and trends toward electronic-only publications, fueled in part by distribution costs, are certainly contributing to this shift (Falk, 2004, p. 184). Even among American public libraries, where budgets have not kept pace with inflation, technology expenditures have continuously and dramatically increased since 1994 (Buschman, 2003, pp. 65-66). Today, the catch-all category of "electronic reference" spending among U.S. public libraries totals almost $53

million (Bogart, 2006, pp. 460-461). Although technological developments often carry the promise of a cleaner, greener world, information technology appears not to have impacted paper consumption as much as once hoped for. In *The Myth of the Paperless Office*, for example, Abigail Sellen and Richard Harper traced repeated cycles of technology innovation throughout the Twentieth Century that promised decreased paper consumption in office environments, but which actually led to increased consumption (Sellen & Harper, 2002, pp. 2-13).[13] At the same time, electronic equipment has brought a whole new set of environmental and sustainability concerns to the table.

On the consumption side, electronic hardware, like print resources, relies on virgin raw materials, the extraction of which is multiplied by short product life-spans. The U.S. National Safety Council estimated that 20.6 million personal computers became obsolete in the year 1998, of which only eleven percent were recycled (U.S. National Safety Council, 1999). Today the number of obsolete computers may be as high as 600 million in the U.S. alone (Jeffries, 2006, p. 21). These consumption statistics drive an electronics industry supply chain that wraps around the globe, with metals shipped to firms in Asia where components and electronics manufacturers export their products to industrialized nations (Jeffries, 2006, p. 23). On the waste end of the equation, obsolete electronics are finding their way to landfills as well as to China and India, where disposal methods are questionable and human health is on the line (Grossman, 2006, p. 142). Already in 1991, a widely cited study by Carnegie Mellon predicted that 150 million personal computers would be sent to landfill by the year 2005; thankfully, when it was updated in 1997, that study's number came down to 55 million due to the increase of

[13] I appreciate Deborah Barreau bringing this book to our attention in her Spring 2007 course, INLS 500: "Human Information Interaction," in the School of Information and Library Science, UNC-Chapel Hill. Print versus digital information preferences was an ongoing theme throughout the semester.

take-back recycling programs available to consumers (Matthews et al., 1997, p. 1). Even with improvements at the end of product life-cycles, however, the sheer volume of electronics required by American information consumption habits poses sustainability concerns.

Cradle to Grave: The Life Cycle of a Personal Computer

Holistic Life Cycle Assessment (LCA) helps illustrate the wide range of impacts associated with a consumer item throughout its product life cycle; the phrase "cradle-to-grave" represents this process. Although the computer manufacturing industry is much newer than the paper or printing industries, its growth has paralleled the development of LCA studies and has inspired product assessment more so than print materials (Erixon, 1999, p. 4).[14] A recent LCA study of a Personal Computer (PC) by Choi, Shin, Lee, and Hur (2006) is relevant to this discussion despite its Korean consumption context. Apart from highlighting its findings, I include a brief summary here to illustrate yet another method of ecological assessment that is relevant to a consumer framework.

To summarize, Choi et al. (2006) found that the PC's pre-manufacturing stage, which is related to the extraction of raw materials and the creation of components and parts, had the largest impact on environmental categories over the entire life cycle of the product, with the exception of human toxicity potential, which peaked at disposal (Choi et al., 2006, p. 125). Pre-manufacturing of electronic components requires substantial

[14] There is an online LCA tool that covers a number of sectors: the Economic Input-Output Life Cycle Assessment (EIO-LCA) tool, recently developed by Carnegie Mellon University's Green Design Institute and located online at www.eiolca.net. It provides Life Cycle Assessment data for 500 commodities or services in the United States, which can be calculated through dollars spent in that sector. "Books printing" is one example, though the calculations from dollar amounts represent producer prices, not consumer prices, which may give it limited value for libraries wishing to self-assess their impact.

material and energy inputs, and it produces large quantities of pollution emissions to air, water, and land (Choi et al., 2006, p. 125). By comparison, the stages of manufacture, distribution, and use of PCs, were relatively low impact in terms of environmental harm (Choi et al., 2006, p. 125). It is significant to point out, however, that the study's comparison of office to home use of PCs found that office environments had at least fifty percent more environmental impact potential than home use, with greater fossil fuel consumption needs (Choi et al., 2006, p. 125). The final LCA stage—disposal—showed the largest potential impact for human toxicity as well as ozone depletion potential, neither of which are solvable through recycling programs alone (Choi et al., 2006, p. 126). The study's final recommendation, to focus on green procurement practices and environmentally friendly substitutions in the pre-manufacturing of PCs, echoes other initiatives, such as Greenpeace's criteria for ranking PC manufacturers (Greenpeace International, 2006), and Europe's Waste from Electrical and Electronic Equipment Directive (The WEEE Directive, 2006a). I will provide a fuller description of both programs in the final section of this paper.

