New millennium, even more technology – can we cope?

Chris Hannan
Eastern Regional Libraries
chrish@eastern.erl.vic.gov.au

Abstract:
This paper discusses some of the problems libraries are likely to encounter in satisfying demand for technology-based services. In particular, it examines the issues that are likely to determine the shape and nature of the IT infrastructure and support services that underpin electronic service delivery. Finally it considers a planning approach which may help in describing, analyzing and justifying important changes that will inevitably be necessary to the IT infrastructure.

A new millennium, even more technology – can we cope?

Introduction

It has become fashionable to see the dawn of a new millennium as a watershed for absolutely everything, so why not for library systems? This of course ignores the obvious, namely that it is all a continuum of events with peaks and troughs along the way but nevertheless still a continuum.   Looking at the library systems continuum over the last twenty years, one thing is self-evident; use of technology grows without ever seeming to diminish in any way.

For many libraries coping with this growth is a major challenge, which get harder rather than easier as the rich diversity of systems options multiply along with our reliance on them.

This paper had its origins in strategic planning originally undertaken at the State Library of Victoria. At the time it was felt that the planning approach being taken might have wider interest. However as the process unfolded more questions were raised than answered and it seemed an ambitious leap to suggest that a proven and complete methodology could be discussed.

The process did however highlight some interesting and possibly important trends that are worth discussing. This paper looks at these trends through the changing face of technology in libraries, and suggests areas where future planning needs to focus. In particular it examines the impact on libraries of maintaining mature systems environments in a climate of ever-expanding services, which demand high reliability and responsiveness.

Three Stages of System Development

As background to the discussion on the systems support issues confronting libraries today it might be helpful to review the systems implementation stages we have gone through in getting to where we are today.

The application of IT within any organisation goes through at least three identifiable phases – *initiation*, *expansion*, and finally *consolidation and regeneration*. In the case of the first two phases, development of separate self-contained IT plans was appropriate and useful. The third phase represents quite a different situation however, and the approach to development of future strategies requires much more thought and consideration.

These three phases when looked at in more detail demonstrate how complex the "technology landscape" has become.

Phase 1 - Initiation

This first phase generally starts with a "Greenfield" state where there are no computer-based systems. The focus is firmly on automating core business functions. In the case of libraries this almost always revolved around technical services functions such as cataloguing and acquisitions with the output of a catalogue product a primary objective. In circulating libraries the process of automating the circulation functions of patron registration and checkin\checkout was also top priority.

Implementation of these first applications took place on a basic system infrastructure as illustrated in Diagram 1.

DIAGRAM 1
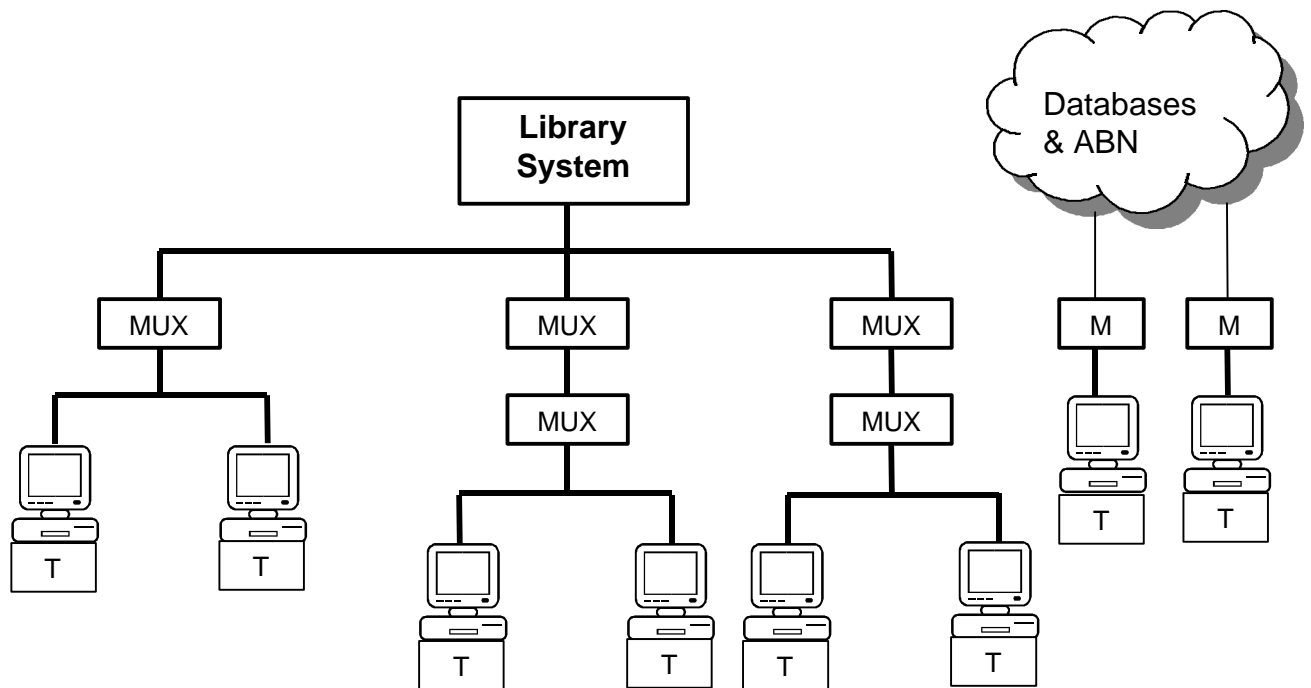
For most libraries the initial phase of automation took place anywhere between 10 and 20 years ago. At that time the life expectation of systems varied between 5-10+ years. Some libraries have had their systems longer than this although the hardware on which it runs will almost certainly has been replaced by now. Expectation of the useful life of data communications and wiring was 8-10 years. Most libraries would have anticipated getting 4-6 years out of their central hardware system, and anywhere up to 10 years out of their terminals.

