The project is funded by the Australian National Training Authority, and advised by the EdNA VET Advisory Group

PREFERRED STANDARDS TO SUPPORT NATIONAL COOPERATION IN APPLYING TECHNOLOGY TO VET

http://www.vicnet.net.au/~neptune

February 1999

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Preferred Standards to Support National Cooperation in Applying Technology to VET

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URL: http//:www.vicnet.net.au/~neptune

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Acknowledgements

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The contribution that the Reference Group has made to the management of the project is gratefully acknowledged.

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Background to the Development of the Standards

The Australian National Training Authority (ANTA) National Flexible Delivery Taskforce was established by the ANTA Board in mid-1995 to provide advice to the Board on how to proceed, at the national level, to make training more flexible. The ANTA 1997 Flexible Delivery Implementation Plan put into effect the outcomes of the Taskforce by commissioning ten Flexible Delivery Projects in 1997. Those projects with a technology focus were referred to the EdNA VET Advisory Group (EVAG) in its wider role of monitoring the national application of Flexible Delivery as endorsed by the ANTA Chief Executive Officers (CEOs) Committee.

One of these projects was the 'National Cooperation in Applying Technology to VET' (stage one). The project was conducted by the Centre for International Research on Communication and Information Technologies (CIRCIT) and concluded in December 1997. It proposed a Standards Policy and a Standards Maintenance Process, which were endorsed out of session by the ANTA CEOs. The CEOs also agreed on a further round of detailed consultations in 1998 to reach agreement on the individual draft standards developed by the project during 1997.

It was recognised that the Maintenance Process was also suitable for developing the preferred standards. This process was therefore the basis for the subsequent project, the 'National Cooperation in Applying Technology to VET' (stage two) conducted by CIRCIT in 1998. The purpose of this project was to identify preferred standards in those technologies which support flexible delivery in the VET sector by conducting an extensive consultation process across the sector. Workshops for each of the seven technology areas were held with State and Territory representatives to identify the preferred standards. Consultation papers were written for each of the technology areas and revised on the basis of workshop discussions.

The Project Report, which includes the revised consultation papers, was endorsed by the EdNA VET Advisory Group.

In recommending the report to ANTA CEOs, the EdNA VET Advisory Group highlighted the utility of preferred standards as an agreed platform for the application of technology that ensures a high degree of national and international interoperability. Such interoperability positions Australia well in a competitive global market, and ensures that there is minimal duplication of resources across states and territories, thus providing significant cost benefits in the medium to long term.

At the meeting on 2 March, 1999, the ANTA CEOs Committee endorsed the following recommendations:

(i) that Chief Executive Officers endorse the Preferred Standards to support national cooperation in applying technology to VET

(ii) that Chief Executive Officers agree to implement the Preferred Standards in a manner appropriate to their jurisdiction, with due regard to 'whole of government' negotiations in their particular State or Territory, but with the intention of achieving the maximum feasible level of implementation and interoperability for the VET sector

(iii) that Chief Executive Officers recommend that the costs for the regular Review and Maintenance Process previously endorsed in 1997 be met from National Projects funding and managed through the EdNA VET Advisory Group on behalf of the ANTA CEOs Committee.

CONTENTS

OVERVIEW REPORT

1. Introduction

Background

The National Flexible Delivery Taskforce was established by the Australian National Training Authority (ANTA) Board in mid-1995 to provide advice to the Board on how to proceed, at the national level, to make training more flexible. The Flexible Delivery Implementation Plan put into effect the outcomes of the Taskforce. It included ten Flexible Delivery Projects commissioned by ANTA in 1997. A number of projects were referred to the EdNA VET Advisory Group (EVAG) in its wider role of monitoring the national application of Flexible Delivery as endorsed by ANTA CEOs Committee.

One of these projects 'National Cooperation in Applying Technology to VET' was conducted by CIRCIT and concluded in December 1997. It proposed a National Technology Standards Policy and a Maintenance and Further Development Process, which are detailed in the corresponding Sections of the Report at:

http://www.vicnet.net.au/~neptune

The Standards Policy includes the following statements:

Policy Statement 1

The Vocational Education and Training Sector will aim to maximise national connectivity and associated interoperability in the application of technology to provide services that best meet the needs of clients and other participants in the VET sector.

Policy Statement 2

National technology standards to support any to any connectivity and associated interoperability will be selected from existing mainstream standards. Standards peculiar to learning technologies will be developed cooperatively with major vocational education and training stakeholders in cases where no satisfactory standard already exists. In both cases the emphasis will be on interface standards rather than particular products.

Policy Statement 3

The selection of national technology standards to support any-to-any connectivity and associated interoperability will include consideration of :

- flexibility and options in training delivery,
- the benefits that the sector requires from the application of a particular technology and the allowable cost,
- appropriateness of recommending particular national technology standards,
- current industry technology standards,
- current technology approaches in the vocational educational and training sector (legacy systems) and

- likely industry and societal developments.

Under the policy, Preferred Standards are those technical standards which:

- maximise value to the sector, i.e., maximise the benefits and minimise the costs and
- maximise interoperability.

Open or formal standards will generally be most likely to meet these criteria.

The Standards Policy – including Statement No. 2 – and the Maintenance and Further Development Process were endorsed by the ANTA Chief Executive Officers in December 1997.

The schema for this overall project is shown in Figure 1 below.

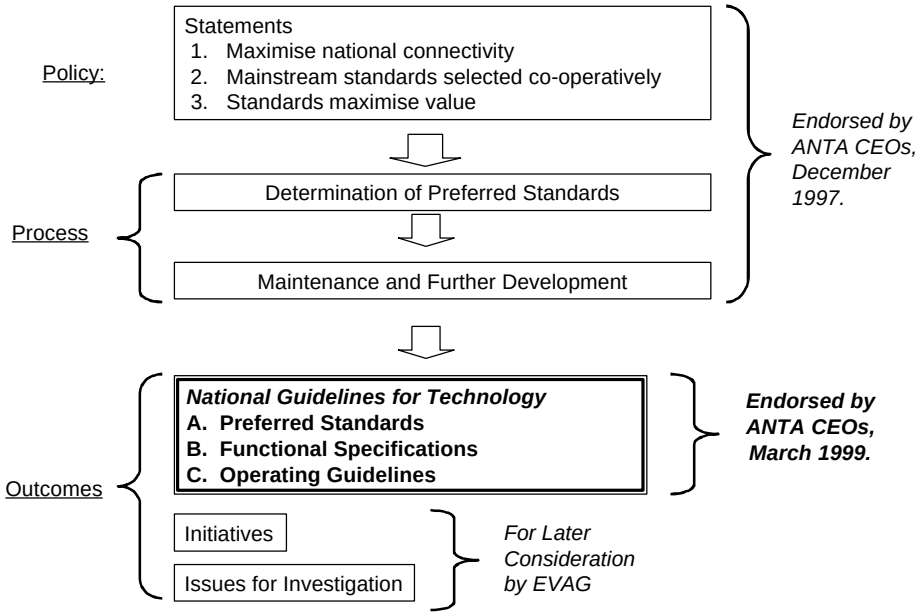


Figure 1. Schema for Preferred Standards to Support National Cooperation in Technology for VET.

It was recognised that the logistics described in the Maintenance Process were also suitable for identifying preferred standards. This process was therefore the basis for this subsequent project, conducted by CIRCIT in 1998, to identify preferred standards in those technologies which support flexible delivery in the VET Sector, by a process involving extensive consultation across the sector. The seven technologies for which preferred standards were identified are listed on page 17 of this report.

The outputs of this project include National Guidelines for Technology (see Fig. 1). These Guidelines were endorsed by the ANTA CEOs for adoption in the VET sector.

The other project outcomes will be considered by the EVAG and, if appropriate, subsequently submitted for endorsement to the ANTA CEOs.

2. Purpose of Project

There are substantial advantages to the VET system and users if States and Territories choose the same technologies, or at least systems which are compatible. A great deal can be done to encourage compatibility through identification and dissemination of information in various areas of technology, and through assisting liaison between users in different States and Territories.

The focus of technical standards development is on communications and multimedia technologies used in educational delivery and support rather than administrative systems, while recognising that the trend is for these areas to increasing share common infrastructure and software systems.

The objectives of this project are to:

- Obtain the maximum feasible level of endorsement and implementation of agreed standards by States and Territories.
- Identify and document standards in additional areas of networked technologies as appropriate for the VET sector.
- Review the Maintenance Process and make recommendations on revisions as required.

It should be noted that while adoption of the National Guidelines for Technology (Preferred Standards, Functional Specifications and Operating Guidelines) recommended in this report will increase interoperability between the participants in the VET sector, the adoption of the Standards is not mandatory. They therefore comprise *Preferred* Standards. Sometimes registered training organizations (RTOs) will not be able to use the preferred standards. Similarly, for operational reasons, individual RTOs may have to customise the Operating Guidelines. In these cases, if they judge that interoperability will be impaired, it is suggested that they advise the interoperating VET bodies of the standards or guidelines that they are using.

3. Definitions and Technology Areas

Important terms, which are used extensively throughout this report, are defined in the paragraphs which follow.

The ***National Guidelines for Technology*** comprise the following three components:

- ***Preferred Standards***. In terms of the needs of the VET sector, the technical standards comprise agreed electronic parameters or information exchange protocols which, when used consistently, enable systems and equipment to interoperate easily.
- ***Functional Specifications*** are agreed descriptions of the required capability of systems or equipment to facilitate their use or interoperability within the sector.
- ***Operating Guidelines*** are agreed ways of using technology to maximise the benefits, minimise costs or support interoperability between different systems using that technology.

Initiatives comprise those actions which the participants in the standards determination process believed would increase the value and/or interoperability of the VET Sector.

Issues for Investigation were those that the participants believe could increase the value and interoperability of the VET Sector, but insufficient information is available at present to allow prescriptive recommendations to be made.

This outcomes of this report are targeted on a range of key technologies which support flexible delivery in the VET sector. These technologies comprise:

- **Computer Managed Learning Systems**: The systems used to support learner enrolment, online delivery of course material, assessment and the allocation and scheduling of resources to support those activities.
- **Data**: Standards to allow portability of student data, the interchange of records between institutes and access to courseware developed by third party organisations.
- **Email**: The server hardware, client software and protocols for data interchange allowing a store and forward means of communication of text and associated files.
- **Groupware**: Software to allow collaborative working between teachers and learners, including directory services, workflow scheduling and scheduling.
- **Internet & Intranets**: The network of networks and associated routing software, which allow users to communicate via email, access information data bases and transfer text, graphics, video and voice files.
- **Personal Computers**: The sets of PC hardware to support general learning for general VET courses and to support multimedia authoring and applications development.
- **Video Conferencing**: The communications hardware and associated video compression and transmission protocols which allow multipoint communication of real-time video, voice and graphics material.

4. Rationale for the Adoption of Preferred Standards

Benefits of Standardisation

The adoption of the appropriate standards throughout the VET sector will provide the following benefits in the implementation of flexible delivery via two partially related mechanisms:

Achievement of Economies of Scale

- Standardisation will enable the States/Territories to achieve economies of scale in the purchase and operation of equipment within the sector. Aggregation of standardised equipment types will allow the VET sector to arrange for bulk purchasing and negotiate price reductions from manufacturers, subject perhaps to Whole of Government mandates as discussed below.

  It also reduces the skills required and the risk involved in purchasing decisions. Importantly, the adoption of standardised equipment, software and operating environments reduce subsequent development, maintenance and training costs. These operating cost components can be considerable and consequent savings are therefore highly beneficial in supporting the economic attractiveness of online delivery.

- Standardisation encourages the development of an open market for the supply of telecommunications and information technology hardware and software: when tenders are expressed in terms of the preferred standards, new suppliers are able to enter the market and supply to those standards because the specifications that they are required to meet are publicly available. This will result in access by the sector to a greater range of products at a lower cost.

- The recommendations of the project represent a coordinated plan for investment in technology. Commitment to the Standards Policy and Maintenance Process will assist long-term planning and purchasing arrangements through an ongoing process of development and review involving environmental scanning and projection.

Attainment of Interoperability

Interoperability is defined as the ability to interwork systems across the sector, allowing the interchange of information. This has the following advantages:

- It allows universal access – based on the telecommunications infrastructure – by learners to course material and thus directly supports the National Strategy for VET 1998 – 2003 'Bridge to the Future' agreed by Ministers, which acknowledges that 'new forms of educational and communications technology will generate increasing demands for flexible, convenient and accessible training.'

- It will allow the sharing of content and resources across the sector. This has both supply and demand advantages. Interoperability allows a tool built to work within one learning environment to work across multiple environments. Content developed according to common specifications can be therefore be sold into a wider – in fact, global – market, at incremental cost. Standardisation

therefore offers business advantages to content developers.
On the other hand, standardisation will allow learners to access a wider range of course material. This means that they will be able to locate material which is most relevant to their needs and of the highest quality. Multiple authoring tools may be used to develop content that can then be pieced together.
Teachers can tailor material for particular learners by selecting and combining material from a variety of sources and customise it to suit the needs of individual users.

- Open markets for content stimulate content providers to produce product of the highest value. This is of direct benefit to learners.
- Interoperability of communications systems enables the sharing of information and, thus, the avoidance of duplication and rework. This benefits the overall efficiency of online delivery in the VET sector.
- Interoperability at the learner level encourages the development of team processes, collaborative working and peer-to-peer learning.
- Access to evaluation and assessment systems allows learners to monitor and track their own progress and chart a personalised course through a training course.

5. Project Methodology

The core part of the project process was the conduct of a series of workshops involving representatives from each State/Territory.

Briefing Papers

The Project Team prepared briefing papers for each of the technologies listed above. These papers served as inputs to stimulate discussion at the workshops, and in some cases, were modified in the course of the workshops. The papers - as modified in the light of the comments at the workshops - are attached to this report.

Web Site and Discussion List

In addition to the website developed for the previous project, a password-protected website was set up. It contained an archived discussion group. This discussion group was active - before and after the workshops - from mid September to the end of October, 1998.

Workshops

As part of the consultative process of the project, seven workshops were conducted over the period 6th to 14th October, 1998. Good representation from the States/Territories was obtained and constructive discussions occurred during the course of the workshops. The workshops considered the briefing papers and inputs from the discussion group. The facilitators allowed representatives to express their views as fully as was possible within the necessary time allotted. The objective was to ensure that the outputs of the workshop represented the views of the States/Territories Representatives rather than those of the Project Team.

Because of the differing states of development of the various technologies, the recommendations vary in level of detail. In order, however, that the outputs represent the consensus obtained, it is not regarded as necessary to harmonise the degree of detail across the Recommendations from the different workshops.

The workshops had an additional benefit. In the course of the proceedings, and afterwards, it was clear that relationships had been established between the attendees which should result in useful networking in the future. In the short term it is hoped that these links will facilitate the resolution of subsidiary issues which are being considered in the discussion group.

6. Project Outcomes

This Section outlines the three components of the ***National Guidelines for Technology***:

A Preferred Standards

B Functional Specifications

C Operating Guidelines

It also describes:

- Initiatives
- Issues to be Investigated

as agreed during the workshop consultation process.

The key output of the workshops - in fulfilment of the overall objectives of the project - was the agreement by the workshop participants of preferred standards. These decisions emerged after discussion of the input briefing papers, auditing of current practices in the States/Territories and detailed discussion of the business and technical issues involved.

In some areas, for example Computer Managed Learning Systems, there are only proprietary products available. In accordance with the standards policy agreed previously, no standards were therefore defined. It was thought to be advantageous to define Functional Specifications, which cannot be stated simply by reference to a formal technical standards document.

The workshop papers, which contain the detailed justifications of the project outcomes, are given in full in the Attachments.

National Guidelines for Technology

These Guidelines were endorsed by the ANTA CEOs for adoption in the VET sector.

A. Preferred Standards

Email

- From client to server and server to server: SMTP. Reference:
  http://www.ietf.org/
- From server to client: POP3, IMAP4. Reference:
  http://whatis.com/pop3.htm

  http://www.washington.edu/imap/
- Attachments: MIME. Reference:
  http://www.ietf.org/
- Directory access: LDAP. Reference:
  http://www3.innosoft.com/ldapworld/

Internet & Intranets

- HTML 3.2. This is the 1996 standard for the language used for web pages. Reference:
  http://www.w3.org/MarkUp/
- Java 1.1 Reference:
  http://java.sun.com/docs/books/jls/html/
- Adobe Portable Document Format. Reference:
  http://www.adobe.com/prodindex/acrobat/adobepdf.html

Personal Computers

The preferred standards for classroom PCs are as given in the table below. For ease of description, Wintel parameters are specified, *but equivalent non-Intel specifications are equally acceptable.*

Component	Standard PC	Advanced PC
Motherboard:	BX Chipset or equivalent	BX Chipset or equivalent
CPU Speed:	>= 300 MHz.	>= 400 MHz.
Memory SDRAM:	>= 64 Mbyte	>= 128 Mbyte
Hard disk:	4 Gbyte	9 Gbyte
Floppy disk:	1.44 Mbyte	1.44 Mbyte[1]
CD ROM:	Yes	Yes
Video display:	15", 800 x 600, 0.28 micron pixel`	>= 17", 1240 x 1024
Graphics card:	2 MB, 64 bit	4MB, 128 bit
Network card:	10/100 Mb/s combo, UTP compatible or N/W Std, PCI Std	10/100 Mb/s combo, UTP compatible or N/W Std, PCI Std
Sound card:	32 bit, 44.1 KHz., PCI	32 bit, 44.1 KHz., PCI
Video Capture	-	MPEG-1 hardware & software
Printer	-	Colour Printer
Common Device Tower	CD-R, CD-W, DVD B/W Laser Printer Scanner	CD-R, CD-W, DVD B/W Laser Printer Scanner Digitiser

Videoconferencing

- H.320 operating at 128Kb/s
- H.323 on campus including gateways to H.320 systems
- T.120

[1] Transportable capacity greater than 1.44 Mbyte is desirable.

B. Functional Specifications

Computer Managed Learning Systems

- All CML products acquired or designed should have a Web interface. Standards for this interface are covered in other standards areas, in particular those for Groupware and for Internet.
- A significant subset of CML functionality is required over low capacity channels, e.g., links to rural and remote areas.
- Management of individual (self-paced) learners is required, as distinct from management of a 'class'.
- Students should be able to access their own data, which must be secure. A policy decision is required to achieve this.
- All CML products purchase should store data in a manner that is recoverable and transportable between systems.

Email

- Email client software must
  - be able to automatically sort incoming emails into user-defined mailboxes based on each email's headers.
  - be able to sort mailboxes, by such attributes as date, author and subject, and to be able to search for words in these fields and in the bodies of all emails in a mailbox.
  - default to using internal editors, rather than external ones such as word-processing programs.
  - be capable of viewing and printing received messages and editing messages to be sent, using a fixed width font.
  - be capable of defining local address lists, to make it easy to send an email to a user-defined group of people.
- Email clients or systems should, if possible, be configured to enable senders to have their lines automatically wrapped on screen as they write to a 70 character limit, and for the message to be sent exactly as it appears.
- Directories of contact data should be available in an LDAP compliant format structured to facilitate browsing by LDAP compliant email clients, for the purpose of finding email addresses and other contact data for VET staff.
- Information on configuring email clients to support VET standards and operational guidelines should be readily available on web sites.

Internet and Intranets

- Web page development should be based on users accessing the site with the latest non-beta release of the major browsers and the previous version, taking into account bandwidth limitations and the needs of learners with disabilities.
- Audio protocols should work with the two major browsers or with plug-ins which are available for both of them.

C. Operating Guidelines

Email

- A staff member's prior consent should gained before their email address or other contact details are made available in an LDAP directory
- The client or the email system should send emails with lines typically no longer than 70 characters, except for lines with quotes from previous messages, which should not generally exceed 80 characters. Users may include some longer lines if they choose, such as for long URLs.
- Quoted portions of messages must be clearly recognisable as such.
- Nested attachments should not be sent.
- Emails should begin with the main message as plain text, rather than RTF or HTML. That message should describe the attached file. RTF, HTML and other file formats should be sent as attachments, unless it is known that the recipient wishes to receive the primary message in one of these special formats.
- An HTML or RTF version of an email message should not be attached to the plain text version unless it conveys further meaning to the plain text version.
- Do not send emails longer than 1 megabyte. VET courses which require the transfer of larger files should use alternative mechanisms, such as FTP.

