

# Use of technology in Singapore libraries

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Libraries in Singapore have invested heavily in implementing technology to manage their operations and provide library and information services to their users. This paper provides an overview on the extent of technology use in various types of libraries and discusses briefly the motivation and drive behind the investment. It highlights some of the key provisions in IT infrastructure, implementation of library automation systems, development of library portals and other technological applications in Singapore libraries.

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## INTRODUCTION

Singapore is an island city-state of 4.2 million people. Due to its small population and lack of natural resources, technology has always been used as a resource multiplier in its growth and development. Technology applications ranged from the large scale to small. For example, about 18% of its 682 square kilometers of land is reclaimed from the sea; reverse osmosis is used to recycle kitchen and bath water into "NEWater" to augment the nation's stock of drinking water; and cashless payment is used in many business and personal transactions.

### Pervasiveness of technology use

The use of technology, particularly ICT (information and communication technology), is pervasive and has become part of the daily lives of all Singaporeans. For example, bus and train fares are automatically calculated and deducted from contact-less cash cards as you enter and leave the vehicle; gantries along high traffic areas automatically record and deduct toll fares from a cash card in the transponder installed in every automobile; and bills and fines can be paid through multi-purpose payment kiosks in shopping malls and post-offices. E-government services are well developed, with about 90% of government services available online (Infocomm Development Authority, 2003). In 2004, fifty government agencies provide about 1,600 online services including income tax filing, registration of new companies, application of passports, etc. In the same year, more than one in two Singaporeans used e-government service (Luo 2005).

The current state of ICT infrastructure and high level of use and acceptance is achieved through a series of national IT plans implemented since 1981. The first *National Computerization Plan* was aimed at computerizing the civil service and developing the local IT industry and manpower pool. The second, the *National IT Plan* in 1986 focused on networking technologies and integration of computing and communications that was then developing rapidly. One of the aims was to provide fast and efficient one-stop services. The *IT2000 Plan* in 1992 was the third plan initiated to "transform Singapore into an intelligent island with IT pervading every sphere of economic and social activity". A nationwide broadband infrastructure was initiated and the *Library 2000* plan was conceived and implemented during this period. By the turn of the Century, the dramatic development and growth of ICT and the emergence of Internet led to the formulation of the *Infocomm 21 Plan* in 2000, the aim of which is to "develop Singapore into a vibrant and dynamic global infocomm capital, with a thriving and prosperous e-Economy and a pervasive and infocomm-savvy e-Society" (Infocomm Development Authority, 2003).

Given this background, it is therefore not surprising that libraries in Singapore developed in tandem with the growth of the country's technological infrastructure. This paper provides a snapshot of the current use of technology in Singapore libraries in mid 2005. The findings were gathered from survey forms sent to 9 of the largest libraries, followed by brief discussions with key personnel of selected libraries. Most of these are libraries are at institutes of higher learning (IHL). The survey did not include smaller libraries.

### Libraries in Singapore

The public in Singapore is generally well served by good modern public libraries that are located in high traffic areas such as shopping malls, community centers and residential areas across the island. All the public libraries are managed by the National Library Board (NLB), a statutory body

formed in 1991 and expanded from the previous National Library to implement plans delineated in the Library 2000 report. It also has responsibilities for national library functions. The NLB operates 18 community libraries, 3 regional libraries and the National Library (an expanded facility will be opened at the new National Library Building in Victoria Street in July 2005). A typical community library has on average about 200,000 volumes and occupies about 1,500 to 4,000 square meters, while a regional library has about 450,000 volumes and occupies about 10,000 to 12,000 square meters. The community libraries are either located in shopping mall or exists as standalone buildings. There are also 18 smaller children libraries (about 200 square meters), consisting mainly of children books for under-10s (averaging 10,000 volumes) that are located in various housing estates.