At the time of installation central hardware and peripherals were expensive to buy and maintain. Software by comparison was relatively inexpensive to purchase (20-25% of the total system cost), and maintain (12% of software).

Phase 2 - Expansion

The expansion phase would typically have started with extension of existing core systems especially the ILMS. This expansion saw:

- The emergence of OPAC systems for the public;
- CD-ROM database access in both stand-alone and networked modes;
- Diversified on-line database access services;
- The beginning of Internet access for a number of libraries.

In systems terms the expansion phase would almost certainly have seen:

- Hardware replacements and upgrades especially of the main system supporting the ILMS;
- The introduction of PC's for Office Automation, CD-ROM access, on-line database access, and limited internet access;
- Additional wiring or networking of PCs, to supplement rather than replace wiring for terminals;
- The acquisition of servers to support LAN services, CD-ROM networking, and possibly other specialised applications;
- Any web-based development at this stage would probably have centred on the ILMS server;
- Growing general use of E-mail.

Diagram 2 illustrates a systems environment typical of this phase.

DIAGRAM 2
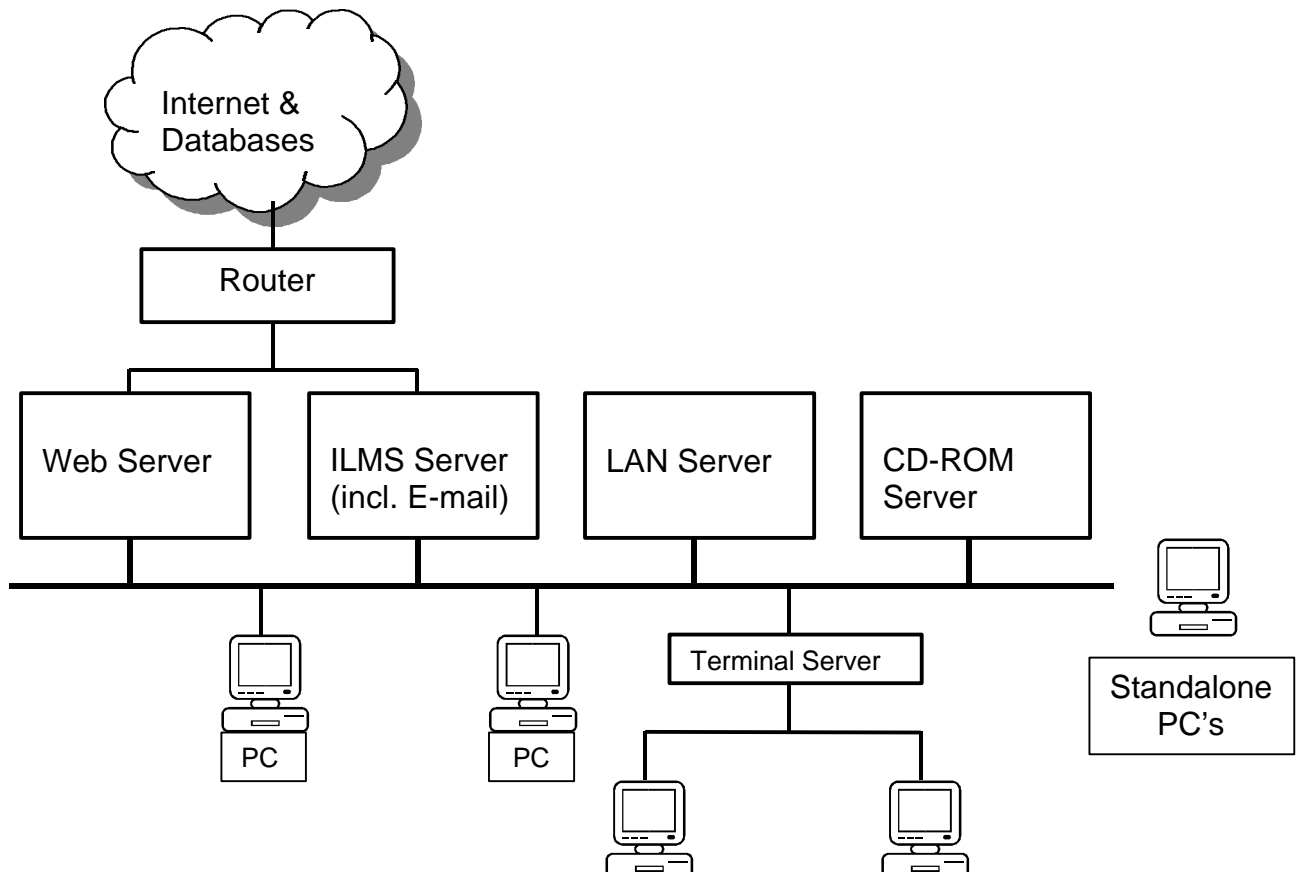
This phase for libraries occurred over the last 4-9 years. While the timeframe gap for its occurrence is still quite big at 5 years, it has contacted from the initiation timeframe range of 10 years.

