The Impact of the Integrated Digital Library System on the CNIB Library

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Abstract

Technological change has been the norm for libraries serving people who are blind or otherwise print disabled. Technology is required to produce and disseminate books in various formats, and technical devices are often used as a means for a person to read the books. However, the development of digital technology combined with the evolution of the Internet has prompted significant change for library services and operations in the past few years. The CNIB Library recognized the opportunity to create more content faster, provide more choice and accessibility, and to streamline and revolutionize processes by building the Integrated Digital Library System (IDLS) in partnership with industry technology leaders. This article describes the technology of the IDLS and the impact on the organization.

"For many people, technology can make things easier. For people who are blind, technology makes things possible."

— Jim Sanders, President and CEO,
Canadian National Institute for the Blind

Introduction

Libraries have always relied on the evolution of technology to acquire, organize, and disseminate information. It can be argued that libraries serving people who are blind or otherwise print disabled are often a step ahead with technical innovation. These libraries must often produce the very materials that other libraries would purchase for their collection. In the case of libraries for the print disabled, technology is required by the library to produce that book in audio, braille, or tactile format. A person who cannot read regular print must find other means of reading; techno-

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logical devices to magnify print, electronic braille, synthetic speech output or human-narrated audio books are current options. Finally, libraries serving people who are blind are often centralized but serving a population scattered nationally. Technology is required to support this service-delivery model.

In 1997 the CNIB laid out a road map with yearly objectives to reach the goal of fully trained staff and volunteers operating in a digital environment and producing digital products to be delivered from Web-based services as well as distributed by traditional postal methods. In 2000 CNIB developed a plan for an Integrated Digital Library System (IDLS). The reasons for this were twofold. On the one hand, CNIB's decision could be seen as one born of necessity and survival given the cumbersome and increasingly obsolete nature of analog production and distribution technologies, upon which libraries for the blind have been dependent for the previous quarter century. However, the vision was also a result of the synchronicity of the development of digital technologies and the evolution of the Internet, which presented opportunities to dramatically improve the timely delivery of accessible content to print disabled Canadians. Such opportunities would have been unconscionable to ignore given the dearth of published material available in alternative formats and the length of time required to convert this content into alternative formats.

The following principles guided the development of the IDLS:

Library Service
- —Expand and improve choice in formats and access points
- —Enable independent management of library services by the end user or "client"
- —Decentralize service and allow for seamless community or home access to a national service
- —Expand content and ultimately eliminate the gap in availability between print and alternative formats

Production Processes
- —Streamline and automate production processes and create the "single source file/multiple formats output" model
- —Store, archive, and preserve the collection
- —Adhere to international standards

This article will discuss the impact of the development and implementation of the IDLS on the CNIB Library. The first section describes the service impact, the second describes the impact on book production, and the third describes in more detail the core technology.

What, then, is the IDLS? What constitutes an IDLS varies from one library to the next. From the earliest conceptual stages CNIB defined its IDLS as an integrated system to handle the creation, management (ac-

quisitions and cataloging), preservation, and distribution of all its digital library content.

Background: About the CNIB Library

The CNIB Library provides print disabled Canadians with access to a collection that is comparable to that of a medium-sized public library but with national scope and unique formats. A print or "perceptual" disability includes vision loss, a learning disability such as dyslexia, or a physical disability that prevents the holding of a print book. The library service is just one of a number of services CNIB provides to Canadians who have vision loss. A sample of other services include teaching white cane skills, vision enhancement techniques, and daily living skills. While most CNIB services are provided locally in communities across Canada, the library is centrally managed. The service is directly available to registered CNIB clients—more than 100,000 people who have vision loss. For those with a print disability other than vision loss the service is available through community partnerships, such as public libraries. A cost recovery fee is charged to the partner agency.

The CNIB Library is somewhat unique in that it is one of the few libraries for the blind in the world not federally funded or government owned. The CNIB is a charitable organization and receives approximately 80 percent of its funding from donations from the private sector. The government provides some project funding, and Canada Post provides the highly valued service of free library postage for people who are blind.

The Collection

The collection reflects the reading and information needs of all ages, education levels, cultures, and regions within Canada, in English and French. Since the inception of the CNIB Library in 1918, format circulation went from a single format (braille) and increased over the years to nine formats now available in 2007: braille, print-braille, tactile, DAISY audio, online digital audio, online resources, e-text, e-braille, and descriptive video. The CNIB Library currently has 60,000 titles and 400,000 items/copies in its physical collection and more than 25,000 electronic resources including books, magazines, and newspapers accessible through the CNIB Digital Library. Newspapers and magazines are also available by phone. For children, the library provides access to specialized online resources such as chat rooms, games, and homework help.

