

## **The future shape of collection storage**

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There have been significant developments in the storage of library and archive collections over the past decade, from the use of a building's thermal mass to help control the storage environment, through to increased attempts at greening and the assessment of the environmental impact of buildings, to the adaptation of elements from warehousing in the retail sector. There is a significant amount of collection storage activity going on. In Australia two of the state libraries and the national library are designing new storage facilities. The Library of Congress is building in two off-site locations. In Denmark, several million euros will be spent on storage for museums, libraries and archives over the next five years following the initiation of a cross-domain national preservation strategy. The Dutch Royal Library is planning new storage facilities in an extension to its current building in The Hague. The Deutsche Bibliothek is planning a new store in Leipzig. The national libraries of Canada and Sweden are planning new storage facilities. Here in Britain, Oxford University Library and the British Library are planning new facilities; Cambridge University Library is constructing a phased extension to its current building, and looking to fund the final phase. Perhaps even more importantly, there are significant developments underway that will affect the storage of library and archive collections in the future. These developments are not just concerned with architecture and technology – the physical storage facilities, but with trends in publishing and information science, as well as organisational and collection management issues.

Firstly, I am going to make some observations about trends in library buildings and trends in collection storage by giving some examples of recent building projects as well as looking at alternative storage solutions. Secondly, I am going to give an overview of developments that will affect what we will be storing, concentrating on trends in publishing, research into the future shape of print and digital publishing, and the views of international comparator libraries about their future collections. Thirdly, I will be looking at some other factors that will have an impact on what we will be storing, professional and political developments such as collaborative storage and the Research Libraries Network. Fourthly, I will give an overview of some recent technical developments, and mention some future possibilities, before making a few concluding observations about collection storage issues.

### **Trends in library buildings**

There are a lot of libraries being built around the world, public, university and national, and there is a lot of thinking going on about what a library and information service should be.

#### **Public libraries**

In 1994 a fire destroyed Norwich Public Library. This was used as an opportunity to re-think and develop the role of a city centre public library. The new library is situated in a larger development in the city centre called *The Forum*, which was built on the site of the old public library. As well as the library *The Forum* houses open-learning facilities, an origins visitor centre, a café, restaurant and BBC East's Regional Radio

and Television Studio Headquarters. An area at the front of the library is called *Express*; it stays open late every night and has been explicitly modelled on a contemporary bookstore, with titles displayed so that they can be quickly and easily recognised. So here the traditional public library has borrowed ideas from the retail sector.

An example in London that has won architectural awards and acclaim is Peckham Library in south London, designed by Will Alsop. It creates a new public space below the main body of the library, and was explicitly designed and built as part of the urban regeneration of the area.

The most recent development to re-examine the future of urban public libraries is the creation of a series of *Idea Stores* in Tower Hamlets, in east London. The aim is to create a series of bright, new buildings in local shopping areas, combining lifelong learning and cultural attractions, with all the services normally associated with libraries, from classic books to DVDs and CDs. The seven *Idea Stores* are being designed to draw together the best traditions of the library movement, the education sector, and the retail and leisure sector. They are being sited in the heart of the neighbourhood shopping centres, next to or near supermarkets wherever possible. 'They will become a focus for the local community, a place where people can come for a coffee, to meet friends, to take a break from shopping, and to enjoy the many facilities, with seven-day-a-week and evening opening.'<sup>i</sup>

### **University libraries**

The use of signature architects is another noticeable trend. For example, moving on to university libraries, the revamped library at the London School of Economics in Holborn, with its signature central spiral, was designed by Norman Foster. Foster is also designing 'The Brain', the Philological Library of the Free University of Berlin, with state-of-the-art energy-saving systems. Frank Gehry is designing a building to consolidate science and engineering within the library at Princeton University. For university libraries, Klaus Kempf talks about the development of hybrid library buildings, reflecting the need to provide different learning zones, ranging from quiet private areas to busy social areas with low-level seating and tables with refreshment facilities.<sup>ii</sup> In such a case the functional boundaries between library and coffee shop are blurred. The following quotations about the new public Central Library in Seattle designed by the Dutch architect Rem Koolhaas underline this trend – 'Designers calculated that the downtown Barnes & Noble bookstore had 40 times the people traffic, per square foot, as the old library. Why? What was the public sector doing wrong that the private sector is doing right? They want to compete.'<sup>iii</sup> This was the result: At the opening ceremony Mayor Greg Nickels exclaimed 'Is that a Seattle library or what? ... Never again will Seattleites be parted from their lattes.'<sup>iv</sup>