The other important development out of this phase is the introduction of more sophisticated networking environments - a move away from modems and multiplexors to routers, hubs and terminal servers.

Most libraries were getting full functionality from their <u>integrated</u> library system although it would have gone through several upgrades. System vendors along with the rest of the IT industry were starting to talk about the next generation of systems based on client\server technology. A few libraries had migrated to ILMS systems provided by alternative vendors.

Phase 3 - Consolidation\regeneration

The consolidation\regeneration phase would typically see a library move to a total client\server environment or its equivalent. It is likely that all "green screen" terminals have been replaced, or plans are in place to do so.

It is highly likely that the ILMS has either been replaced or migrated to a client\server version from the same vendor. If not, then plans are in place for this to happen. It would also be expected that libraries are using most if not all of the functionality that the systems vendor has to offer to the library.

There is a greater emphasis on self-help, PC-based client services, representing a major shift from mediated to unmediated services. The provision of 24-hour seven-days-a-week access to electronic services is either already available or under consideration.

There has been considerable broadening of the client base, with all staff using the systems for some purpose or other, as well as a very high percentage of library patrons. The demand from customers for access to more sophisticated electronic information services is growing continually.

In terms of the systems environment, the library finds itself well and truly a participant in technology churn. It is probably employing at least two different operating systems on the desktop, and at least two in the server area. The more complex library IT systems may be employing four or more different server operating systems. The number of servers in place is likely to have doubled and be on the increase.

Data communications systems based on hardware alone have given way to router\switch environments with their own operating systems that need to be configured and tweaked. Once you graduate to configurable systems, the support cost goes up exponentially with even more things to potentially go wrong. Internet-accessible services are no doubt proliferating and along with them the number of servers, firewalls, proxies etc., representing even more infrastructure to maintain and support. Some standardisation of the infrastructure is clearly desirable alongside components that are highly scalable at minimum cost.

Some libraries are probably onto their third or even fourth main system server. More than likely they have replaced their original terminal cabling totally. Along with this they are probably on to their second or third generation of data communications equipment. Diagram 3 illustrates a possible systems setup in place at a major library today.