Unique Ways of Serving

Because the library is located centrally, clients access services in the following ways: receiving books and other materials in the mail, accessing books and information resources online, and/or by visiting their local library. Phone access is also available for some resources. A core team of

Reader Advisors registers clients for services and in most cases will create a personal profile for the client containing format preference, language, service frequency, subjects (fiction and nonfiction), and authors. A profile also indicates if the client does not want to receive material that includes strong language, violence, or explicit sexuality. The library's system compares the service profiles with what is available and selects items to send to each client. An item card with the client's address is printed, and circulation staff retrieve and ship the item to the client by mail. Including online materials, the library circulates 1.8 million items a year.

The Impact on Library Services

Library Services before the Digital Transformation

To grasp the full impact of the digital transformation of the library, it is useful to know how library services used to operate. Reading profiles for clients and book shelving and retrieval were functions managed in a completely manual way. In earlier days, with few formats, the mode of service delivery was well defined and straightforward. When the library implemented an online library system, staff in local CNIB offices across Canada signed up clients for library service. Reader Advisors assisted clients primarily over the phone to refine service profiles or suggest reading materials, and the automated system selected materials for shipping by mail. Clients had few technology needs or decisions to make, as their local division provided a free permanent loan of a standard 4-track cassette player upon starting of library service, and Reader Advisors were the gatekeepers to collection holdings. Reader Advisors and local division staff had encountered most issues that could affect service and could rely on scripted responses.

The collection was fairly small and contained due to manual production of alternative formats and limitations with producing copies. While not ideal for clients, a relatively small collection in limited formats made management of the service straightforward compared to the postdigital transformation of library services.

First Steps to Digitization and the Leap

Three important service implementations beginning in the early 1990s paved the way for the implementation of the Library's IDLS: the online catalog, automated circulation, and the introduction of digital books and online information resources.

The Library had changed little over the past thirty years. Then, within a period of just three years, the digital transformation radically changed both the types of services offered and how they are delivered. Established services and modes of delivery, which were well known to clients and staff, now seem simple compared with the complexity of a digital environment.

The transformation has not meant simply automating old processes, or "paving the cowpaths," but doing things differently.

The CNIB Library made the definitive leap from the old to the new way of doing things on November 23, 2003, with the launch of the CNIB Digital Library and Children's Discovery Portal. Built in partnership with Microsoft Canada and recognized by Bill Gates as a foundation for the global library for the blind, this platform was unveiled with public fanfare and promoted around the world. A year later, on June 30, 2004, the CNIB Library made a second leap when it stopped producing analog formats. The CNIB Digital Library (CDL) is the public face of the IDLS; it is a secure, password-protected, accessible Web interface specially designed for persons with perceptual disabilities. The CDL provides instant access to works in electronic text, electronic braille, and digital audio files.

Digitization Goals Achieved Post-2003

The following goals for creating the IDLS have been met:

- The economical expansion of choice through accessible online resources. When the online version of the Encyclopedia Britannica was offered to clients, one young blind high school student called to say this was the first time she was able to use an encyclopedia. It had not been produced in braille or audio due to the length and enormous expense.
- Clients can independently manage their service if they choose. Clients can go online and browse and order or instantly read books and information resources without relying on an intermediary. They may also change display features and personally customize search preferences, among other options in their own personal online profile. (See Figure 1 for client comments.)
- Partner libraries (public, academic, and school) can seamlessly access the Library's collection online to provide services directly to their patrons.
- Predigital, many libraries were using a variety of cassette formats including 2-track, 4-track, and 6-track, making resource sharing difficult or in some cases impossible. Digital technology, and specifically the DAISY standard, has facilitated greater resource sharing.
- Improved audio book experience. The move to digital and the DAISY standard is a significant improvement over analog and commercial audio; the entire book fits onto one CD, the sound quality is better, and the client has more control over his reading experience with the capability of navigating pages, sections, etc.
- Wireless check in and check out. All books are shelved according to barcode placement and checked in or out via a wireless laptop on wheels. When the Library moved into its new headquarters in 2004, circulation staff checked in 75,000 Library items in three days. Books can be sent more quickly from one client to another.

"I am thrilled to be using the new digital library, including the Oxford Dictionary, Ebscohost, etc. It's wonderful! I have been listening to audiobooks from CNIB since I was 14, and I am now 52. The digital library is a gigantic step forward."