### **National libraries**

The new British Library building here in St Pancras, London is one of the more controversial national library constructions of the past century. It was opened in 1998, around the same time as the new François – Mitterrand site of the Bibliothèque nationale de France in Paris and just before the so-called Black Diamond, the Royal Library of Denmark, on the waterfront in Copenhagen. These national libraries represent *grands projets*, major national cultural statements, with significant collection storage requirements that were not all satisfied on completion of these builds. All have significant future collection storage requirements. Harry Faulkner-

Brown has been one of the most influential library designers of recent times, and was consultant to the Black Diamond. In 1999 he posited some thoughts on the design of major library buildings, and suggested Ten Commandments for the intelligent library building.<sup>v</sup> It should be:

1. Flexible, with a layout structure and service that are easy to adapt.
2. Compact, for ease of movement of reader, staff and books.
3. Accessible, from the exterior into the building, and from the entrance to all parts of the building, with an easy, comprehensible plan needing minimum supplementary directions.
4. Extendable, to permit future growth with minimum disruption.
5. Varied in its provision of book accommodation and of reader services.
6. Organised to impose appropriate confrontation between books and readers.
7. Comfortable, to promote efficiency of use.
8. Constant in environment, for the preservation of library materials.
9. Secure, to control user behaviour and loss of books.
10. Economic, to build and to maintain, with minimum resources both in finance and staff.

## **Trends in collection storage**

### **New buildings**

There is a range of solutions for storing collections, some of which involve building buildings, some of which do not. With regard to institutional collection storage buildings, a comparatively recent trend has been towards high-density, high-bay, semi-automated warehouse type facilities. Starting in the US in repositories such as Harvard University and Yale University, it is currently being developed for the Library of Congress's modular facility at Fort Meade, as well as Stanford Medical Library, University of California Berkeley and University of Utah. In mainland Europe, it was used at the Bibliothèque nationale de France's Marne La Vallée site near Disneyland, and most notably at the National Library of Norway's site in Mo i Rana in northern Norway, just below the Arctic Circle. The Mo i Rana facility receives single copies of Norwegian legal deposit material (both print and modern media) which is stored in a vault built in a hall blasted out from within a mountain.<sup>vi</sup> Characteristically, these collection stores borrow technologies from the warehousing sector: semi-automated cranes, high shelving, high-density stacking systems, standardised containers, barcoding and automated warehouse tracking systems.

Any building can be characterised as a combination of people, place and process. A feature of this sort of facility is that the store is often distant from the main reading room, and they separate out people from place and process, with attendant service implications. The National Library of Norway's store in Mo i Rana is about 621 miles from Oslo, the Bibliothèque nationale de France's Marne La Vallée site is about 50 miles outside Paris, and the British Library is planning its new storage facilities in Boston Spa, West Yorkshire, 250 miles away from the reading rooms in London. There are many reasons for these decisions, but often they are economic. The British Library's property strategy is for any new storage building to be built in Yorkshire rather than central London, because it costs about a quarter of the price. There are then attendant decisions to be made about the value and the use of the collections to be stored, the environmental requirements, the service levels to readers and so on.

In terms of new collection storage development we have seen a blurring of boundaries between library stores and retail warehouses. Ideologically they are very different. Providing access to, and ensuring the long-term survival of the national documentary heritage is ideologically worlds away from shareholder profit margins. But practically, high-volume just-in-time retail warehousing facilities and contemporary library storage facilities use the same kind of technology: barcoding, radio frequency identification tags, high-bay, high-density racking, semi-automated cranes, automated cranes, conveyor belts, warehouse management IT systems, low-oxygen environments.