DIAGRAM 3
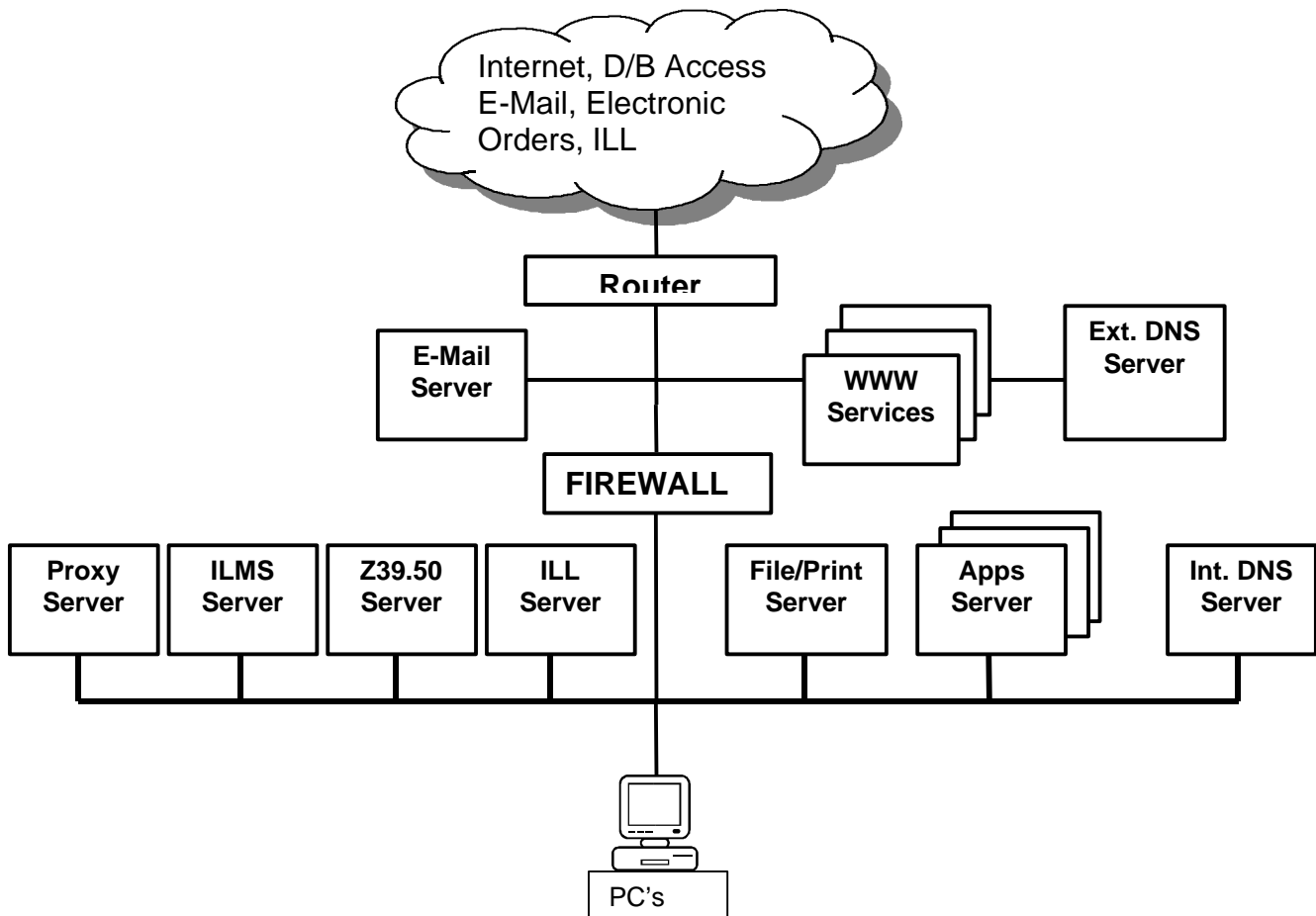
For many libraries this type of configuration is already a reality. The rest are rapidly approaching this state. The time gap between the early adopters and the rest is now down to 3-4 years. Effectively nearly all libraries are finding themselves able to introduce new technology much earlier than they could ten, five or even three years ago. Effective support of this burgeoning technological wonder is now the major challenge. Despite vendor marketing, these systems do not run themselves.

Changes in technology have much to do with this so it is worthwhile looking at what have been some of the key changes and trends.

Technology changes and trends

There have been numerous changes and trends in technology that have already influenced the development of IT systems in libraries. Some of these are illustrated in Table 1 below.

TABLE 1

Area of Technology change	Movement		Order of magnitude of tech. change
	Capacity	Price	
Servers			60-100 overall
Disk Storage			1,500 overall
Communications equipment			20
Communications bandwidth			6-10
Cabling			10-100
Database Software			2-3
PC Software			0.5-1
PCs			100
Terminals			<1
CD-ROM equipment			25
Hardware maintenance			2-3
Software maintenance			2-3
Database support			6-8
General software support			3
Operating system support			3-4
Communications support			New cost (high)
LAN support			1-2
Consumables			No real movement

In essence the above demonstrates that chip and other hardware related products and services have increased markedly in performance while at the same time undergoing reductions in cost, in some cases quite significantly.

On the other hand products and services that rely heavily on human input have demonstrated little or no improvement in performance, and increased significantly in cost.

These two over-arching trends summarise the seductive dilemma we face: highly affordable technology which can be expensive to support and maintain.