"The CNIB Digital Library will make a huge contribution to the quality of my life. It will be a window onto the world for me."

"I couldn't be bothered to read when cassettes were the only option, but now that we have this system [DAISY] I am interested in reading again."

"I am finding the DAISY books very easy to use . . . in fact I can't wait until all audio is stored either online or as DAISY."

Figure 1: CNIB client comments about the move to digital service

There are also many challenges that come with digitization:

- Clients require various levels of technical skill and access to technology to read books in alternative formats. This includes access to and understanding of talking book machines, Internet access, and adaptive technologies. While technical troubleshooting is not a library function, it is reality that clients will turn to the library for support. Some Reader Advisors have developed specialized knowledge of adaptive technology to assist clients when accessing library resources. They must decide if an issue is related to the service, technology, or client skill level. Controlling the amount of time spent on technical support is an ongoing challenge.
- The move to a digital format also posed a significant challenge for staff in the deployment of players. With previous transitions, the client base was smaller, and there was one standard and less complex player that was provided on long-term loan. Now, clients purchase their own DAISY players, and CNIB continues to raise funds for those who cannot purchase their own. Local front-line staff were required to inform clients about the change from loan to purchase, introduce a selection of players, and provide training. These were significant changes.
- A three year transition period was planned to allow clients time to purchase players and the production team to convert the collection to digital. During 2004-07, the talking book service was provided on two platforms—analog and digital. This had a significant impact on local front-line staff, library reader services in managing calls, and the library circulation department. For example, when the library ceased analog production (not circulation) in 2004, the analog collection was no lon-

ger refreshed or repaired, so it diminished and deteriorated during the three-year transition. This meant fewer books for clients who had not yet made the transition to DAISY and, therefore, more demand on staff responding to inquiries. The circulation team had to work with packaging and shelving issues caused by managing two talking book formats.

- The CNIB Library produces its own content under the exception for persons with perceptual disabilities in the Canadian Copyright Act. However, it remains sensitive to copyright owners' increasing concern over digital content and, as a result, has taken extra steps to ensure its practice and procedures regarding access to this content are transparent.
- Content selection has become a complex process. A digital environment should provide access to every title in a variety of formats so clients can choose the one that best meets their needs. A complete "set" of just one book can include five formats. To avoid duplication in production, collections librarians must consider potential sources for each format carefully. A set for one title might come from multiple sources: for example, DAISY and electronic braille from libraries in the UK, hard copy braille from the United States, electronic text from a public domain repository, and online digital audio through an online subscription service. Even when an item can be purchased, it often requires additional processing or specialized instructions to make it fully accessible to clients.
- A global standard (DAISY) for producing talking books is a significant benefit. However, interestingly and unfortunately, the move to a digital format in some instances has limited previous resource-sharing arrangements. For example, the United States service Recordings for the Blind and Dyslexic permitted Canadians to borrow from their valued collection of educational materials on cassette. When they moved to digital DAISY books they were no longer able to lend these materials to non-U.S. residents. This was a huge loss to Canadians who cannot access print and meant that resources had to be produced twice.

The Production Systems Impact

CNIB Library is Canada's largest alternative format producer. The production platform supporting the Library is housed in Toronto, Montreal, and Winnipeg. Working in English and in French, a team of 66 staff and 620 volunteers create books and magazines in braille, audio, and accessible electronic text. Tactile images created for braille textbook materials are produced both digitally and by hand-crafted methods. The range of material is vast, from romantic novels, to children's storybooks, popular biographies, textbooks in advanced biology, a calculus exam, and complex technical manuals. The challenge was to improve production processes so that audio books sound better, braille would be produced faster, and accessible text be made available.

From the beginning, the "holy grail" was the "single source" text file—an encoded file that could be read by adaptive technology, transformed into braille, enlarged on a computer screen, rendered in synthetic speech, and integrated with human narration for superior audiobooks. Just as the print publishing industry has discovered the relative ease and economic benefit of repurposing digital content, CNIB wanted one source file to be used for many outputs. DAISY, an open standard for text encoding, built on the common Web technical standards of XHTML, XML, MPEG3, and SMIL and promised the flexibility sought for the single source file concept.