### **Alternative storage solutions**

Although there is a lot of building going on there are other storage solutions. When institutions do not have the funds for new storage facilities, or when short-term or medium-term storage is required, off-site commercial facilities can be rented. Business archives in particular use this sort of option. Some of these outsourced facilities are located underground. This is not new. During World War II many art treasures from the National Gallery, British Museum, the Victoria and Albert Museum and private collections were stored in off-site underground facilities.<sup>vii</sup> Apart from the cost benefit calculations for renting as opposed to buying storage, there are clearly crucial risk factors to be calculated with outsourced storage, including environment, security and access. At the British Library we do use off-site rented underground storage as an interim short-term storage option for negative microfilm. As a generalisation, I would say that we have found that the costs of storage are comparatively low, and the costs of access are comparatively high. Therefore the material that we store there is by necessity low-use. We have also been offered storage in an underground nuclear bunker, which was rejected because the environmental specifications could not be met. On the whole commercial storage facilities have not been designed to meet the library and archive sector specifications in terms of temperature, humidity etc as detailed in British Standard 5454.<sup>viii</sup>

### **What will we be storing?**

#### ***Publishing trends***

So much for options for the physical storage of material, but what exactly are we going to be collecting, and therefore, what are we going to be storing in the future? How much material and what format will it take? Should we not worry about the storage of paper, printed or archival material in the medium term, and put all our resources into digital storage, digital object management and digital archiving? To make the case to the UK Government for the new storage building programme here at the British Library, we carried out research to address the question ‘What will we be collecting in the future?’ The expectation of the Department of Culture, Media and Sport, our sponsoring ministry, was that it would increasingly be digital. This then engendered the ‘flip-over point’ debate; at what point would the majority of material change over, or flip over, from being predominantly paper-based, printed material, to predominantly digital, e-published? The British Library commissioned research into predictions of publishing trends to 2020, for the UK and for overseas publishing output, including long-term projections of the growth rate for electronic publishing. To back up this research, we also asked for the expert professional views of the directors of comparator libraries around the world, on the suitability of digital as a long-term preservation archival surrogate for print, and about their own anticipated

storage needs based on their collecting projections. The headline findings of the research were:

- In terms of the volume, or amount of material, the annual output of UK monographs will increase by 100% between now and 2020. So the British Library, whose current intake of legal deposit monographs is 150,000 per year, needs to plan for twice that number.
- The annual output of UK serials will increase by 70% between now and 2020. Overseas publishing output will increase by up to 5% between 2010 and 2020.
- By 2016, 50% of serials will be published solely in e-format. Currently, 65% of serials are hybrid, which means that they are published both on paper and electronically.
- By 2020, 25% of newspapers will be published solely in e-format with virtually none published solely in print.
- By 2020, 40% of UK monographs will be in e-format only.

So this confirmed the continuation of the trend towards more publications being originated electronically. However, it will not necessarily lead to a corresponding shift in the format of the British Library's acquisitions, because, on preservation grounds, the current policy is to acquire a publication in printed format, even when an electronic copy exists. Two areas of concern govern this policy:

- Divergence in content – there may be significant differences between the electronic and print version.
- Preservation of material in electronic format – at present there is not sufficient confidence in the digital medium for it to be a substitute for print when long-term archiving is required.

The British Library is working with publishers and the UK Government following the Legal Deposit Act of 2003 to develop regulations for the deposit of electronic material, and is currently developing a digital object management system. The point at which the electronic version is preferred to print as a long-term archival copy is a matter of prudent professional judgement, and hot debate.

### ***Collecting trends***

In conjunction with the publishing trends research, we sought the views of the directors of sixteen major international libraries in Europe, North America and Australasia; twelve were national libraries and four had legal deposit responsibilities.<sup>ix</sup> They were asked the following three questions:

1. What is your expert view on the suitability of digital as a long-term preservation archival surrogate for print where the identical content is available in parallel formats?
2. If content is available in parallel formats, do you currently choose to keep the print format, or the digital format, or both, for preservation purposes?
3. In your expert view, do you foresee the situation changing in the next five years?