There are currently 3 universities - National University of Singapore (NUS), Nanyang Technological University (which includes NIE, the National Institute of Education) (NTU) and Singapore Management University (SMU). The universities offer up to graduate level and PhD courses. A newly formed open university will be operating soon under the Singapore Institute of Management (not included in the survey). There are also 5 polytechnics (Nanyang, Ngee Ann, Republic, Singapore and Temasek) that provide para-professional training in a wide range of disciplines. These form the institutes of higher learning sector (IHLs). The National University of Singapore (NUS) Libraries is the largest in this group of libraries and has a central library and 5 branches (totaling about 2 million volumes on 30,000 square meters and serving 30,000 students). There are also a number of research institutes, most of which are affiliated with one of the universities. Most do not have their own library except for the Institute of Southeast Asian Studies which has built up a well known collection over many years. There are 338 primary and secondary schools and 18 junior colleges & pre-university centers. Almost all primary and secondary schools have their own libraries though they are usually not managed by professional librarians or teacher librarians. Currently the new libraries at Singapore Management University and the Republic Polytechnic are outsourced to NLB.

There are special libraries in both the public and private sectors, but the numbers appear to be declining. Many special libraries in government bodies are outsourced to and managed by NLB, while private sector special libraries are usually small and found mainly in law firms. Exceptions are in some theological seminaries and the Singapore Press Holdings library which operate sizeable special libraries.

## **IT INFRASTRUCTURE IN SINGAPORE LIBRARIES**

Singapore is an early adopter of broadband technology. In 1996, a consortium was formed to operate an ATM backbone network, providing a national broadband infrastructure, known as Singapore ONE. By December 1998, broadband became available commercially on a nation-wide basis and was rolled out to public libraries, schools and other government agencies. Thus, library users have been enjoying broadband services for a number of years now.

Today, all academic libraries in IHLs also provide wireless access in practically every corner of their premises. Staff and students are therefore able to access their institution's IT network and online library services anywhere on campus. In addition, since 2004, the IHLs have initiated the "Education Wireless Integrated Network" (EDUWIN) program, which link up their wireless hotspots, allowing visiting students and staff to connect up to their home network while in a foreign campus. Thus students can surf the net, check their emails and log on to their home library and institutional resources via VPN (Virtual Private Network) as though they are in their home campus.

The public also enjoy wireless surfing in all public libraries. The wireless hotspots in all the regional and community libraries are operated and managed by commercial ISPs and users are charged accordingly.

### **Provision of PCs in libraries**

Most libraries continue to provide workstations or personal computers (PCs) for their users on site. Typically a small proportion is dedicated as OPAC terminals while the majority is for access to library electronic resources. Most are also loaded with the usual Microsoft office software suite. Libraries recognized that most users do not go to the libraries just to use or access library resources but also to do their work using normal productivity software.

	<b>NLB - National Library Board</b>	<b>NTU - Nanyang Technological Univ</b>	<b>NUS - National Univ of Singapore</b>	<b>SMU - Singapore Management Univ</b>	<b>NYP - Nanyang Polytechnic</b>	<b>NP - Ngee Ann Poly-technic</b>	<b>RP - Republic Polytechnic</b>	<b>SP - Singapore Polytechnic</b>	<b>TP - Temasek Polytechnic</b>
No. of libraries	22	3	6	1	1	1	1	2	2
No. of computers for users (PCs)	653	500	235	45	70	54	12	488	117

*Table 1 : Number of PCs in libraries*

The number of PCs provided to users by each library is shown in Table 1 above. There are 2 approaches taken by IHL libraries in the provision of workstations. In Nanyang Technological University (NTU) Library and Singapore Polytechnic (SP) Library, a large number of workstations, about 500 each, are provided on site. For example, NTU aims to maintain 1 computer for every 3 students (campus-wide). Each staff and student is also given generous online disk space (500MB and 150MB respectively) to store and access their files anywhere they work. The idea is that a student can walk into any facility on campus and have immediate access to equipment as well as the files and electronic workspace easily. In the other approach, such as in Ngee Ann Polytechnic (NP) Library, a comparatively smaller number of workstations (54) are maintained as every student is expected to own individual laptops through a bulk purchase, low-cost scheme. The laptops are preconfigured to facilitate access to the Polytechnic's intranet (including library e-resources) at the point of purchase. Thus users are expected to bring their own laptops to access the library resources on site or remotely. Generally, library users in Singapore, particularly students have easy access to personal computers and the Internet.