E-Waste and its Human Impacts

Not surprisingly, the issue of electronics disposal, with its potential impacts on human health, has generated a lot of recent attention. With current design and consumption patterns generating tons of Waste from Electrical and Electronic Equipment (WEEE) each year, the growth of "e-waste" is estimated to be approximately three times greater than the growth of average municipal waste (AEA Technology, 1997). An estimated eighty percent of this yearly waste is shipped from the first world to the third (Grossman, 2006, p. 8). While some of this material finds its way to India, China, and

Africa through legal channels as second-hand computers and mixed electronic scrap, large amounts are also sent illegally as “metal scrap,” which renders it more likely to be dumped or landfilled than reused or disposed of properly (Jeffries, 2006, p. 22). Large amounts of such illegally imported computer waste have been traced to ports in Chennai, India and Lagos, Nigeria among others (Jeffries, 2006, p. 22-23). With this equipment’s potential to leak toxic substances, such as cadmium, copper, and lead, into groundwater or pollute the air if incinerated, it is particularly troubling that economic incentives are making third world sites the toxic dumping grounds of first world consumption habits (Jeffries, 2006, p. 22). Today, about a dozen individual countries regulate the disposal of e-waste, and though the U.S. is not among them, more than half of U.S. states have introduced related legislation (Grossman, 2006, pp. 8-11). Many, however, argue that the real change has to come from computer manufacturers, who should be held accountable for their use of toxic materials and who should take greater responsibility for the disposal end of their products’ life cycles (The WEEE Directive, 2006a).

The human face on this e-waste cycle cannot be overlooked. Exposure to lead, cadmium, and mercury as a result of improper disposal of computers and other electronic devices may cause brain and kidney damage among other adverse health impacts (Grossman, 2006, p. 19). The incineration of other toxic elements and plastics in computers release toxic fumes. The Basel Action Network, an activist group monitoring international trafficking of e-waste, has filmed workers in China tearing such electronics apart with their bare hands and has measured nearby water supplies, where lead levels are 190 times higher than deemed safe by World Health Organization standards (Grossman, 2006, pp. 182-185). In Nigeria, too, workers handling e-waste are paid little and lack

protection through health and safety regulations (Jeffries, 2006, p. 23). In such a context, American consumption of electronic equipment that is essentially designed for disposal carries many hidden costs that stretch far beyond the space and time of our immediate communities.

Reflections on the Supply Chain

Given the consumption, waste, and human health impacts of the print and electronic materials supply chain, the notion of serving our communities through library services may have to extend beyond our current conceptual boundaries. At present, the nature of the global supply chain and our collective American affluence distances us from the effects of our habits, which Vandana Shiva has drawn attention to in her *Development Dictionary* essay on "Resources." The following passage, in particular, sets the stage for her call to action:

> In spite of severe ecological crises, the dominant modern paradigm of viewing nature as a resource continues to operate because, for the North and for the elites of the South, the destruction remains largely hidden. For they have become more affluent through the privatization of nature's commons, and through their affluence, they have been able to create protective barriers between themselves and an impoverished nature and impoverished peoples. The ecological costs of the economic processes consequently still remain largely invisible to them (Shiva, 1992, pp. 212-213).

As brokers of information consumption, librarians and information professionals are connected to the global marketplace, where economic incentives often triumph over sustainability, environmental, and social responsibility concerns. Libraries may not be able to extricate themselves from the global capitalist economy, but as institutions with enormous consumer interests in certain industries, they can potentially voice their concerns for the greater good. They can also take actions in the acquisition and disposal

of materials and rethink operational norms to reduce their overall environmental impact. In doing so, they can give visibility to ecological concerns, and shift the paradigm that Shiva so depressingly characterizes above. The final section of this paper will cover best practices and offer suggestions that point in this direction of global social responsibility for librarians and information professionals.

Resources for Environmental Sustainability in American Libraries

Librarians and information professionals concerned about their institutions' place in the global supply chain may feel helpless to effect change, but one upside to participation in a consumer society is the ability to exercise purchasing power. Historically, the main drivers for environmental pressure on business and industry have been final consumption and affluence, particularly in the industrialized world (Princen, 1999, p. 348). Although the commodity supplier is responsible for direct ecological impacts in terms of how a product or service comes to market, the final consumer supports that process by paying for its end result, a concept known as "shared responsibility" (Lenzen et al., 2007, p. 32). In the case of library and information services, there is an extra layer of indirect consumption if the final user does not pay on a service-by-service basis. To best mediate between our users and our suppliers, we may have to actively work towards responsible purchasing while raising awareness of these issues among our constituents. The following "best practices" and accompanying resources reflect tools and strategies that can assist with both.[15]

1. Ecological Footprinting: Accounting for Borrowed Books

[15] I appreciate the generation of ideas that fed into this section from fellow graduate students working towards the Certificate in International Development. They represented schools and departments from across the UNC-Chapel Hill campus, such as Social Work, Public Health, Business, City and Regional Planning, and Geography, and they listened to an early presentation version of this paper in January 2007. Niklaus Steiner, Director of the Center for Global Initiatives (formerly the University Center for International Studies) facilitated these bi-monthly workshops for certificate earners during the Spring 2007 semester and also provided helpful feedback on this topic.

