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ORIGINAL PAPER

Beyond "green buildings:" exploring the effects of Jevons' Paradox on the sustainability of archival practices

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Abstract The sustainability of archival institutions will be greatly affected by attempts to mitigate their carbon footprint to meet the challenges of global climate change. This paper explores how recordkeeping practices may enhance or undermine the sustainability of archives. To enhance sustainability, it is a common practice to increase the efficiency of recordkeeping practices. However, increases to efficiency may lead to a phenomenon known as Jevons' Paradox. Jevons' Paradox occurs when improvements in efficiency to a system or process result in an increase in use (instead of a decrease) of a resource. The failure of the paperless office demonstrates Jevons' Paradox, and it has wide implications for the future sustainability of repositories. This paper advances the notion that "green" technologies alone are not enough to ensure sustainability. They must be deployed in concert with a systematic use of archival practices and theories for environmental sustainability to be ensured.

Keywords Jevons' Paradox · Efficiency · Paperless office · Sustainability

Introduction

Recent literature on the environmental sustainability of archives has largely focused on "greening" repository design and infrastructure (Kim 2008; Saïe Belaïsch 2008; Jankowska and Marcum 2010). The drive toward green archives reflects a larger movement that uses energy efficient technology to mitigate the carbon footprint of buildings. Climate change and dwindling natural resources pose external risks to the sustainability of archival repositories through higher energy prices and "carbon

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taxes."[1] The implementation of energy efficient infrastructure is a needed and a logical response to such environmental risks. However, the process of transitioning archival repositories to energy efficient and environmentally sustainable institutions cannot rely on infrastructure improvements alone. Our professional theories and practices must also be understood and applied in such a way that they enhance the sustainability of repositories.

The exponential growth in the number of records poses internal risks to the sustainability of repositories. It is widely acknowledged that information technology (IT) and office automation have wrought tremendous growth in the number of modern records (Lyman and Varian 2003; Hey and Trefethen 2003; Pember and Cowan 2009), which in turn suggests that archivists will be confronted with increasingly larger collections. Information about how bulk in recordkeeping organizations grows is important in understanding the scope of the problem of mitigating the environmental impact of storage and preservation requirements. Bigger collections require bigger repositories, which exact costs through building materials and energy usage. What is the significance of the exponential growth of records in a future where smaller and potentially more expensive building design is required?

This paper explores the causes of growth in records through the lens of Jevons' Paradox. Jevons' Paradox is an observation that *efficiency* enhancements to a system or a process can actually increase overall usage of a resource instead of decreasing it. In the fields of energy conservation and economics, Jevons' Paradox is used to dispel the notion that sustainability can passively emerge solely from efficiency improvements to energy use (Alcott 2005; Polimeni 2009). This paper explores the same line of inquiry as it relates to IT and archival practices. My use of Jevons' Paradox will be explored through the advent of the personal computer (PC) revolution to better understand the causes of the failure of the "paperless office," and its implications for archival sustainability. For instance, Jevons' Paradox may give us new insight in how the growth of records has compelled archivists to use increasingly sophisticated archival practices and technologies. This sophistication, while allowing us to sustain our archival missions, also brings increasingly higher costs in time and resources. Minimal processing and postcustodial strategies are briefly explored in light of the discussion about efficiency as two relatively new practices that may offer directions toward archival sustainability.

Jevons' Paradox and the problem of efficiency

In the nineteenth century, economist William Stanley Jevons posited that when improvements in technology make it possible to use a resource more efficiently, the overall consumption of that input will *increase*, not decrease contrary to conventional wisdom. Jevons (1865) published his ideas on efficiency in a book entitled, *The Coal Question: An Inquiry Concerning the Progress of the Nation, and*

[1] A "carbon tax" is a tax levy on the use of carbon-based fossil fuels intended to slow the rise of global warming (Hoeller and Wallin 1991).