Library PCs are in high demand during various time and periods in the year. Several libraries such as those in SP, NP, NYP, TP and NLB have designed and implemented centralized PC booking systems to ensure better management of these resources. SP Library uses a campus wide booking system, which students may use to make advance/on-the-spot bookings to use the 488 computers available in the library. Students also use the system to book project rooms within the premise. TP Library designed their system such that free PCs show a green logo on the screen while booked PC shows a red logo to alert users to find other free PCs. A similar system is used in NP Library.

## LIBRARY AUTOMATION

Libraries in Singapore started implementing library automated systems in the early 1980s. NUS Library started their online catalogue using MINISIS (a information management system sponsored by Canada's International Development Research Centre, IDRC) in 1982. It then built a home grown circulation system in 1984. Other libraries such as the then National Library, Ngee Ann Polytechnic (NP) and Singapore Polytechnic (SP) libraries started to acquire integrated systems soon after in the mid 1980s. Today, all libraries, large and small have integrated library systems. Larger libraries use systems provided by major vendors such as INNOPAC, SIRSI, CARL, ALEPH 500 and Dynix Horizon (used by Institute of Southeast Asian Studies, not shown in the table). 3 libraries (including the Singapore Management Institute, which is not shown in the table) use SPYDUS, an Australian system which is used by some smaller libraries as well. There is also a home-grown system, known as VTEC System which is used by a number of special libraries.

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Library automated system	CARL	SIRSI	INNOPAC	CARL	SPYDUS	SPYDUS	CARL	INNOPAC	ALEPH
No. of automated check-out machines	151	8	10	2	6	5	3	5	5
Info & payment kiosks	Yes	Yes	Yes	No	Planned	Yes	Yes	No	No
Use RFID (year implemented)	1999	No	2000	2000	2001	2001	2003	2003	2005
Use automated check-in?	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Automated sorting of returned books	Semi-auto	No	Yes	No	No	Yes	No	Yes	Yes

*Table 2 : Library automated system and RFID implementation*

### Automated check-out system

In Singapore libraries, there is a strong focus on the automation of the loan process to reduce the use of manpower and improve the turnover time for library users. All the public libraries and academic libraries provide easy-to-use automated check-out machines, often with video instruction and printed date due receipts. Library users were weaned off the traditional loan counters very early on and now check-out books themselves willingly.

### RFID

Singapore libraries have also been early adopters of RFID technology. The National Library Board started the ball rolling when they partnered a local technology company, STLogicTrek to implement RFID in all public libraries in 1999. Since 2000, other academic libraries, except NTU and the National Institute of Education (NIE) libraries have all implemented RFID, using 3M systems and products.

### Automated check-in system

RFID had also facilitated the implementation of automated check-in machines in these libraries, complementing the automated check-out machines that have become de-rigueur in Singapore libraries. Instead of depositing returned books at the loan counter or book bins, users are able to instantly discharge their loans when they return their books through the automated return chutes.

In SP, NP and TP libraries, the returned books are automatically sorted on a conveyor belt and deposited into 5 to 6 separate bins for subsequent shelving using 3M Smart Sorter system. NUS Library designed their own automated check-in system, piecing together various component parts in a wooden casing. Returned books are sorted into those that have reservations and those that can be returned direct to the shelves. NLB, with 22 libraries, handles a higher volume of check-ins daily and the process is complicated by the fact that users can return their books at any branch other than the one they borrow the book from. Their check-in system is semi-automatic. When books are returned from chutes, they are first scanned to determine their location. The appropriate shelves that the books are to be re-shelved are indicated on large screens. Those that belong to other branches are placed aside to be collected by the Singapore Post Office (contracted to deliver all public library books to various branches). These are scanned again at the Singapore Post Office premise to sort out the books into various branches for delivery.

RFID also enable libraries to take inventory of their book stock easily and in locating and checking missing or mis-shelved books. New applications to take advantage of RFID technology are being looked at by various libraries. Both NLB and NP Library will be implementing a "browse count" system where statistics of books taken out of the shelves for browsing by users are captured to measure actual use of materials in the library and not only through loans. In addition, NP Library will be implementing a usage tracking system of its academic periodicals collection. NUS Library is thinking of using RFID to track books in special collections being taken out to other locations in the Library.