Although the Ecological Footprint calculation in this paper was meant to critically examine library consumption, there is evidence from other Footprint assessments of libraries' sustainable contributions—namely through borrowed print materials. The City of Toronto's Ecological Footprint reduction strategies webpage includes the tactic, "borrow magazines/books from the library instead of buying them" (City of Toronto, 2007). Additionally, an Ecological Footprint quiz for individual students awards diminishing impact points for those who 1) always buy books; 2) sometimes borrow, sometimes buy books; or 3) always borrow books (Institute of Biology, 2004). These are positive impacts that libraries could do a better job of promoting, even if they do nothing else to address sustainability. Vocalizing them holds the potential to raise awareness of environmental issues and reiterate library value to communities.

2. In-House Policies and Practices

Small actions, over time, can have a big impact, and ecologically-minded ones can work to cut down the size of a library's Footprint. TheGreenOffice.com, which hosts the online office calculator referenced in the first section of this paper, offers a number of helpful tips for reducing the environmental impact of office settings, in particular. What if every library:

- bought recycled-content paper and furniture;
- sought out products with reduced chemical content;
- purchased energy efficient products;
- installed water-saving fixtures;
- encouraged employees to walk, bike, or utilize mass-transit;
- set double-siding as a default on all printers;
- monitored waste carefully and promoted recycling;
- encouraged minimal and recyclable packaging from suppliers;
- donated unwanted materials to good homes;
- replaced disposable cups with reusable ones?

And what if they offered patrons similar strategies for their home environments? The collective impact might be immense! Starting small may be the best way for libraries to effect change, and these everyday practices can decrease environmental impact while increasing awareness.

Resources: The GreenOffice.com Website at www.thegreenoffice.com.

3. Corporate Social Responsibility (CSR)

Office supplies, such as those listed above, may represent a small portion of the average library budget, but why not apply the same principles to all purchases? Since the 1970s, in the wake of environmentalism, companies have gone to great lengths to prove their corporate citizenship to consumers. The movement is generally known as Corporate Social Responsibility (CSR), and it has increasingly evolved from "good deeds" reporting to "no harm" disclosure on levels of environmental and social responsibility (Esrock & Leichty, 1998, p. 310). As consumers with large stakes in certain industries, librarians and information professionals may find CSR stances useful in differentiating between certain vendors. Furthermore, there is growing demand for CSR on the part of the general public—a fact librarians and information professionals should bear in mind as they purchase library goods and services on users' behalf. For example, the percentage of consumers who would consider a company's CSR stance before purchasing a product rose from 28 percent to 48 percent between 1996 and 2002 (Marketing Week, 2002, p. 31). In fact, there is evidence that library consumers have already voiced their concerns about companies engaging in business practices that are less than socially responsible. The case of North Carolina State University faculty criticizing Elsevier Reed for its ties to the gun trade in 2003 is a notable example (NCSU Faculty Takes Hard Line, 2003).

Since CSR is manifested in a variety of ways and often represents self-reporting, its use for company comparisons may prove limited. One place to start is with industry and company profiles in business databases, which often touch on corporate social responsibility in a condensed format. A free alternative is the CSR Wire website, which allows searching by company name to return related news and CSR reports. Ultimately, though, the best resources for CSR comparisons may be certification standards and rating systems, a few of which are described below.

Resources: CSR Wire Website at www.csrwire.com.

4. Forest Stewardship Council (FSC) Certification

One label that conveys environmental responsibility with regard to print materials is Forest Stewardship Council (FSC) certification, and book publishers have taken notice. In 1992, loggers, foresters, and environmentalists established the Forest Stewardship Council to push the industry toward certification standards in forest management. Like other certification programs, the end result was FSC standards that accredited bodies can translate into certification. These currently include Forest Management certification, granted to responsibly managed forests, and Chain of Custody certification, which accounts for production processes beyond the forest. The first book printed entirely on FSC-certified paper was published in 1999: *A Living Wage*, by Lawrence B. Glickman (Forest Stewardship Council, 2003). More recently, FSC certification was granted to the entire Random House Group, the first consumer publishing entity to attain this status (Print Week, 2006, p. 11). FSC products are on the rise, and while it may be impossible to stock an entire library with certified products at this time, voicing an interest in FSC

and actively purchasing its certified materials is one way of promoting environmental responsibility among suppliers.

Resources: The Forest Stewardship Council Website at www.fsc.org.