The responses to the first question indicated that digital is not generally thought of as a suitable long-term preservation archival surrogate for print; it is regarded more as an access medium. The reasons were not just technical, but ranged from legal, political, strategic, financial, managerial, and organisational to the availability of appropriate

skills. As a long-term preservation medium, digital was generally seen as unstable, experimental, immature, unproven on a mass scale, and unreliable in the long term. Here are some of the replies:

Digital formats are not yet sufficiently stable to serve as long-term archival surrogates (Oxford University Library Services).

Good in theory. However, the technology is too volatile to be relied on at present (National Library of Scotland).

All the evidence still points to print as being more stable and cheaper to preserve on a long-term basis than electronic (Cambridge University Library).

We have seriously considered the question. We think that you have today the technology to preserve digital copies, but it is still not secure that we will have the resources to keep up with the demands of migration or emulation, and we have not yet entered into any agreement with publishers that will secure the files that are transferred to us and therefore preserved. We have so far not taken any decision to let a long-term preservation archival surrogate substitute for a print edition. We have taken the position of wait and see, for at least a few more years, and within the digital field, to concentrate upon the material which is born digital, and for which there is only one preservation option (The Royal Library of Denmark).

As to the second question ‘If the content is available in parallel format, which do you choose to keep?’ just under half chose to keep both formats for preservation purposes; just under half were choosing to keep print only; one was currently choosing to keep digital only. Collecting and storing print formats was generally seen as insurance, particularly by the legal deposit libraries. The National Library of Norway said:

We keep both. The lifespan of the material will be dramatically longer if you keep it under the climate conditions that are present in our storage vaults...Actually, some materials (*they cite magnetic tape*) have proven to be in better condition after five years of storage in the vaults than it was when we initially received it.

The National Library of the Netherlands, the Koninklijke Bibliotheek (KB) which is the one library that does currently choose to keep digital, said:

The KB adheres to a very simple and strict policy. In the case of parallel formats, we collect and archive the digital version only. We have already started cancelling the paper versions of scholarly journals. We are strongly committed to safeguarding permanent accessibility of digital information, particularly electronic scholarly journals. We introduced this policy in order to demonstrate our commitment, to force ourselves to take this commitment very seriously, and to increase cost-effectiveness. However, this does not mean we no longer need traditional stock rooms. Actually, we have just started building new stock rooms as an annexe to our premises. The reason is that the flow of single-format printed material for the national deposit collection is not diminishing, at least not yet.

As to the third question, ‘Do you foresee this situation changing in the next five years?’ there was a very mixed response. Some believed that the flip-over from predominantly print to predominantly digital would happen within the next five years, due to increased digital publishing and pressure on storage space; some thought that that changes were dependent on critical factors, such as investment by the computer industry, more managerial and financial experience of digital archiving within institutions, more proof that digital imprint manifestations are identical, and

investment in digital infrastructure; some were deeply sceptical after repeated failed prophecies of change. So the headline findings from the comparison of these major research libraries around the world, such as the national libraries of Germany, France, Australia, Library of Congress, Harvard and Yale were that:

- Digital is currently seen as an unsuitable format for long-term archival preservation.
- All libraries are experiencing a growth in printed collections.
- All libraries are continuing to make additional storage provision for this growth in printed collections.

The preservation of the print publication as artefact is becoming an increasingly important factor whereby the look and feel of the printed format has intrinsic value for future research. Similarly, safeguarding the authenticity of the national published output for legal and research purposes is seen as a reason for collecting and retaining the printed format. So, the international comparator findings concluded that in the short term there is a need for physical storage, and even the Koninklijke Bibliotheek, which made the momentous decision to collect only the electronic version of Dutch legal deposit material from 2003 is planning 24 linear km of new storage space to accommodate fifteen years of projected growth at a cost of 8.2 million euro.