Internet and Intranets

- "Navigational" web pages - all publicly available material other than instructional pages - should allow rapid loading, for instance 15 seconds via a 28.8 Kb/s modem. The total size of the HTML file and all included graphics files should be no more than 50 KB.
- The site should be navigable with descriptive text mode links.
- Instructional pages should only contain objects related to the educational purpose of the page.
- Pages which contain graphics should specify the size of the graphic image in the HTML.
- Web pages should be designed as much as possible so that progress is visible while it is loading.
- Web site organisation should be as simple as possible

- Avoid the use of excessively long file and directory names.
- For file and directory names, use lower-case letters and numbers. Do not use spaces within file names.
- When an instructional page contains a link to another site,
  - make the link open that site in a smaller browser window which overlays the current page.
  - make it clear that the link leads to a separate site, and that its copyright belongs to authors or owners of that site.
- Pages which encourage users to download executable programs should link to the original site of that software
- The technical requirements for a web-based course should be clearly stated to students before they enrol.
- Copyright should be observed for print resources.
- Pages should be viewable without the need for users to scroll horizontally.
- On each web page, include the date of last update, and contact details for the webmaster or author.
- Care should be taken to ensure maintenance of web material to ensure, for instance, that material is up-to-date and that there are no broken links.
- Institutions should establish and follow quality guidelines for web material.
- Metadata should follow the standards established by EdNA.
- In all navigational pages, a search facility and/or site-map link should always be visible.

Video Conferencing

Technical

- The choice of technology needs to match the application. Desktop or PC based videoconferencing is a personal space while room systems are generally for groups.
- The user interface device also needs to match the situation.

Peripherals

Recommended peripherals are:

- Scan converter for computer based information such as presentation graphics
- Document/graphics camera for showing real objects and writing
- Videotape recorder
- Monitors : 1 – 4
- External speakers preferred
- Phillips fluorescent tube for colour balance: TLD 83, SS
- Teacher preview monitor

- Echo canceller
- Desktop units should be equipped with earpiece rather than open speakers to avoid echo problems

General Environment

- Help desk access should be available through a speed dial telephone in the room for assistance in case of technical failure.
- Booking facilities should not be located in the videoconferencing room
- For heavy use facilities, the furniture should be arranged for good viewing angles to the monitors and avoidance of reflections from lights
- Room lighting levels should be 50% above office lighting levels. This can be achieved by the use of 3 tube fixtures with plastic diffusers at the normal light fitting spacing
- Electrical and communications cables and wires should be installed in conduits to avoid safety hazards in pathways within the room
- In multipoint conferences, microphones should be muted unless speaking
- Carpet should be installed for better acoustic
- Avoid castors on chairs to discourage unnecessary movement

Staffing

A lean, but coordinated videoconferencing management structure is required within the Registered Training Organisation

Initiatives

A range of new initiatives should be developed at the State/Territory level and at the national level in connection with application of the preferred standards. In the course of the workshops and in subsequent discussions the participants themselves proposed several important initiatives. These are listed below under the relevant technologies:

Computer Managed Learning Systems

- Achieve a workable interface between CML and legacy systems such as student management, course management, human resource and financial management systems.
- Systems should be put in place to enable the more flexible use and management of staff resources as new forms of learning organisations (e.g., learning networks) develop.
- Systems should be instituted to link the management of learning events (e.g., classes, online sessions) with staff and resources planning and management.
- While enrolment systems are partly implemented, action should be taken to complete their availability

Data

- Extend the AVETMISS data standards to include data standards for data interchange between Institutions. The minimum datasets required are:
  - Client
  - Customer
  - Training Packages
- Develop a policy for data interchange between Institutions and implement processes to support and facilitate that initiative.
- To enable resource identification, set up a national search engine using the emerging EdNA standard metadata tags as the search criteria. Concurrent with that, in each Institution, set up web sites describing resources in accordance with the EdNA metadata standards.

Groupware

- Prepare a business case to determine whether a Virtual Private Network (VPN) should be established for the VET sector. A VPN would strongly support overall interoperability. It would:
  - increase security by providing physical access restrictions and implementing a firewall around the VET systems
  - enable communication price reductions to be achieved from the carriers.
- Priority functions for development are:

    - Directory Services.
    - A Process Manager comprising functions including workflow and document management
    - Scheduling and calendar functions
- Undertake a business case to institute a single Groupware Service Provider who would establish a groupware capability for institutes wishing to collaborate on particular projects. The Service Provider would use preferred standards for the groupware components identified by the approved standards determination process.

General

- Join with telecommunications user group initiatives to reduce communications costs - particularly resulting from the current ISDN pricing regime.
  Analysis shows that a large part of the cost to the VET sector of interoperating some of the technologies above - particularly videoconferencing - comprises telecommunications transmission costs

Implementation of these initiatives would have financial implications involving capital expenditure against potential cost savings and benefits arising from increased interoperability.

EVAG will review these proposals and report to the ANTA CEOs in the future.

There may be advantages in linking these initiatives to the Infrastructure Program.

Issues to be Investigated

Technology	Issue for Investigation	Time for Resolution
Computer Managed Learning Systems	• Secure synchronisation of staff and student authentication data to enable consistency and integrity of administrative data across the sector	March 2000

Email	• Style Guidelines to assist the readability of emails:
	  • Quoting styles
	  • An operational guideline on the "Re: " subject line prefix used when replying to emails.
		March 2000

	• Access to allow users to access their email from a variety of locations:
	  • External accessibility of email accounts
	  • Arrangements for providing web access to email accounts
	  • Adoption of IMAP4 access to email servers.
		September1999

Groupware	• Groupware workflow with the object of implementing mailing list services in the short term	September 1999

	• The state of maturity of standards for the following groupware components:
	  • Diary functions
	  • vCalendar (Internet Mail Consortium)
	  • iCalendar (IETF)
	  • Address lists
	  • vCard (Internet Mail Consortium)
	  • Document management
	  • ODMA - Open Document Management API
	  • DEN - Document Enabled Networking
	  • Shamrock (for libraries)
	  • JDDS – document delivery software.
	  • Workflow
		September 1999

Technology	Issue for Investigation	Time for Resolution
	• ODMA extension for workflow • Distributed workflow architecture API (Workflow Coalition) as a basis for interworking of components between collaborating institutes and the VET Groupware Service Provider.	September 1999
	• The possibility of linking the VPN to the AARNET and/or State initiatives.	
Internet & Intranets	• Cascading Style Sheets and XML, as part of reviewing acceptance of HTML 4.0 instead of 3.2.	September 1999
	• Web server functionality and administration.	March 2000
	• Use of cookies (short pieces of text which are stored by a server on the browser's hard disk of information, and which may raise privacy and security problems).	
Personal Computers	• The technology for realising transportable storage greater than that available from a floppy disk , for the Advanced PC	September 1999
Video Conferencing	• H323 - IP and LAN developments, is it yet viable for a production option?	March 2000
	• H324 - viability for analog access to homes on the general telephone network	
	• T.120 for datasharing and whiteboarding	
	• Internet and hybrid delivery of videoconferencing • Web based quality of service • Virtual private circuits	
	• WAN trends in owned networks and use of excess capacity for videoconferencing applications	
	• Techno-economic aspects of metropolitan videoconferencing	
	• Polling systems - multiple choice keypad devices	
	• Video streaming: one-way, – return chat text	
	• IP addressability	

Technology	Issue for Investigation	Time for Resolution
Thin Clients (software) and Networked PCs (hardware)	• Feasibility of deploying these innovations in order to reduce the costs to end users by • simplifying the equipment required by end users and • reducing the hardware upgrades required.	March 2000

Table 1. Items to be Investigated in Maintenance Process

Experience in the course of this project indicates that the Maintenance Process, used to obtain the Outcomes of the project, is capable of bringing together the necessarily high level of technical, educational and policy expertise and of securing agreement across the States/Territories on a large number of issues. It is therefore appropriate to confirm the **Maintenance Process** described in the 1997 Report.

The scope of the Maintenance Process for 1999 should include the above issues raised in the course of the workshops, including the new technology area identified

The resources required to perform the Maintenance Process would generally comprise:

- an independent technical consultant to prepare a briefing paper
- an independent facilitator to conduct a workshop to review the relevant technology, with the aim of identifying preferred standards and
- representatives from each State/Territory, who have the required degree of technical and educational experience, to participate in the workshop and
- a manager to oversight the process.

In some cases these issues could be addressed via online discussions and workshops.

7. International Comparisons

The preferred standards recommended in this Report generally comprise those developed by international telecommunications and information technology standards organisations, e.g., the WWW Consortium (W3C), ADRIANE, Dublin Core etc. This is in accordance with the Standards Policy approved in the 1997 Report.

The outcomes of this project are at the forefront of – but entirely consistent with – international standard setting in the education sector. Pertinent information concerning the work of consortia in the education sector, is cited below.

A key issue for the development of online content is the ability to use this content across a range of computing platforms. Australia has recently joined a cooperative of more than 30 other academic, commercial and government organisations based in countries like the United States, The United Kingdom, The Netherlands, Israel and Singapore which are participating in the development of a common technical framework (an Open Architecture for Learning) for online learning materials. The international Instructional Management System (IMS) project

http://www.imsproject.org

of which all Australian universities, colleges and schools are now members through Commonwealth funding, aims to develop sets of standards and protocols to insure inter-operability between varied online teaching and learning systems. The development of these standards will enable Australia's education and training sectors to develop applications, which are compatible internationally.

The IMS will release a technical specification and a proof of concept implementation that will enable the creation of quality learning environments and materials.

The IMS project has undertaken a broad scope of work. Building out from the requirement for interoperability of instructional content and management systems and from the requirement for working within complex educational enterprises, it has identified five main areas in which they are developing specifications and building prototype code:

- Metadata, the labelling of educational materials
- Content, the actions and responses that IMS-compliant content may perform
- Management functions such as access control, session management, tracking students' progress through learning processes, control over the virtual learning environment, and security.
- Profiles of students and instructors that include personal, performance, and preference information.
- External Interfaces to services external to the core management system such as electronic commerce, backoffice, full-text indexing systems, digital library services and databases.

Their scope includes any educational setting that can be reached by the Internet, which extends to on-the-job, at-home, as well as in the traditional classroom settings.

The IMS technical specification will provide the general guidelines and requirements to which developers must write, in order to create interoperable content and management

systems. A prototype management system will be one example of a functional IMS compliant environment that utilises IMS compliant tools, materials, and external services.

The European Union has developed a Memorandum of Understanding**, Multimedia Access to Education and Training in Europe – A Partnership for a Common Approach to the Production and Delivery of Learning Technologies, Content and Services,** *November 1998*. The URL is:

http://www2.echo.lu/telematics/education/en/news/mou.html

The aspects of this MoU apply to all areas of lifelong learning and technological activity. The MoU also refers to building consensus around the standards that will underpin the development, location and distribution of educational content. Amongst other functions of the MoU co-operative framework, it is intended that the consensus to be developed here should, by defining user requirements, contribute to emerging standards in this domain – in order to produce genuinely international standards for learning technologies. Research, technological development and demonstration activities by European consortia such as ARIADNE and EUN, as well as individual contributions from authorities, institutions and companies, will bring significant benefits to the MoU co-operation. Worth noting is an intention to collaborate with consortia based outside the EU, such as IMS, to contribute to the emergence of a single set of world-wide standards that meet global learning needs and to the development of higher level standards in the future.

The University of Pennsylvania is conducting a Desktop Computer Standards Project at:

http://www.upenn.edu/computing/arch/standards/desktop.html

Information Systems and Computing (ISC), Penn's central computing organisation, in consultation with the Penn community, annually publishes recommendations for new desktop computers. The recommendations help hold training and support costs in check, make it possible for people across campus to work together, and ensure access to key administrative systems and tasks. They clarify buying decisions and help in planning equipment life cycles. They also help determine how ISC's efforts in these areas will be focused in support of campus providers of computing services. For "supported" desktops ISC provides specific training, documentation, and hardware and software problem diagnosis.

The Advisory Group on Computer Graphics for Multimedia Standards in the UK, at

http://www.agocg.ac.uk/AV/standards.shtml

provides a single national focus for computer graphics, visualisation, multimedia and virtual environments within the UK higher education community and is concerned with the handling and processing visual information in all its forms. The AGOCG WWW pages provide information about standards for Graphics, Multimedia, Visualisation and Virtual Environments.

8. Whole of Government Aspects

In some State/Territories “Whole of Government standards” are being developed for use by all agencies in the particular State/Territory jurisdiction. The standards proposed in this report are not mandatory standards and individual States/Territories may therefore be generally constrained to adopt the mandated standards of their State/Territory. Without adequate involvement, the standards adopted may result in VET users having to use systems whose functionalities and default settings are at variance with the needs and standards of the VET sector.

The VET Sector therefore needs to be proactive in influencing their central agencies and fully represented in negotiations covering Whole Of Government IT strategies. Since many Whole of Government strategies are still in the formative stages, there is a window of opportunity for the VET sector to contribute to the debate on the basis of industry wide standards agreed via the processes in this project. There may also be an opportunity for the VET Sector to put its position to the Online Government Council, perhaps via the Ministerial Council, as an example of an initiative demonstrating cooperation between the States/Territories in the important field of education.

WORKSHOP PAPERS

Attachment 1

Computer Managed Learning

Flexibility and Options in Training Delivery

Computer managed learning is a term whose definition is not universally agreed. It is used by some to refer only to learning support related to obtaining, completing and marking assessment items, while others use it to encompass many aspects of the process, including provision of learning materials and interaction between students and teachers in various ways. For the purpose of this paper, the following definition has been adopted.

> Computer Managed Learning involves the use of computers to manage the delivery of learning, automating much of the assessment and administration that is associated with teaching or training programs. CML is distinct from computer based instruction, in that the computer is not generally used as the primary medium of delivery. Rather, it is used to manage the progress of students through a learning program.i

Courseware authoring tools have been excluded for the purposes of this paper.

CML may be used by individual learners or groups, in a self-paced classroom or laboratory, in the workplace or at home. It may include facilities for draw-down assessment items, computer or tutor marking of assessment, interaction between teachers and students, access to learning materials and records of students' progress, and enrolment.

The definition above allows for CML to be used both on line and in stand-alone forms which are offered, for example, by the use of CD-ROMs. Full interactive functionality assumes online use. It is noted, however, that users in remote areas where communications infrastructure does not easily support online activity may find stand-alone forms of CML useful.

The ANTA National Flexible Delivery Documentation Project (SA02), *Functional Requirements: Online Delivery Platform for Australian VET Providers Part 2* (Draft April 1998) (referred to as ODP) includes much valuable material which will assist the development of functional specifications for CML.

Importance to VET Sector

Business Drivers

CML is particularly useful in supporting flexible delivery objectives in the following ways:

- it supports self-paced and time-independent learning since it allows learners to use online learning materials and to be assessed when they are ready, without waiting for the rest of the class
- it supports place-independent learning but is also suitable for use in classrooms and learning centres

- it facilitates the learning process when more than one organisation is involved in supporting the learner, as for example when a learner is enrolled in a TAFE course but doing most learning at the workplace

Supporting Factors

- it can provide the choice of automated or teacher-marked assessment processes
- in addition to formal assessment, it can be used for formative assessment to enable learners to monitor their own progress where this is seen as a desirable part of the learning process
- when accessible online from outside the training organisation, it allows learners to use online learning materials and to undertake assessment tasks at any time of the day or night
- it facilitates active discussion between students and teachers and within groups of students physically removed from each other; such interaction can be asynchronous (using e-mail) or real time (using chat rooms or conferences)
- automated recording of achievement can, as part of a larger student records package, facilitate credit transfer and generally simplify the administration process both for training organisations and for learners who may study at multiple organisations at one time or over a period of years.

CML may be used as part of a course delivered wholly or in part online, or it may be used in conjunction with distance learning materials in other media, or as an adjunct to face to face teaching, especially in self-paced classrooms and learning centres.

Security is an issue of concern to providers. The possibility of cheating (an important issue) is constantly debated in relation to all aspects of online delivery. For commercial reasons, too, access to much material should only be available to enrolled students and staff. Password protection and user authentication are therefore important, though public access may be given to some material, for example where online enrolment or registration is permitted.

Issues of security and privacy are important to learners as well: that is (given that CML allows for multiple attempts at a given level), what detail of successful and failed attempts is recorded on learners' transcripts? Even if this detail is not recorded on official documentation, is it possible for outsiders to find out this detail by legal or illicit means?

Security also requires adequate firewalls between CML and other online delivery devices accessible to students, and administrative and other confidential data held by the provider.

Current Technology Approaches in the VET Sector

NSW	Institutes make their own decisions. OTEN has its own Virtual Campus using WebCT but this does not integrate with existing business systems. Functional specifications are likely to suit the needs of NSW.
SA	Pockets of CML exist in laboratories. 'Manager' and 'Smart' are used. These are not web compatible by manage tracking of outcomes, assessment and communication. 'WebCT' is also used. This tracks by modules. It is a statewide initiative and is accessible to all through the Web. It is password protected and offers different levels of logins. It needs further management features to be developed. An identified issue is to what extent should student management be built into ODP specifications, and to what extent into the student management system? The current view is that CML should focus at the classroom level.
WA	In WA a common College Management Information (CMIS) is used by all autonomous TAFE colleges. The CMIS system .was originally based on SA's SMS system but has been developed into a distinct product due to differing business needs and priorities between the states. A variety of CML products are used within WA. A CML product developed by the CMIS Team, and currently used by West Coast College's Joondalup Campus, has been proposed for integration with the CMIS system.
ACT	
TAS	
Vic	The Virtual Campus and the VET Management Information System are about to be launched. A statewide initiative to develop a student records system is in progress. In some Institutes several systems may be in use. 'The Learning Manager' and 'WebCT' are used by some; others have developed their own systems. A key issue will be the ability to interface with the Virtual Campus.
QLD	At present all 16 Institutes feed enrolment information into the CAP program. This is currently under review. FlexiSAS links to CAP for distance enrolments. CAMS was developed by VEATT for use at the classroom level. VETTWEB is the online equivalent of these programs. Consideration is now being given to how these four (which are sets of processes rather than software solutions) can be combined into one.
NT	NTETA does not provide CML functionality, though it may be used by NTU and schools. Office systems about to be introduced are expected to provide better levels of support with up to 120 desks for training across NT.

Figure 1 (below) provides a simplified depiction of the current context of relationships of CML and student management systems.

AVETMISS standards are clearly important in this context. These form the subject of recommendations for data interchange in the paper on Database Standards.

The required standards for interface to the world wide web are defined under Internet Standards.

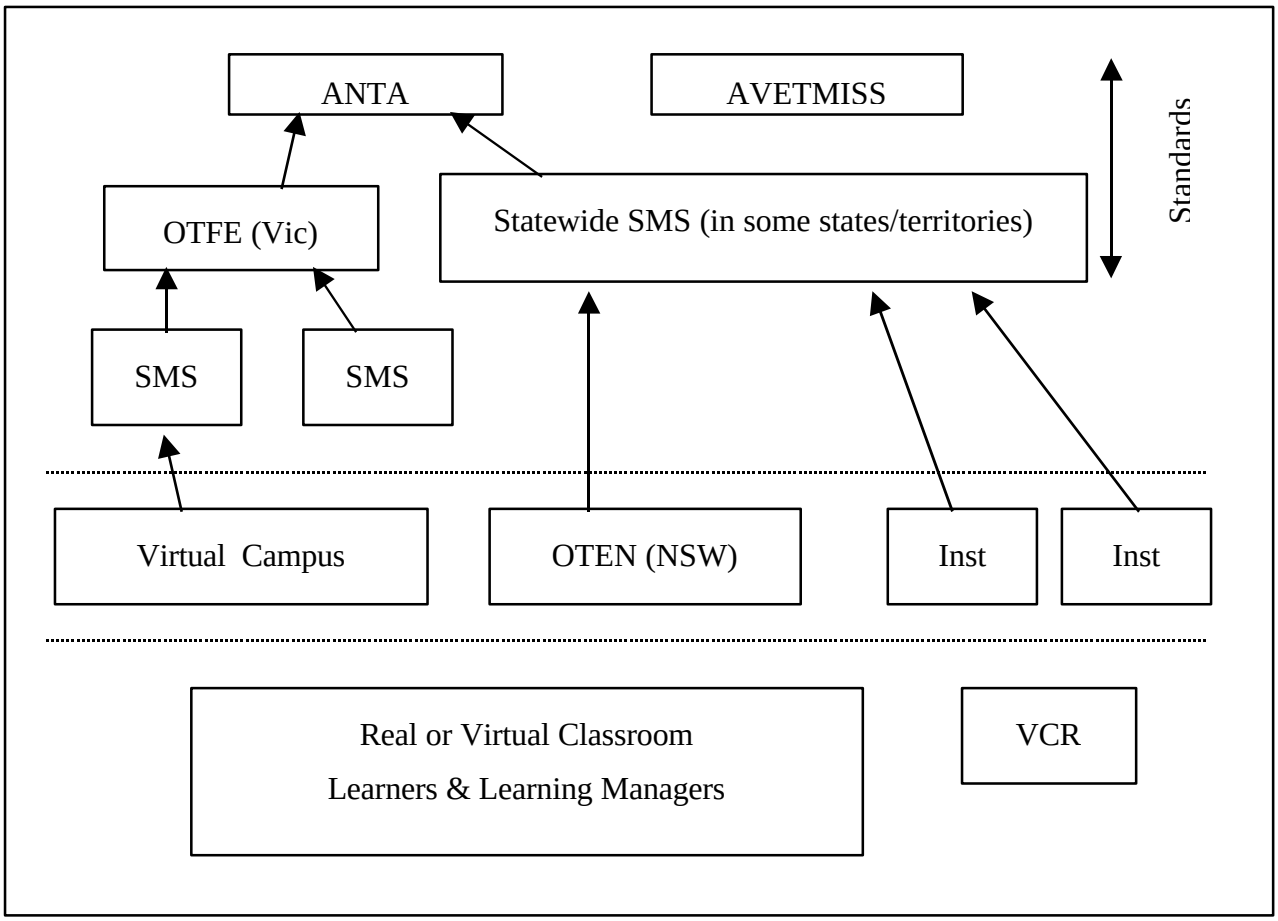


Figure 1: Current Context of CML Development

Likely Industry and Society Developments

As training organisations expand their horizons beyond their traditional geographical catchment areas, the number of learners who are enrolled (at one time or over a period) at multiple providers is increasing. Such learners will often wish to accumulate credits from these organisations to obtain an eventual credential from one organisation. Records that are both accurate and easily transportable will be vital. This reinforces the need for systems that can interwork successfully.