5. Recycled Paper Initiatives

While FSC certification accounts for wood products originating directly from forests, the promotion of recycled paper is a related environmental sustainability tactic. According to a 2005 Opinion Research Corporation survey, over eighty percent of consumers are willing to spend more for books and magazines published on recycled paper, a statistic that cuts across age groups, geographic regions, educational levels, and income levels (North American Publishing Company, 2006). Recent publishing initiatives reflect this interest, most notably in the run of seventeen million *Harry Potter and the Order of the Phoenix* books on one hundred percent post-consumer waste paper (Hitchcock, 2005, p. 30). In a related, industry-wide campaign, the Green Press Initiative has spearheaded the *Book Industry Treatise on Responsible Paper Use* with the goal of increasing the industry's use of recycled paper content from five percent to thirty percent in five years' time (Green Press Initiative, 2006). Libraries can support these efforts by purchasing recycled-content books and promoting their savings in natural resource terms. New Leaf Paper, for example, has translated the recycled paper used for seventeen million Harry Potter books into trees, waste, and water saved (New Leaf Paper, 2006).

Resources: The Green Press Initiative Website at www.greenpressinitiative.org.

6. Environmental Rankings Tools for Electronics Purchasing

Electronics purchasing can also reflect environmental preferences, with several tools that offer a comparative look at manufacturers and their specific products. Greenpeace published a *Guide to Greener Electronics* in 2006, which evaluates brand-owners on the presence of hazardous substances in their products as well as recycling efforts at the company level (Greenpeace, 2006). It currently reports on fourteen of the leading personal computer and mobile phone manufacturers worldwide and will be updated quarterly. The Electronic Product Environmental Assessment Tool (EPEAT) is an online resource that further distinguishes between products. As an EPA-funded program of the Green Electronics Council, EPEAT was designed to help institutional purchasers compare desktop computers, laptops, and monitors based on their environmental impact. EPEAT allows manufacturers to self-report according to required and optional criteria, resulting in bronze, silver, and gold tier product rankings. With an American audience and fifteen participating manufacturers at present, this tool has been effectively integrated into federal government purchasing, among other sectors. It is interesting to note, however, that no current product has attained gold status. (Green Electronics Council, 2006).

Resources: The EPEAT Website at www.epeat.net.

The Greenpeace Guide at www.greenpeace.org/international.

7. Extended Producer Responsibility (EPR)

Incorporated in these electronics rankings is the idea of Extended Producer Responsibility (EPR), a green policy that is gaining international recognition and support. The goal of EPR is to make brand-owners responsible for their products' disposal at the end of the life-cycle, which would create more incentive for green design. EPR also

encompasses social justice principles such as eliminating workers' exposure to toxic substances. The concept emerged in Europe in the 1980s and today the European Waste from Electrical and Electronic Equipment (WEEE) Directive is helping to advance EPR policy (The WEEE Directive, 2006a). While the European Union and Asia have actually implemented EPR legislation, U.S. efforts have been led by individual states and cities. The EPR Working Group, composed of primarily American and Canadian representatives of environmental, labor, health and environmental justice organizations, developed a set of EPR Principles in 2003, which have certainly contributed to these efforts (Extended Producer Responsibility Working Group, 2005). EPR initiatives have also come from within the industry, as Hewlett Packard and Dell, among others, increase product "take-back" programs (Attinger, 2006). By supporting groups and brands committed to these principles and raising awareness of EPA initiatives, librarians and information professionals can take an important step in helping to link the currently separate production and waste processes in this sector.

Resources: EPR Working Group at www.eprworkinggroup.org.

WEEE Directive at www.weeman.org/html/directive/index.html.

8. Responsible Recycling

Until Extended Product Responsibility gains wider acceptance, however, there will be a continued need for responsible recycling efforts at the end of product life-cycles. The Basel Action Network (BAN) maintains a list of "responsible e-cyclers" across the United States, which have signed the "Electronic Recycler's Pledge of True Stewardship." This pledge supports keeping e-waste out of landfills and prevents its illegal shipment to developing countries, among other things (Basel Action Network,

2003). As a supplement to the relatively small number of BAN e-cyclers, the Earth 911 website provides recycling center information customized by zip code along with ideas for donating electronics for reuse. Lastly, progressive book reuse programs should not be overlooked. Instead of sending books to landfills, incinerators, or even recycling centers, consider programs that redistribute them to disadvantaged communities in the United States and abroad. Although book donation programs have been criticized in terms of their true value and effectiveness to users, groups that make an effort to weed donations and match books to appropriate audiences should not be overlooked as a recycling alternative.[16] The International Book Project has been operating since 1966 out of Lexington, Kentucky, and is a standout example of providing appropriate-level donations to communities in need. More creative, local solutions to landfilling books might pair libraries with local businesses, as the University of Utah libraries did with Redi-Therm, turning their shredded books into insulation (Pierce, 2005, p. 71).

Resources: BAN's list of e-cyclers at www.ban.org/pledge/Locations.html.

Earth911 Website at www.earth911.org.

International Book Project at www.internationalbookproject.org.