### **Loan enquiry and self-service fine payment**

Many libraries have also designed and build information and payment kiosks to enable users to check their outstanding loans and settle their library fines. Most of these machines use SIP2 (Standard Interace Protocol version 2), a proprietary communication protocol developed by 3M, to pass data regarding a user's fines from the library system to the payment kiosk. Payment is made by cash card or a link to a bank's ATM. Once the appropriate money is deducted, the updated data is passed back to the library automated system, which instantly updates the fines record of the borrower. NUS Library designed and built their system in-house while the others (NLB, NTU, NP and NYP libraries) engaged vendors to build according to the functionality required.

### **Towards self-service libraries?**

With automated check-out and check-in machines, and machines to check loans and clear library fines automatically, the loan transaction in the RFID libraries has been made fully automated at the front end. This has led to the idea of a totally self-help library, which does not required direct supervision by library staff. Such a library was put in operation at the Seng Kang Community Library, a branch of the NLB. The Library is unmanned except for a security guard who patrols the premise regularly. According to NLB, the self-help library has been a success in terms of reducing costs and manpower. They plan to convert all community libraries in shopping malls to self-service operation as most users just want to pick up books quickly to take away. However the stand-alone community libraries will continue to be managed and serviced by library staff and more resources will be put in them to provide higher level of services.

## **LIBRARY PORTALS**

Like many other libraries elsewhere, Singapore libraries now offer a vast amount of electronic resources and services to their users. There is therefore a natural trend towards pulling all the various electronic resources and services together to provide a single interface for users' convenience. Many have therefore implemented their own library portals.

There are varying definitions of what constitute a library portal. For some, a library portal is merely a webpage that allows users to link to all the electronic resources and services in one place. For others, a library portal must include some personalization engine that recognizes a logged-in user and provide him access to resources and services that are tailored to his needs and interest profile. Library portal implementation in Singapore libraries vary along this spectrum.

Many of the libraries in the survey use commercial software to build their portal, often with the assistance of their IT departments and system vendors. The system used by each library to build their portal is shown in Table 3. Apart from providing links to OPAC, electronic databases and news bulletins, most of the portals provide access to online booking or reservation forms for various library services such as book recommendations, document delivery and inter-library loan requests.

	NLB - National Library Board	NTU - Nanyang Technological Univ	NUS - National Univ of Singapore	SMU - Singapore Management Univ	NYP - Nanyang Polytechnic	NP - Ngee Ann Poly-technic	RP - Republic Polytechnic	SP - Singapore Polytechnic	TP - Temasek Polytechnic
Software used to build Library portal	-	Microsoft Sharepoint	BEA Weblogic	-	Oracle	IBM Websphere	Microsoft Sharepoint	Microsoft . NET	-
Federated searching	-	Encompass	Encompass	-	Cicada Info Portal	Webfeat (planned)		MetaFind (planned)	Metalb, VPN
Remote access	-	EzProxy (enhanced)	EzProxy (enhanced)	VPN	VPN	VPN	VPN	Ezyproxy	Metalib
Link resolver	-	LinkFinder Plus	LinkFinder Plus	-	-	planned		WebBridge (planned)	SFX

NUS Library developed their portal (launched in 2004) on BEA Weblogic, separately from the University's staff and student portals. The NUS Library portal therefore is based on a "multi portal" model. On the other hand, NTU Library portal (launched in 2001) was designed to integrate the library, finance, personnel and administrative systems of the entire university from day one. Based on Microsoft Office SharePoint Portal Server 2003, the system provides single sign-on to all university services and library resources. In addition, a student or staff can create his own personal or project web sites and enable or disable the sharing of these resources to other selected users.

The most frequently used services in both NUS and NTU library portals are the vast range of commercial databases and e-journals subscribed by both libraries. Other academic libraries at SMU and the polytechnics also provide many commercial databases through their portals, though on a smaller scale than NUS and NTU.