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the Probable Exhaustion of our Coal-mines. As the title suggests, Jevons was concerned about the sustainability, in modern parlance, of Britain's accustomed way of life and its political and economic supremacy. The efficiency improvements made to steam engine technology made coal an affordable energy source for trains, boats and homes: the applications were endless, and coal consumption rose like never before. Jevons (1865) writes:

> It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth (p. 103).

Britain's industrial expansion was due, in part, to its seemingly endless supply of coal reserves to fuel its factories. But, once Jevons observed the steady increases in coal consumption, he feared that Britain would soon exhaust the valued resource and its supremacy would decline. Because coal as a fuel for transportation and heating was eventually replaced by natural gas and oil, Jevons' writings were seldom read until the oil shocks of the 1970s.[2]

Without an understanding of Jevons' Paradox, institutions that aim to become sustainable through energy efficiency, technology improvements or "green" repository design might actually consume more energy and resources rather than less (Polimeni and Iorgulescu Polimeni 2006; Holladay 2009). Jevons' Paradox, however, is not limited to understanding the economics of energy use and building design. The failure of the paperless office might be better understood through the lens of Jevons' Paradox.

The failure of the paperless office

Over 30 years have passed, and we are still waiting for the arrival of the paperless office, yet paper proliferates like never before. In Lancaster's (1978) book, *Toward Paperless Information Systems*, a bold vision of the modern office was presented in which the records creator writes, stores and retrieves all of his information through a computer monitor, unencumbered by paper. The exponential growth of records has haunted archivists for decades if not centuries, but it was not until the advent of the PC that information and computer experts thought that this trend could be slowed and potentially stopped. Building on the growing belief that word processing would revolutionize office communication ("Office of the Future" 1975), Lancaster (1978) believed that Vannevar Bush's futuristic Memex machine could finally be realized in what Lancaster dubbed the "The Library in a Desk" (pp. 2–3). The dreams of a

[2] The "Khazzoom-Brookes postulate" rearticulated Jevons' Paradox as the "rebound effect" for fuel consumption for the automobile. The postulate was based on research conducted during the oil shocks of the 1970 s to better understand patterns of fuel consumption. Economists Daniel Khazzoom and Leonard Brookes independently observed (interestingly with no knowledge of the work of Jevons) that high gasoline prices drove down consumption and inspired greater fuel efficiency in automobiles only temporarily. The net effect of improved efficiency was an overall increase in fuel consumption in the long term. See, http://en.wikipedia.org/wiki/Khazzoom-Brookes_postulate. Accessed 13 January 2011.

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paperless office not only fulfilled the desire to get access to the organizational knowledge locked away in filing cabinets, but it also promised to increase the productivity of the organization.

The advent of modern information technologies such as vertical filing, teletype and pneumatic tube systems helped give rise to modern recordkeeping; these technologies allowed organizations to coordinate actions through memos, circulars and other communication methods in ways that surpassed handwritten, hand-delivered communication (Yates 1989). The history of the modern office has been one where the design of organizational structures is informed by contemporary communication technologies. The fanfare and excitement from business experts preceding the widespread introduction of the PC perhaps makes the failure of the paperless office even more notable. In hindsight, we can see the advent of the PC was another defining step in the evolution of the relationship between IT and the environment of organizations.

Lancaster's notions about the future of information were visionary, but one shortcoming of this vision was to assume that the introduction of computers would dictate the decline of paper documents (Young 2008, p. 852). With the rise of cheap computer equipment and word processing software, it was believed that digital documents would be substituted for paper as a resource and lead to the demise of costly paper usage. Contrary to expectations, paper usage increased like never before, leading York (2006) to label this phenomenon the "Paperless Office Paradox". York (2006) makes a fine distinction between Jevons' Paradox that hinges on efficiency and his own assertion of the "Paperless Office Paradox," suggesting that substituting one resource (electronic document storage) for another (paper document storage) leads to the same increase in consumption though their causes may have diverse explanations. York (2006) focuses on determining whether or not Jevons' Paradox can be generalized to other efficiency and consumption situations and concludes that it can be.