9. LEED Green Building Rating System

With current U.S. library building projects numbering close to two hundred in the 2005-2006 academic year, green building design could have a potentially large impact on resource conservation (Fox, 2006, p. 42). The Leadership in Energy and Environmental Design (LEED) Green Building Rating System has quickly become the measure by

[16] On the topic of questionable book donation value, I found Margaret T. Hite's 2006 Master's Thesis, *Traditional Book Donation in Sub-Saharan Africa*, particularly illuminating. It is available in PDF format from the UNC-Chapel Hill School of Information and Library Science Electronic Theses and Dissertations Web site: http://etd.ils.unc.edu/dspace/bitstream/1901/307/1/margarethite.pdf.

which today's green design and construction in the U.S. is judged. LEED is a project of the U.S. Green Building Council, begun in 1993, and represents a voluntary, third-party certification system. LEED promotes whole building sustainability through indicators related to site development, water use, energy use, materials, indoor environmental quality, and design. Certification is awarded at one of four levels: certified, silver, gold, or platinum. Although LEED projects are generally more expensive than conventional construction plans, the program is gaining momentum with federal, state, and local agencies, among others. (U.S. Green Building Council, 2007). And cost-saving potential is a plus over the long term in energy and water savings, among other areas. Recent LEED library projects include the Santa Monica Public Library in California, the Bronx Library Center in New York, and the Fayetteville Public Library in Arkansas. Others, such as the Grand County Public Library in Utah have incorporated LEED components without going for full certification (Kuzyk, 2006, p. 36).

Resources: LEED Website at www.usgbc.org/LEED.

10. Carbon Off-setting

These days, if you cannot tackle energy consumption at its source, as with a newly-designed LEED building, you at least have the option to off-set your habits. The term "carbon footprint," like "Ecological Footprint," has been used to represent the amount of carbon dioxide released to the atmosphere by a particular entity, generally through energy consumption and the burning of fossil fuels. In recent years, carbon off-set service providers have channeled the concern over global warming into concrete action, by planting trees on behalf of paying customers. Trees absorb carbon dioxide at a measurable rate, which allows off-setters to calculate a tree-based counterbalance for

certain consumption habits, such as cross-country air travel. In the case of libraries, which not only use energy, but indirectly contribute to the removal of trees through book and paper consumption, carbon off-setting provides an opportunity to shift the balance back. This is a rather expensive option, with little concrete return, but carbon off-setting does have the potential to raise awareness, and fundraising activities could be geared to this end. Before investing in a service provider, check the Tufts Climate Initiative website, which includes carbon offset company rankings (recommended, recommended with reservations, or not recommended). Many of these companies also include online carbon calculators, which could help raise awareness without the actual investment of community dollars.

Resources: Tufts rankings at www.tufts.edu/tie/tci/carbonoffsets/ratings.htm.

Conclusion

Through practices that diminish waste at its source, promote socially responsible purchasing, prioritize recycling, and support overarching policy changes, librarians and information professionals have a range of options for creating more sustainable, environmentally-aware institutions. Operationally, the suggestions above could translate into a number of top-down or bottom-up initiatives, including self-assessment, the installment of energy-saving devices, greater visibility of recycling bins, the switch to recycling-friendly glues by in-house bindery departments, utilization of Extended Producer Responsibility programs, such as the Hewlett Packard ink cartridge return system, employee recognition programs for carpooling, and much more. When libraries and information centers explore these kinds of opportunities, they recognize their place in a larger resource ecology and affirm their connectedness to other communities worldwide. It is worth noting that while the best practices described here are primarily couched in an individual institutional framework, the best way forward may be a collective one. For years, libraries have successfully formed consortia to negotiate contracts with vendors, leveraging their collective purchasing power against high pricing schemes. Would it be so far-fetched for library consortia to also use their collective might in seeking out contracts with environmentally progressive vendors? As long as consumer demand continues to drive suppliers' practices, this may be the most effective means of advocating for social change within a capitalist framework.

Of course where change is the goal, there are always costs involved. For librarians and information professionals, these may represent time and energy costs, as well as actual costs for certified or responsibly produced goods and services. Whether formally or informally, any new process or procedure involves a cost-benefit analysis, and taking environmental impact into account represents an extra layer of costs in the equation. The good news is that many environmentally friendly suppliers have already calculated the cost-saving potential of their products, and not just in terms of the number of trees saved. Over time, energy-efficient products, in particular, can provide cost-savings to institutions in terms of their bottom line. It may be harder to grasp that our natural resources are diminishing and worth saving when competitors continue to drive raw material prices down. Libraries and information centers willing to take on additional costs for recycled paper and electronics that support Extended Producer Responsibility principles may have to justify them from a social responsibility point of view. What I have attempted to demonstrate in this paper is that ecological costs are measurable, social responsibility is justified, and both are of growing interest to the average American consumer. As of yet, libraries have not had to respond to pressures for social accountability from their patrons in the way that corporations have; since they already provide "good deeds" work in local communities, this is not especially surprising. As Corporate Social Responsibility has demonstrated in the business world, however, the costs of ignoring these issues has meant a loss of trust among stakeholders and ultimately, loss of revenue (Griffin & Mahon, 1997). Libraries operate differently from corporations, as much as trends towards "customer-driven librarianship" have come to the fore (Buschman, 2003a, p. 109).[17] But precisely for this reason—for what libraries

[17] John E. Buschman has proposed this term, but is critical of the trend it represents in terms of libraries

represent that businesses do not—the time is ripe for libraries to "go green," to take the lead on sustainability issues, and to become true beacons of social responsibility, on a local and global level.