Transforming Production: The Human Resource Challenge

Nowhere was the challenge more difficult than in the area of human resources. Suddenly there was an increased demand for skills in both staff and volunteers. Often, the remarkable skills that people brought to their jobs, such as describing a diagram or accurately narrating a book, were still needed, but now excellent technical, analytical, and problem solving skills were necessary as well. Staff were using increasingly sophisticated programs, balancing system resources, and participating in international standard-setting bodies. New production methods required such skills as text markup, CD-R duplication system operation and maintenance, and expert opinion on digital audio requirements of compression and sampling rates.

It was essential to inventory staff and volunteer skill sets, compare them to the required talents, and document the gap. Subsequently, new job descriptions were developed, training programs introduced, and some tough decisions made as to the suitability of our workforce. Some volunteers were gracefully "retired" and some staff left the organization. Newly hired staff now had advanced technical skills such as computer science degrees, digital audio recording experience, and in-depth knowledge of production systems. Volunteer recruiting took into account the need for excellent computer skills, and recently retired baby boomers often fit the bill.

Electronic Publishing: Implementation of a New Unit

Previously operating in either braille or audio mode as separate production entities, CNIB realized the need for a center of expertise in creating and encoding text files, the output of which would then feed into the alternative format production streams. Staff in this area needed excellent desktop skills and advanced knowledge of mark-up languages. Initially all books were cut apart, scanned, proofread, and edited for accuracy before they were handed off to the next process in the production stream. Complex technical and educational material required manipulation of tables, screen shots, and code listings. Books required structured markup to sup-

port levels of accessibility in accordance with the type or complexity of the book, to the point, for example, where a reader of a cookbook could go directly to the recipe for chocolate mousse.

Throughout this evolution, publisher cooperation was sought, but often the publisher, although willing, did not have the text file that corresponded to the print book. That file had remained with the printer or been discarded after the final print file was created. An ill-formed file, or a file produced in an old format, is virtually useless; it is quicker to scan and code the book than decipher an unfamiliar format. A complete and final publisher's file is golden—it eliminates delays and avoids potential inaccuracies. Recent years have seen the digital transformation of the publishing industry. The CNIB contracted for the delivery of files from major publishers such as McClelland and Stewart, Random House Canada, and Harlequin. Staff became expert in using publisher's online permissions forms, and a pilot project in 2005-06, the Electronic Clearing House for Alternate Format Production, sponsored by the Library and Archives of Canada and the Canadian Library Association (http://www.collectionscanada.ca/accessinfo/s36-206-e.html) provided access to publishers files within ten days of request.

As CNIB progresses, text files are increasingly coded to the DAISY/NISO Standard 2005 (previous standard ANSI/NISO L39.86) specification, but there are limitations in the human resources required to hand-code files. As publishers move closer to supplying usable files, and as conversion routines are developed to support transforming these files to DAISY format, more books and magazines will be created from this single source file.

Braille Transformation

Braille production has been transformed by digital technology. As early adopters of computers, braillists created electronic braille files by keying words directly into a file using braille conversion software in a manner similar to using desktop word processing programs. These braille files were archived on a variety of media over the years and transformed to current versions when a copy of a book was requested. Now the CNIB Electronic Publishing Unit provides braillists with accurate text files to be processed through braille translation software. Programs such as DUXBURY, a braille translation package, imports files in various text formats, then translates to braille with one command. The braille displays on screen exactly as it will look when embossed, and the braillist can edit and correct errors in the files. Braillists' expertise is still very much required to resolve complex braille formatting issues. The resultant braille files are then sent to high-speed embossers and made available on the CNIB Digital Library for clients to read. Experiments importing DAISY/NISO 2005 encoded text files into DUXBURY to create braille files have been extremely promising.

Audio Transformation: Cassettes to CDs and Online Reading

Although CNIB was committed to utilizing new technologies, the evolution of technology in the music industry also forced the change. It became increasingly difficult to source cassette tapes. CNIB consumed over 500,000 per year. The equipment to record onto analog open reel tapes and make cassette copies was rapidly becoming obsolete and expensive to maintain. (See Figure 2 for an analogue recording station.) Replacement parts for this equipment were found on e-Bay or scrounged from a generous supplier's backroom. The crown jewels were the master recordings on open reel tapes. These tapes had to be stored off site in an expensive climate-controlled environment after a cassette sub-master and the required number of cassette copies was made. There was no choice but to move to digital recording.

As early adopters of the DAISY standard, enthusiastic CNIB recording studio staff were experimenting and participating in software development. The first CNIB DAISY book, *From Aligoté to Zinfandel* by Tony Aspler, was recorded in 1996. A book of wine appreciation that features a guide to wine terminology and proper wine pronunciation was a perfect candidate to showcase the features of DAISY. An audio reader looking for information on Beaujolais could go to the index, find the page reference, and go directly to that page—access that was never possible on a cassette book.