Increasingly, CML products are web-based. This offers increasing opportunities to integrate administration of learning, learning delivery and support, assessment and credentialling. As yet, most organisations make use of some but not all these possibilities. For example, in many cases registration can be done online, but enrolment confirmation and payment must be completed by more conventional methods.

Features such as multimedia learning materials and MOOs (multi-user domains, objected oriented) may be introduced in the future, but at present the bandwidth required means that such applications are at present feasible for only a minority of training organisations, and for few if any learners working from home or their workplaces with dial-up access.

Appropriateness of Recommending Particular National Technology Standards

Most CML products are either proprietary or custom-built. Open standards are not available, except in the sense that open standards exist for supporting functions such as HTML. It would seem, then, that standards for the VET sector may best be identified in terms of functionality. This functionality can form a subset of the ODP referred to above.

Desired Functionality

This section scopes functions required in CML products and issues for consideration in selecting products. Figure 2 identifies existing and desirable linkages between functions of CML and other systems, together with priority areas for action.

Accessibility and security

- Hardware requirements
- Bandwidth issues
- Bandwidth issues
- Availability of client software (downloadable or distributable)
- Password protection and authentication
- Firewall issues
- Customisation potential
- Modularity of the package (to enable Registered Training Organisations (RTOs) to select required features)

Program/training package selection

- Provision of information in required detail about curriculum, modules, study paths, completion requirements, Recognition of Prior Learning and enrolment procedures

Enrolment and registration

- Security of transaction where online payment is permitted
- Security of personal data
- Compatibility with systems and procedures used for non-online enrolments

Learning delivery, support and assessment

- Security of transactions and personal data
- Compatibility with requirements of training packages and competencies
- Access for teachers and learners to learning materials in multiple media (online and support for non-online)
    - dynamic allocation of access rights for learners to appropriate materials
    - automatic bookmarking function to enable quick resumption of study on the next log-in
    - Access for teachers and learners to assessment activities in multiple media

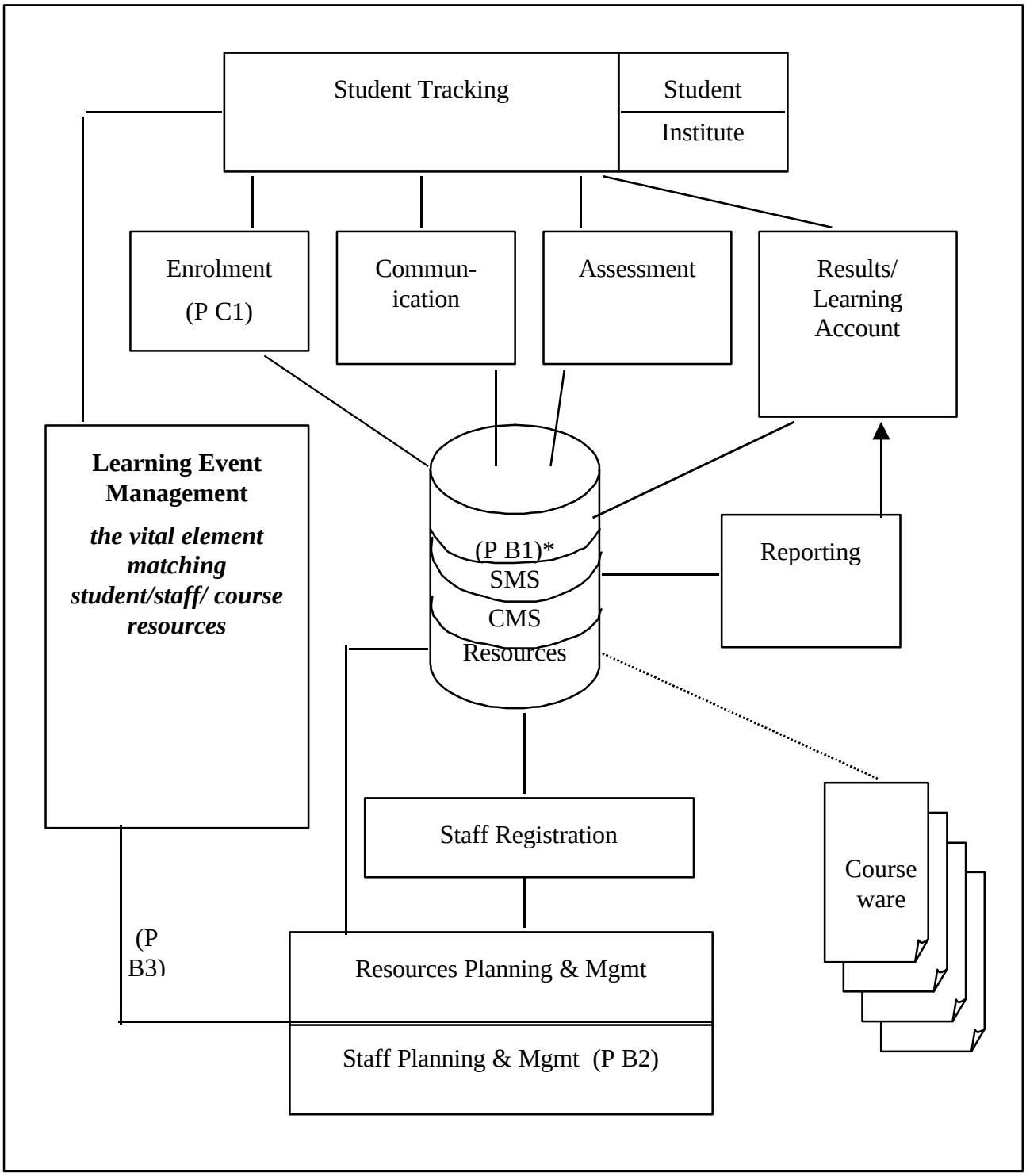
    - Access for teachers and learners to assessment results (whether teacher or computer assessed)
- Provision for resubmission of assessment activities
- Communication facilities to support person to person and group communications with teaching and other staff and learners
    - web forums/conferences
    - discussion lists
    - e-mail
    - chat rooms
- Enabling moderation by authorised staff of communication facilities for groups
- Security of communication between teachers and individual learners for confidential interactions
- Support for online library services and other learner support systems
- Support for online purchase of learning materials
- Support for group working options
- Easy export/import of data to/from spreadsheets, databases, word processors

Learning management

- Security of organisational data where the product is used through a LAN or otherwise hosted by the organisation's server
- Provision of information to teachers and other authorised staff about students
- Ability to flag learning events (such as non-submission of work by a required date) for teachers' attention

Records and progress monitoring

- Security of personal and organisational data
- Provision of information to teachers and other authorised staff on learners' progress compatible with requirements of training packages and competencies
- Provision of information to learners about their own progress
- Support for updating and tracking of records
- Facility to store results of multiple attempts at assessment
- Provision of interface compatible with providers' existing administrative systems.



Legend:(see recommendations for explanation)

P C1: Priority 1 (cost factor) P B2: Priority 2 (benefit factor)

P B1: Priority 1 (benefit factor) P B3: Priority 3 (benefit factor)

* items which have been partly or wholly implemented

Figure 2: Desirable Functionality and Linkages of CML Systems

Value Assessment of Possible Options

From the many characteristics identified in the previous section it will be apparent that assessment of value in relation to CML is a complex matter.

Players in the online value chainii include content providers, RTOs, teachers/ trainers and learners (and their employers).

For content providers, the value of CML resides in its ability to make learning materials and support structures available in ways compatible with the content and presentation design.

For RTOs, the value is linked to the role of CML in providing better service to existing learners and reaching new markets by improving the quality of service and reducing time and place dependence; the potential for cost saving is also an important factor.

For teachers and trainers, the value lies in the ability of CML to provide delivery and learning support in ways which enhance both learning effectiveness and interpersonal communication. These criteria apply also to learners, with cost and access being additional factors.

The diagram below may be used to notionally assess the cost, benefit and value aspects of various CML products as an aid to decision-making about those which will best suit the needs of the organisation or situation.

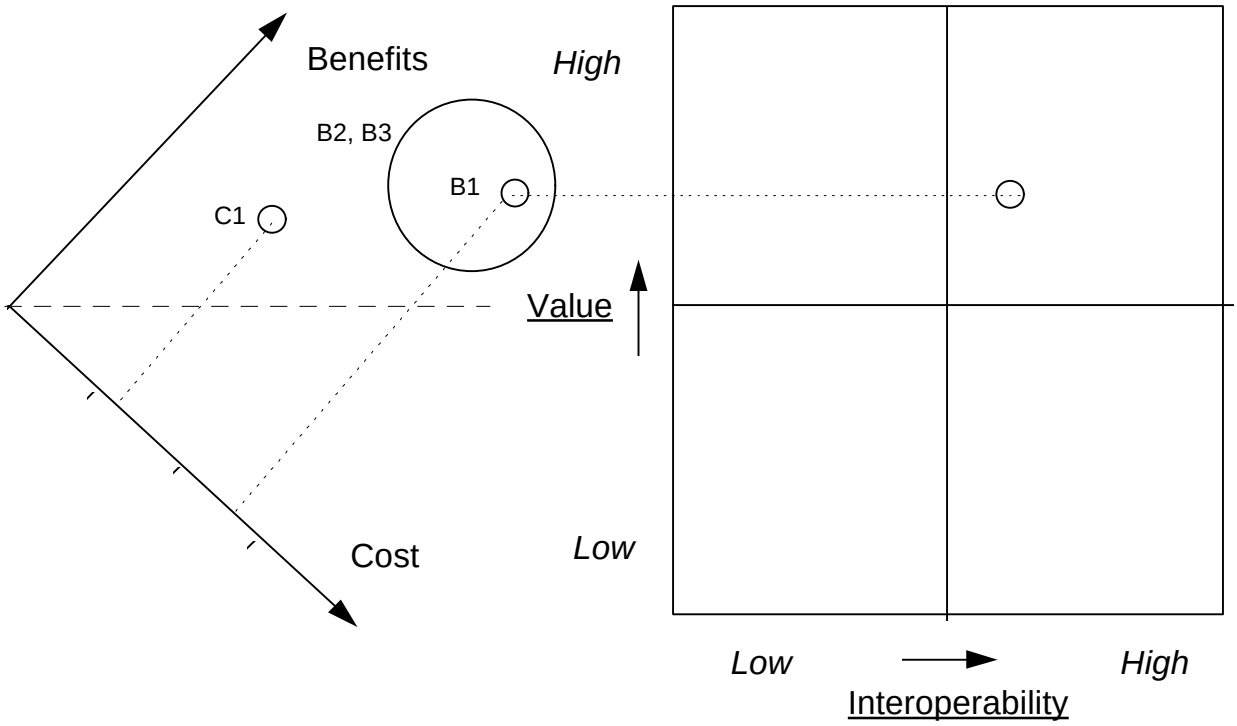


Figure 3. Value Diagram for CML Priorities

The Priority B1 is that with the highest potential benefits. It is the first step in implementing CML systems and using the data within existing systems. It will also

increase interoperability. The other benefit priorities are located in the same general region of the diagram.

The priority C1 will produce lesser benefits, but the cost of implementation is expected to be less, resulting in significant value.

Recommendations

Functional Specifications

- All CML products acquired or designed should have a Web interface. Standards for this interface are covered in other standards areas, in particular those for Groupware and for Internet.
- A significant subset of CML functionality is required over low capacity channels (high capacity content may be delivered off line by means of CDs or floppy disks).
- Management of individual (self-paced) learners is required, as distinct from management of a 'class'.
- Students should be able to access their own data, which must be secure. A policy decision is required to achieve this.
- All CML products purchase should store data in a manner that is recoverable and transportable between systems.

Initiatives

- Action should be taken to achieve a workable interface between CML and legacy systems such as student management, course management, human resource and financial management systems (PB1).
- Systems should be put in place to enable the more flexible use and management of staff resources as new forms of organisation develop (PB2).
- Systems should be instituted to link learning event management with staff and resources planning and management (PB3).
- While enrolment systems are partly implemented, action should be taken to complete their availability (PC1).

Issue to be Reviewed

Secure synchronisation of staff and student authentication data is required, so that authorised users may enter a system at any point and need only authenticate themselves once. The Internet Lightweight Directory Access Protocol (LDAP), which is a client-server protocol for accessing a directory service, is not sufficient for this purpose.

Data

1. Flexibility and Options in Training Delivery

Data forms the basis of learning. Storing, codifying and joining data to create new understanding is the creative process of using data. The challenge for teachers is to help students to creatively use the data by developing appropriate practices for interacting with, and coming to know, the data of the relevant discipline. In such a scenario, students and teachers need first class data management and manipulation systems. Online delivery includes the use of data storage, datasets and access mechanisms to facilitate creative data use.

2. Importance to VET Sector

Important aspects for consideration to achieve interoperability are:

- Data access mechanisms
- Data transfer between Institutions
- Resource identification

Data access is subject to policy decisions in terms of what data can be accessed and by whom and what access methodology is allowed. However to achieve VET online service delivery goals, databases in the sector must provide public and appropriately secure user interfaces using Internet protocols and provide information to users on:

- Provider, training packages, and competencies
- Provider services
- Enrolment options
- Delivery options
- Customised learning packages.

Data access mechanisms must also enable online training package registration and enrolment, including secure online financial transactions. Standards to support access mechanisms and processes are being addressed by other segments in this report. ie Internet and Email standards.

The second aspect for consideration is data transfer between Institutions. This is an ongoing requirement and is only partially addressed by AVETMISS data standards. To support and attain VET interoperability goals, further data interchange standards for data transfer between Institutions is required. Data format standardisation for data interchange has been identified by the State Technical Experts as critical in supporting VET interoperability objectives.

The third aspect is data tagging to enable identification of resources available in the VET sector. Data tags will reduce wasted effort and duplication of course and curriculum modules.

3 Current data standard approaches in the VET Sector

The use of data standards to achieve VET interoperability objectives is currently embodied in the AVETMISS standards. These standards are insufficient to cover the reported data interchange requirements and extensions to the data coverage are required.

4. Likely Industry and Society Developments

- C++ and object oriented extensions to relational databases are becoming common. These extensions enable the complex data objects required by multimedia applications to be managed. Metadata standards to describe complex objects are becoming available and these metadata identifiers will be included in databases. The ANSI open standard SQL3 has been formulated to enable queries on complex multimedia objects.

- Middleware such as SQL, web site or web browser technology and CORBA, interface databases to organisations and the external environment, enhances database use and improve process efficiency by enabling online processes. This type of Middleware isolates systems from environmental changes and gives the appearance of a more modern database management system. When interposed between databases and users, it hides the underlying databases and database management systems from the users. The use of these techniques enhances data access and leads to major efficiencies and new ways of doing business.
- Access to and interoperability between databases will become transparent as data standards evolve.

5. Appropriateness of recommending particular National Technology Standards

It is not appropriate to recommend vendor products as VET standards. It is, however, appropriate to identify processes, datasets and interfaces critical to achieve VET objectives and to recommend functionality standards for databases and access mechanisms to support interoperability of those critical processes and interfaces.

The box labelled “X-Form” in Figure 1 shows where data interchange is required in the system layer hierarchy. Areas of the system hierarchy subject to policy decisions are shown on the left hand side and typical standards for interworking between layers are shown on the right hand side of the hierarchy.

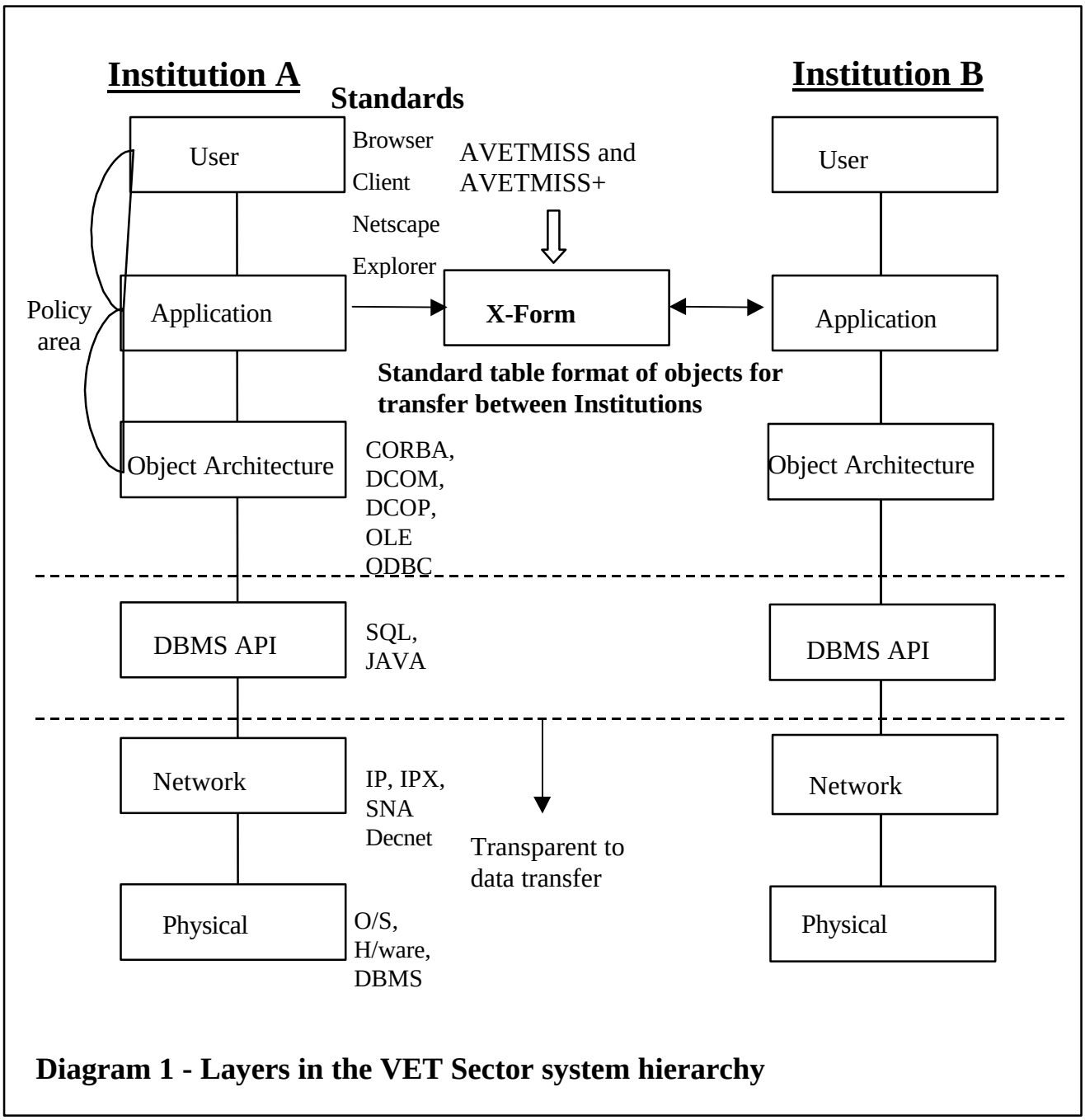


Diagram 1 - Layers in the VET Sector system hierarchy

6. Options for Consideration for Adoption by the VET Sector

Interoperability requires access to the data held in various database products, e.g. DB2, Oracle, Informix etc, from access platforms, other than the native mode platform. The use of Web Browsers and Internet technology simplifies this access. Access to data is also required for data interchange between Institutions. The issues, as seen by the State Technical Experts, were not standards for data access but policy decisions on what data can be accessed and in what data interchange format.