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recasting their users as "consumers." I am inclined to agree, despite my interest in library accountability, which Buschman offers as an example of the shifting discourse towards consumerism.

Appendix A: Ecological Footprint Calculator Values for Public Libraries, 2004/1994

Source of Questions: Office Footprint Calculator™ (TheGreenOffice.com)

How many people work in your office? [visitors included]

2004 = 77 people 1994 = 64 people

Calculated as staff plus hourly density of visitors. Staff calculated as total FTE staff divided by total libraries. Visitors calculated as total visits divided by total libraries divided by annual service hours (based on peak distribution of weekly service hours multiplied by 52 weeks/year).

2004 Source: National Center for Education Statistics. (2006). *Public libraries in the United States: Fiscal Year 2004*. Retrieved January 17, 2007, from NCES Web site: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2006349. Table 13, page 62 for total FTE staff (136,014); Table 1, page 12 for total libraries (9,207); Table 8, page 42 for total library visits (1,322,396,000); Table 4, page 26 for peak distribution of library service hours/week (40-49, for a mean of 44.5 hours/week).

1994 Source: National Center for Education Statistics. (1997). *Public libraries in the United States: 1994*. Retrieved January 18, 2007, from NCES Web site: http://www.nces.ed.gov/pubsearch/pubsinfo.asp?pubid=97418. Table 8, page 50 for total FTE staff (112,823); Table 1, page 26 for total libraries (8,921); Table 4, page 38 for total library visits (821,689,000); Table 3, page 35 for peak distribution of library service hours/week (30-39, for a mean of 34.5 hours/week).

Your zip code [no geographical difference; tested several]

TRANSPORTATION

How many people take the bus to work?

2004 = 6 people 1994 = 5 people

What is the average one-way commute of people who take the bus?

2004 = 5 miles 1994 = 5 miles

How many people take light rail (subway, metro, trolley, etc.) to work?

2004 = 3 people 1994 = 2 people

What is the average one-way commute of people who take light rail?

2004 = 5 miles 1994 = 5 miles

How many people take the train to work?

2004 = 1 person 1994 = 1 person

What is the average one-way commute of people who take the train?

2004 = 5 miles 1994 = 5 miles

How many people take their car or a taxi to work?

2004 = 67 people 1994 = 56 people

What is the average one-way commute of people who take a car or taxi?

2004 = 5 miles 1994 = 5 miles

How many combined hours per month do people in your office spend flying for work?

2004 = 0 hours 1994 = 0 hours

If people in your office walk or bike to work, congratulations!
The Calculator assumes the impact of these activities is negligible.

Calculated as percentages of total workers/visitors, above.

2004/1994 Source: Bureau of Transportation Statistics. (2002). *Daily travel quick facts from the National Household Travel Survey, 2001-2002*. Retrieved January 18, 2007, from BTS Web site: http://www.bts.gov/programs/national_household_travel_survey/daily_travel.html. Site notes among Americans, 87% make daily trips in personal vehicles; 91% commute to work in personal vehicles. For this calculation, I used 87% with the remainder by bus, light rail, and train. Percentages assigned at 8% bus, 4 % light rail, 1% train, 87% car, flying (o%). Average distance for all modes estimated at 5 miles: Source: Getz, M. (1980). *Public libraries: An economic view*. Baltimore: Johns Hopkins University Press (Page 29).

FACILITY, ENERGY, AND WASTE

Building

How would you describe your building?

1) concrete and/or steel 2) wood 3) designated green building

2004 = concrete and/or steel 1994 = concrete and/or steel

2004/1994 Source: Oehlerts, D. E. (1991). *Books and blueprints: Building America's public libraries*. New York: Greenwood Press. Common building materials for public libraries noted on page 139.

What is the size of your building?

2004 = 25,037 sq feet 1994 = 25,037 sq feet

2004/1994 Source: NCES. (2006). Table 26, page 114 for average square footage of central libraries by state (for a mean of 25,037 sq. ft./library nationwide). This question did not appear in the NCES 1994 survey, so the 2004 figure was used.

How many years old is your building?

2004 = 40 years 1994 = 40 years

Based on calculator's suggested U.S. average of 40 years. Although 30 years might seem like a better response for 1994, the calculator uses current consumption aggregate data, and will not truly reflect 1994 consumption habits. So this factor was kept unchanged.

Paving

How much of the land directly surrounding your building is covered by parking lot, sidewalk, or other impervious space?