### **Alkaline paper**

I have been talking about the volume and format of publishing output so far, not the materials from which the collections are made. Obviously there are other significant factors that have an impact on what and how we store collections. The good news for libraries seems to be that the pH of paper is going up. In Japan, a sixteen-year survey of incoming monographs shows a steady increase in the percentage of alkaline paper from about 50% in 1986 to over 80% in 2002, and surveys in Poland and Hungary have produced similar findings. A pilot survey of legal deposit UK monographs here at the British Library showed that in 2003 approximately 80% were made of alkaline paper. The bad news, especially for archives, seems to be the increased use of recycled paper, and the preservation and storage challenges that that presents.

### **Collaboration**

So we know something about what publishers are going to be physically producing that we will need to store, but what are the other political and strategic and conceptual issues that may affect storage in the UK? Do we have to store it all ourselves? What are the developments in collection policies? Collaborative collection development, rationalisation, disposals, de-acquisitioning, the emphasis on regionalism and devolution, collaborative collections consortia, and what has been termed deep resource sharing, the open access movement within academia, are all developments that could have an impact on who is storing what. University libraries and the national libraries are debating the role of institutional repositories, in both the digital and the print arena. The higher educational libraries are looking to develop shared responsibilities with national libraries and the Research Libraries Network<sup>x</sup> has been set up to advance this. The role of the Research Libraries Network is to provide strategic leadership in relation to the provision of research information in the UK. Sponsored by the four UK higher education funding councils and the three UK national libraries, it will address strategic issues such as retention and storage.

Currently the British Library is discussing the potential for collaborative storage with the universities of Leeds, Sheffield and York – the White Rose Consortium.<sup>xi</sup> Neil Dumbleton will be speaking this afternoon about CASS, the Collaborative Academic Store for Scotland.<sup>xii</sup> In the museum sector, storage facilities such as Blythe House in west London are shared by the British Museum, the Science Museum and the Victoria and Albert Museum. Although this presents many organisational, managerial, financial and logistical challenges it makes a lot of economic sense. Another interesting model is being developed in the Netherlands by a company called Helicon Conservation Support, which is planning a facility called *Cultures Keep*, that will be a ‘shared storage facility built specifically with optimum storage and preservation of the cultural heritage in the Netherlands, separating out the public functions for security, low-oxygen for fire prevention and pest management; no sprinklers for accidental water damage; automated chip technology system for registration and tracking....’<sup>xiii</sup> As I understand it, one company is building the building, another company is offering a conservation storage operation, and public sector institutions are the anticipated clients.

## **Disposal**

The corollary to sharing the responsibility for storing collections is deciding not to keep material individually. Weeding is obviously a basic principle of archives, and in the library sector, disposals and de-accessioning are hotly debated topics. Again, across the cultural heritage sector, the National Museums Directors’ Conference has a working party looking at the very thorny, often emotive issue of de-accessioning.<sup>xiv</sup> At the British Library we are finalising our disposal and de-accessioning policy, and we are proceeding with extreme caution. In the international survey of comparator libraries discussed earlier, the libraries were asked if they disposed of the original hard copy after digitisation, and all said that they did not. Such policies clearly have implications for storage.

## **Technical developments**

### ***The environment***

Coming full circle to the technical developments in physical collection stores, I would reiterate that any building can be seen as a combination of people, process and place. The logical conclusion from a preservation perspective, in theory, for a collection store, is to separate out the people, so that the environment is suitable for the collections rather than for the people. Then, with no light, the risk of damage from photo-catalysed oxidation of the collections is reduced; the risk of damage from UV is minimised and the heat from light is minimised, reducing the cost of the air handling. It is sobering to think that by separating out the collections, one of the highest security and fire risks to the collections is removed, namely, people. The single most effective action you can take to look after a collection is to improve the environment in which it is stored. British Standard 5454 was revised in 2000, and continues to be the kite mark for environmental specifications in the UK, even though there is still a great deal of professional debate about environmental parameters. The case for a stable, relatively low temperature environment as a means to increase the longevity of largely organic collections has been very well made. However, there is a need for easily digestible, easily understood predictions of the effect of environmental conditions on the life expectancy of paper collections, in order to make the case for new or improved storage facilities. Fortunately, the Image Permanence Institute has provided