CNIB continued to record and test DAISY books, but there were no funds to convert recording facilities and the operation continued in an analog environment. Then in 2000, in honor of the millennium, the government of Canada provided a grant to assist with the conversion of the production platform. In 2001 the first proof of concept for the single source file was created. Canadian publishers provided digital files for five recently released titles and these files were transformed to the DAISY source file. From this file DAISY audio books, braille books, and screen reader–friendly text files were produced.

With three of the fifteen recording booths digitally equipped, CNIB began recording books for CD distribution. (See Figure 3 for a digital recording station.) The initial deployment of DAISY books began in January of 2002 with a small number of clients equipped with digital talking book players. Gradually, as funding became available, studio booths at all three sites were equipped with computers and digital audio recording software. In 2001 25 volunteers were trained in the recording process; by 2003 all 443 volunteers were proficient in using the recording software, and all master recording was in digital format.

To preserve an audio collection that was produced over decades it was necessary to convert analog titles to digital. These titles are still being converted to digital DAISY format in a two-step process that creates a digital file from the analog master reels and then passes this digital file on for DAISY markup and indexing. CD copies of the book are then added to the circulating collection.

Figure 2: An analog recording station

As the digitization project progressed, the expense of maintaining two production streams increased, due to both the process of creating content digitally and then converting it back to analog for cassette distribution and the effort to keep the old processes from impeding the introduction of new processes. There were some cost savings; the cost of CDs decreased as the format became more popular in the mainstream, an entire book fits on one CD rather than multiple cassettes, and there was a lower damage rate with CDs. Monthly magazine compilations on CD reduced costs and provided a "magazine rack" to clients in one mailing. Costs were further reduced in 2004 when all new CNIB audio books and magazines were produced exclusively in digital format and the conversion back to analog ceased. (See Figures 4 and 5 for cassette and CD duplication stations.)

More Content and Formats

With the launch of the CNIB Digital Library all content had to be available for online access. Knowing that client home computers could not easily handle the download of an entire DAISY book, CNIB provided "progressive play" online digital audio (ODA) books and magazines for clients. In the course of two months, a team of three contract employees, each equipped with five workstations, reformatted over 1,300 DAISY digital

Figure 3: A digital recording station

audio titles for instant online reading. An added bonus resulting from the project included regenerating these DAISY titles to DAISY 2.02 with the newest DAISY validation tools, a process necessary for ongoing DAISY production. Content from other organizations is also prepared for online reading and posted to the CNIB Digital Library.

Titles acquired from partner organizations such as the Royal National Institute of the Blind (RNIB), although "born digital," need processing to meet CNIB requirements. A set of requirements detailing compression rates, file naming conventions, digital audio specifications, etc., for incoming content were prepared and scripts created that modify the DAISY books by replacing RNIB specific messages to clients (for example, "return this book to RNIB") with CNIB information.

In the interest of increasing audio content without increasing staff and volunteer resources, CNIB experimented with Loquendo, a text-to-speech (TTS) software program. Clients value good human narration, but TTS production can result in more content faster. Some magazines and topical information resources that have a limited life span were suitable for TTS production. CNIB also experimented with using synthetic speech to record indices in books. The indices were rarely recorded in the past as they had little value on a cassette tape. However, the DAISY standard has made

Figure 4: A cassette duplication station

this portion of the book highly usable. The body of the book is narrated with human voice and the indices produced with TTS software. This alone saves several hours of "booth time."

One of the problems found in using TTS software was incorrect pronunciation, especially of proper names or words with origins in different languages (for example, "quesadilla"). A continually growing custom pronunciation dictionary was built to address this problem. While the first few books produced using TTS actually took longer to produce than a human narrated book, the opposite is now true.

Transforming Library Technical Services

Catalogers developed methods for creating records for new formats such as electronic braille and online digital audio (ODA). Some of the material to be cataloged was "click through" content such as the e-book and audio book resources of NetLibrary, which CNIB clients accessed through the CNIB Digital Library. The Online Computer Library Center (OCLC), owners of NetLibrary, supplied complete MARC records containing the standard bibliographic information for e-Audiobooks (electronic or online digital audio books), including narrator, duration of book, format, and file size. Scripts were developed that modified the OCLC record for CNIB's catalog.