The portal functions in NLB are implemented in their "E-Library-Hub" system. This is a fee-based service where charges incurred in accessing online services are deducted from a deposit that can be topped up regularly by users. The E-Library-Hub consists of links to various subject resources collated by the library staff as well as access to commercial databases such as *Factiva* and *Ei Village*. Corporate customers can select different database packages that offer a mix of commercial online databases access.

#### Remote access

All academic libraries provide their users with remote access facilities to maximize the use of their expensive database and e-journal subscriptions. SMU, NP, NYP and RP users utilize virtual private networks (VPN) to access their libraries' electronic resources. TP users access them through the Library's Metalib system while NUS, NTU, NIE and SP users are authenticated through Ezyproxy. In addition, both NUS and NTU enhanced their Ezyproxy implementation (through a vendor) with program scripts to monitor and prevent excessive downloading by remote users. For example, a library-defined threshold can be set on download size over a period of time for every remote user. If the threshold is exceeded for a particular user, the system will immediately block downloading activity and suspend the user's access privileges for a specific period of time.

## Federated searching and link resolvers

A few libraries have implemented or are starting to implement easier searching tools, such as federated search and link resolvers to enable their users to use their electronic databases and electronic resources more widely and easily. TP Library uses ExLibris Metalib and SFX as their federated searching and link resolver respectively. NUS Library had just implemented Endeavor's ENCompass and LinkFinder Plus while NTU Library will be launching the same in July 2005. NP Library is implementing WebFeat later this year, while SP is implementing MetaFind and WebBridge. A local system, Cicada Information Portal provides NYP Library with federated search functions.

## In-house content - digital libraries and repositories

Most libraries provide online access to local content owned by their parent bodies. In academic libraries, the most common type of electronic content are past examination papers, followed by student dissertations. Other contents include institutional photographs, staff publications and digitized resources. The way in which the content is hosted varies amongst libraries.

In TP Library, local contents are stored in the Digital Media Repository (DMR), a component of their Digital Library Portal. This was developed using IBM Content Manager and includes workflow for uploading, indexing, verification and publication. Content includes selection of student project work, corporate newsletters, publications and videos and past examination papers. The contents are born-digital and there is no significant digitization effort involved. All the images are watermarked and users can request originals by sending requests through the DMR system which route them to the respective owner departments. Access to the DMR is restricted to staff and students of the Polytechnic.

NTU Library also has a digital repository of its own publications and content known as NTU Publications. There are about 19,000 items comprising student dissertations, past examination papers, conference papers, staff research project reports, annual reports, university handbooks, etc. There is an ongoing project to digitize the entire theses collection and this should be completed in 2006. The repository is built on Microsoft Sharepoint and provides basic functions for staff and students to submit items for approval. Searching on the repository is rudimentary and the repository is accessible only to staff and students. Funds have been allocated to move the repository to a better platform.

Although NUS does not have a formal institutional repository, it has done the most significant digitization work, including the digitization of nearly the entire run (except for the first few years, where the hardcopy have been lost) of *Lat Pau*, the first Chinese newspaper in Singapore (1881-1932) and another influential early Chinese newspaper, *Sin Kok Min Jit Pao* (1919-1933). Some books published by the Singapore University Press were also digitized. Other content includes archival photographs of NUS and selected photographs of Singapore buildings. All these are available through the NUS Library Portal.

In NLB, in-house content comprise a small collection of digitized books on Singapore and its history. It is a small eclectic collection of books of various imprints, including some from the British Library collection. Recently, it also set up the NLB *Online Repository of Artistic works (NORA)* which comprise drama, fiction and poetry of local writers. These are housed in and accessible through their E-Library-Hub portal.

## OTHER TECHNOLOGY APPLICATIONS

NUS Library is the only institution that uses electronic document delivery system through *Ariel* (from *Infotrieve*). In addition it has also built in a series of programs to automate the document request, approval and delivery workflow. Through these programmes, requesters are able to keep track of the status of their document requests via the web.