Efficient data interchange between institutions needs data standards and standardisation of operational processes for that interchange.

As a minimum, data standards are required for data describing:

- Client
- Customer
- Curriculum

These can be achieved by utilising the data standards in AVETMISS and by extending the AVETMISS datasets to include data interchange requirements. In the above Figure this is shown as AVETMISS+. Concurrent with extending the AVETMISS standards, standardisation of data interchange processes should be determined. It was noted by the State Technology Experts that data interchange processes required policy decisions to facilitate data transfer.

Metadata identifiers on data resources/content (text, video, sound, graphics, images) should be linked to National and State curriculum codes where appropriate.

7 Recommendations

Initiatives

- Extend the AVETMISS data standards to include data standards for data interchange between Institutions. The minimum datasets required are:
  - Client
    - Name
    - Address
    - Telephone Number
    - Student results
    - Unit of competence
    - Qualification
  - Customer
    - Name
    - Address
    - Telephone Number
  - Training Packages
- Develop a policy for data interchange between Institutions and implement processes to support and facilitate that initiative.
- To enable resource identification, set up a national search engine using the emerging EdNA standard metadata tags as the search criteria. Concurrent with that, in each Institution, set up web sites describing resources in accordance with the EdNA metadata standards.

Attachment 3

Email

1. Flexibility and Options in Training Delivery

Electronic mail is a fundamental means of communication in many workplaces and between VET sector participants, including learners, teachers, trainers, administrators and student-support counsellors. It provides a powerful communication mechanism in both one-to-one and one-to-group modes. Email is rapid and reliable, is unaffected by distance and has very low costs. It is ideal for distance education and the group communication which is so important in most educational activities and in many workplaces.

2. Importance to VET Sector

The value of email for rapid, asynchronous communication between two individuals is well known. This analysis places special emphasis on the use of mailing-lists, both for classes and for communication between VET professionals with common interests.

It is assumed that the learner needs email communications for research, for communicating with other learners and VET staff and/or for continuing their educational work from home or from the workplace. While it cannot be assumed that every learner wants or needs email, or needs to study from home, it could be argued that both email and Web access should be considered as a basic resource and skill-set for much vocational educational training, not just those involving flexible delivery to learners at remote locations or those fields of work which directly involve computers.

Firstly, email supports easy communication to the class, from the teacher/trainer or from any of the learners, which is not usually feasible with paper or telephone based forms of communication. It is low-cost, does not require the other person to be available at any particular time, allows carefully considered responses with easy quoting of the original text and works with electronic text which can be stored, printed and forwarded to others. Secondly, email is a valuable means of communicating with other learners in the same class, as well as with the teacher/trainer. Finally, email is increasingly part of many working environments, so email skills are of direct vocational value.

At the email workshop, Claire Hughes of the Canberra Institute of Technology, said: "Email is a fundamental tool for any kind of collaborative endeavour. It is vital for professional development and class work." She added that it is needed not just for students working from home, but for those who study on site, because email provides a better (in some respects at least) means of communicating with teachers, and because due to time pressures, "teachers find it very difficult to have an open door policy".

3. 1998 Approach in the VET Sector

The LANs used in VET institutes generally provide some form of Internet connectivity - often with restrictions due to security or for the economic reason of reducing traffic

to and from the Internet. LANs typically run the TCP/IP protocols of the Internet, but may also carry traffic using older networking systems, such as Novell's.

VET institute email systems interwork with the Internet, but some of these systems, such as those of Microsoft, Novell and Lotus, were initially designed to work over proprietary LAN protocols and to carry proprietary message formats. The way these systems interwork with the Internet is the source of significant technical and operational difficulty, for the users of such systems and for Internet users who receive their emails. It appears that all these systems are technically capable of respecting Internet standards and supporting Internet usage. The difficulties arise when they are installed in a manner with inappropriate configuration settings.

Ideally, teachers and learners who have email accounts at the VET institute should be able to access those accounts freely from anywhere outside the institute, but this capability is not always provided. Users within the institutes are typically capable of accessing their email accounts on servers external to the institute. This depends on the configuration of the institute's firewall to allow POP3, and ideally IMAP4 traffic.

The current status of technology deployment is shown in the following table:

	Application Objectives	Key Success Factors	No. of students	No. sites	Metro/ Regional ?	Existing Technology/ Standards
NSW TAFE	Staff/student interaction & information exchange	Student use	Approx 27,000 full time 270,000 part time		Metro & Regional	MS Exchange (for staff) MS Exchange client version 5 for student pilot
SA DETAFE	Universal and economical email communication and attachments	Minimal maintenance Economical transparent	Approx 2000	60+ Internet	50/50	SMTP/MIME POP3 Eudora MS Mail (move to Exchange being assessed)
ACT/ CIT	Staff/student interaction and information exchange.	Student Use		7		MS Exchange NT4.0
TAS Flexible Learning Centre	Tutor-student feedback/ interaction	Timely assistance	350	22	Intrastate Interstate Overseas	Novell Groupwise 5.2 POP3 IMAP4
Vic TAFE				Included in Groupwise		SMTP adopted
WA						Novell Groupwise 4.1 and 5.2 MS Mail

Table 1. Email Technology Deployment in the VET Sector.

4. Likely Industry and Societal Developments

The ascendancy of the Internet and its SMTP approach to email is assured - over proprietary protocols and the X.400 approach to addressing and forwarding mail. Similarly MIME as a method of attaching files is gaining universal acceptance.

The importance of email for many purposes of communication, including many educational purposes is well recognised. Email is likely to become at least as valuable as telephony for many of those who can access it.

POP3 is the most established protocol for clients accessing incoming email from the account's server, but the IMAP4 protocol is increasingly being adopted in place of POP3 or, more commonly, as an alternative. IMAP4 provides improved security and a much more sophisticated functionality which enables a user to maintain some or all of their mail, in separate mailboxes, at the server. This enables users to access incoming emails and past emails from multiple computers. IMAP4 support in client software is growing - notably with the full support offered by the Messenger email client within Netscape's web browser.

5. Options for Consideration for Adoption by VET

5.1 Protocols

There are a number of ways in which mail-clients and mail-servers communicate, and a number of ways in which mail-servers communicate with other mail servers. For instance proprietary networks and office/groupware suites may implement email client and server functionality in ways which make sense within that suite, but which are awkward or incompatible with email to and from the Internet.

Globally, the primary approach to email addressing and forwarding is SMTP (Simple Mail Transport Protocol). This is a 1982 standard from the Internet Engineering Task Force - RFCs 821 and 822. SMTP is used by the client when sending to its server, and by that server to the recipient's server.

POP3 and IMAP4 are also Internet standard protocols. They both enable a client program to retrieve emails from the server on which the user's account resides. Like SMTP, the server and client can be located anywhere in the world, rather than the proprietary approaches which only work on particular networks, or with particular software or operating systems.

POP3 typically, though not necessarily, downloads all emails and deletes them from the server. IMAP is a more sophisticated "client-server" approach in which emails are typically accessed from, and managed and stored for long periods at the server in response to commands from a remote client program. POP3's authentication method is a security problem since the user's password is sent directly over the Internet, while IMAP4 uses a cryptographic challenge-response system which has no obvious security flaws.

The other major approach to addressing, routing and delivering email globally is X.400. This is a formal ISO (International Standards Organisation) standard, which is used by some organisations, primarily in Canada and Europe. Such organisations typically have email gateways to the Internet's SMTP system.

5.2 Archiving, flattening and compression

When a larger file or multiple files are stored and sent as email attachments, it is often most convenient to compress the file(s) into a single, more compact archive. There are three major approaches to this on the three major types of operating system platform. On the Macintosh, Stuffit is most commonly used. On MSDOS/Windows machines, PK-ZIP has long been the standard. On Unix systems, the Free Software Foundation’s GNU-ZIP format is most widely used.

Such programs perform two or three functions:

1 - Archiving: combining multiple files, with their names, dates and other details (which are likely to be operating-system-specific) into a single file. The archive may also contain sub-directories and arbitrarily complex directory structures.

2 - "Flattening" a file. This is only applicable to Macintosh files, which have two components - a "resource fork" and a "data fork". Flattening combines the two sections into a single file in a form that they can be separated later.

3 - Compression: reducing the amount of data required for conveying the information in a file, or an archive of files.

Compression is important for longer text, word-processing and spread-sheet documents. For instance one of the most reliable ways of transferring a Word document is to convert it to Rich Text Format, but the result can be a very large file indeed - especially if the document contains graphics. Such files can typically be compressed a great deal, and so be faster to send and receive, and so they fit within size limits imposed by some servers, user mailboxes and mailing list servers.

Fortunately anyone using archiving is likely to be sending the archive to a recipient with the same operating system - so there are fewer interoperability problems. In an environment where Windows, Macintosh and Unix are widely used, the file compression problems are typically solved by the recipient having software capable of handling both PK-ZIP and GNU-ZIP - but there are still problems for many users, especially when receiving Macintosh Stuffit archives on Windows or Unix systems.

5.3 Attachments

A second issue relates to how files are attached to emails. Existing approaches include:

- UUencoding - one of the earliest methods of encoding files into the plain text which is carried via email systems.
- Base 64 - another form of file encoding.
- BinHex - used primarily with Macintosh systems.
- MIME - Multipurpose Internet Mail Extensions.

Of these, only one is used almost universally and is an accepted, open-ended, global standard: MIME from the Internet Engineering Task Force. MIME uses Base 64 encoding, amongst others, in a clearly defined manner which enables an email to have multiple sections, each of which can be text, a file or material in a particular format, such as HTML. An attached file will typically be encoded with Base 64, which uses about 1.4 characters per byte of the file.

5.4 Operational issues and functionality of email systems

All email users must be able to reliably and easily send and receive files as email attachments, email to the groups of people of interest to them, and receive such email from members of those groups. Thus email can be used as a basic form of "groupware", without the need for any special software.

While basic email usage is quite straightforward, the most valuable, sophisticated uses require significant skills, organisation and appropriate software or services. Advanced use of email, such as participating in several busy email-lists and keeping a record of all received and sent emails, requires client software with functionality such as being able to filter incoming email automatically into particular mailboxes, based on the contents of headers, and the ability to sort and search mailboxes in a variety of ways.

Unfortunately there has been increased adoption of email clients, or email systems, which do not send emails in the form they appear to the sender as they are being written - or at least standard email clients of recipients are not guaranteed to be able to reconstruct what the sender wrote. In some cases this is caused by the sender's client

enabling fancy text formatting - and sending the email as HTML or RTF, perhaps with a plain text version as well. However few recipient clients are capable of interpreting HTML or RTF, and the plain text version does not convey what the sender thought they were sending. Another problem relates to clients or email systems which display the email to be sent with a certain line length on screen, but actually send the text after wrapping it to a different line length, or with each paragraph as an arbitrarily long line.

In all these cases confusion results because firstly the recipient sees something different from what the sender wrote, and secondly the sender is typically unaware of this.

Operational guidelines and related email client functionality are discussed in greater detail in the following sections. Generally it is assumed that the email server does not alter the message at all, and that the sender and their client software is entirely in control of the message which is sent. In some systems, such as Lotus ccMail or Novell Groupwise, the client and server do not follow this model, do not use Internet standards and do not necessarily follow the conventions and standards of Internet email. In those cases compatibility with Internet standards may be handled by a third item of software - a gateway. Thus there can be problems of a significant difference between what the sender sees when they write the email (which is probably similar to how it appears to recipients in their office), and what is actually sent to Internet recipients.

The operational guidelines include both what users should do, and how their "client" software - or in the case of non Internet email systems, the combination of client, server and gateway - should be configured.

Users of Internet compliant software sometimes disparage the continued use of proprietary systems such as Novell Groupwise or Lotus Notes, based on the awkward or hard-to-read emails they sometimes receive from these systems. However their continued use is inevitable since within their own system they provide additional powerful "groupware" functionality which is valuable to larger organisations and which cannot currently be provided with standard Internet protocols. All these systems can be configured to respect Internet technical standards and conventions (although perhaps not in a way which the sender can see or control) - the problem is that they are sometimes mis-configured by default, creating difficulties for all their users.

6. Value and Interoperability Assessment of Possible Options

For simplicity this discussion is based on the Internet model of email, in which a client sends an email to a server, and that server performs no changes on the content of the email, but sends it to one or multiple other servers where the recipients' accounts reside. Finally each recipient's email client software retrieves the email from their server. Other than converting quoted-printable encoded text into 8 bit ASCII, the servers do not alter the content of any email which complies with SMTP.

Proprietary LAN-based email systems may operate in a different manner. The client and server may not use Internet protocols at all, nor may the messages they send comply with SMTP or follow accepted Internet email practice. A third item of software - a gateway - may translate the internal format into an SMTP compatible form for sending to the servers of Internet recipients. This raises problems of the outgoing email having been changed from what the sender wrote on screen, without the sender realising.

It is not possible to discuss in detail how such proprietary email systems should function internally (in terms of their clients, servers and gateways) in order to best support communication with Internet users. The goal in choosing and configuring such proprietary systems should be that the sender can easily write an email in a form which is compatible with Internet standards (such as not showing fancy formatting which cannot be conveyed in plain text) and that the system should send the email to the Internet in that form, without transformations to the content which are not visible to the sender.

Two other architectural variations are sometimes used by VET institutes. Firstly a program which behaves as an email client, and perhaps server as well, but which functions as a web server so that remote users interact with it via standard HTML and/or a downloadable Java applet. Secondly the use of a "Windows Terminal" program, where remote users operate an email client program of some sort which is actually running on a server at the VET institute. The remote user can do this via the Internet or a dial-up modem connection, using special software or using a Java applet in a web browser - using a computer running Windows, Unix or the Macintosh operating system. In both these cases the client is really at the central server, and the protocols by which users operate that client are not important to the functionality of the email system - provided they pass through any firewall at the institute, and any firewall at the site where the user is situated (such as their workplace).

There are several areas in which technical and operational factors affect the ability of the user to communicate clearly and efficiently with email:

1. The mail-server's interoperability with the Internet.
2. The protocols by which the email client program accesses the mail-server, and any barriers to accessing that server from within or outside the VET institute.
3. The functionality of the email client program - for instance its ability to automatically sort incoming mail into mailboxes, such as for email-lists which the user participates in.
4. The method used to attach files, and to archive a file (or multiple files) before attachment.
5. Encryption and Digital Signatures for email.
6. The use of mailing-list servers to facilitate group email communications.

Some operational matters- such as line-length and quoting style- if standardised, would make email easier and more reliable to use. These are discussed in the section on client program functionality. Successful outcomes in these fields depend on several factors:

1. That the software (typically the client, but in proprietary systems the client, server and gateway) is capable of supporting Internet standards and the operational guidelines.
2. That the software is configured by default to support these standards and guidelines. This involves clear information being available to users and administrators on how to configure each type of software appropriately.
3. Users being familiar with the operational guidelines and their rationales.

Some of the approaches discussed below relate to Internet technical standards and others relate to features of the email-client program which best support the group

communications which VET participants will be using as part of flexible delivery. (This focus on the client assumes that the server is a standard SMTP server, such as "sendmail" or "qmail", which does not alter the content of the email.)

The provision of email discussion-list servers does not involve standards, other than the choice of which software package is most suitable, but it would be advantageous if operational guidelines could be developed to help new users productively participate in email-list discussions.

Cost is not necessarily an issue in choosing software with the optimal characteristics. Robust, widely used server software for providing email services on Unix systems is available without cost. Full-function standalone freeware client programs for Windows and Macintosh are also available - such as Pegasus Mail - and both Microsoft's and Netscape's browsers have built-in email clients.

The cost of commercial email clients and servers for Windows and other operating systems, or broader systems such as Groupwise or Notes, may be justified by their consistency of user-interface and integration with office-suite applications. However the difficulties which some of these monolithic proprietary systems may present when sending email to Internet recipients should be considered when estimating their total contribution to productivity.

6.1 Internet Connectivity

A VET institute system’s email should be capable of sending and receiving email, including email with MIME attachments, to and from all Internet email servers in order to support distance education and the many other purposes for which email will be used. Therefore it should exchange email with Internet servers using the SMTP protocol.

6.2 Sending to and retrieving from the email server

Except in the case of proprietary systems as discussed above, SMTP is the only option for sending email from the client to the server.

Traditionally all email servers would accept an email from any client or server, but the abuse of this by commercial mass mail "spam" advertisers has forced a change in the standard configuration of servers. Accepted practice for mail servers is now to only accept email from client programs running on computers on the network which is owned by the organisation which runs the server. This is a reasonably effective means of preventing misuse of the server by unauthorised people. Such is the problem of such abuse of mail servers that some system administrators are configuring their servers to refuse to accept email from servers which still allow relaying of email from computers outside a trusted network. Therefore there are good reasons why VET institutes should not allow their servers to be accessible for relaying email from outside their networks. The workshop did not discuss this as a standard or operational guideline, and it is evident that many VET institutes are restricting relay access to their servers appropriately.

Consequently a standard or operational guideline for servers to communicate with all other Internet servers using SMTP does not include the requirement to accept email relayed from clients outside the institutes network.

POP3 is the most widely used protocol for accessing email from the server, and should certainly be supported. IMAP4 enables more sophisticated email use for the user who must access their account from several computers, including those which they do not own themselves. A perfect example of such a user is a VET learner who uses one machine at work, another at home, one or more at various locations in the VET institute - and perhaps a laptop with a GSM phone as well.

The most widely used, and freely available, packages on Unix systems for both POP3 and IMAP4 are the following from the University of Washington:

Server

- The IMAP source distribution includes the **IMAP4rev1** server (including documentation), as well as a POP server that, in addition to offering the normal POP service, can relay commands to an IMAP server, thus permitting existing POP clients to access an IMAP server
- Precompiled binaries for various Unix versions can be found in the directories

  ftp://ftp.cac.washington.edu/pine/unix-bin/

  and (compressed for faster downloading)

  ftp://ftp.cac.washington.edu/pine/unix-bin-compressed/

  in the files imapd-bin.**X**, where **X** designates the platform as specified in

  ftp://ftp.cac.washington.edu/pine/README

Clients

- **Pine®, a Program for Internet News & Email**

Further details can be found at:

http://www.washington.edu/imap/

A separate issue is the accessibility of the POP3/IMAP4 server from various Internet locations. A server which is only accessible to clients within an institute's network makes it impossible for users to access incoming email when they are at home or at their workplace.

There are difficult questions regarding the cost of bandwidth to support externally accessible email accounts. Ideally accounts should be accessible externally with both POP and IMAP4, but there may need to be limits on storage capacity (in the case of IMAP especially, where users typically leave their mail in mailboxes at the server) and bandwidth. On the other hand, imposing limits on mailbox capacity may result in bounced emails which further add to traffic, cause loops in mailing lists and disrupt communications.

One approach to bandwidth management is to impose a limit on the size of emails - perhaps with different limits depending on the time of day. It would be desirable to establish a national standard on what the lowest limit is, so that all VET users can send emails which are below this limit without concern about them being rejected. A 1 Megabyte limit was chosen by the workshop.

6.3 Functionality and proper usage of Email Client Programs

It is valuable to standardise minimum client functionality and to develop operational guidelines for configuring the software and for general email usage.

To maximise communication and minimise confusion, it is necessary to specify certain guaranteed functionality at the recipient client, and to ensure that the sender's client enable the sender to easily compose an email which will display without alteration in the recipient's client environment. Any disparity between what the sender sees on their screen before they send the email, and what the recipient sees on screen or on paper, will cause confusion to the recipient - and so from the sender's point of view will invisibly interfere with communication.

- Clients should be able to display and print of emails, both those to be sent and those received, with lines of up to 80 characters. The workshop did not adopt this formally as a functionality standard, because all clients are capable of doing this - depending on factors such as the window width, font selections and the printer's configuration and paper size. The fact that this 80 column capability is effectively guaranteed, but that capabilities beyond 80 characters are not, is significant for the question of line lengths in email.

- Text formatting of email to be sent. Normal Internet email practice is to limit lines of text to 60 to 70 characters. Unless there is a specific reason, this is a good standard to keep to, since most email programs are expecting lines of up to 80 characters, and since quoting text usually adds two or three characters to each line.

  Some email client programs can be configured (or are configured by default) to send each paragraph as one long line. Some email systems such as Groupwise (and apparently Lotus Notes), have a single setting in the server (the Message Transfer Agent, which may include a SMTP gateway) which either wraps all outgoing emails of all users to a particular line length, or sends all emails of all users with each paragraph as an arbitrarily long line (unless the user manually sets the line length by pressing "enter"). In neither case does the user control this single, system-wide, setting. Nor may the server's wrapping correspond to what they see on screen when writing.