us with the concepts of the Preservation Index and the Time-Weighted Preservation Index which enable us to do just that.<sup>xv</sup> Recently the British Library used the Preservation Index to make the case for improved newspaper storage in a way that could be easily understood by politicians and journalists. We used the Time-Weighted Preservation Index to show that at 27°C (81°F) and 50% relative humidity, which was typical of last summer, the predicted time to the point of noticeable change for a newspaper, using the preservation index, is 19 years. At 16°C (61°F) and 45% relative humidity, which fall within the parameters of BS 5454, the preservation index is 83 years. At 10°C (50°F) and 45% relative humidity, so cool storage, it is 182 years. And then at cold storage, 5°C (41°F) and 45% relative humidity it is 260 years. So, it could be easily seen that for each reduction of 5°C, the life expectancy of the newspaper was roughly doubled.

Whilst the importance of stable environmental conditions is generally recognised as a method of slowing the deterioration of our largely organic, cellulose collections, there have been changes over the past years in how these stable environmental conditions are achieved. Sustainable alternatives to high maintenance, high cost air-conditioning systems have been sought. At Library and Archives Canada the Gatineau Preservation Centre<sup>xvi</sup> building uses the land mass around the building as thermal inertia. Here at the British Library we looked at berming or semi-berming for our new storage building in Boston Spa, that is, fully or half-covering the building with earth. My favourite low-tech example is the Imperial Palace archives in the centre of Tokyo. I visited there during the height of the summer when outside the relative humidity was 95%. Inside, the archives were kept at a very steady 55% RH. This was achieved not with air-conditioning, but by lining the walls with cedar wood planks, butt-jointed along the walls, and not fixed so that they had room to expand and contract. Scrolls were kept in individual palonia wood boxes. Not only did the cedar wood even out the relative humidity, but it acted as an insecticide and suffused the whole building with a wonderful aroma. So sustainability, greening, environmental impact assessments, low energy, energy efficiency are all relatively recent economic and political imperatives.

There have been interesting developments in low-oxygen environments. Low oxygen environments are being used in museums for de-infestation, particularly of ethnographic collections. In warehousing, a fairly recent development is the use of low-oxygen environments for fire prevention, as an alternative to fire suppression using sprinklers and misters. The thinking is that a low-oxygen environment will not support ignition, and so prevents fire starting in the first place. The Hugo Boss warehouse in Stuttgart is a fully automated, high-bay storage facility for rolls of cloth. Being fully automated, there are no people in it and the facility is run at 14–15% oxygen (as opposed to the usual 21%). It is planned that the new British Library storage facility in Boston Spa will operate with a low-oxygen environment. There is a potential preservation dividend for storing cultural heritage materials at lower oxygen levels, but this has not yet been fully proven.

### ***Cleaning***

Collection storage is not just about storing collections. In preparation for a move, a lot of opportunistic cleaning and stock maintenance and housing can be undertaken. At the Library of Congress, cleaning stations have been designed for the move of their books to the new storage facility at Fort Meade, and there are whole programmes of work to clean the books before they are moved to the new locations. Here at the British Library we are assessing the Italian Depulvera book cleaning machine for cleaning the stock ahead of it being moved to the new building in Boston Spa.