SP, NP and NTU Libraries implemented some form of virtual reference system. In SP Library, the "Ask Librarian Live" is a chat service that allows users to contact and interact with a reference librarian online for enquiries. NP Library staff designed their virtual reference system, known as "Ask a Librarian" which allow the reference librarian to show and co-browse web pages to users to guide them in their search in real time. It also provides a knowledge base of answers to common reference questions answered by the Library. NTU Library has a similar facility that can "take over" and control a user's terminal remotely to assist in solving their surfing or access problems. NLB has been operating their "Cybrarian" service for a few years. In this service, users go to a Cybrarian terminal in the library and consult a librarian via video and phone. All these implementations can only be used on site and not remotely. The usage of these services is quite low as users seem to prefer face-to-face interaction when relating their information access or reference queries.

A number of libraries such as NUS, NTU, NYP and TP provide Video-On-Demand (VOD) services on a 24/7 basis, though these are not substantial services due to limited number of licenses available. In TP Library, videos are also piped to users in the library, lecture theatres and classroom through Video Commander, an analogue-based streaming system. NTU Library also has a vendor customized system called *Livefeed* that stream videos to users' terminals on demand.

## TECHNOLOGY DEPLOYMENT

The above paragraphs have highlighted some of the technological application in Singapore libraries, particularly in the user services areas. Interestingly, when the librarians in the surveyed institutions were asked to identify the most successful technology application that their library has implemented so far, most pointed to their RFID implementation. One of the most visible impact for many RFID libraries is the reduction in manpower at loan counters and improvement in the circulation workflow. In SP library, the implementation of automated check-in machines together with their earlier automatic check-out systems had enable them to reduce two loan desks to one.

Technology applications in libraries generally require substantial budgets to realize and also to maintain. As most libraries belong to the public sector, government support and funding is critical to their implementation. In Singapore, funding is comparatively easier to obtain for IT projects as the country already has a strong predisposition towards technological solutions. There is also a strong belief that technology offers many opportunities for providing new services and enhancing existing services. When asked what drives their deployment of technology, almost all libraries cited "provision of new services" as the most important consideration. While manpower reduction and cost saving were cited as well, they were considered to be important, but secondary factors.

### Technology planning

In looking towards the future, the larger libraries continue to focus on how best to introduce and deploy technology to create new services. For example, NLB has been keeping track of the profile of their users and identified that the non-library users are generally people in the 18-34 age group. They are now looking at how technology could be used to turn these non-users into users of libraries. Borrowing a leaf from current knowledge management ideas, and focusing on the learning function of libraries, they are investigating whether some platform or vehicles could be created to facilitate the creation of a community of practice that will aid the peer-to-peer learning mode of people in this age group.

In thinking about new services for users, NUS Library is casting its eye on the increasing popularity of portable devices among their users. It is thinking of ways in which library services could be integrated with the PDAs, mobile phones and personal gadgets that users are bringing into the Library. For example, wireless and RFID technologies could be used in providing location sensitive tour and guides to facilities within the library.

NTU Library is on an expansionary phase, with plans to build a few new libraries to cater to new academic schools that have just been set up. In the short term, its technology plan will focus on planning building and facility related technology that will enhance the learning experience of their users.

The preoccupation for most of the polytechnic libraries in recent years had been on better and more efficient management of limited resources. It has to be said that most of the established polytechnic libraries have very strong quality assurance programmes already in place and service levels are well defined. However, there has been continuing pressure on manpower resources due to a public sector wide mandatory manpower reduction policy. The polytechnic libraries are market testing some of their processes for cost efficiency and have been encouraged to look towards outsourcing some of their work. Some of the areas that the polytechnic libraries have identified as suitable candidate for outsourcing are in technology support areas, e.g. maintenance of IT equipment, IT and network support. There is also a trend towards centralizing IT manpower resources. Thus library system administrator positions have been slowly transferred to Central Computer services department, as is the case in TP Library.

## CONCLUSION

This paper is largely descriptive in nature, highlighting some of the ways in which technology, particularly ICT, has been applied in Singapore libraries. The description is also limited to common library services areas in larger libraries and did not cover in detail on developments in technical and operational areas due to limitation of time and space. At the very least, it is hoped that the paper serves as an introduction for further investigations into the impact of technology on librarians and their users in a pro-technology community of decision makers and users.

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