Figure 5: A CD duplication station

All titles are reported to Library and Archives Canada's AMICUS, the Canadian National Catalogue listing the holdings of libraries across Canada (http://www.collectionscanada.ca/amicus/). This ensures that CNIB's holdings are available nationally and internationally. This database also serves as a record of works in progress so that no other production facility wastes scarce resources producing an alternate format version of a title when one is underway.

Production Implications: Looking Forward

The relentless progress of technology has meant that production systems that had previously lasted twenty years or more now change with increasing frequency and require acquisitions of hardware, software, and new staff skills on a regular basis. New tools and client use must be continually

evaluated and tested. Relationships with outside vendors have formed in the areas of hardware and software acquisition, and outsourcing companies are evaluated for their potential to perform certain functions that may provide lower costs or variable capacity.

CNIB is totally reliant on the technical infrastructure—if the network is down, almost all functions halt. Staff must coordinate proper data management and backup at all sites. The limitations of one piece of software can cause major problems in an integrated system and software and tools must always be accessible. Staff must be receptive to continuous process improvement and to ongoing requests for new or improved functionality.

Motivating staff and volunteers to embrace technology and understand the vision behind the process improvement has been challenging. In production areas, as expertise and tools evolve in the areas of digital publishing, the lines between format processing (what is created for braille as opposed to what is created for audio) become blurred and will gradually disappear. The future is bright for more timely production of alternative format books. In addition to only having access to less than 5 percent of what is published in print, clients would have to wait months or even years after the print publication for an accessible version. Digital developments have transformed their opportunities. Information resources such as newspapers are now electronically available at the CNIB Digital Library before the paper version can be delivered to the front door. Previously it could take two months of production time to produce a braille version (acquiring, scanning or typing, proofreading, embossing); now with direct access to the original publisher file, it can take two weeks. The ultimate goal is simultaneous production in all formats, including print.

The CNIB Integrated Digital Library System Infrastructure

It was the revolutionary nature of CNIB's vision that attracted the technology partners that worked with the Library development team to create a solution. These partners—Microsoft, IBM, Open Text, Geac, Navantis, and Corus Entertainment—made expertise and technology available that would eventually result in the IDLS.

The IDLS was designed to evolve as 3 integrated modules:

- The Digital Handling System (DHS)—a repository and distribution component
- The Production and Sales Management System, which manages the production of digital assets with the concomitant scheduling of work and resources
- A new integrated library system, which would continue to provide traditional library functionality of acquisitions, cataloging, and circulation of physical materials.

While both library and manufacturing systems exist "off the shelf," the DHS was a different matter, and it was this component that the CNIB and its technology partners set out to design and develop as a first step.

Logical Architecture

In accordance with CNIB Library's requirements, the system was designed on a Microsoft Windows/.NET platform, which is scalable and extensible, as well as being a reliable and cost-effective solution platform. The infrastructure consisted of the components identified in the logical architecture of the DHS system presented in Figure 6.

The E-Delivery System is the user facing interface where clients can browse, request, and access a variety of content from the traditional library catalog via the Web; available content includes online books and magazines, newspapers, encyclopedias, and dictionaries. This piece is known to clients as the CNIB Digital Library and Children's Discovery Portal. The Web delivery system uses Microsoft Commerce Server as its core functionality, providing the elements of a shopping basket similar to Amazon.com and other online commerce sites with the single exception being that this Commerce Server application is a zero dollar–based shopping basket. Clients can conduct a bibliographic search of the online catalog for books of interest, listen to online digital audio books directly by means of streaming media tools, or "check out" a book for delivery through the mail. The catalog is rebuilt each day with up-to-date bibliographic data from the digital repository and circulation system.

Unlike most other accessible Web sites, the E-Delivery system was built from the ground up to be accessible. User case studies and the participation of blind and visually impaired clients from its inception guaranteed a high degree of accessibility. The E-Delivery system is designed to ensure that Library clients can employ their preferred access technology.

Digital production requires a secure repository for all digital assets, whether works in progress or completed titles. Open Text's digital asset management system administers user rights, security management, and metadata management. It also provides a workflow engine that manages the movement of an asset through the library process to its ultimate destination either as a distribution master or an archive master. Record management classifications were developed that govern the lifecycle of digital assets and rules set for what would be maintained for a month, a year, permanently, etc.

Functions were developed to manage books with multiple files, and a multiple book "Check-out, Check-in" feature manages multiple audio books being produced in several booths over several daily shifts. A customized user interface was developed for accessibility with screen reading software.