While photocopiers had been a common feature in the modern office, the desktop printer and printer/photocopier units made the unprecedented proliferation of paperwork a possibility. Before the rise of inexpensive, labor-saving office computers and printers, commercial printers handled the majority of printing using offset printing, a process that was expensive and required specialized knowledge. Additional time was required to place the order and deliver the document for printing. The cost, compared to today's standards, would have limited printing to the final product only. Innovations in desktop publishing software and printer technology have led to new forms of office printing, such as the ability to print images on photograph paper or to create large posters for office charts and displays.

Between 1983 and 1993, there was only a 5% increase in photocopiers in offices, but PC printers increased by 600% (Sellen and Harper 2002, p. 14). The explosion of cheap printer technology allowed offices to create and print documents on demand with newfound ease. At every desk, the office worker could print limitless drafts of documents and circulars, and print out emails, no matter how trivial (van der Merwe 2006). The printing of email alone accounts for as much as 14% of paper consumed at one university (Riley 2001). Sellen and Harper (2002) suggest the

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paperless office failed due to the unrecognized *affordances* of paper. Paper, they demonstrate, affords users the ability to stack, annotate, share and arrange in meaningful and effective ways that promote productive information sharing and reference. Their research on paper document usage offers a fresh view of office culture that has been almost entirely ignored in favor of human–computer interaction research. Jevons similarly believed that it was the utility and the low cost of a commodity that drove its consumption.

But what Sellen and Harper fail to explain are the Paradoxical effects of efficiency-enhancing tools such as the office PC and desktop printers. When given the opportunity (through inexpensive or time saving methods) to consume a resource of high utility such as paper, people and organizations tend to consume more rather than less. While the effects of efficiency improvements to IT are apparent in the statistics, we read about paper usage, their theoretical causes are difficult to understand and it has been acknowledged that more research is required (Sorrell 2009). The lack of "provability" has been the rub for many critics of the alleged connection between efficiency improvements and increased use. Perhaps the industry research that tends to look only at increased efficiency of a single device on the micro-level misleads office managers about the true macro-level effect efficient IT brings to the entire recordkeeping environment. Jevons (1865) states that "new applications of coal are of an unlimited character," and this certainly holds true for new ways to "consume" paper through office communication (p. 151). While beyond the scope of this paper, cheap data storage has offered unprecedented ways to consume and create information. Businesses looking to "cloud computing" to reduce costs are having second thoughts; most reports suggest that the cheaper IT becomes the more likely data storage needs will increase (Brooks 2011). The unceasing increase in data storage needs is leading some IT experts to express doubt about the ability of "cloud computing" and greater investment in IT to reduce greenhouse emissions (Tomlinson et al. 2011).

Jevons' Paradox poses great concerns to the environmental sustainability community, especially since we often rely on efficiency gains as a primary method to lower the impact of our carbon emissions. However, one might argue that it is through efficiency improvements that organizations have been allowed to grow and build on past successes. Economists and business leaders talk of "growing" and "expanding" business, so it follows that records and communication would be a necessary component of that growth. These unintended consequences of increased efficiency beg the question: what do business leaders mean when they talk about "sustainable growth"? Greater efficiency, it is typically thought, allows businesses to do the same with *less*. If Jevons' Paradox holds true for recordkeeping organizations as it has for the energy conservation sector, it suggests that every increase in efficiency to records creation will most likely be accompanied by *more* information to process, manage and preserve. When we consider methods to control the growth of records, Jevons' Paradox questions the notion that sustainability can *passively emerge solely from efficiency improvements* to technologies and archival practices. The following section explores how archivists have been affected by the ever-increasing efficiency in production of records.