Other trends of importance to libraries include:

- The move away from monolithic host-terminal systems to client\server ones leading to a proliferation of systems elements to support;
- The "unitization" of server functions – the tendency to require a separate server to run a particular function e.g. Z39.50; ILL;

- The emphasis on customer-oriented services and products, away from back-room operations.

These marked changes in the technology landscape have given rise to an new set of issues that libraries must address. The most important of these are discussed next.

Issues

From observation of how the changes discussed above have impacted on library services, the following are four of the key issues to be considered in future library IT planning.

Improved systems reliability
In most libraries this might be simplistically stated as moving from 99% systems availability to in the first instance 99.5% and then 99.9 %availability. The cost of moving to anything better than 99.5% increases exponentially i.e. for every dollar spent in improving reliability from 99-99.5% you will need to spend ten to get the extra0.4% improvement.

Other barometers of improved reliability, some possibly more important than the 99.X% objective, include:

- Fast response time delivered as a constant, with no discernible degradation due to "peaking";
- Rapid repair of any failure;
- No repetition of failures.

To achieve this there needs to be in place systems infrastructures that:

- Are fail proof i.e. have few if any points of failure. An example of a potential point of failure is a system that has only one disc controller;
- Use hot swappable components;
- Are where possible based on duplication of systems elements, including servers, which can be brought into production use quickly and transparently in the event of failure of the primary element it duplicates.

Systems management is particularly important, with for example, full testing of all new versions of software (operating and applications) before bringing them into production. Back out procedures should wherever possible be tested and in place.

Tighter security
While on the surface it would seem that libraries would be low on the list of targets for hackers, experience would suggest that little or no discrimination is exercised when it comes to breaking systems security. This has to be of serious concern to libraries as they increase their presence on the Internet.

There has to be in place a system and data protection regime that can respond to a variety of external and internal "threats". These threats may stem from:

- System failure, or data corruption due to system failure;
- Operating system or application failure, or data corruption due to hacking;
- System or data loss due to disasters such as fire or flood.

Such procedures require rigorous adherence to system backup routines, and tested and documented procedures for system and data restoration. This may require further enhancement to the systems infrastructure.

When the primary users of the system were staff, and the system was essentially closed to the rest of the world, security could be a little less vigilant. With most libraries participating fully in the Internet this is no longer the case and security has to be constantly monitored and improved. This upgraded response to security is a necessary new cost that all libraries really have to meet, and ignore at their own peril.

Containment of support costs

The cost of systems support goes up with monotonous regularity. Software maintenance costs rise either through general CPI increases, or more importantly, through the regeneration and unitisation of applications software. The Integrated Library Management System is really a thing of the past. What we have now is a series of "new" modules or components rather than enhancements to the old core systems. Each is a new cost, and the maintenance of them is also a new cost. Incidentally, I would be very surprised if any of you have seen a compensating reduction in the maintenance costs of the core system you still have! The reason for this is quite simple:

- The cost of human resources has been on the rise for the last fifty years or more and this will continue;
- Systems development requires skilled IT resources that come at a very high premium;
- The diversity of systems that are brought on stream brings with them an expanding set of support costs.

There have been other significant developments that have impacted on the cost of systems support to libraries:

- Operating systems support costs were previously included in hardware purchase and maintenance costs, these have now been unbundled and are charged separately;
- The numbers of operating systems products to be supported has for most libraries increased;
- DBMS costs were in some cases previously included in ILMS support costs. These are almost universally charged for separately now;
- The move to a client\ server environment and a growing level of direct participation on the Internet has seen the number of applications products in use in libraries perhaps double;
- More sophisticated data communications systems with software elements rather than straight black box installations also need support.

There are also what for many libraries are the hidden costs of supporting and maintaining access to database and CD-ROM products which increasingly call for some level of technical expertise.

Not only is it becoming more difficult to fund systems support, but it is also becoming increasingly difficult to recruit or gain access to the skills and resources necessary to undertake the task, be it through direct recruitment or outsourcing.

Provision for infrastructure renewal

The infrastructure for any mature IT environment now comprises at least the following:
- Cabling, both copper and Fibre optic;
- Routers, switches, hubs, modems, and possibly still multipexor equipment;
- Servers, workstations (PCs or thin clients), possibly terminals;
- Operating systems, DBMS systems, major applications software packages;
- PC Applications.

Ten years ago all these elements had a life span of at least four years, and in many cases 5+ years. Monolithic software systems such as ILMS packages were expected to last 5-7 years at least. Now hardware has a life span of 2-4 years, and software varies between two and five. Software maintenance invariably covered all new releases. Today it only tends to cover bug fixes and minor enhancement releases. New releases, particularly in the client\server environment often become chargeable especially on the client side.