The Geac Advance System is used for acquisitions, cataloging, and circulation of physical assets. In the context of the DHS the Advance System

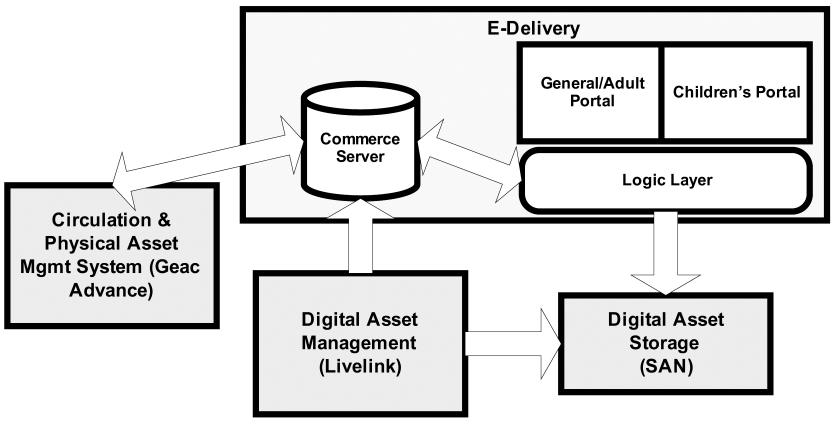

Figure 6: The Digital Handling System

updates the bibliographic information in the E-Delivery system, while E-Delivery places hold requests for physical digital assets (talking books on CD, braille books, etc.) with Geac Advance for circulation via Canada Post to the client.

The final major component of the technology infrastructure implemented as part of the IDLS was a Storage Area Network (SAN) upon which to store the Library's digital content, as well as Tivoli Storage Manager (TSM) software to manage that content. The entire area of storage technology and storage capacity was challenging. Consider that the majority of files to be stored are audio files, an average book is twelve hours in length, and there are thousands of complete or in progress audio books. Many organizations face challenges with data storage and retrieval. CNIB faces the additional challenge of storing a data type not traditionally managed by, for example, the manufacturing, banking, or insurance industries. As a result there was limited industry experience to draw upon when developing best practices.

Physical Architecture

The overall physical architecture is based on industry standard best practices for security, redundancy, and scaling. Security is tightly integrated with the Microsoft Active Directory. This model allows a server (or set of servers) to act as the authorizing authority for asset access—the gatekeeper role. The security model is further divided such that guests accessing the CNIB Digital Library have less authority than registered and authenticated CNIB clients, who in turn have less authority than authenticated staff.

Redundancy of the production environments was accomplished by the

use of the Microsoft Clustering Service. In this service, multiple servers are connected together and present themselves to the client's community as a single virtual server. The cluster of servers then responds to the client request for service in a manner that makes the client think the request was answered by a single server. The benefit of this deployment model is that if a server fails or if the load is greater than what a single server can handle, the client does not experience any delay.

Organizational Impact

The Information Systems Organization The IDLS brought with it significant changes in the responsibilities and core competencies of CNIB's Information Systems (IS) organization. Prior to the advent of the DHS project, the IS Operations departmental focus was primarily on desktop support for standard office applications, email, and application support for a few enterprise-wide applications, specifically, financial and fund development systems and the Geac library and production systems.

In contrast, the DHS infrastructure mandated that the following resources be applied:

- A technical systems manager to monitor and manage the overall technical solution including system security
- A storage specialist with comprehensive knowledge and extensive experience in working with Tivoli and the SAN environment
- An experienced technical specialist to manage the application, which had been heavily customized for the CNIB's purposes
- A SQL resource to write scripts in SQL and Windows
- A Web master to support the Library's information management on E-Delivery portals

In addition, IS had to increase its technical support to take care of accessibility issues and to support users at the workstation level and in the Recording Studio.

The Technology Blueprint With the infusion of the IDLS technology, the worldwide portal access to Library services, and a Data Centre with complex technology, the CNIB's technology environment was, to quote Margaret McGrory, the Vice President and CIO of CNIB and Executive Director of the Library, "all grown up." CNIB now owns and operates a significant and complex hardware, software, and networking infrastructure. IS now leverages technologies brought to CNIB via the Digital Library Systems project to the benefit of the entire organization.

And indeed going forward the CNIB has used the digital library technologies as a springboard to an enterprise architecture that deploys a nationwide integrated approach to the management and support of its client and business information. Gradually, as the IS transformation takes

place, CNIB is moving from being an organization of diverse and disparate systems to an organization with an integrated technology infrastructure building upon the systems, tools, and resources required for the IDLS.