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Repositories in the "age of abundance"

Rapport (1981), writing under the influence of the 1970s energy crisis, stated: "space, material, energy, instead of being free and limitless, are becoming scarcer and costlier" (p. 143). Rapport was writing at a time when concerns over energy costs were a part of everyday life in the business sector. Rapport's insistence that reappraisal be a regular archival practice was not just an attempt to get unused records off the shelves and into the dumpster, it also implicitly suggests his understanding that limits to growth were in order if repositories were to remain viable into the future. Ham (1984) has coined our era of modern collections as the "age of abundance." With each generation of archivists, the task of acquiring and preserving documents has become increasingly marked by the need to apply increasingly more theory and practice that accommodate the growing complexity and bulk in modern collections. The alarming trend in the rising number of records to be appraised by archivists has not changed, yet the engagement of its cause has been sparse in recent archival literature. Schellenberg (1956), writing before Ham and Rapport, adopted a Malthusian tone toward the topic:

> Records management is thus concerned with the whole life span of most records. It strives to limit their creation, and for this reason one finds "birth control" advocates in the record management field as well as in the field of human genetics (p. 37).

Schellenberg bemoans the existence of documents, but if they must exist, they must serve a clear and important business need. Schellenberg's attitude contrasts greatly with contemporary archivists who have adopted a seemingly self-imposed belief that "life" must be preserved at all costs; a belief that is even more evident with electronic records. In contrast to Schellenberg's era, there is a growing interest to preserve records that once would have been considered ephemeral or beyond the technical expertise of archivists.

According to Blouin (2011), Ham "focused on *eliminating* records rather than preserving them," which contrasted greatly with his contemporary, Frank Burke, who pressed archivists to be more active in interpreting and shaping the historical record (p. 45). Our profession continues to view the historical record from both perspectives: that of the historian who must shape the collection and that of the pragmatist who must manage an ever-increasing collection. The historian's view of the archives may, in fact, limit our ability to look at the problem of bulk pragmatically. Jenkinson's (1922) admonishment that "the Archivist is not and ought not to be an Historian" (p. 106) remains an important reminder to those seeking sustainable archives. Concurrently during the 1970s, library literature began to focus on the increasing inability to weed and manage book collection sizes among academic libraries. The library building boom of the 1960s was winding down, and it was understood that book collections were overshooting the space limits of the libraries that were built for them; additionally, the cost of heating and cooling of libraries was an imminent concern due to the oil shocks of the 1970s (Mason 1975;

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Gore 1974; Durey 1978).[3] Indeed, libraries and archives were concurrently experiencing the same problem of overabundance. Blouin points out that, "by the end of the 1970s, American archivists along with their colleagues in other nations recognized the sheer practical impossibility of retaining the vast majority of diverse materials that societies were now generating about themselves" (p. 47).

Modern collections have brought us increased bulk and duplication of paper records, and they have also increased the difficulty of conducting appraisal (Ham 1984). However, conventional wisdom suggests that archivists, in the face of this abundance, will need to invest in appraisal activities like never before. Yet, archivists have historically been reluctant to engage actively in appraisal for many reasons, and this neglect has led to the costly problem of large backlogs (Greene 2010, pp. 177–178). Ironically, this foundational practice of the archival profession has been relegated in many cases to the processing room where student workers or interns carry out appraisal on an item-level basis (Greene 2010, p. 177). This *de facto* practice suggests that appraisal is a slow, laborious task that yields little in terms of impact on the collection except for insuring that duplicates are tossed and rusty paperclips are removed. Engaging the topic of appraisal has been additionally complicated by the increasing notion that it need not be conducted at all in some cases of electronic records. There is current discussion and action to preserve the Twitter archive (Raymond 2010), and there are calls to preserve cell phone records (Caswell 2009). One national archivist suggested that a "retain everything" approach could be used to preserve e-government records (Theimer 2009). It seems that the proliferation of digital information and widespread access to inexpensive storage have emboldened archivists to preserve electronic records to a degree that contrasts greatly with comparable paper records.