2004 = 75,111 sq feet 1994 = 75,111 sq feet

Calculated as three times the square footage of the building, above.

2004/1994 Source: Connecticut State Library. (2002). *Library space planning guide*. Hartford, Conn.: Connecticut State Library. Retrieved January 17, 2007 from WebJunction Web site: http://data.webjunction.org/ct/documents/6181.pdf. Recommends that the library building represent ten percent of the total square footage of the site and parking thirty percent, page 18. Square footage was not part of the NCES 1994 survey, so the 2004 figure was used.

Electricity

How much electricity does your office use?

2004 = 2,025 kilowatt hours 1994 = 1,683 kilowatt hours

Based on calculator's suggested average of 26.3 kilowatt hours/person, using worker/visitor figures, above.

How much of this electricity is from clean, renewable sources?

2004 = 3% 1994 = 3%

2004/1994 Source: U.S. Department of Energy. (2006). *U.S. Energy Statistics*. Retrieved January 18, 2007, from Energy Efficiency and Renewable Energy Web site: http://www.eere.energy.gov/states/us_energy_statistics.cfm. Under "U.S. Energy Consumption," one finds a three percent contribution of non-hydro renewable energy.

Natural Gas

How much natural gas does your office use?

2004 = 2,071 therms 1994 = 1,722 therms

Based on calculator's suggested average of 26.9 therms/person, using worker/visitor figures, above.

Waste

How much waste does your office generate per week and what percentage is recycled or composted?

Paper/cardboard

2004 = 96.3 lbs, 80% recycled 1994 = 85.7 lbs, 80% recycled

Calculated as employee waste plus waste from deaccessioning books. Employee waste based on calculator's suggested average of 5.3 lbs/week/employee, using number of FTE library staff above (not including visitors). Book waste based on weeding five percent of total library collection annually, calculating at 1 lb per print material item, and dividing annual total by 52 weeks for a weekly rate.

2004/1994 Weeding Rate Source: Connecticut State Library. (2002). Page 3 recommends five to ten percent total collection weeded yearly; lower end used to account for more realistic figures.

2004 Library Print Collection Source: NCES. (2006). Table 12, page 58 for peak distribution of library print material collection of 10,000-24,999 (for a mean of 17,500 print materials).

1994 Library Print Collection Source: NCES. (1997). Table 7, page 47 for peak distribution of library print material collection of 10,000-24,999 (for a mean of 17,500 print materials).

Estimated eighty percent recycling (calculator suggests 42% average), based on library book sales and other donation/recycling programs.

Aluminum

2004 = 12 lbs, 28% recycled 1994 = 10.4 lbs, 28% recycled

Based on calculator's suggested average of 0.8 lbs/employee, 28% recycled, using FTE library staff figures, above (not including visitors).

Other metal

2004 = 4.5 lbs, 35% recycled 1994 = 3.9 lbs, 25% recycled

Based on calculator's suggested average of 0.3 lbs/employee, 35% recycled, using FTE library staff figures, above (not including visitors).

Glass

2004 = 7.5 lbs, 26% recycled 1994 = 6.5 lbs, 26% recycled

Based on calculator's suggested average of 0.5 lbs/employee, 26% recycled, using FTE library staff figures, above (not including visitors).

Plastic

2004 = 24 lbs, 5% recycled 1994 = 20.8 lbs, 5% recycled

Based on calculator's suggested average of 1.6 lbs/employee, 5% recycled, using FTE library staff figures, above (not including visitors).

Water

How much water does your office use?

2004 = 61,600 gallons/month 1994 = 51,200 gallons/month

Based on calculator's suggested average of 800 gallons/person/month, using worker/visitor figures, above.

PRODUCTS AND SERVICES

Supplies

How much paper is used in your office?

2004 = 37 reams/month 1994 = 33 reams/month

Calculated as employee use plus book acquisitions. Employee use based on calculator's suggested average of 2 reams/month/employee, using FTE library staff figures, above (not including visitors). Acquisitions based on new purchases of 10% of total library print collection annually, calculating at 1 lb per print material item, converting to reams of paper (at 20 lbs each), and dividing by 12 for a monthly rate.

2004 Library Print Collection Source: NCES. (2006). Table 12, page 58 for peak distribution of library print material collection of 10,000-24,999 (for a mean of 17,500 print materials).

1994 Library Print Collection Source: NCES. (1997). Table 7, page 47 for peak distribution of library print material collection of 10,000-24,999 (for a mean of 17,500 print materials).

What is the average post-consumer recycled content of the paper used?

2004 = 4.8% 1994 = 4.8%

Based on calculator's suggested average of 4.8%.

Technology

How many desktop computers are in your office?

2004 = 15 1994 = 4

Calculated as public-use internet terminals plus estimated one desktop computer per librarian (not all FTE library staff—just librarians). For 1994, public terminal figures not included in the NCES survey, so calculated as 1 desktop computer per librarian.