The significance of this is that libraries will have to plan for much more frequent renewal of all aspects of their infrastructure with the probable exception of cabling infrastructure. Even if some of the individual elements cost less, two other things are certain: maintenance and support costs will continue to increase, and more and more hardware elements will be added to the mix.

Planning

Technological change constantly challenges us to rethink how we conduct our business. Planning for our business future therefore has to respond to these changes. This response includes reviewing the basic premises and processes on which planning itself is based, more on this later.

There has been a longstanding practice of developing IT strategic plans as a separate exercise from organisational strategic planning. My personal view is that except in extreme circumstances this is no longer an appropriate way to go. Today, in any reasonably sized organisation, information technology is as much a part of the business as human resources management, financial management, or customer services, and in fact will almost certainly underpin the effective operation of all these three areas.

While organisations can make choices about whether they want to operate IT as an in-house activity, or out-source all or part of it, management and planning of IT strategies is still seen as a critical and integral element of organisational development and is almost universally maintained within the organisation.

The changing IT planning process

Planning for a green field situation, which applies to any organisation at the beginning of its computerisation strategy, really does demand a plan focusing primarily on how the strategy is to be achieved. The fact that most libraries embarked on such a program at a time when skills and expertise in the field were scarce dictated that a separate IT strategic plan had to be prepared.

The expansionary phase often coincided with the end of the first strategic planning period and a review or reframing of the initial plan gave effect to a further 3-4 year plan to cover the expansion into new services.

IT strategic planning in libraries from this point on (which equates to the beginning of the mature stage for most libraries) is likely to be quite varied ranging from no planning at all, all the way through to the preparation of a third or fourth separate IT strategic plan.

Strategic planning based on predicting future technological change is fraught with uncertainty. The further out you try to predict, the less successful you are likely to be. While there will be the occasional and important exception, most new strategies will be in reaction to technological and systems developments rather than preceding them. On the other hand we can be quite certain about what elements of the systems we have will need replacing once in place. Whether the replacement is affordable is another matter.

A planning approach that more sensibly recognises the changed circumstances faced by libraries might employ the following elements:

- Strategic functional objectives derived from and driven by the organisational (library) strategic plan. This is likely to be based on a 2-5 year horizon;
- Annual business plans reflecting the strategic weighting of functional priorities and the funding of their implementation;
- Development of a separate IT infrastructure development and replacement plan that reflects the life expectancies of the various infrastructure components. This will be a rolling plan with a 3-4 year horizon based on the replacement timetable for the hardware, software, telecommunications and services components that have a determined "shelf life", or in the case of services, contract life. The key aspect of this plan is that unlike strategic planning it has a high degree of certainty attached;
- An annual review of the rolling three (or four) year infrastructure plan to confirm action for the current year and to update it with any changes necessitated by the overall organisational strategic plan.

11

A very broad model of how to treat these elements and achieve a measure of interconnection is discussed next.