Finally, the DHS project generated significant project management expertise such as business analysis, business process re-engineering, application and enterprise architecture, data modelling, project management, and training and testing specialists. Under the auspices of the Technology Blueprint, a project management office was established in January 2004 to fulfill the following mandate:

- All new business applications will be developed from concept through implementation in concert with IS, and will be supported by a business case, appropriate approvals, and standard project management methodology.
- All new applications will be designed to deploy industry-standard user interfaces where possible, and provide a consistent look and feel. Benefits include lower costs for training and support, and over time, reduced costs for developing business solutions.

CNIB continues to maintain its relationships with its technology partners and has also attracted new partners such as Cisco, Hewlett Packard, and Bell Canada as it continues to evolve its digital library's infrastructure and content. As well, a number of organizations for the blind around the world have expressed interest in components of the CNIB's IDLS for their libraries, paving the way for a future global library for the blind.

Conclusion

To look back, the development and implementation of the IDLS was not simply a means of enhancing current services and production streams using new technologies. The IDLS transformed the CNIB Library and replaced an operation that had evolved but had not fundamentally changed since 1918. In 2003 the library literally detached from the concept of the library as a physical place, and the impacts were enormous. Internally, the library is now in a position to be part of the global library for the blind, workforce skills and business processes have dramatically changed, and the organization as a whole now has the ability to manage complex technologies. From a services perspective, "digital" clients now have far greater choice of information resources, reading material, and format, more timely access, and the opportunity to manage their library service independently. The Canadian library community and the Canadian government, through the Library and Archives Canada, have endorsed the creation of a nationwide network of equitable library services for people with print disabilities. The CNIB, because of the implementation of the IDLS, is an integral part of this network.

A by-product of the library's partnership with Microsoft Canada was an

international forum—Libraries for the Blind and Print-Disabled: Moving Toward a Digital Future, in Redmond, Washington, in 2004. This forum, sponsored by Microsoft, brought together executives from libraries for the blind around the world to discuss common standards for creating, storing, and sharing digital content in the context of a "Global Library for the Blind." From this a number of cooperative international initiatives were established by these libraries to fulfill the aims of the global library.

For further information about Integrated Digital Library Systems, please refer to: Designing and Building Integrated Digital Library Systems, Guidelines, published by IFLA Libraries for the Blind Section and available at http://www.ifla.org/VII/s31/.

Margaret McGrory, Vice President and CIO of CNIB and Executive Director of the CNIB Library, joined CNIB in 2002 with the primary objective to complete the digital transformation of the Library's operations and services. Specifically, she implemented an Integrated Digital Library System encompassing a first-of-its-kind digital repository and e-delivery system integrated with the Library's production management and library systems. Prior to CNIB, Margaret's library experience included the Toronto Public Library and the Metropolitan Toronto Reference Library, latterly as Assistant Director. Her corporate experience includes Torstar Corporation, where she introduced e-business in Internet publishing, and more recently, Vice President of Corporate Information Systems at the Toronto Stock Exchange. Margaret is a member of the Board of the international DAISY Consortium and the IFLA/Libraries for the Blind Standing Committee. In 2005 she co-authored the IFLA publication *Designing and Building Integrated Digital Library System—Guidelines.*

Barbara Freeze is the National Director of the Project Management Office at CNIB. A former librarian, she directed a number of technology projects for the CNIB Library during her fifteen-year tenure there and was Program Director for the Digital project in 2002-03.

Margaret Williams is the Manager of Digital Library Portal Services and previously managed the Collection Department at the CNIB Library. Formerly, as Director of Information Resources at 2-1-1, a community information and referral service, she developed online directories and resources in English and French for job seekers, newcomers, and youth. She has also worked as an editor in scholarly and educational publishing.

Karen Taylor, Director of Production and Technical Services at the CNIB Library, is responsible for the acquisition and cataloging of material for CNIB Library as well as the production of braille, audio, and electronic text for CNIB and other institutions. Karen has participated in key initiatives relating to the development of accessible text and courseware through membership on the Council on Access to Information for Print Disabled Canadians; the National Information Standards Organization

(NISO); the Learning Opportunities Task Force, directing university programs to support advanced education of youth with learning disabilities; and SNOW (Special Needs Opportunities Window), providing online courses and resources for educators of students with special needs. Before joining CNIB, Karen developed system requirements for tracking compliance with charitable law in Ontario and was Library Product Manager for ISM, a division of IBM.