  Arbitrarily long lines can be sent within SMTP standards using the "quoted-printable" MIME type.

  If such arbitrarily long lines are sent as plain text, then the 1,000 character limit of SMTP may be reached and the sending client or system may wrap the line arbitrarily there, or may send it out longer than 1,000 characters. If this happens, a recipient SMTP server may reject it, or break the line. In one instance a plain text email from Groupwise 4.2 exceeded the 1,000 character per line limit. That paragraph, of 1,253 characters was broken in mid word by a SMTP server just before the 1,000th character. This and later versions of Groupwise are used in a significant number of VET institutes, where the system is valued for many functions apart from its Internet email capabilities.

  The question of email line lengths generated a substantial discussion on the project's mailing list, and readers are referred to the project web site for either the archive of that discussion, or a permanent record of key elements of it.

It was resolved to recommend an operational guideline of email clients (or systems) sending emails with text lines no longer than 70 characters (or so), except when the sender specifically wanted to include a longer line, or when text lines were quoted, and so longer than 70 characters.

- Traditionally all Internet communications was done with the fixed width fonts of terminals and printers. Now that proportional width fonts are in wide use on screen and with printers, many email clients have a default of displaying emails to be sent, and those which are received, in a proportional width font. All clients can display and print with a fixed width font, such as Courier, and some (such as Eudora Pro) have a button in the reading window to toggle between fixed and proportional width fonts.

  Fixed width fonts enable the sender to format their text carefully - for instance with communicative indenting and columns of text - in the knowledge that the reader will be able to see them clearly. Fixed width fonts enable diagrams and tables composed of text characters to be made and viewed without distortion. While proportional fonts may be aesthetically pleasing, the use of fixed width fonts extends the communicative nature of email and reduces confusion.

- Quoting styles. The established approach to quoting a line of text: "> " is no longer the only approach. Other methods, which are the default in Groupwise and perhaps other clients or email systems, are much harder to understand, at least in some circumstances, since they mark only the start of the paragraph as a comment, rather than the start of each line. A plethora of incompatible quoting styles is a source of error and frustration for novices and experienced users alike - so an operational guideline standardise on "> " was decided upon, with the matter to be reviewed within 12 months or so.

- Text, rich text (RTF) and HTML formats. Some email client programs send both a plain text version of the email and an HTML version. This increases the email's size and creates extra complications for many users who must read it. It was decided to establish an operational guideline stating that unless there are clear communicative advantages to doing this, email should be sent as plain ASCII text and not as HTML or RTF, and that all emails should begin with a plain text message - with all non text components as attachments.

  There are additional reasons for discouraging HTML in email: an HTML file, when opened in a browser, can cause the browser to connect to any number of remote servers, and to download any number of files, including Java applications. All this can occur without warning, within a second or two of the user opening an email which they may know nothing about - so there is great potential for security breaches and confusion.

  Rich-text, HTML and other formats should be discouraged - except as attachments.

- The ability to create an address list in the client program, for instance, of the learners and teacher(s) in a class. This makes it easier for the user to communicate with a group, without the need for setting up a mailing-list server.

- The ability to automatically filter incoming email into separate mailboxes. A participant in an email-list may involve a large number of incoming email messages,

and it is tiresome and error-prone to have to read each one and manually place it in the correct mailbox for that particular aspect of the user's email activity. The better email programs enable automatic filtering of incoming emails, based on such things as particular strings of text in the 'Subject:', 'From:' and 'To:' lines.

- The ability to sort the contents of mailboxes, by such attributes as date, sender and subject.
- The ability to search the emails in a mailbox for particular text, in specified headers and/or in the body of the email. (These search, sorting and filtering capabilities are available on all substantial email programs, and are supported by the IMAP4 protocol for accessing email accounts on servers - which is where the searching, sorting and filtering must be performed.).

6.4 Methods of File Attachment and Compression

As discussed above, a necessary requirement for email clients is the ability to send and receive MIME attachments. However the clients may be capable of sending in other formats, so it is desirable to establish an operational guideline that MIME should always be used when sending attached files.

Where there is a need to archive and compress several files together for attachment, a problem arises because of difficulties in extracting the files on Mac, PC and other systems.

As discussed in Section 5, the most popular formats are: PK-ZIP format, Stuffit and GNUZip. Fortunately, widely used programs such as Stuffit and WinZip are capable of extracting files from the other formats - but this can be tricky for the user. While it may be desirable to establish a usage guideline for archiving files before attachment, the workshop did not decide on a system to standardise upon.

6.5 Encryption and Digital Signatures for Email

While Internet security threats are easily overstated, there will often be a need to encrypt and/or digitally sign text and files which are sent via email. The most widely used program for doing this is PGP - Pretty Good Privacy - which is available (free for individual users) for Windows, Mac and Unix machines. The recently released version 5 of PGP is very much easier to use than its predecessors. Email clients are likely to integrate more closely with this program.

PGP can also be used to attach digital signatures to emails. Digital signatures enable the recipient to check the entire email with the sender's public key to verify that the message is genuinely from that person and has not been corrupted. Since it is easy for impostors to send email so that the sender seems to be someone else, digital signatures are a valuable method of detecting and discouraging such practices.

These fields - encryption, signatures and the Public Key Authentication Framework (PKAF) for validating signatures - are rapidly evolving and the workshop decided that it is premature to set standards for them at this time. A valuable resource for email security is:

http://www.imc.org/mail-standards.html

which mentions the Open PGP and S/MIME standardisation work.

6.6 Email List Servers

Flexible delivery using email involves not just one-to-one communication, but the ability for a member of the class, whether a learner or a teacher/instructor, to email to all members of the class. One approach is for all class members to have an address list in their email program, but this is difficult to manage and update.

A far better approach is to use an automated email-list server. The freeware Unix program MajorDomo:

http://www.greatcircle.com/majordomo/

or MajorDomo 2:

http://www.hpc.uh.edu/majordomo/

is most often used for this purpose. It can support moderated mailing-lists - where an editor checks what is posted to the list members - or it can forward all emails from members immediately. MajorDomo and other mailing-list programs such as Listserv must run on a Unix machine which is operating as a mail server. A Unix list server requires some expertise to set up, but is relatively easy to administer. Each list can have separate administrators and moderators, and all interaction with administrators takes place via email, or via a web interface. The list server provides a single address for list members to use, and enables changes in the membership of the class to be handled by the list administrator and/or for participants to join and alter their addresses themselves.

Some shareware Windows 95/98/NT mail server programs include mailing-list functions, for instance FTGate from:

http://www.floosietek.com/

A useful extension of an email-list server is to make the list's activity available as an archive on a Web site, typically password protected so that only the list members can access it. If this is done by a program which automatically structures the threads of the class discussions, then the resulting archive is a valuable resource for all class members, especially those who join the discussion after its commencement, or who are unable to keep up with the discussion for a period. Ideally the archive would be searchable. Software is available (for Unix and other systems) to create thread-structured web-based archives of mailing lists, for instance MHonArc, which also decodes MIME attachments and makes them available as clickable links. Search engines for such archives include Glimpse and Wilma. These three programs are freely available via the MajorDomo 2 site mentioned above.

Email-lists are valuable for almost any group of people with common interests. A good example would be a mailing-lists for VET teachers, instructors and course creators who are involved in a specific subject area.

One approach to supporting these mailing-lists and any related Web-based archives is for a special site and administrator on a state or national basis to be devoted to this task. A more decentralised approach would involve multiple sites and administrators around the country, who could assist each other by communicating via a mailing-list.

The technical experts agreed that mailing lists were extremely valuable and in high demand. It is beyond the scope of the current project to recommend how it can be achieved, but it is clear that VET education, especially that involving flexible delivery, would be greatly facilitated by all teachers having an easy way to establish and manage

mailing lists. This involves the provision of servers and Internet connectivity - with the technical staff to manage them and to support all those who want to establish and run mailing lists.

The question of operational guidelines and any technical standards for mailing lists has not been considered here.

7. Recommendations

The following sections include the formal outcomes of the workshop.

7.1 Technical standards

From client to server and server to server: SMTP. Reference:
http://www.ietf.org/

- From server to client: POP3, IMAP4. References:

  http://whatis.com/pop3.htm
  http://www.washington.edu/imap/

- Attachments: MIME. Reference:
  http://www.ietf.org/
- Directory access: LDAP. Reference:
  http://elvira.innosoft.com/ldapworld/

7.2 Functional Specifications

- Email client software must
  - be able to automatically sort incoming emails into user-defined mailboxes based on each email's headers.
  - be able to sort mailboxes, by such attributes as date, author and subject, and to be able to search for words in these fields and in the bodies of all emails in a mailbox.
  - default to using internal editors, rather than external ones such as word-processing programs.
  - be capable of viewing and printing received messages and editing messages to be sent, using a fixed width font.
  - be capable of defining local address lists, to make it easy to send an email to a user-defined group of people.
- Email clients or systems should, if possible, be configured to enable senders to have their lines automatically wrapped on screen as they write to a 70 character limit, and for the message to be sent exactly as it appears - rather than be subject to some other wrapping which is not visible to, or controlled by, the sender.
- Directories of contact data should be available in an LDAP compliant format structured to facilitate browsing by LDAP compliant email clients, for the purpose of finding email addresses and other contact data for VET staff.
- Information on configuring email clients to support VET standards and operational guidelines should be readily available on web sites.

7.3 Operating Guidelines

- Since LDAP directories represent a target for automated systems of identifying people and building lists of email addresses for unsolicited and unwanted email, a staff member's prior consent should gained before their email address or other contact details are made available in such a directory.
- Quoted portions of messages must be clearly recognisable as such.
- Each line of quoted text is to be prefixed with the greater-than character and one space: "> ". To be reviewed.
- The client or the email system should send emails with lines typically no longer than 70 characters, except for lines with quotes from previous messages, which should not generally exceed 80 characters. Users may include some longer lines if they choose, such as for long URLs.
- Nested attachments should not be sent, as could be done by attaching an email which itself contains attachments. While RFC 2046 allows for a MIME type for an email message, many email clients cannot decode MIME attachments within such MIME attached messages.
- Unless the capabilities and preferences of the recipient(s) have been previously ascertained, all emails should begin with the main message as plain text, rather than RTF or HTML. That message should describe the attached file, so that recipients can easily read the sender's description of what the email contains. RTF, HTML and other file formats should be sent as attachments, unless it is known that the recipient wishes to receive the primary message in one of these special formats.
- An HTML or RTF version of an email message should not be attached to the plain text version unless it conveys further meaning to the plain text version.
- Do not send emails longer than 1 megabyte. MIME attachments typically expand by 40% or so, so the maximum size of attached files should be about 700 k bytes. VET courses which require the transfer of larger files should use alternative mechanisms, such as FTP.

7.4 Issue to be Investigated

- Quoting styles.
- External accessibility of email accounts.

  While it was recognised as being desirable for a VET institute to provide email accounts for all teachers and all students who wanted them, and for those accounts to be accessible (via the Internet using POP3 and/or IMAP4) from outside the institute, a number of barriers to achieving this were identified:

  1 - Security issues regarding access to servers from outside the institute.

  2 - Problems with the bandwidth needed by some email users. This is partly a question of Internet bandwidth cost and server space, and partly a question of network congestion.

- Arrangements for providing web access to email accounts, either through future versions of programs such as Groupwise, or by any other means by which the account and client resides on a remote machine, and it is accessible by straightforward HTML and/or Java. Such web-based systems are capable of supporting the sending and receiving of attachments.
- An operational guideline on the "Re: " subject line prefix used when replying to emails. The traditional Internet approach does not seem to be codified anywhere, but works well: to reply to any subject line by prepending "Re: ", except those already starting with "Re: ". Now that some email clients or systems use "RE: ", "Re[2]: ", "re: " or other variations - including prepending more than one "Re: " - the traditional Internet approach is disturbed and many of the new approaches do not recognise the others. This can cause subject lines to grow with multiple versions of "Re: " on the subject line as replies are replied to. It also plays havoc with automated systems which try to recognise "Re: ", such as the subject sorting facility of an email client, or a web archiving system for a mailing list.
- Groupware workflow - with the object of implementing mailing list services in the short term.

Email mailing lists are an important and easily accessible form of "groupware" for classes and groups of people with common interests, such as teachers in different institutes - and in other countries - who teach the same subject. Since a mailing list involves some technical expertise to establish, and must be run from a mail server, it would be desirable for institutes or states to provide resources for the staff and servers so that any teacher who wanted to establish a mailing list could do so. The staff would technically support the mailing list and potentially its searchable password-protected web archives, and support the list owners - who would be responsible for the membership and potentially the moderation of their lists.

- Adoption of IMAP4 access to email servers. This is to improve security and to support users who access their account with multiple computers - for instance a laptop, and desktop machines at the VET institute, at work and at home.

  POP3 is a simple protocol which has security problems because it sends the password in cleartext to the server. It's functionality is adequate when the user is accessing their email account with one computer, or for low volumes of mail via multiple computers. IMAP 4 is a secure protocol which enables the user to maintain some or all of their email on the server, with multiple mailboxes and with powerful search, sort and filtering facilities under direct control of the client. Suitable email clients (such as that of Netscape Communicator 4.5) can access these mailboxes at the server as well as maintaining mailboxes on the client computer and transferring emails between them.

  The functionality of IMAP4 is essential for serious email users who must access their account from multiple computers. Email server software and combined IMAP4/POP3 software to access the server's email accounts is freely available for Unix systems. Server computers which support IMAP4 will typically require

greater storage for user's multiple mailboxes, and users are likely to generate more traffic with the server than if they were simply retrieving the email with POP 3.

Attachment 4

Groupware

1. Flexibility and Options in Training Delivery

Traditionally, learning takes place in an environment where verbal and non-verbal cues between teachers and students, and between students, aid the learning process. In an online learning system these cues are not present in the normal sense and tools are required to support techniques that go some way in simulating classroom learning. Business products that support collaborative project development between remote knowledge workers support some of the interactive cues and are readily adaptable to online learning and flexibility in training delivery.

These products are loosely termed Groupware and are a class of software products that enable remote groups of people and people connected together on a LAN or WAN to access documents and share tasks such as writing, editing and contributing comments in a controlled way.

Groupware products encompass both web technology and PC video conferencing.

2. Importance to VET Sector

This type of software is essential for VET flexible delivery objectives as it provides the following benefits:

- Project/course management – Allows controlled management of collaborative course development and course/student progress
- Communication capability and telecommuting – Enables collaborative learning and course development
- Information availability and information management – As course managers, students and course information are linked, information remains current and accessible.
- Facilitates networking and collaborative effort.

Groupware that has enabled interoperability within organisations is well established and works well, but to achieve the VET objectives of interoperability for flexible delivery of learning materials, interoperability - particularly for administrative functions - across organisational boundaries is required.

3. Current Technology Approaches in the VET Sector

The use of Groupware is well established and many different products are used in the national base.

The current status is summarised in the following table:

	Application Objectives	Key Success Factors	No. of students	No. sites	Metro/ Regional ?	Existing Technology/ Standards
NSW TAFE	Internet based delivery of education			NEIT	Regional	MS FrontPage, however this is not a standard Share Vision where ISDN links are not available
SA DETAFE	WebCT being used for online delivery incorporates elements of groupware	Effective online learning Preparation for workplace	2300 concurrent enrolm'ts	60 campuses on intranet and Internet	50/50	TCP/IP
Vic TAFE	Admin operations		800			Groupwise WP office (Ex Novell Perfect Office) First Class
WA Great Southern Reg College	Internal staff communication, meeting scheduling, task management, bookings of resources	"Time-shift" convenience	4000	100	Regional Albany, Katanning, Mt Barker	LAN Novell Groupwise Lotus Notes Trials of Web CT, Learning Space
Qld	Admin, meeting scheduling		5000+			Lotus organiser C Coningham Mail Lotus Notes RecFind
NT	Admin, scheduling, calendar					Groupwise

Table 1. Status of Groupware products in the VET sector

4. Likely Industry and Society Developments

Collaborate work and distance learning over the Internet will grow rapidly. Application suites that enable seamless interoperability of group work scheduling, document manipulation and management, and audio and video conferencing will be required for effective workgroup activities. Proprietary application suites, often based on available standards are meeting this market demand.

The established Groupware suites, Lotus Notes, MS Exchange, Netscape's Collabra Share, Novell's GroupWise, are being joined by a new group of vendors: Attachmate Corp's OpenMind, Digital's TeamLinks Office, Mesa's Conference+, Oracle's InterOffice, SoftArc's FirstClass, TeamWare's TeamWare and Uniplex's onGo Office.

This plethora of groupware suites can be interpreted as a real world indication of current unsophisticated market demand for groupware, and until the customer base determines what functionality is essential in groupware to support business needs, and understands how to use it effectively, a bewildering array of features will continue to be produced.

Aiding and abetting the development of groupware products is the increasing take-up of Internet access by the general community and the integration of web technology with groupware product suites. In conjunction with that is the imminent standardisation of a 2Mb/s ADSL product (G-Lite). G-Lite will provide a 2Mb/s capacity from premises to the Internet. It is expected that the G-Lite product will be priced so that 2Mb/s ADSL will become a commodity product within the general community living in Metropolitan areas. The transmission capability in non-metropolitan areas will continue to lag behind metropolitan capability.

The advanced features of commercial groupware products are ahead of the standards bodies. With maturity in the market, however, a reduction of products will occur through industry shakeout. The use of open standards underlying the products will lead to improved interoperability between vendor products. Already, some effort is being made by some commercial developers to establish standards which will ensure long term interoperability, thus guaranteeing that after the sectors' honeymoons have passed, there will be extensive use of Internet facilities as replacements of paper based systems. Macromedia, for instance, has approached the educational market with such a strategy, looking to grow the market rather than take a small proprietary-bound share of what currently exists.

5. Appropriateness of Recommending Particular National Technology Standards

Improvements in functionality and interoperability transparency between basic functions are occurring, eg, word processing. The current capability for interworking is however not perfect: for example, Word 6 on Windows 95 cannot read Word documents prepared in Office 97. Significant costs can arise when it is necessary to convert documents between different products and even between different versions of the same product.

It is not appropriate to recommend groupware vendor products as VET standards; however it is appropriate to identify processes and interfaces critical to achieve VET objectives and to recommend functionality standards for groupware to support

interoperability of those critical processes and interfaces. Figure 1 is a high level diagram of the groupware concept with the important functional blocks depicted. It can be seen that the groupware concept provides a common interface into a number of discrete functional building blocks that have, in some instances, emerging standards for interoperability. Examples include Calendars, Meeting Schedular Document Management, Address Lists, etc. These standards are generally open standards.

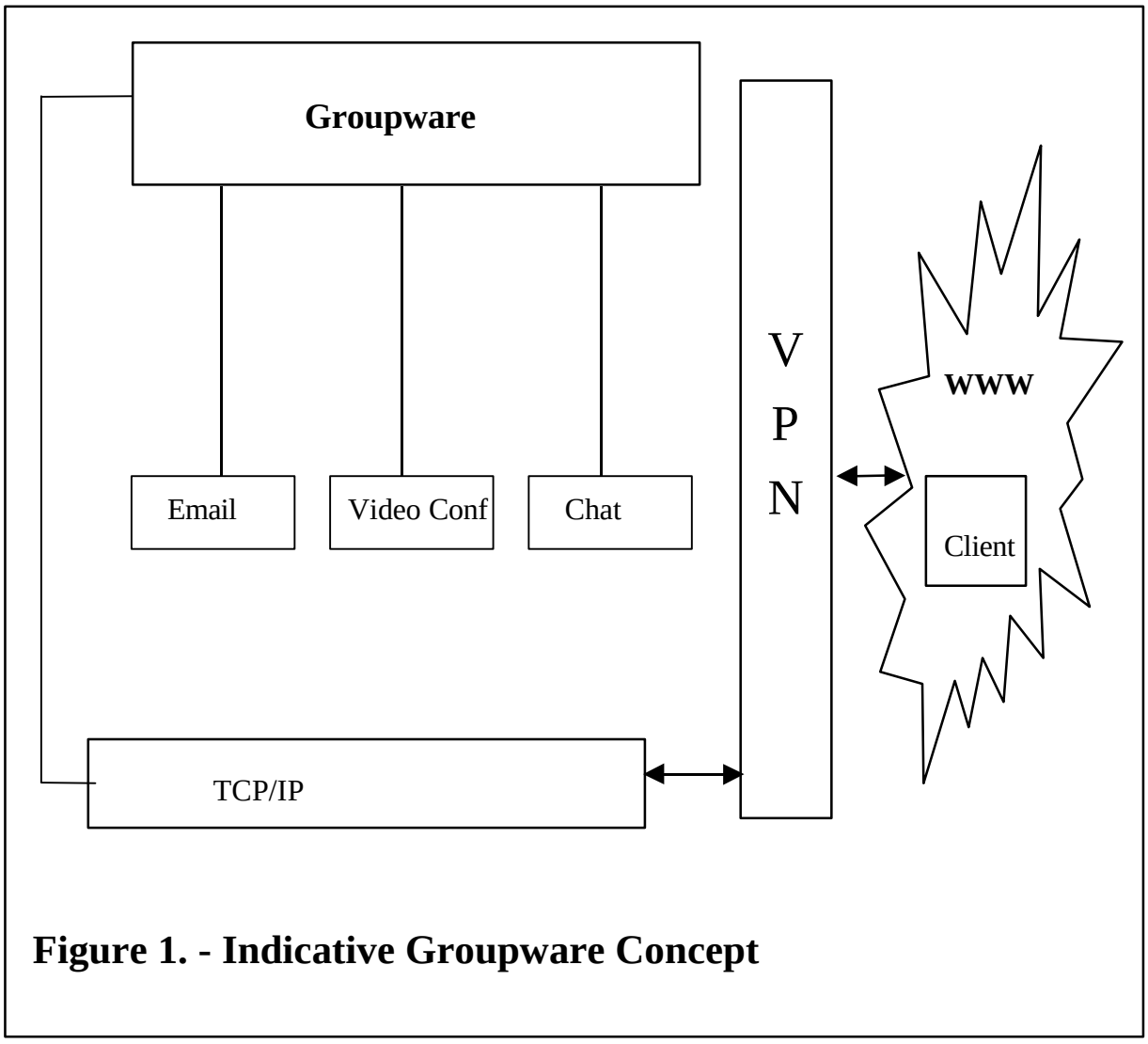


Figure 1. - Indicative Groupware Concept

6. Options for Consideration for Adoption by the VET Sector

PC based Video Conferencing, Workflow and Document Management products are becoming assimilated into the groupware class. Multimedia applications and Internet-enabled products are facilitating the ready acceptance of these products.