THE MODEL

As part of planning for future IT development at the State Library of Victoria a simple model was developed that attempted to define and describe the elements that should be included in a rolling IT infrastructure plan or program.   The model also tried to identify those elements that should be more appropriately considered as part of the overall Library Strategic Plan. This doesn't eliminate the obvious option of including these in any annual planning process. In its simplest form the model divides spheres of planning into two areas – Services and Infrastructure.
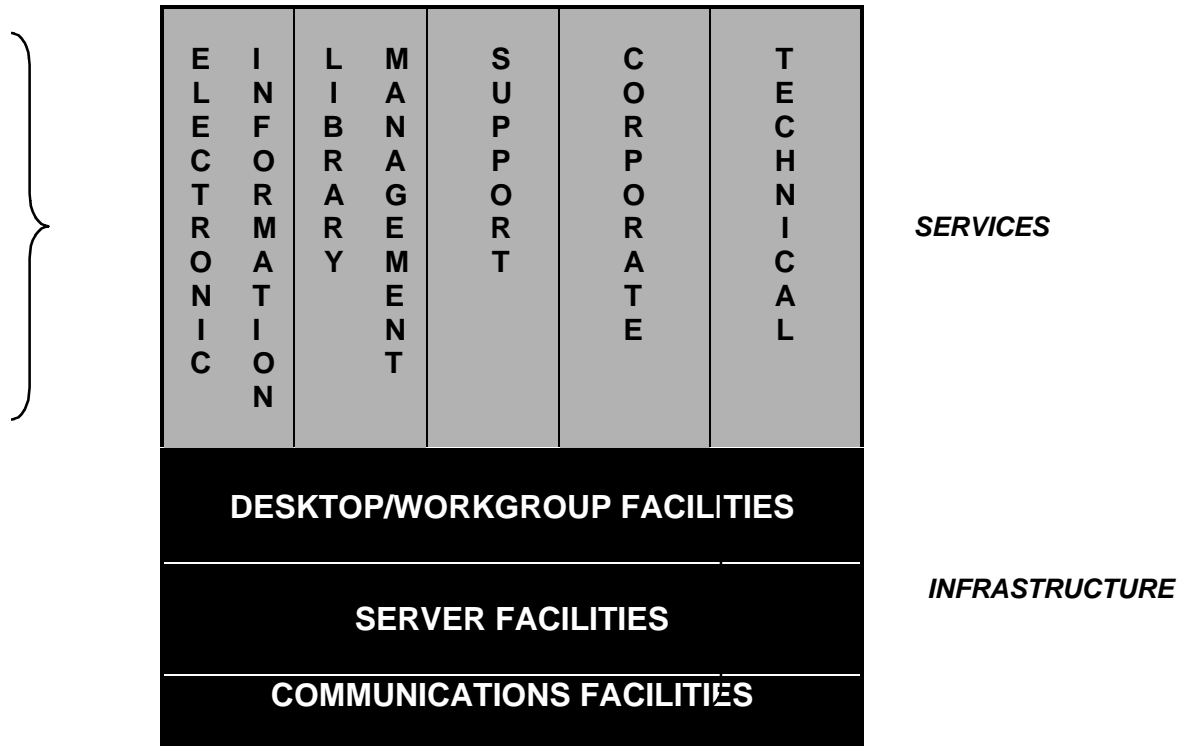
Services are almost always cross-organisational in terms of implementation and operation. The delivery of services, especially computer-based services relies on a sound support infrastructure
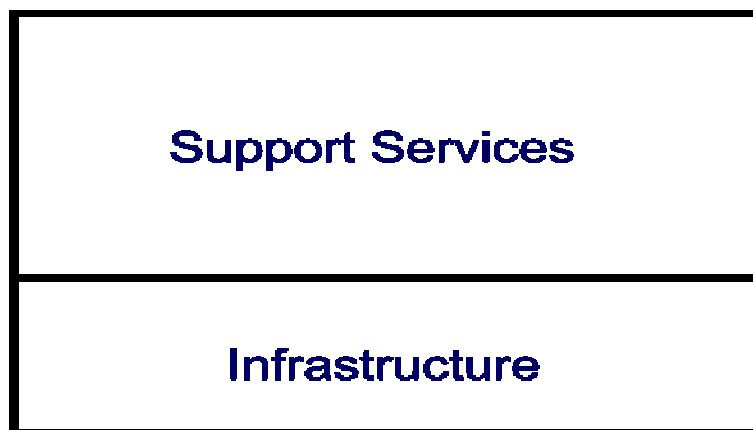
Services can be categorised as follows:
- Services to the public
- Collections\Library services
- Staff Services
- IT services

Some libraries may not want to make some of these distinctions, others may want to introduce further categories as illustrated in the next example

ELECTRONIC	INFORMATION	LIBRARY	MANAGEMENT	SUPPORT	CORPORATE	TECHNICAL	**SERVICES**
DESKTOP/WORKGROUP FACILITIES							
SERVER FACILITIES							**INFRASTRUCTURE**
COMMUNICATIONS FACILITIES							

Services normally reflect the primary objectives of the library, and the effective delivery of them is of general concern. There are always IT support implications stemming from the implementation of computer-based systems to support operational objectives. These need to be identified as part if IT planning for how it delivers the services it provides to the rest of the organisation.

Two other elements I have illustrated as services in the diagram above are Human Resources and IT services, and I would like to say a little more about these.

Human Resources is particularly important from the training and development perspective. If it is not patently obvious already then it will soon be the case that all organisations not just libraries come to recognize the critical importance of proper training of staff and customers in the use of the technology at their disposal. Properly skilled, both staff and users will be able to obtain maximum benefit from the services and facilities offered by the organisation. Where little training is provided, there is the real possibility of degradation of services through the misuse of the computer-based services. Additionally poorly trained staff and users add to the cost of support.

IT services are those that any organisation should expect to be available to support the systems they use. These would include:

- Help Desk services – the recording, assignment and resolution of systems faults reported by users.
- Software support – assistance with effective use of software packages employed by the organisation. It may be that such assistance is outsourced to third party organisations. Alternatively in smaller organisations this may fall to the expert user, someone in the organisation other than an IT support person

who has been well trained in the use of the package and is skilled in the use of its functions.

- Maintenance of equipment - this will in most cases involve third-party support. What underlies this is sound management of maintenance and warranty agreements.
- Project management and planning;
- Staff (and possibly client) registration and authentication services allowing hem to use the systems facilities (and only those facilities) for which they are authorised;
- Provision of LAN services such as e-mail, file storage and printing.