Modern collections, arguably, have become by conventional standards increasingly lower quality. Received wisdom about modern collections suggest that future records will reflect this trend of more bulk (and complexity), thus hindering archivists' ability to appraise and researchers' ability to understand the transactional and informational significance of modern records. Ham (1984) also points out that with modern collections, "despite the redundancy of modern records, there is also a problem of missing data" (p. 12). Yet, Ham's notion of recordkeeping environments must be balanced against the increasingly popular notion that modern collections are more than just redundant information.

New directions in archival theory suggest that recordkeeping environments, like natural environments, are complex ecologies. Archival theories and practices, then, may be enhanced by ecological concepts developed in the natural sciences (Moore 2007). Like the current understanding of the infinite relationships that exist between living organisms in their natural habitats, "the interconnections between archives," Moore points out, "become more apparent; they become less like zoos and more like biomes, defined by their scope and locations, much like climate and latitude" (2007, p. 118). An ecological view of collections and repositories builds on the

[3] Just as the 1970s energy crises inspired conservation and "limits to growth" among archivists and librarians, the return of relatively cheap energy available in the 1980s led one author to reject Gore's call for zero growth libraries (Dowd 1989).

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notion that human interactions, and thus the records those interactions create, are much more dynamic and complex than current archival theory affords. In environmental ecology terms, collections once viewed as useless "swampland" then become better understood as dynamic, interconnected and productive ecosystems. Writing from the perspective of a business historian, Yates (1985) suggested that acquisition of written communication in organizations could not be limited to top executives or the "tip-of-the-iceberg."

While this ecological view of records is more reflective of the nature in which people transact, it poses a difficult question regarding how this new view will inform archival practice: What are the *costs* associated with this new view? These new holistic frameworks suggest that archivists seeking to take custody will likely be required to gather and make sense of additional information during the appraisal and selection process and consequently devote more resources in the form of processing and additional storage. The effects of increased speed and efficiency of IT have helped create modern records collections that have increased the workload of archivists, who are subsequently faced with a dilemma: deploy more complex applications of practices such as appraisal, arrangement and description to tame the bulk and complexity of modern collections; or simplify and look for ways to work within a framework of repositories and collections that mitigates the rising costs of processing complex records collections that require increasingly larger storage facilities.

Minimal processing as a labor-saving practice

Minimal processing brings new efficiencies through simplification of archival processing and the overall workflow of providing access to archival materials. Minimal processing greatly challenges previously held notions about what constitutes effective archival practices and moreover what are sustainable practices in light of growing backlogs of unprocessed materials. While enjoying great popularity, especially in recent economic austerity, this new efficiency is not without its critics (Van Ness 2010).

The appraisal and processing techniques that were the mainstay of the archival profession during "the age of archival scarcity" functioned well for archivists. The processing standards that emanate from that era have become increasingly more complex and cumbersome to administer. Recent trends in bulky collections, however, require that repositories increasingly use more resources in order to attain the same past productivity in processing collections. Arrangement and description increasingly entail costly processing due in part to the failure of the PC to better control office communication as discussed previously. Growing organizational complexity of records creators through increased interdependent linkages across functional departments suggests that we may never meet the same standards of arrangement and description once attained in decades past, except for those repositories that severely limit their collecting scope and mission.

Minimal processing has been promoted for the practical purpose of increasing access to collections. Advocates of minimal processing assert that many of our arrangement and description practices were born during the age of scarcity and must be altered if we are to process our growing backlogs. The detailed, folder, and

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sometimes item-level archival processing that we have grown accustomed to can no longer be maintained in the "age of abundance." To maintain, it would require that repositories increasingly use more resources in order to attain the same past productivity in processing collections. In the history of modern archives, minimal processing represents the first formal effort to bring increased labor-saving techniques to archival processing or, in other words, to make the practices of repositories more sustainable. Greene (1998) summarizes the rarely acknowledged crux of our records problem:

> Despite lip service to having breached the transition to "an age of abundance," we as a profession have not devised or embraced a practical means of refining our acquisition and appraisal approaches to fit our goals and resources (p. 128).