Standards for some of the functional blocks accessed by the groupware applications have been set in the ITU arena and these open standards are replacing proprietary standards. For example, the core standards established for video conferencing are T.120, H320, H323, H324 and major vendors are bringing out products based upon these standards. For example, MS NetMeeting is based upon the T.120 standards.

The Internet Mail Consortium (IMC) has developed standards for calendars and address lists and The Internet Engineering Task Force (IETF) has posted memos on further standards development of Calendars and Address Cards. W3C is entering the arena with a particular emphasis on the use of Internet for collaboration.

The JDDS (Joint Electronic Document Delivery Software) aims to develop electronic document delivery software that will give library users greatly increased access to electronic information. The JEDDS partners have agreed to jointly develop document delivery software which has a MIME (Multipurpose Internet Mail Extensions) compliant delivery system. The JEDDS partners are working with The Research Libraries Group Inc., based in California, to enhance their existing document delivery product, Ariel for Windows™, to provide the functionality required. By the end of the project, Ariel® for Windows™ will have the ability to interface to Inter Lending and Document Request Management Systems (ILDRMS) through standard interfaces such as the International Interlibrary Loan protocol (ISO 10160/10161), and will make use of the facilities within the Windows™ environment to allow streamlined or transparent interworking between the document delivery system and the ILDRMS and associated software. The software will also enable electronic documents to be delivered directly to the End User desk top, received via standard MIME mailers, and viewed and printed on a variety of platforms. The JEDDS project brings together in an international co-operative initiative, three organisations which each form a development focal point for significant sectors of the library community in their own country. The Australian Vice-Chancellor's Committee, The National Library of Australia, Joint Information Systems Committee (JISC), Electronic Libraries Programme (United Kingdom)(eLib).

We can expect robust, industry-supported standards to start emerging from those groups within a short time.

7. Value Assessment of Possible Options

The use of a single groupware product across the nation would have benefits in reduced training and improved interoperability. On the other hand the actual cost of migration to a single product may be higher than the expected benefits. The use of a single product would also restrict the ability of administrations to innovate.

The immediate business need is for administrations to interoperate and to do this well, a VET Intranet interconnecting the functional blocks, as shown in Figure 2 is practically essential.

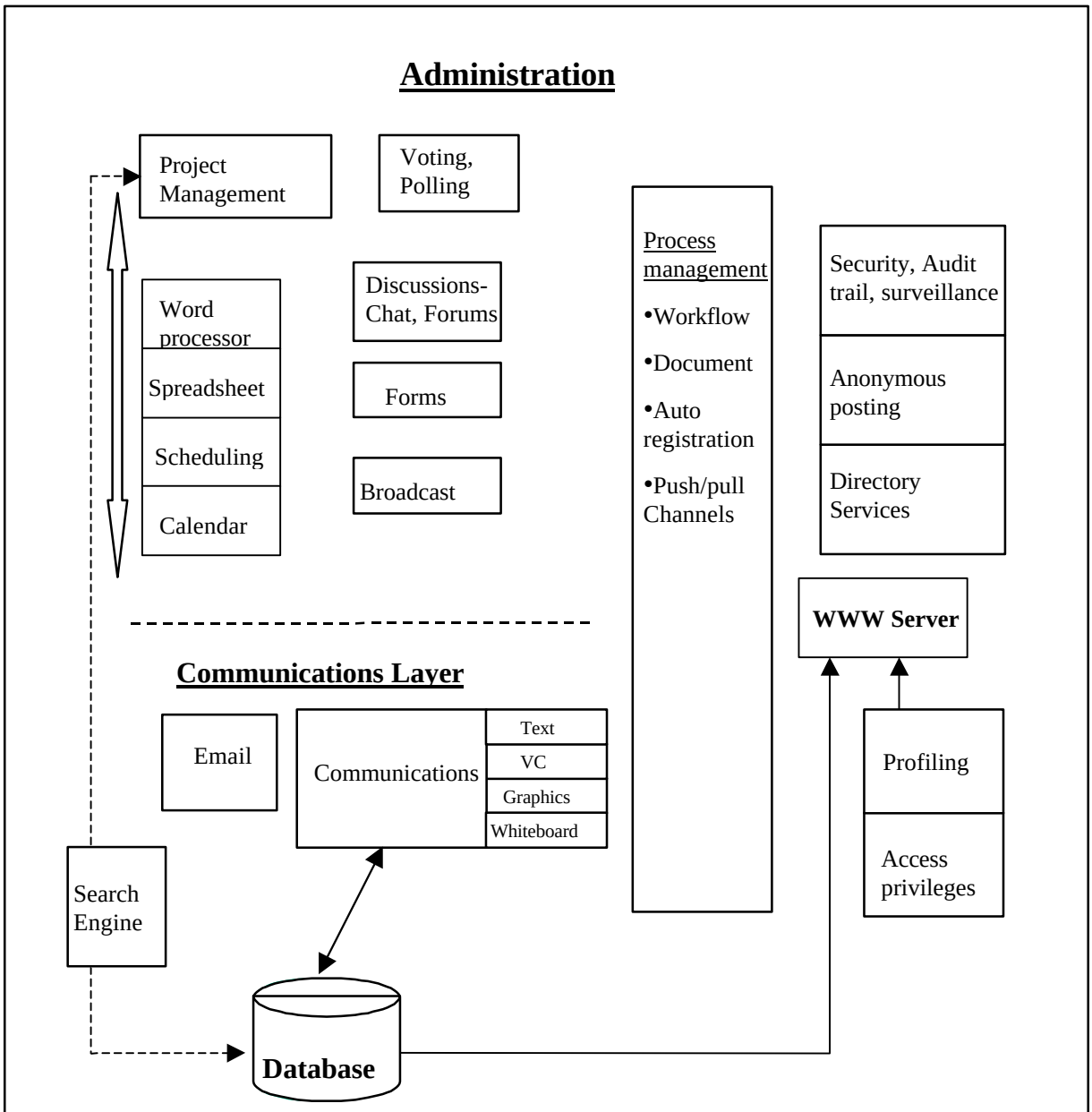


Figure 2 - Functional blocks in VET

The Workshop also identified the need for an overall Groupware Service Provider to ensure interoperability.

A Virtual Private Network (VPN) puts a shell around VET, moves the firewalls from individual institutions to the wall of the shell whilst still maintaining firewalling for key administrative functions.

The business drivers for a VET VPN are:

- Competitive edge
- Access to current information

- Improved decision making
- Quality assurance
- Access to products, resources etc
- Flexibility and speed of response

Linking a VET VPN to AARNET and other State initiatives may add considerable value to the VET sector.

Within that concept of VPN and groupware, value assessment by the State Technical Experts has identified 5 high priority functions for standards. These are:

1. Directory Services
    - People
    - Services
    - Products
2. Search Engines
3. Process Management
    - Workflow Management
    - Document Management
    - Automatic Registration
    - Push/pull Channels
4. Scheduling and calendar
5. Discussion capability
    - Chat
    - Forums

8 Recommendations

Initiatives

- Prepare a business case to determine whether a Virtual Private Network (VPN) should be established for the VET sector. A VPN would strongly support overall interoperability. It would:
    - increase security by providing physical access restrictions and implementing a firewall around the VET systems
    - enable communication price reductions to be achieved from the carriers.

- Priority functions for development are:
    - Directory Services. Web technology can be used to search for physical resources. The people directory would be included in the VPN Manager. This functionality would employ or include a Search Engine
    - A Process Manager comprising functions including workflow and document management
    - Scheduling and calendar functions
- Undertake a business case to institute a single Groupware Service Provider who would establish a groupware capability for institutes wishing to collaborate on particular projects. The Service Provider would use preferred standards for the groupware components identified by the approved standards determination process.

Issue to be Investigated

- The possibility of linking the VPN to the AARNET and/or State initiatives.
- The state of maturity of standards for the following groupware components:
    - Diary functions
        - vCalendar (Internet Mail Consortium)
        - iCalendar (IETF)
    - Address lists
        - vCard (Internet Mail Consortium)
    - Document management
        - ODMA - Open Document Management API
        - DEN - Document Enabled Networking
        - Shamrock (for libraries)
        - JDDS – document delivery software.
    - Workflow
        - ODMA extension for workflow
        - Distributed workflow architecture API (Workflow Coalition)

as a basis for interworking of components between collaborating institutes and the VET Groupware Service Provider.

Attachment 5

Internet and Intranet Protocols, Java

1. Flexibility and Options in Training Delivery

Whether at home, work or at the training institute, there are three global networks which enable the two-way communication which is vital for flexible delivery: the telephone network, the postal system and the Internet. The Internet is faster than the post and more cost-effective in many situations than the post or telephone. It is a relatively simple, flexible network which supports sophisticated and easy-to-use applications because it connects directly to the user's computer, which can run a wide variety of software which can communicate instantly with any other Internet-connected computer.

A dial-up Internet connection suffers from low and uncertain transmission speed - which precludes the use of demanding applications such as videoconferencing - but within these limits, it is a superb communication system for flexible delivery.

2. Importance to VET Sector

For most users, email will be a very important aspect of Internet communications. Email is discussed in an earlier section. This attachment is concerned with a wide variety of other protocols - most particularly those associated with what is loosely called the "World Wide Web".

The focus here is on choosing technologies and the means of using them to best facilitate flexible delivery. The choice of technologies in this field typically has no direct cost implications, since most of it is implemented in freely available software. However, in order to achieve clear communication, in a sophisticated and approachable way, complex technologies must be used wisely. This can only be achieved when teachers are supported with proper in-service training, support staff, and appropriate hardware, software, Internet access and other forms of support - such as email discussion lists and web-forums for teachers with a common field of interest.

The official Internet standard protocols are intended to maximise interoperability - in contrast to some proprietary protocols which are also used widely. In many aspects of Internet communication, there is only one applicable standard, or a standard such as HTTP 1.0 which is superseded by the compatible HTTP 1.1 - so there is little or nothing to choose between or standardise for VET purposes. Conversely, since Internet communications is evolving rapidly there are quite a number of fields in which standards and deployed technologies are conflicting, incomplete or partially adopted - leading to interoperability and performance difficulties for the VET sector's use of the Internet for flexible delivery.

One major constraint on interoperability is the technical capabilities of the computers of those who need to interact with the VET institute via the Internet. These may be learners involved in distance education, or potential learners and their employers. This is particularly so of Web based communications, because of bandwidth and browser software limitations. For instance if every learner had an up-to-date PC and an

uncongested multi-Mb/s link through the Internet to the institute, then flexible delivery could use such highly communicative, but bandwidth-intensive, approaches such as video-conferencing.

Interoperability for Internet communications can best be assured by finding approaches which work reliably with restricted bandwidth, without assuming too much about the user's PC or web-browser and which provide a rich communicative environment in a form which technically inexperienced users will be happy to use.

This attachment focuses on these Web access questions, particularly regarding HTML standards, Java, Active-X and portable document formats.

While multicasting is technically possible, it is insufficiently practical at present to be discussed here.

Any institute which uses the Internet - and particularly those flexible delivery providers who service many learners via the Internet - faces some challenging problems with the security of their network and protection against malicious use of its services. Computer security is a vital and rapidly involving field. There may be arguments for setting standards for the level of security and privacy must be achieved by VET providers - or for standardising the means of achieving this to enhance interoperability nationally - but this is too demanding a field to be covered here.

One area of difficulty for flexible delivery is the tension between three priorities:

1 - The desire to maximise Internet connectivity and computing resources for users inside and outside the VET institute when accessing resources within the institute and, similarly, the desire to maximise connectivity of local users to the Internet outside the institute.

2 - The desire to minimise bandwidth, network management costs and computer support costs.

3 - The desire to maximise security, most typically by restricting the communication and computing activities of users, in terms of bandwidth and/or by allowing only a small set of protocols.

Flexible delivery can best be achieved when there are minimal barriers to communication, when the network and link to the Internet support all protocols - including novel protocols for innovative software - and where the network and its computers are nonetheless secure against misuse and attack.

The solution lies in adequate resources for computers, routers etc. and for suitably high capacity links to the Internet - and in well-resourced staff who can manage the network and provide support for teachers and learners.

3.. Current Approaches in the VET Sector

The current status of Internet technology in the VET sector is shown in the following diagram

	Application Objectives	No. of students	No. sites	Metro/ Regional	Existing Technology/ Standards
NSW TAFE	Educational delivery	Approx 27,000 full time 270,000 part time	2300 schools, 12 institutes/250 colleges	Metro & Regional	No streaming allowed across WAN links, JAVA allowed, SMTP, POP3, NTP, HTTP, FTP, IRC CHAT can be used internally (more protocols will be allowed with the new firewall)
SA DETAFE	Multiple including online delivery, information services and corporate Intranet Standards based Development Tool	2000 - 3000	60+ Internet	50/50	SMTP/MIME POP3 NTP Webforum IRC Majordomo Some Java CGI predominantly Perl Ph: DNS Active Server Pages
ACT CIT	Education Delivery Information Services Corporate Internet				
VIC				State WAN	VicOne with VETNET subnetwork
NT			286, some secondary schools		WAN intranet
TAS	Education and student accounts via POP server				Groupwise
WA	Administrative and academic		72 nodes		restrictive with case by case review
QLD	Email, limited HTTP			All TAFE colleges and regional offices on WAN	HTTP, SMTP

4. Likely Industry and Societal Developments

The basic transport standard of the Web, HTTP 1.0, is about to be replaced by a higher performance and backward-compatible version 1.1. This will improve the speed and functionality of the Web. Currently, each file in a web page - the HTML page itself and every graphic file it contains - must be retrieved with a separate, independent HTTP session, each of which is based on its own TCP session. This involves significant handshaking and communications overhead for each file. HTTP 1.1 enables multiple files from the same server to be retrieved in a single HTTP session.

Servers and browsers are expected to adopt HTTP 1.1 rapidly, but older software will continue to interoperate normally. Therefore HTTP 1.1 does not raise interoperability questions for VET organisations. VET will naturally adopt HTTP 1.1 as browser and server software is updated.

There are four areas of Web-based communications where protocols, file formats and usage are unstable in ways which are likely to detract from VET's goals of interoperability with a wide range of remote users. These areas are:

1 HTML text, graphics, video and sound - and web page and site design.

2 Web programming and application interfacing: Java vs. Active-X

3 File formats - especially 'portable document' formats, but also word processing, graphics and spreadsheet formats.

4 Metadata - hidden information in web pages to aid indexing.

The first three areas are characterised by rapid technical evolution, rapid growth of the user base, increasingly complex and diverse requirements of users and the resultant tensions which arise between software companies and standards organisations. There is a further tension between the desire of some organisations to create an impression of sophistication and impressive technical and financial resources and the desire of most users for clear, easily navigable, quickly accessible information.

Some of the current problems will be solved within a year or so as the HTTP 1.1 protocol and HTML 4.0 specification become adopted. HTML 4.0 in particular will enable much more sophisticated control of screen and printed presentation of text and graphics.

5. Options for consideration for adoption by VET

The Internet Engineering Task Force (IETF) is responsible for all the lower level standards of Internet communication, such as TCP/IP, routing and the Domain Name System. Similarly the IETF is responsible for basic 'application' protocols, such as Telnet, FTP, SMTP, HTTP and many others. See:

http://www.ietf.org

and:

http://rs.internic.net/

Many other protocols and file formats which are important in Internet communications, for instance voice communication protocols, HTML and Adobe Inc's Portable

Document Format, come from companies and other organisations such as the World Wide Web Consortium (W3C).

Many of these Internet standards do not arise from the mainstream formal standards organisations, but the processes of the IETF and the W3C are generally as open, public and well-respected as those of the more established standards bodies.

This discussion concentrates on the protocols and file formats of the World Wide Web - and on guidelines for using these in ways which best support flexible delivery. The primary organisation which is responsible for these standards is the World Wide Web Consortium (W3C)

http://www.w3c.org/

which works with the IETF, although many companies are also active in creating and attempting to standardise their proprietary approaches. The W3C site is the authoritative source of information on many technical and social aspects of Web communications.

Technical standards for HTML concern which kinds of tags should be used in Web documents, and which browsers should be used to ensure acceptable or identical interpretation of the one document. This is a rapidly evolving field, with a base set of HTML standards - the W3C's HTML 4.0 replacing version 3.2 and the proprietary extensions by both Netscape and Microsoft which are implemented in their competing browsers.

Within Web documents there is a need for still graphic images, and .GIF and .JPG formats are generally sufficient for this at present. There is little need for VET standardisation here, because prevailing Web practice is simply to use one of these formats and there are no interoperability problems. However a new format - .PNG (Portable Network Graphic) - will be used in the future as well.

Animated graphics can be achieved with the widely supported .GIF format, or by a variety of proprietary standards such as MacroMedia's ‘Shockwave’, which also provides sound.

There are a number of competing open and proprietary standards for delivering sound. Open standards include MPEG Audio layer 2 and the higher performance layer 3 (MP3). The widely accepted standards ‘.WAV’ and ‘.AU’ can usually be played by multimedia PCs, but they do not offer the compactness of the MPEG formats, and so lead to much longer download times. Freeware players are widely available for MP3:

http://www.mp3.com

Since the specification and decoder source code is freely available, this functionality can be built into other programs, although it is a highly CPU-intensive process. It is generally not possible to achieve better than speech quality audio in real-time through a dial-up Internet connection: any file containing quality reproduction of non-voice signals must be downloaded to hard-disk before it is played. However more efficient compression algorithms and 56 Kb/s modems are making real-time playing of music and other non-voice sounds more viable.

Proprietary standards include Real Audio, Liquid Audio and Netscape Streaming Audio. Support for these formats in the major browsers is improving rapidly.

Video formats include MPEG-1, Apple Quicktime and Windows AVI.

There are a number of competing standards for embodying complex computer programs in Web documents. These programs are run within the Web browser and may work with files and programs on the same computer, or on remote computers connected to the network, including the Internet. Sun's Java is the most prominent standard, but Microsoft's Active-X and VBScript are also contenders in this hotly contested field.

File formats for text and graphic documents, which aim to achieve portability between operating systems, include HTML, Adobe's Postscript and Acrobat .PDF formats and the various Microsoft Word file formats.

6. Value Assessment of Possible Options

The following discussion reflects the workshop paper and discussions during the workshop regarding a variety of technical standards, functional requirements and operational guidelines, which if standardised, would facilitate VET flexible delivery. In some cases the rationale for the recommendations is obvious, so these are not listed here.

Some of the problems discussed below relate to technological problems with bandwidth and the evolving nature of web-browser and sound and video software. Others arise from poorly considered use of existing web functionality.

6.1 HTML Text, Graphics and Sound and Web page and site design

In the timeframe of standards emerging from this workshop, it seems reasonable to assume that VET web sites will be accessed by browsers which are compatible with HTML 3.2 and later 4.0.

Goals for VET HTML usage and web design may include:

1 - Ensuring compatibility with HTML 3.2.