## **Management systems**

In library storage, we are used to things moving, as compact shelving or rolling racking has been in use for decades. With compact shelving, the stock moves and the person still retrieves. With automation, the stock stays still and the automated crane or robot retrieves it. Full automation means storing the books in containers or totes. The issue of the size and material of totes is critical, as the container is the building block around which the operation is sized and designed. With automation, bar codes or radio frequency identification tags (RFIDs) are used. As well as improving the management of the collections through automated item storage and retrieval RFIDs can also improve inventory processes. In the Vatican Library 'each volume will eventually have its own RFID tag that can store a document's catalog data, including author, title, number of pages, and publication date. The chips can then communicate that data with hand-held monitors so librarians can locate missing books and perform routine inventory checks.'<sup>xvii</sup> All the predictions are that we will see more RFIDs in libraries and archives after they have become cheap enough to be used with low-value items in the retail sector. Wal-Mart has ordered all their supply chains to use them, and Tesco is experimenting with RFIDs on expensive goods and is piloting self-scanning.

The current automation options involve either a person in a crane being hoisted to a container of books on a shelf and the person picking out the book, or a container of books being automatically retrieved from a shelf, put on a conveyor belt and delivered to a person elsewhere who then picks out the book. The next logical step for automation would be for a robotic arm to take an individual book off a shelf, which is an idea that is being developed at Johns Hopkins University in Baltimore. The idea is for one robot to retrieve the volume in an off-site store, take it to a scanning station, where the volume is scanned and its pages turned automatically by another robot for instantaneous digital relay to the reader, who could be 30 miles away on the main campus, or could be sitting at home at their laptop. There are a couple of automatic page-turning scanners already on the market. Further development could come from research, such as that being conducted at Leeds University into scanning a book without even opening it, using terahertz imaging. There is also talk about using medical CAT scans to digitise books without opening them.

## **Summary**

I will end with some observations on the future shape of collection storage, returning to my broad themes of trends in buildings, trends in what needs storing, and political and professional trends. Collection storage solutions are borrowing from the retail and warehousing and sectors. We are adopting the warehouse technology of prefabricated construction and shelving. We are adapting the retail technology of barcoding, process flow, automation, RFIDs and low-oxygen environments. But also, at the other end of the spectrum to these high-tech energy-dependant developments is the low-tech, sustainable, greening, or cedar wood infused approach to collection storage. It seems that for the near future at least we will have to store both digital and print material. As to how we store, there are many hybrid public-private storage alternatives, and as an organisational adjunct to that, there is a climate that can support more collaborative storage. Harry Faulkner-Brown posited Ten Commandments for an intelligent library building, and I am going to suggest Ten Commandments for an intelligent storage building. It should:

1. Be flexible.
2. Be compact.
3. Be extendible.
4. Be organised.
5. Be constant.
6. Be secure.
7. Be economic.
8. Separate out people, process and place.
9. Allow storage according to use, value, material.
10. Take advantage of developments in other fields.

## Notes

<sup>i</sup> *A Library and Lifelong Learning Development Strategy for Tower Hamlets. A joint accommodation strategy developed by Customer Services and Education Directorates for the Arts, Leisure, Sport and Youth and Community Services Committees, April 1999.*  
<http://www.ideastore.co.uk/downloads/strategy.pdf>

<sup>ii</sup> Klaus Kempf, Working places, furniture and technology: Strategies of flexibility of university library buildings - the case of Bozen/Bolzano in *LIBER Quarterly - The Journal of European Research Libraries* Volume 14 (2004)/ No.2.  
<http://webdoc.gwdg.de/edoc/aw/liber/lq-2-04/Kempf.pdf>

<sup>iii</sup> William Dietrich, Meet your new Central Library in *Pacific North West, The Seattle Times Magazine*, 25 April 2004.  
<http://seattletimes.nwsourc.com/pacificnw/2004/0425/cover.html>

<sup>iv</sup> Monica Soto Ouchi, Patrons flock to Central Library grand opening, in *The Seattle Times*, 25 May 2004.  
<http://seattletimes.nwsourc.com/news/local/library/stories/patronsflock.html>

<sup>v</sup> Harry Faulkner-Brown, Some thoughts on the design of major library buildings, *Intelligent Library Buildings in Proceedings of the 10th seminar of the IFLA section on Library Buildings and Equipment*, edited by Marie-Françoise Bisbrouck and Marc Chauveinc. München : SAUR, 1999.  
<http://www.ifla.org/VII/s20/>