Greene considers the benchmarks set for description and arrangement sustainable during the age of archival scarcity, but unsustainable now. Applying seemingly more simplistic processing practices might at first suggest a diminished understanding of a collection of records or the systems that created them. However, this simpler approach is one that recognizes not only the immensity and cost of detailed processing but also implicitly recognizes the inherent complexity of incoming collections, especially modern collections. Archivists have historically been tasked with creating order out of chaos, yet this view of recordkeeping agencies as "chaotic" is becoming increasingly less tenable.

Minimal processing has in effect brought to the fore the issue of who bears the burden of the new found efficiency. For example, a common criticism of minimal processing is that it shifts the burden from the processing unit of a repository to the reference services. Since there is less arrangement and detailed description on the folder level, reference services must then take on the burden of retrieving more boxes for every patron inquiry. Yet, advocates of this technique counter that patrons are much happier having *any* access to minimally processed collections than ones that linger in backlogs indefinitely (Gorzalski 2008, p. 192). Critics and advocates both see, and feel, the systemic effects that economizing an archival practice can cause in a repository, suggesting that certain archival practices might not be suitable for all collections or repositories. Minimal processing does in effect push the burden of preservation to the repository's climate control system (Greene and Meissner 2005, p. 231), which I cautiously believe is currently a workable solution. The assumption follows that traditional preservation treatments such as refoldering and reboxing with acid-free enclosures, removing metal fasteners and the like are not needed with modern climate control. Our strict standards for climate control have required modern repository design to incorporate expensive heating and cooling systems. Thus, minimal processing is a relatively inexpensive approach to preservation, which may become a stumbling block later when institutions want to curb their carbon footprint. The debate surrounding who or what should bear the burden of efficiency-enhancing practices perhaps warrants further consideration for those wanting to transition to more sustainable repositories.

Looking at minimal processing through the lens of Jevons' Paradox, the costs of processing collections would decrease initially because of the newfound efficiency

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of this processing technique. The repository will have solved their backlog problem. But once this newly found efficiency has been put into practice, it follows that the repository will seek out even *more* acquisitions to further its mission as a collecting repository and the new efficiency would actually cause an overall increase in the holdings of a repository. Once there is no backlog that space can then be theoretically converted to permanent storage. Similarly, minimal processing techniques that harness finding aid information and other efficiencies are being developed for the application to digitized collections (Dietz and Ronallo 2011). With relation to the "efficiency paradox," Bade (2010) states that we have "been dependent upon this "paradox" and in fact many information professionals are delighting in it and dreaming of a glorious future in which we will be the crown jewels of the information society." Archives that measure organizational growth through acquiring and processing collections will be at odds with ensuring the goals of becoming more environmentally sustainable. In addition, McFarland (2007) points out, "the slaying of backlogs is not an end in and of itself" (p. 138), and she suggests that the user-centered philosophy that minimal processing endorses can be applied to many management functions in the archives. As more efficiencies are brought to the archives, managers need to be even more on guard for potential ways to "consume" their new found surpluses of time and space.

Minimal processing can in essence replicate the same burdensome effects of increased bulk by bringing even more collections into the repository. In this light, minimal processing can become victim to the problem it was designed to alleviate: *backlogs*. By accepting that limits to growth are a necessary component of sustainability, minimal processing cannot stand on its own; other archival practices must be used in concert to offset the potential overcrowding of repositories. Rigorously applying reappraisal and deaccessioning, practitioners of minimal processing explicitly admonish archivists to *actively* manage repositories through such complimentary techniques (Greene 1998, 2006). Clear and concise collecting policies must guide and limit archivists who may be eager to expand collections. Minimal processing offers the custodial archivist a method to "give in" to the inherent complexity of archival collections and poses the difficult question of whether or not our conventional descriptive practices of the past will ever be adequate to capture the interconnected nature of our collections. Minimal processing signals a potential way to enhance archival sustainability through simplification and efficiency-enhancing techniques rather than attempting to maintain the often burdensome and complex archival practices of the past. While minimal processing does not directly lower the size of archival collections, if used with care, it does lower the costs of processing to those repositories with declining budgets.