2 - For the front, navigational and informational pages of VET web sites - if not the instructional pages - maximising accessibility to users who are using a text-mode browser, such as Lynx, or who are using Lynx or a graphic browser with a speech synthesiser. Therefore the material should be navigable in the absence of any graphic images - precluding the use of image-maps and any unlabelled images which form the sole means of linking to other pages.

3 - Avoiding the use of Java and Javascript unless they are the only way of achieving a genuinely communicative or instructive purpose.

4 - Minimising bandwidth and download time - by eliminating graphics and especially animated graphics except where they are the most communicative approach. Where graphics are used, it is best to specify their dimensions in the HTML. This enables the browser to lay the page out quickly and to fill in the graphics as they arrive. Without this, Netscape Navigator will not display much of the page until it has started retrieving all its graphics, and Internet Explorer continually reformats the page layout as it starts retrieving those files - leading to a highly distracting movement of some or all of the page's elements. Two common practices which

cause one or both browsers to halt the display until all or most of the material has been received are: firstly not including image dimensions in the HTML, and secondly placing all or most of the text and other material inside a table.

5 - Simplifying the navigation. This involves measures such as avoiding the following:

- The use of frames unless there is no better way to present and organise the information. Frames make navigation and printing of pages more difficult, and typically do not allow the display of the URL of the currently visible page - making it more difficult to bookmark or refer others to particular pages.
- Overly long URLs.
- URLs which change dynamically.
- Overly complex site organisation.
- Large numbers of small pages where one longer page would suffice.
- Java-script ticker tape messages which are distracting and obscure the display of the URL when the cursor is placed over a hyperlink.

Image maps should be an optional method of navigation. Frequently used links should be placed near the top of pages, with clearly descriptive text descriptions, rather than at the bottom, where they may only become visible after graphics have loaded or the user has scrolled down hoping to find them.

Frames can play havoc with browser navigational tools such as Netscape's "Go" history list or the "Back" button. Few users know how to open a frame's contents in a separate window: it is a right-click in the frame with Netscape, and may not be possible with Internet Explorer.

6 - The avoidance of overly complex URLs or URLs which are likely to change from time-to-time - except where absolutely necessary as part of material which must be retrieved from a database. Such URLs may be so long as to be unintelligible to humans, too long to fit in the header of a hard-copy print-out and too long to be reliably cut and pasted into an email.

7 - Avoiding the use of material which can only be viewed with browser plugins - such as Shockwave - unless there is no better way of achieving a particular communicative purpose.

8 - Avoiding the user having to choose between "Frames" and "No-frames" versions of the site, and the error-prone practice of the web-server determining the browser capabilities in order to send it differing material.

9 - Avoiding the use of auto-load pages which quickly change the browser to another URL. This confuses the user and makes it more difficult for them to refer other people to the URL. This should only be used when a page has moved, and then the user should see a clear statement that this has occurred, for five or ten seconds, before the new URL is loaded.

10 - Unless there are compelling reasons, all Web sites should be designed for rapid viewing via an Internet connection which works at around 28.8 Kb/s on a 256

colour screen with resolution of 800x600 without the need for horizontal scrolling. Navigation and as much of the content as possible should be available to people using only a text-based browser, and the most important navigational links should appear near the top of the page within a few seconds.

11 - Avoiding the use of spaces within file names. Not all operating systems support such file names, and they make it harder for users to recognise it as a single file name rather than multiple names or words.

12 - Unless there are compelling reasons, avoiding using upper case characters for file and directory names. Lower case is often easier to read, and since most URLs are lower case, occasional upper case characters are distracting and may not be remembered if the URL is entered manually.

13 - Avoiding the use of special characters in file and directory names. These characters include slashes (forwards and backwards), "?", "*" and others which may not be compatible with all operating systems.

14 - When linking to an external site, make it clear to the user that this link leads to a separate site and the user needs to press the back button to return. This is particularly important in instructional material. Alternatively, have the link open as a separate browser window which only partially overlays the current window - so the user can easily return.

15 - When linking to external sites from an instructional page, or any other copyrighted material, inform the user that the linked-to material is covered by a separate copyright.

The resulting web design is clear and potentially elegant, is primarily text-based, has little or no extraneous adornment such as irrelevant or distracting graphics, blinking text or animated graphics. This respects the genuine needs of the user.

An excellent, free, online service for checking Web page compatibility with HTML 4.0 (and previous versions) and with the standards of particular browsers is ‘Bobby’ from the UK disability organisation Center for Applied Special Technology:

http://www.cast.org/bobby/

This service is one of the many online resources and Web software tools listed at:

http://www.ncl.ac.uk/wwwtools/

For instance a page which relies on image-maps for navigation, rather than providing simple text-based hyperlinks as well, is inaccessible for those using a text-based browser.

Web browsers normally support graphic files using .GIF, .JPG and animated .GIF formats. However there are other proprietary graphic and sound formats which require the use of special software ‘plug-ins’ to the browser. Unless the use of these formats is necessitated by the educational application, they should not be used in VET sites. This includes MPEG video and Shockwave multimedia formats.

The situation with sound is less advanced than with still images: there is no single, widely accepted format for sound with today's Web browsers. Consequently, where sound is necessary, it should be in a format for which plug-in players are available for both major types of Web browser on both Mac and Windows machines. Hopefully in the near future, MP3 will meet this requirement - or better still be supported directly by the browser.

6.2 Web Programming and Application Interfacing

While frames are not a part of the HTML 3.2 specification, they are supported by both Netscape's and Microsoft's browsers and so are safe to use in Web-sites which must be accessible to most users. However frames can make navigation more difficult to understand, so they should only be used when they are vital to the communicative purpose of the site.

Netscape's JavaScript, an embedded scripting language for HTML which resembles Java, is supported by both major Web browsers, and so can be used when necessary. In contrast, Microsoft's VBScript is not supported by Netscape and so should not be used.

Both major browsers support Java 1.1, so this can be used today as a sophisticated means of programming interactive applications inside the browser. Java's transition from being a proprietary Sun standard to an open one under ISO, is not complete, but its future seems assured.

Microsoft proprietary Active-X technology performs some functions for which Java is intended. Active-X has other capabilities, especially for linking to programs running on the browser's machine. It is an application programming interface for the Windows operating system and is not applicable to Mac or Unix systems. Active-X will never be a Web standard which can be relied upon in terms of interoperability - so its use should be avoided unless there are compelling reasons.

Fonts are another are of incompatibility between browsers. Web designers who specify special fonts should do so in a way that a suitable font is likely to be found on Windows and Mac systems, using the browsers of both Netscape and Microsoft.

For the body text of web pages, the use of small or larger than normal font sizes should be avoided.

Cookies - short pieces of text which are stored by a server on the browser's hard disk of information, and which can later be sent to the same server automatically - raise some problems regarding privacy and security. They are typically intended to enable the server to provide some continuity within one or multiple browsing sessions by the same user, by storing potentially personal information in the cookies. However many VET users may be accessing the site from a computer which is not their own, and some browsers are intentionally configured by network managers to retain cookies in RAM for the current session, rather than on the hard disk. Cookies are potentially useful, but it would be desirable if sites continued to function properly with browsers which do not support them. Since cookie storage and retrieval is usually not seen or understood by users, any use of cookies to record personal information should be subject to the user's informed consent.

6.3 File Formats, Especially ‘Portable Document’ Formats

Many file formats are used by word-processing, page-layout, graphics and other kinds of programs. There is a need for people to view on screen and print these documents even though they lack the application program which created them. Ideally it would be possible to search the document and cut and paste text, data and graphics from it as well.

It is usually difficult or impossible to convert complex printed documents into HTML, but if this is possible, then HTML is the first choice for a 'portable document' format because it can be universally viewed, searched and printed with a standard Web browser. Over time, with HTML 4.0 - and its successor XML - HTML will become such a powerful language for screen and printed display that it is likely to supplant word-processing file formats in many applications.

The usefulness of HTML as a portable format is increased by programs which convert it back to other formats more compatible with word processing programs, such as Rich Text Format. An MS-DOS program to achieve this - preserving a great deal of layout information, including tables - is freely available at:

http://www.cena.dgac.fr/~sagnier/htm2rtf.htm

The most widely used word-processing program is Microsoft Word, and there are file-format incompatibilities between the various versions of this one program. It is common practice to avoid, where possible, the use of the latest version's file format - and to exchange files in Word 6/95 format. Rich Text Format is another alternative, but leads to large file sizes - especially if the document includes graphics. Microsoft has published its Word file format, but few companies have produced software which can read or write the full range of Word file formats.

By far the most widely used 'portable' document file format is Adobe's PDF format. This is based on Adobe's Postscript printer language, which is used in many office environments and in the production of virtually all books and magazines. Both Postscript and PDF are published, proprietary standards, so companies other than Adobe can write application programs which read or write PDF files.

The PDF format enables virtually any design which can be printed on paper to be made available on screen in a Web browser and to be printed on paper. PDF viewers as stand-alone applications and plug-ins for Web browsers are available without charge for a variety of computer platforms, including Windows, Mac, OS/2 and a variety of Unix systems including Linux.

PDF is a powerful method of communicating pages and large documents of great complexity, generally with the conversion being done semi-automatically. This means that documents which are primarily produced for hard-copy presentation - such as reports, books and catalogues - can easily be made available electronically. The resulting PDF files are relatively compact. However their contents are not as useable as they would be in HTML: they are harder to search and are not normally visible to Web based search engines. Capturing text and graphics from the PDF document can be more awkward than from an HTML or a word-processing file. With Adobe's Acrobat Reader, browsers can load and display PDF files within the browser window. PDF files can include video and sound and can contain links to external web material and targets so particular locations within the file can be accessed via a URL.

6.4 Metadata

Metadata is information included in the header of an HTML document, but not normally displayed to the user - for the purpose of automating its inclusion in external indexing systems.

For instance, by viewing:

http://www.edna.edu.au/EdNA/

and reading the first paragraphs of raw HTML source, by using Netscape's "View: Source" command (or the same command in Internet Explorer, which produces a less readable representation), the impressive body of metadata in this file can be seen.

While the low-level specification for metadata has long been part of the HTML specification, there are several higher level "languages" for expressing metadata, for instance the widely used "Dublin Core". For metadata to be effective in a particular field - such as VET educational sites within Australia, all educational sites within Australia or perhaps ideally all educational sites in the world, a particular metadata language must be standardised upon, and the structure of the metadata defined in a centralised way suitable for the indexing information which it is desired to convey. Such information is highly dependent on the nature of the field - for instance, educational material and course options require different metadata structure and content from genetic engineering.

There may be no need for VET to develop its own metadata standards. It will be necessary to ensure that VET web-site authors are aware of the extensive metadata work going on in the educational field within Australia, that they have the software and expertise to generate the appropriate metadata, and that they understand which web material should have valid metadata.

Arguably the web-pages made for password-protected access by learners in a particular class need not contain metadata since they will not be visible to the nation-wide metadata-based indexing structure - but perhaps metadata proponents would argue the opposite. It is vital that all material which represents the primary web-based description of available courses should include valid metadata.

In addition to metadata, certain aspects of the "outward facing" material of a VET institute's web site probably should be standardised to make them reasonably compatible across the nation. This is to make the course offerings of all Institutes appear in a reasonably compatible format to assist employers and potential students who are deciding whether to become involved in VET.

EdNA and VET metadata material is available at:

http://www.edna.edu.au/EdNA/genericpage.html?file=/edna/aboutedna/metadata/index.html

or by searching for "metadata" at the EdNA site.

7. Recommendations

7.1 Standards

A large number of technical standards underlie all Internet communications, such as the TCP/IP protocol, SMTP for email and HTTP for web access. It is not necessary to standardise on a particular version of HTTP, since there will be a smooth and automatic transition from the current 1.0 to the higher performance and downward compatible 1.1 as server and browser software is upgraded.

Those fields in which evolving or divergent technologies make it desirable to set a VET standard for 1999 - in some cases to be reviewed after six months, in early to mid 1999 - are:

HTML 3.2. This is the 1996 standard for the language used for web pages.
Reference:

http://www.w3.org/MarkUp/

- Java 1.1
  Reference:

  http://java.sun.com/docs/books/jls/html/

- Adobe Portable Document Format.
  Reference:

  http://www.adobe.com/prodindex/acrobat/adobepdf.html

7.2 Functional Specification

- Web page development should be based on users accessing the site with the latest non-beta release of the major browsers (Netscape and Microsoft) and the previous version, taking into account bandwidth limitations and the needs of learners with disabilities.
- Audio protocols should work with the two major browsers or with plug-ins which are available for both of them. The audio should be carried via HTTP, rather than some other protocol which is unlikely to be passed by a firewall which some users may be behind.

7.3 Operating Guidelines

- "Navigational" web pages - all publicly available material other than instructional pages - should allow rapid loading, for instance 15 seconds via a 28.8 Kb/s modem. The total size of the HTML file and all included graphics files should be no more than 50 k bytes - except where there is no alternative to providing a large amount of communicative text and/or graphic material on a single page. The aim is to avoid the use of large graphic files, or large numbers of small ones, for purely decorative - rather than communicative - purposes, and so to ensure that remote users will not have to wait excessively long to view the page.
- The site should be navigable with descriptive text mode links, or at least with graphic image links which contain a descriptive alt text description. Image map links may be used, but should be supplemented by text based links.
- Instructional pages should only contain objects related to the educational purpose of the page. For instance, the use of irrelevant animated .gif graphics should be avoided.
- Pages which contain graphics should specify the size of the graphic image in the HTML. This enables the browser to quickly lay out the page on screen and for the graphics to become visible as they are loaded, without the layout rapidly changing.
- Web pages should be designed as much as possible so that progress is visible while it is loading. For instance there should be text at the top of the page and graphic images should not be so large that a single image fills the user's screen.

- Web site organisation should be as simple as possible. For instance using pages with a substantial amount of text relating to one topic, rather than a series of small pages.
- Avoid the use of excessively long file and directory names.
- For file and directory names, use lower-case letters and numbers. Do not use spaces within file names.
- When an instructional page contains a link to another site, make the link open that site in a smaller browser window which overlays the current page, so that the user still sees the instructional page and will not become lost and unable to return to it.
- When an instructional page links to material at another site, make it clear that the link leads to a separate site, and that its copyright belongs to authors or owners of that site, and not to the authors or owners of the instructional material.
- Pages which encourage users to download executable programs should link to the original site of that software, rather than to other locations such as shareware sites. Users should be discouraged from executing software received by email. These measures are necessary to reduce the likelihood of running virus-infected software, or programs which function as a Trojan horse.
- The technical requirements for a web-based course should be clearly stated to students before they enrol.
- Copyright should be observed for print resources.
- Pages should be viewable without the need for users to scroll horizontally. In practice, since most browsers are maximised on an 800 x 600 screen, the maximum width of tables, graphics and formatted text should be no more than 760 pixels wide. For printing on A4 paper in portrait format with default browser margins, the width limit is 640 pixels.
- On each web page, include the date of last update, and contact details for the webmaster or author.
- Care should be taken to ensure maintenance of web material to ensure, for instance, that material is up-to-date and that there are no broken links.
- Institutions should establish and follow quality guidelines for web material.
- Metadata should follow the standards established by EdNA.
- In all navigational pages, a search facility and/or site-map link should always be visible. This could be consistently at the top, or at the bottom of pages, or alternatively available from a frame which is always visible.

7.4 Issues to be Investigated

- Cascading Style Sheets and XML, as part of reviewing acceptance of HTML 4.0 instead of 3.2. References:

  http://www.w3.org/Style/

  and:

  http://www.w3.org/XML/

- Web server functionality and administration. A web-based body of instructional material will involve HTML and, typically, software which depends on other server capabilities, such as server-side includes, Microsoft FrontPage extensions and the ability to run complied programs from /cgi/bin/. For a variety of technical and security reasons, web servers in VET institutes may not provide such facilities - for instance they may only work with Perl executables in /cgi/bin/. This divergence of capabilities, together with the instructional designer's desire to make the most of available technologies, is likely to cause serious barriers to the portability of web-based instructional material between the servers of VET institutes. Agreement on a standard for web server capabilities would make it possible to create complex web-based instructional material which is portable within VET.
- Cookies - items of information from the web server, stored (typically) on the browser computers hard-disk, to be returned to that server, in order to make the site more responsive to the activities of that user. For privacy and potentially security reasons some browsers may not be configured to accept cookies - or to retain them for one session only. Instructional sites which assumed the normal acceptance of cookies would therefore not work properly for some users.

Attachment 6

Personal Computers

1. Flexibility and Options in Training Delivery

Whether in classrooms, the workplace or in the home, learners will be communicating and using a variety of software, both general-purpose and education-specific. These activities depend entirely on a personal computer, its operating system and network connections. The appropriate configuration in some cases will be specific to the nature of the particular training course.

2. Importance to VET Sector

VET educational uses of PCs and Internet communications will concentrate on email, Web access , and 'groupware' communicative functions, including running Java applications within a Web browser. Non-Internet applications include word-processing, running specialised educational applications and CPU-intensive applications such as MPEG video playback from CD-ROM, CD-R, DVD (Digital Versatile Disc) or the Local Area Network.

Each year, software generally requires a higher level of CPU speed, memory and disk storage, and specialised peripherals such as MPEG video decoders and sound cards. Because this is a rapidly evolving and demanding field (in terms of bandwidth and the ability to run complex software at sufficient speed), there are strong arguments for investing in reasonably powerful computer systems which will remain productive for several years.

The aim of the VET sector is to provide a flexible computing platform which is reasonably easy to use in a classroom or library setting, in a Registered Training Organisation.

Broadly speaking, VET educational uses will include some audio and visual functions - for instance MPEG-1 video playback from CD-ROM or the LAN - but will not involve the games which are an important driver of consumer demand.

3. Approach in VET Sector

In the VET sector PCs are generally considered to have an overall life of about 5 years – although this is continually shortening and the time of deployment to particular groups is less, as will be seen below. The practice is generally to deploy newly purchased PCs in the classroom. After about 3 years their performance is no longer adequate for use in the classroom, and they are typically moved into the administrative sector. After a further 2 years, they are moved on further to the typing pool where they are used for text input. Ultimately they find their way to the hardware laboratory, where they are used to instruct students in hardware assembly and upgrading.

Of the total number of PCs in a typical institute, the distribution is as follows:

- Classroom: 50%
- Administration: 45%
- Developers: 5%

By a small margin, therefore, classroom PCs are the major category in VET institutes. They are used primarily for:

- Running text and graphics applications
- Networking
- Multimedia

In a minority of cases, they are also required to stream audio and video.

4. Likely Industry and Societal Developments

The 'Multimedia PC' is now an established, but rapidly evolving, consumer and business item. A typical 'mid-range' Windows/Intel system in August 1998 might comprise:

- Pentium II/Celeron or AMD K6-2 CPU and motherboard running at around 300 MHz, with PCI and ISA bus, serial, parallel, USB (Universal Serial Bus) ports and EIDE hard-disk and floppy controllers.
- 32 or 64 Megabyte RAM.
- 4 Gigabyte hard disk.
- 1.44 Megabyte floppy disc.
- High speed video display card with 2 Megabytes of RAM, typically for 800 x 600 pixel 64k colours, probably with MPEG-1 video decoding in hardware.
- CD-ROM drive.
- Sound card, for 16 bit 44.1 kHz stereo input and output, with simple synthesiser capabilities and software to drive this from MIDI commands inside the machine. Loudspeakers are included.
- Keyboard.
- Mouse.
- display monitor which provides a resolution of 800 x 600 and may be capable of 1024 x 768 pixels.

The full retail price of such a hardware system is currently around $1300 to $1900 including tax - no higher than that of last year's mid-range system, although many aspects are 50 to 100% faster or more capacious than the most common system a year ago. Software costs will be significant, but less than hardware costs.

During 1999 it is likely that the CD-ROM drive will be replaced or supplemented by a CD-R drive which can read CD-ROMs and write the write-once CD-R discs. Another variation is CD-W - which can write both CD-R discs and rewriteable CD-W discs. As DVD drives drop in cost, they will also increasingly be used in place of CD-ROM drives.

Typically the other items to be purchased with such a system would be the Windows 98 operating system, a modem for around $130 and a colour inkjet printer for around $400.

Other popular items include flat-bed colour scanners and 100 Megabyte Zip drives for backup and data interchange between machines.

The above domestic 'Multimedia PC' is capable of performing almost any Internet communication function - including Internet "phone" applications, subject to the bandwidth limitations of its link to the net. With the addition of a small video camera - and, if necessary, a plug-in board - the system is capable of desktop video conferencing if it has an ISDN link or a high-speed Ethernet connection to the LAN or the Internet. (The Videoconferencing Workshop has recommended Standard H.323 as the preferred standard for LAN videoconferencing)

5. Appropriateness of Recommending Particular National Technology Standards

In accordance with the PC population distribution above and the typical lifetime history of PCs within institutes, the most appropriate course is to specify the parameters of the PC for classroom use.