2004 Source: NCES. (2006). Table 13, page 62 for FTE librarians (45,037) per library (9,207). Table 10, page 50 for average number of public-use internet terminals per stationery outlet (10).

1994 Source: National Center for Education Statistics (1997). Table 8, page 50 for FTE librarians (38,048) per library (8,921). No public-use computer information available.

How many laptop computers are in your office?

2004 = 0 1994 = 0

No laptops estimated.

How many phones, faxes, and other business machines are in your office?

2004 = 8 1994 = 7

Estimated as one phone per FTE librarian, plus one office fax and two office copy machines.

2004 Source: NCES. (2006). Table 13, page 62 for FTE librarians (45,037) per library (9,207).

1994 Source: NCES. (1997). Table 8, page 50 for FTE librarians (38,048) per library (8,921).

How many CDs or floppy discs does your office use?

2004 = 68/month 1994 = 31/month

Calculated as new audio/video purchases, and based on annual acquisitions of ten percent of total library audio/video collection. Sum of audio and video collection divided by total libraries, divided by ten, and divided by twelve for monthly rate.

2004 Audio/Video Collection Source: NCES. (2006). Table 11, page 54 for total audio materials (38,779,000) and total video materials (35,957,000), divided by total libraries (9,207).

1994 Audio/Video Collection Source: NCES. (1997). Table 6, page 44 for total audio materials (23,568,000) and total video materials (9,268,000), divided by total libraries (8,921). Although it is acknowledged that audio/video formats have changed since 1994, no additional calculations have been made for consistency's sake.

Furniture

What is the approximate weight of the wooden furniture in your office?

2004 = 8,900 lbs 1994 = 8,900 lbs

Estimated as twenty tables (200 lbs each), 50 chairs (50 lbs each), 8 desks (300 lbs each) for a total of 8,900 lbs.

2004/1994 Source: Pierce, W.S. (1980*). Furnishing the library interior*. New York: Marcel Dekker, Inc.

What is the approximate weight of the plastic and metal furniture in your office?

2004 = 25,600 lbs 1994 = 21,200 lbs

Calculated as metal shelving for books. Shelving needs estimated at 100 volumes per shelving section (36 in. x 7 shelves high), and shelf weight of 100 lbs per shelving section. Source: Pierce, W.S. (1980). *Furnishing the Library Interior*. New York: Marcel Dekker, Inc. (Page 148).

2004 Total Collection Source: NCES. (2006). Table 12, page 58 for peak distribution of library print material collection of 10,000-24,999 (for a mean of 17,500 print materials). Table 11, page 54 for total audio materials (38,779,000) and total video materials (35,957,000), divided by total libraries (9,207).

1994 Total Collection Source: NCES. (1997). Table 7, page 47 for peak distribution of library print material collection of 10,000-24,999 (for a mean of 17,500 print materials). Table 6, page 44 for total audio materials (23,568,000) and total video materials (9,268,000), divided by total libraries (8,921).

What percentage of your office furniture is made from recycled or certified renewable materials ?

2004 = 25% 1994 = 25%

Source: Green Seal (2005, July). *Choose Green Report*. Retrieved January 18, 2007 from Green Seal Web site: http://www.greenseal.org/resources/reports/CGR_officefurniture.pdf.

Janitorial

How many gallons of cleaning or hygiene products are used in your office?

2004 = 4 gallons/month 1994 = 4 gallons/month

Estimated as one gallon per week.

Breakroom

How many cups of non-organic or non-Fair Trade Certified coffee or tea are consumed?

2004 = 510 cups/month 1994 = 442 cups/month

Based on calculator's suggested average of 34 cups/month/employee, using FTE library staff figures, above (not including visitors).

How many small appliances (e.g. microwaves, toasters) does your office have?

2004 = 3 small appliances 1994 = 3 small appliances

Estimated as one of each of the following: microwave, toaster, coffee-maker.

How many large appliances (e.g. fridges, stoves) does your office have?

2004 = 1 large appliance 1994 = 1 large appliance

Estimated as one fridge.

Services

How many total nights do people stay in hotels?

2004 = 0 nights/month 1994 = 0 night/month

No hotel stays estimated.

How much is spent per person on dry cleaning or external laundry service?

2004 = $0.00/month 1994 = $0.00/month

No dry cleaning or external laundry estimated.

TOTAL CALCULATED ECOLOGICAL FOOTPRINT

Per worker/visitor:

2004 = 58.5 global acres* **1994 = 58.6 global acres**

Total organizational footprint:

2004 = 4,502 global acres **1994 = 3,749 global acres**

"How You Compare"

"If all organizations operated like yours, we would need 0.95 planets to sustain the *workforce alone*. This does NOT include the vast amount of natural resources and ecosystem services consumed by individuals" (Office Footprint Calculator™).

*"Your Footprint is measured in a common unit called a 'global acre,' which is an acre of land with average global biological productivity. Expressing the footprint in global acres allows comparison across different regions with varying land uses" (Office Footprint Calculator™).

All data input on January 17, 2007.

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