<sup>vi</sup> For more information see Gunhild Kristin Myrbakk, Preservation and Cold Storage – “Forever”, in *International Preservation News* No.30, September 2003.  
<http://www.ifla.org/VI/4/news/ipnn30.pdf>

<sup>vii</sup> Paintings from the National Gallery were stored in Manod Quarry, a slate mine in the mountains above the village of Ffestiniog. Treasures from the Victoria Albert Museum and the British Museum were stored in Westwood Quarry in Wiltshire. The British Museum also stored material in an underground storage tunnel within the grounds of the National Library of Wales, Aberystwyth.

<sup>viii</sup> *British Standard 5454: 2000 Recommendations for the storage and exhibition of archival documents*, British Standards Institution, 2000.

<sup>ix</sup> *Digital versus print as a preservation format – expert views from international comparator libraries*, The British Library, 2004.  
<http://www.bl.uk/about/collectioncare/digpres1.html>

<sup>x</sup> <http://www.rln.ac.uk>

<sup>xi</sup> <http://www.whiterose.ac.uk>

<sup>xii</sup> <http://scurl.ac.uk/projects/cass/>

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<sup>xiii</sup> Taken from promotional literature. More information can be found on the Helicon website at <http://www.helicon-cs.com/>

<sup>xiv</sup> *Too much stuff: disposal from national museums*, NMDC, October 2003.  
<http://nationalmuseums.org.uk/de-accessioning.html>

<sup>xv</sup> Preservation Index (PI) is a concept introduced by the Image Permanence Institute in 1995 to express the ‘preservation quality’ of a storage environment for organic materials (carbon-containing materials like plant and animal products, plastics, paper, dyes, etc). Such materials tend to spontaneously decay, a phenomenon often described as natural aging. Natural aging is a chemical process. Heat energy causes chemical reactions to go faster; therefore, temperature is the most important environmental factor in natural aging. Because many chemical decay reactions involve water, relative humidity (RH) is also very important. Together, the temperature and RH of a storage area determine how rapidly or slowly organic objects will deteriorate. Pollutants, light, and mishandling can speed the decay of organic materials, but every organic object will tend to spontaneously decompose, even in the absence of these factors. PI values, expressed in units of years, show us the combined effect of temperature and RH on the decay rate of vulnerable organic materials in collections and give a general idea of how long it would take for them to become noticeably deteriorated, assuming that the temperature and RH did not change from the time of measurement onward. PI helps us to quantify how good or bad the environmental conditions are at that moment. Nearly every storage environment is dynamic, changing with the weather, with the seasons, or by conscious actions taken to save money or to be more comfortable. It is difficult enough to know the effect of any given static condition on the decay rate of a collection; the total effect of changing conditions over time was impossible to obtain at all, until the conception of the Time-Weighted Preservation Index (TWPI). The TWPI makes it possible to measure the effects not of just one set of conditions but of fluctuating conditions, over a period of time, expressed as a single value. TWPI is an average of changing PI values over time. If PI values are obtained at regular time intervals, a relatively simple recursive calculation (one that is repeated again and again with new data) can produce a single number that accurately expresses the average rate of deterioration for the time period. This number is the TWPI. It represents the approximate length of time, in years, that vulnerable organic materials would last if every time period in the future were just like the one during which the TWPI value was measured. TWPI values can represent the cumulative effect of a week’s, a month’s, or several years’ worth of temperature and RH conditions.  
[http://www.imagepermanenceinstitute.org/sub\\_pages/8page17a1.htm](http://www.imagepermanenceinstitute.org/sub_pages/8page17a1.htm)

<sup>xvi</sup> [http://www.collectionscanada.ca/preservation/1302\\_e.html](http://www.collectionscanada.ca/preservation/1302_e.html)

<sup>xvii</sup> Vatican Library Employs RFID Tracking in *RFID Gazette*, 9 July, 2004.  
<http://www.rfidgazette.org/2004/07/>