Systemic thinking through postcustodial strategies

The postcustodial era was born out of an attempt to raise awareness of the problems that unsystematic collection management has brought to repositories in the "age of abundance." The material conditions of repositories drove much of Ham's philosophical thinking about the historical role custody played in the modern

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archives. Ham (1984) admonishes archivists to look beyond their own repositories and consider a more systematic approach to their work:

> This age of overabundant records and information, combined with increasing scarcity of resources, is forcing archivists to replace their essentially unplanned approach to archival preservation with a "systematic, planned, documented process of building, maintaining, and preserving collections" (p. 13).

For Ham, the modern repository had become an ossified institution lacking long-term planning ability to accommodate an "age of abundance." Just as minimal processing asks that archivists relinquish control over the minutiae of their collection processing, postcustodialism asks that archivists relinquish control of managing the costly archival infrastructure that custodialism requires. Taking custody of records enacts costs on the repository through climate control, storage space, processing the collections and providing access. Rather than shifting the burden of custody as once understood to the archives, postcustodialism *actively* manages records as they reside with the records creator (Pearce-Moses 2005). Ham saw how unsystematic repositories had become in the way they passively functioned and in their lack of understanding of the "ecosystem" of records creators and preservers. Ham's view of this situation is akin to Peter Senge's pithy observation that "the cure can be worse than the disease." Senge (2006) explains:

> The long-term, most insidious consequence of applying non-systemic solutions is increased need for more and more of the solution. This is why ill-conceived government interventions are not just ineffective, they are "addictive" in the sense of fostering increased dependency and lessened abilities of local people to solve their own problems. The phenomenon of short-term improvements leading to long-term dependency is so common, it has its own name among system thinkers—it's called "Shifting the Burden to the Intervener" (p. 61).

For archivists, the increasing complexity and bulk of modern records have compelled more costly practices and maintenance of repositories. In a more sustainable approach, the archivist manages the system rather than the individual records or "outputs" of the system. Proponents of this "do nothing" approach to management can be found across disciplines (Fukuoka 2009). In food systems, permaculture practitioners have discovered that imitating natural food producing environments is more productive than conventional agriculture. Food patterns found in nature are imitated to increase productivity and minimize labor. Decentralizing how records are managed has helpful parallels to the permaculture movement, which reveals how conventional agriculture has shifted the burden of maintaining the functionality of the natural ecosystem to the intervenor (farmer). Permaculturalists Jacke and Toensmeier (2006) pose the problem as such:

> The unintended consequences of this intervention throw the system out of balance, disrupt essential functions, and increase the system's reliance on intervention to maintain balance. The intervenor then bears the burden of maintaining the system's integrity (p. 20).

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By intervening in a healthy and self-maintaining ecosystem with pesticides and herbicides, the farmer takes on the costly burden of maintaining the healthy function of that ecosystem. The farmer (custodial archivist) unintentionally degrades the ecosystem's self-maintenance abilities (records creator) and sets up a cycle of developing expensive unsystematic solutions to problems. The intervenor then becomes the caretaker of the *entire* system. As Ham recognized, maintaining the archives as the sole place of custody has required ongoing problem solving that inherently brings with it unwanted costly complexity. The era of electronic records has made the burden of custody even more acute. Archivists are charged with managing the transfer of electronic records from a myriad of systems, each with its own applications, operating systems, hardware and file formats. In this instance, custodialism compels the use of additional energy rather than *following*, in effect, its abundance, which can be seen residing with the creator whether it be in business or community records. While additional "custodial" costs can mount on top of the costs of the system itself, relatively affordable options may present themselves to the creator not available to the custodial archivist (Bearman 1991).