As part of Services both of these are vital to the effective use of technology in the Library.

Infrastructure

I would now like to look in a little detail at the components of IT infrastructure, and then consider the implications for planning of its support and maintenance over a defined program timeframe. As described in the model there are three sets of components. In a typical medium to large library they might comprise the following:

Communications Facilities

- The physical cabling comprising abundant high quality Category 5 or 5E UTP cabling plus optical fibre if appropriate, especially between buildings or major concentrations of workstations;
- Strategically located communications cabinets linked to purpose-designed cable reticulation systems;
- State-of-the-art communications equipment at the centre of the communications system as well as in key locations around the complex or network – including hubs, switches, routers and associated firmware\operating systems;
- Low speed connectivity facilities such as dial-in services;
- The maximum affordable bandwidth between branches;
- High bandwidth connectivity to the Internet.

Server Facilities

- Purpose-specific servers with high speed links onto the main communications backbone e.g. ILMS server, file\print servers, mail server;
- Varying levels of redundancy built into these servers commensurate with their criticality to business functions;
- Mission-critical servers should be highly scalable;
- A mix of operating and DBMS systems in place;
- Several test environments in place;
- Tried and tested backup and recovery facilities covering all systems;
- Applications software systems, and the server-side components of client\server systems;
- Software\data distribution and control.

<u>Desktop Facilities</u>

- PC "thin clients" and terminals;
- Printers, scanners and barcode readers;
- Desktop operating systems software;
- PC applications software;
- Client-side components of client\server applications software.

Capital versus Recurrent Funding

If we look carefully at the components listed above they can be classified into either capital or recurrent items, or they can be described in terms of the percentage of capital or recurrent that they require:

By moving from a dependency on capital expenditure to a largely recurrent base, there is an opportunity to develop rolling programs with greater funding certainty.

Three, four and even five-year projections can be made for known expenditures such as:
- Loan and lease payments;
- Software maintenance and licensing fees;
- Staff;
- Support contracts costs;
- Data communications (with reasonable certainty).

Component	Previous Capital level	Capital	Recurrent
Cabling	100	100	
Communications "cupboards"	100	100	
Communications equipment	100	0-5	95-100
Comms. eqpt. maintenance	0	0	100
Low-speed connectivity	20	0-20	80-100
WAN connectivity	0	0	100
Internet connectivity	0	0	100
Servers	100	0	100
Server redundancy	100	0	100
Operating and DBMS systems	100	0	100
Test systems	100	0	100
Backup facilities	100	0	100
Applications software	100	0 or 100	0 or 100
SW\data dist. and control	20	0	100
Hardware maintenance	0	0	100
Software maintenance	0	0	100
PCs etc.	100	0	100
Printers etc.	100	0	100
Desktop O\S	100	0	100
PC applications software	100	0	100
PC maintenance etc.	0	0	100

Reasonable certainty can also be attributable to the upgrading of commercial PC applications and operating system software – three years.

With this in mind a three-year infrastructure program is reasonably easy to develop. This can be overlaid and modified quickly in response to business plan changes, and even in response to any significant changes in overall strategy caused by new technology shifts.

Suggested planning aims

In summary the following are the main aims we should have for a revised approach to IT planning:

- As a general principle seek to minimise dependency on capital funding to sustain recurrent activities. This can be done for example through the migration of capital items to lease expenditures.

- Establish a realistic and sustainable level of recurrent funding for IT services. This is likely to be between 7 and 15% of the total recurrent budget. This may not be achievable immediately but such an objective should be a key organisational objective for the medium term.

- Enable "Planning for Uncertainty". As organisations become more "systems mature" they need to be a position to react quickly to new opportunities that arise in areas of electronic service delivery. This will be heavily dependant on creation of an infrastructure that is highly scalable (at low cost), open, and in the connected world of today, Web-aware.

- On the support side, establish relationships with IT service providers who can provide specialist support services either as first-line support, or as backup to in-house resources in emergency situations. Also look for opportunities to participate in group arrangements e.g. through consortia that will give you access to a wide range of IT support services at a reasonable cost.

Summary

Inevitably libraries move through the various stages of systems development to the state of mature systems users. Once this stage is reached the approach to IT planning needs to be reconsidered. "Blue sky" projects start to give way to ones concerned with systems upgrade and replacement. The emphasis switches to ensuring the reliability and integrity of the systems on which we have become so dependant. Containment of support costs is also a major issue. This is the time to look at implementing IT plan oriented towards rolling infrastructure maintenance, but flexible enough to respond to unpredictable developments in systems or technologies which give new impetus to organisational strategies overall.