Another example can be seen in how *respect des fonds* and original order might find their ultimate expression by remaining in the originating agency, a concept that has recently found expression with the rise of "community archives." Bastian (2003) has expanded our conventional notion of custody and provenance and suggests that a "community of records may be further imagined as the aggregate of records in all forms generated by multiple layers of actions and interactions between and among the people and institutions within a community" (p. 5). The postcustodial era offers archivists opportunities to relegate their control to the records creators and independent preservers as another technique to mitigate the increasing bulk of their collections. The "community archives" phenomenon (Flinn 2007) finds nonprofessional organizations and communities asserting ownership of their own histories; this development "can problematise the conventional notions of the archive" (Flinn et al. 2009, pp. 73–74). In some cases, community records have been deaccessioned and given back to their cultural owners, and repositories have entered into mutually beneficial relationships (Wareham 2001).

In the postcustodial era, many archivists have gravitated toward a more holistic view of recordkeeping. Inter-institutional cooperation along with distributed custody may be just one method for promoting what the late Hugh Taylor (1993) calls "soft energy paths" that are "relatively self-supporting" (p. 209). Postcustodialism and minimal processing are suggestive of possible productive frameworks for archivists to build a more sustainable future; both feature methods for "harnessing complexity" in ways that minimize direct, and costly, intervention in the complexity of the records by the archivist.

Conclusions and reflections

Failed attempts to reduce paper consumption in modern businesses through the introduction of the PC have serious implications for the future sustainability of repositories. The growing abundance of paper-based records suggests that archival

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repositories will be challenged by internal risks to sustainability from the rising amounts of records to appraise and preserve decades into the future. And, at the same time, archivists will need to respond to the increasing external pressures to mitigate their carbon footprint associated with brick and mortar repositories. Jevons' Paradox is regaining attention among sustainability experts, which will shed additional light on this poorly understood subject for the archival profession to consider. Jevons' Paradox teaches us that the temptation to look for new places to "spend" a newly earned "savings" from an efficiency improvement to a repository, whether it be through improved building design or labor-saving practice, may be too great for organizations that are conditioned to grow.

Ultimately, the environmental sustainability of our repositories is as much a behavioral hurdle as it is a technological one. Until there are economic incentives or mandates to choose environmental friendly technologies such as a "carbon tax," archival institutions are unlikely to voluntarily make deep and long-term commitments to such choices. Indeed, the Climate Change Act of 2008 has put carbon reduction front and center for higher education institutions in the UK (SQW Consulting and SQW Energy 2009). If a "carbon tax" is our only chance to mitigate our environmental impacts, then archivists will have to redefine how they mark prosperity in their repositories in a future where repository sizes may remain stagnate or even shrink. While a governmental mandate may be our only hope to mitigate the climate change crisis, legislation is coming up against fierce resistance in Australia because of fear that such a tax will degrade living standards (Martin and Grattan 2011).

As we better understand the risks that Jevons' Paradox poses, archivists must use both archival theory and practice in developing a more coherent and realistic understanding of the modern records creation process. Forays into electronic records research have created new tools for modeling and analyzing recordkeeping systems (Upward 2000); these tools can provide valuable information to archivists seeking to enhance their sustainability. While I believe that minimal processing and postcustodial practices hold great hope for archivists looking to obtain new efficiencies in their repositories and archival programs, even the low maintenance requirements of such practices, if not applied properly, may lead to unintended increases in collections to manage and preserve. As the need to mitigate energy consumption in our repositories comes into focus, we may need to reconsider what custody actual entails in terms of the size of the repository and the energy and building materials it requires.

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