Two types of PC are considered for the purpose of identifying preferred standards: a Standard PC and an Advanced PC. Their characteristics are defined in the following table:

Type	**Applications**	**Interoperability**	**Proportion of PC Population, 1999.**
Standard	Office Suites Encarta	WAN Internet	90%, decreasing
Advanced	Animation Multimedia Development	LAN	10%, increasing

There are three primary goals in setting technical standards for PCs in the VET sector:

- Performance - to be able to run the required software at sufficient speed.
- Low maintenance, management and capital costs and
- Interoperability - of software, communicative functions and file formats.

Other goals include:

- Optimal ergonomic factors
- Ease of use, in the context of conforming to the most common operating systems which used in Australian workplaces.
- Security and robustness in respect of deliberate and accidental misuse and of attacks by viruses.

Internet communications and associated standards such as HTML, Java, and MPEG audio/video are increasingly the basis of software likely to be used by VET. While Computer Managed Learning software historically was based on hard-disk and CD-ROM, possibly without a network connection, current development in this field is on systems which operate using the Internet's TCP/IP protocols - via a LAN and/or a dial-up connection.

This trend means that the underlying operating system of the PC is becoming less important than in the past. The choice of hardware/operating system is discrete - with a clear distinction, for instance, between Mac and Wintel (Windows/Intel) PC for instance. The choice of CPU speed, memory etc. is incremental. The choice between peripherals may be incremental - such as hard disks of various capacities - or it may be fundamental such as between a CD-ROM, CD-R or CD-W drive.

Ideally standards would specify capabilities rather than the methods of achieving these outcomes - however it is difficult to specify how fast, for instance, computer programs should run. It is difficult for a benchmark program to properly measure all the factors which affect a system's performance in real applications, and the range of applications and their rapid evolution makes the task of accurately specifying performance targets for PCs even more problematic.

A formal VET standard (or standards) for PCs will be a guide for purchasing new equipment - especially to replace systems as little as two or three years old. Three-year replacement cycles are unusual for capital items, but the following points constitute a powerful argument for such a strategy:

- Computers are used in most workplaces, so computer skills are increasingly as valuable or essential as literacy and numeracy.
- PCs are the foundation for many educational activities - directly in class work, for research and for communication within the class and with learners and staff and support services beyond the class.

  With performance of PCs increasing by around 70% per annum, and with the most sophisticated applications requiring "this year's mid-range consumer PC" hardware

standards and performance, it follows that after three years, a PC's performance is only 20% of the current baseline. The costs, per year, of being unable to run up-to-date software, and of time lost to learners and teachers in trying to coax older equipment to do what they want, are likely to exceed the cost of a new PC. It is vital that many VET learners gain experience with the latest software and hardware - as they will be using in the workplace. The arguments for keeping all computing hardware up-to-date also apply to equipment, infrastructure and services such as LANs, WANs and Internet access.

Because of the rapid advances in technology - whereby the functionality is increasing but the cost is constant or even decreasing in real terms - and applications, the validity of any detailed standards below will diminish significantly over the course of time. The focus should be on the capital intensive hardware since software is changing rapidly.

The standards recommended below are therefore deemed to apply to the purchase or upgrade of a PC at the beginning of 1999.

6. Options for Consideration for Adoption by VET

The aim is to arrive at a specification for purchasing Standard and Advanced PCs which are capable of supporting Internet communications and both Internet and CD-ROM based 'Multimedia' applications, as specified above.

In addition to the most common Wintel configuration, two other architectures are significant or predominant in certain fields in which VET learners may be working.

- The Macintosh hardware architecture and operating system: for graphic design, pre-press and sound production. These applications typical demand high levels of CPU, RAM and hard disk performance.

- A Unix or Unix-compatible operating system running either on Intel PC hardware, or on workstations or servers from Sun, Silicon Graphics etc. While some CAD applications are migrating to Windows, the Unix OS is commonly used for mechanical CAD/CAM and for advanced electronic printed circuit CAD. One field which used to be specialised but is now becoming central to many businesses comprises servers and firewall machines for Internet applications. Unix - and in particular the freely available Linux operating system running on standard Intel PCs - is often the architecture of choice for robust, secure, flexible and high-performance Internet servers. A Unix-based PC is arguably the best choice for learners involved in the technical aspects of Internet communication and web-site management and programming. Fortunately, Linux and other forms of Unix use ordinary Intel PC hardware - so any hardware specification for the Wintel PC supports Linux, Free BSD and some commercial Unix operating systems such as Solaris.

Because of the variety of tasks which are addressed in the VET sector, the range of equipment already deployed and the Whole of Government mandates applying in some States/Territories, no recommendation will be made concerning system architecture. Most of the standardisation choices relate to questions of RAM, hard-disk capacity, CPU speed etc. These are generally choices within a range of capacities and

performance levels - and the chosen value in one year is likely to be 50 to 100% higher than what was optimal a year earlier.

In the longer term, thin client developments could provide options relevant to the VET sector. Similarly, for the purchase date targeted above, the widely touted 'Net PC' is not suitable for VET because such systems are experimental and will not provide the wide range of functions which are required.

7. Value Assessment of Possible Options

The level of functionality required will be determined by the influence of the two key players in the VET sector, viz.:

- Clients (learners or companies) and
- Competitors.

In general, clients are becomingly increasingly aware of the latest developments in personal computers. They are purchasing advanced systems – in the home or in the workplace – according to the following scenarios:

- At home, learners are enabled by their experience at school and tend to be familiar with PC technology. They purchase PC in accordance with the following drivers:
    - Updates in operating systems provided by the major vendors. When purchasing or upgrading their PC they obviously purchase the latest version of the available software
    - The necessity to run games requires them to purchase powerful hardware
    - A price constraint of typically $2000
    - If the home includes an office (the SOHO sector), a powerful PC is required to run the latest business packages.
- In the workplace, business training requirements impose demanding requirements on PC technology. In the publishing and graphics areas, advanced processing capability is required. Manipulative operations can require the ability to stream video and Intranet communications impose the need for powerful browser and communications capabilities.

The net result is that clients – be they learners or companies – expect top end PC technology to be available in the classroom because that is the level of capability to which they are accustomed in the home or in the workplace. Consequently, in order to implement the client focussed approach which is the ANTA objective for flexible delivery, the choice of standards for the classroom PC must provide clients with the functionality which is comparable and consistent with the level they expect.

The increasing decentralisation of the VET sector is resulting in the entry of new, private training providers. These entrants tend to deploy a high level of technological resources – including top end PCs for their clients. To remain competitive, other providers must therefore match this level of technology deployment.

Computers and Internet communications require significant skills and concentration on the part of the user, but can greatly extend their ability to communicate, research and learn. Barriers to computer usage, such as poor ergonomics, slow performance and

difficulties with printing and disc storage need to be minimised - because they seriously disrupt the learner's and teachers ability to concentrate on the task in-hand.

In particular, the mouse, while being intuitively easy to use, has well recognised ergonomic problems because it involves precise and stressful movements of hand, arm and shoulder. In addition it requires a clear space on the desk, has cord-tangling problems and very often becomes unusable due to dust build-up on the rollers.

There are several designs of trackball which are ergonomically problematic as well. Trackballs in general involve rollers which become clogged with dust like mice. However one design, used by Logitech and perhaps other manufacturers is far superior to mice and most other trackballs. The Logitech Marble has no rollers - it uses optical sensing and is unaffected by dust and other contaminants.

There are a variety of alternatives to a standard CD-ROM: CD-R, CD-W and DVD. If it is clear that these offer immediate performance benefits, then their extra expense may be justified. However, since it is relatively easy to install such devices at a later date, and since their prices are still declining, it seems reasonable to purchase PCs with standard CD-ROM drives now and add a new drive if and when the need arises.

ZIP drives or some other form of high-capacity storage are likely to be essential for learners who are working with large sets of data - such as in the graphic design and pre-press fields. There are significant interoperability issues here, since the storage medium should be compatible with that used at work and on their home computer. Given the rapid development of removable hard-discs, and the CD-R and especially the CD-W drives which will arguably replace them (except where rapid writing and reading is a necessity), it is fortunate that a PC can easily be upgraded with one of these peripherals when the need arises.

All PCs need to be connected to a reasonably fast laser printer. The usefulness of a computer system is greatly enhanced by the ease of creating hard-copy. If printing is cumbersome or discouraged, then many valuable learning opportunities arising from hard-copy - for reading immediately or later and for hand-written annotation - will be lost.

It is likely that black and white print-out will suffice for most educational purposes, but the usefulness of colour hard-copy cannot be ruled out. The cost-effective approach to colour in low volumes is an ink-jet, because of the low cost of the new generation of colour ink-jet printers, but this should be separate from the higher volume black and white laser printer. The latter printer needs, however, to be capable of handling all the graphics and fonts which are used by the operating system and application programs. Other considerations rule out ink-jet printers (too slow, expensive and difficult to operate) and dot-matrix printers (too slow and lacking in resolution) for the main black and white printer.

The USB (Universal Serial Bus) is a new, open, standard for connecting a wide range of peripheral devices to a PC. It is standard equipment on most new PCs and is supported by Windows 98 - but devices which use it are yet to emerge in quantity. Since USB may add little to the cost of a PC, but will make it significantly easy to use and upgrade in the future, it probably should be included in any VET standard for PCs.

For the Standard PC, which covers a large population of classroom PCs, the maximisation of value is the criterion for the choice of standards.

Value is defined in this case as the benefits to the players in the online delivery value chain minus the cost. The players in the delivery chain comprise particularly

- Learners and
- Institutes or Industry Training Bodies.

Benefits and costs applicable to these players are given in the Report cited.

To determine the best combination of value and interoperability, the value diagram shown below is used. In this diagram, the benefits and costs are semi-quantitatively plotted against the inclined axes. The value, being the difference between them, is proportional to the vertical distance above the origin.

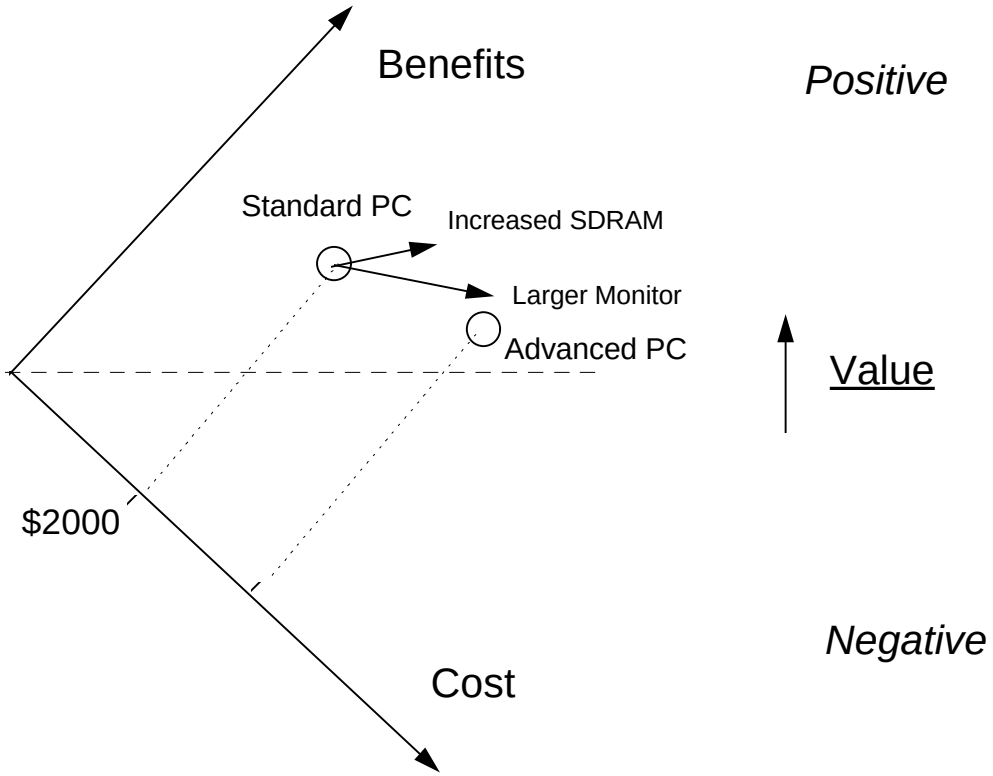


Figure 1. Value Relationships for PCs.

As an example of maximising value, the addition of extra memory to the Standard PC, adds benefits greater than the additional cost - and thus increases value. Increasing the size of the monitor, on the other hand, significantly increases the cost, for a relatively small increase in benefits - and thus may subtract value. The former course is therefore preferred.

The diagram also shows the notional relationship between the Standard and the Advanced PCs.

8. Recommendations

Standards

The preferred standards for classroom PCs are as given in the table below. For ease of description, Wintel parameters are specified, *but equivalent non-Intel specifications are equally acceptable.*

Component	Standard PC	Advanced PC
Motherboard:	BX Chipset or equivalent	BX Chipset or equivalent
CPU Speed:	>= 300 MHz.	>= 400 MHz.
Memory SDRAM:	>= 64 Mbyte	>= 128 Mbyte
Hard disk:	4 Gbyte	9 Gbyte
Floppy disk:	1.44 Mbyte	1.44 Mbyte[2]
CD ROM:	Yes	Yes
Video display:	15", 800 x 600, 0.28 micron pixel`	>= 17", 1240 x 1024
Graphics card:	2 MB, 64 bit	4MB, 128 bit
Network card:	10/100 Mb/s combo, UTP compatible or N/W Std, PCI Std	10/100 Mb/s combo, UTP compatible or N/W Std, PCI Std
Sound card:	32 bit, 44.1 KHz., PCI	32 bit, 44.1 KHz., PCI
Video Capture	-	MPEG-1 hardware & software
Printer	-	Colour Printer
Common Device Tower	CD-R, CD-W, DVD B/W Laser Printer Scanner	CD-R, CD-W, DVD B/W Laser Printer Scanner Digitiser

Issues to be Investigated

The technology for realising transportable storage greater than that available from a floppy disk , for the Advanced PC is to be reviewed in 3 months.

Technology for Future Standards Identification

The following technology is to be investigated in order to determine whether it is appropriate to set particular standards:

- The related software and hardware technologies of Thin Clients and Networked PCs, respectively.

[2] Transportable capacity greater than 1.44 Mbyte is desirable.

Attachment 7

Videoconferencing

1. Flexibility and Options in Training Delivery

Most learning at present takes place with the client attending a classroom, laboratory, place of work or other location where a teacher instructs in or demonstrates a particular base of knowledge or skill.

Videoconferencing allows communication between the teacher and clients who are remote from the physical learning environment. The clients may be communicating from home via a PC or from a regional telecentre using either a PC or room installed videoconferencing equipment. Guest experts can be 'brought in' to supplement a class as well, using public or private videoconferencing facilities, adding a 'real world' exchange for students remote from those environments, anywhere in the world.

2. Importance to VET Sector

Videoconferencing is a potentially powerful technology for the VET Sector because it provides multimedia (voice, video, text and graphics) communication between the participants in the learning process. Videoconferencing is a good medium when interaction is expected and desired: it is not television in the broadcast sense of the word. High levels of production, in the TV broadcast/telecourse model, are not required; rather self-managed classroom teaching with adaptation of materials to suit the different format.

Teaching methodologies chosen should take advantage of videoconferencing when appropriate to do so. A good instructional design support program will help to identify areas that need adjusting to the new medium and ways that videoconferencing can bring new opportunities for better teaching and learning.

The ability to transmit moving video is particularly beneficial in cases where manual skills and techniques are being imparted. Videoconferencing technology has also the capability to transmit still and moving graphics (diagrams, sketches etc.) which can greatly facilitate learning in an interactive environment. The latest development of including data sharing also leverages investments in other computer based technologies such as presentation systems [Powerpoint], multimedia software teaching systems [Macromedia Director], and standard office productivity tools [word processing and spread sheets] in a live, interactive, and manipulable way.

These combinations of input/output devices can support a rich teaching and learning environment. The type of application for which the equipment will be used changes the decisions or range of options required for an installation. Quality concerns may be higher for administrative negotiations where facial expression is an important communication signal, but in a standard teaching activity, the image quality may be less demanding. The need for a personal space for individual connections may be suited with a desktop videoconferencing approach in a smaller office space. It would also be a waste of space to put a single person in a large lecture theatre. But a teaching application may range from a small tutorial room to a large lecture theatre at the originating program site.

Motivators and Incentives, Assumptions and Perceptions

Videoconferencing as a delivery mechanism for education and training can succeed or fail based on the understanding that the organisation has of its advantages and limitations in serving learning needs. Therefore the technology choices made should take these factors into account for specific situations within a VET organisation. Some relevant observations are:

- Completion rates are found to be very high in videoconferencing courses, in many cases much higher than online courses or other traditional distance education modes.
- Student incentive to participate in videoconferencing delivered classes is also important. One factor of value is reduction in travel distances to access programs, particularly those living in regional or remote areas. Local urban students find the medium less attractive.
- Room systems are good group environments for teaching applications, despite the hyperbole surrounding PC and IP based videoconferencing.
- The student profile that is attracted to videoconferencing as a learning medium may vary. Age and experience may be factors to adjust for in this medium, just as they often are for online computer based delivery. Other factors include the pace of the program, the access arrangements, differing program needs, and learning styles.

3. Current Technology Approaches in the VET Sector

The use of videoconferencing for flexible delivery and for administration varies widely across the national base. South Australia is a particularly large user and has an extensive network of sites. Most other states use videoconferencing on an occasional basis over a lesser number - typically half a dozen - sites.

The current status is summarised in the following table:

Currently Deployed	Application Objectives	Key Success Factors	No. of students	No. sites	Metro/ Regional	Existing Technology/ Standards
NSW TAFE	Deliver educational live, interactively and using video	No. of students, quality of transmission & interactivity between students & teachers	Variable detail available from contacts	NEIT WIT RIT IIT	Regional	On demand ISDN 128 kbps (preferred) Share Vision where ISDN links are not available
SA DETAFE	Taking courses to students Access and participation Admin network	No. of courses and no. of course completions	18,500 site hours	37 6	6 Metro 31 Regional State Wide	 NetMeeting 1LS 1.0
ACT/CIT	Amin/class use		small			ISDN 128k PC based.
TAS Flexible Learning Centre	Learning outcomes, competencies	Transparency to user	30	3	All	PictureTel PC-based BT Net meeting
WA Department of Training						

Currently Deployed	Application Objectives	Key Success Factors	No. of students	No. sites	Metro/ Regional	Existing Technology/ Standards
VIC (see attached chart for complete known installations)	Education and administration					PictureTel: rollabouts, portables and PC based VTEL/CLI
QLD	Education and administration, seminars			26 TAFE		PictureTel: rollabouts, portables and PC based

Table 1. Status of Videoconferencing in the VET sector.

The most commonly used equipment is PictureTel. States using this technology include South Australia, Western Australia and NSW. Victoria uses VTEL and PictureTel equipment.

4. Likely Industry and Society Developments

Worldwide, videoconferencing is on a relatively slow learning curve. The advantages of videoconferencing, at least in the business sector, in terms of convenience and travel substitution need to be qualified by more subtle behavioural needs in the social context concerned. In the education sector, the economic value of not travelling is not as significant as the combination of wider convenience factors such as domestic conviviality, given the sacrifices students make to their study.

Education is, however, a major user of videoconferencing.

The conduct of a successful videoconference has two aspects. One, the technical, is assisted by sophisticated production techniques including tracking cameras and directional microphones. The hardware and software to achieve this on an economic basis is still under development. The other, the human communication dimension, is assisted by well-developed practices of interaction, equivalent to but different from those used in face-to-face situations.

In the longer term, the inevitable decrease in the price of broadband communications links and improvements in video coding techniques will allow high quality videoconferencing to be conducted over statewide distances at reasonable costs. Simultaneously, the increased use of videoconferencing will lead to familiarity with effective ways of using the communication channel.

The industry will, clearly, evolve in two directions:

- Increased use of multimedia or telematic equipment will allow documents, spreadsheets and access to Web sites to be shared by participants in a structured way, including collaborative multimedia production and the evolution of Virtual Studios and Virtual Theatres and
- Increased use of videoconferencing to the desktop or PC will occur as prices for the powerful processors necessary - either the CPU or specialised hardware - fall in accordance with computing equipment trends.

In the longer term, the inevitable decrease in the price of broadband communications links and improvements in video coding techniques will allow high quality videoconferencing to be conducted over statewide distances at reasonable costs.

5. Appropriateness of Recommending Particular National Technology Standards

The improvements in coding technology and the falling costs cited above mean that the attractiveness of videoconferencing as an aid to flexible delivery is increasing. Consequently, penetration in the VET Sector is likely to increase in the next few years. Because incompatible standards in the industry already exist and significant costs can arise when it is necessary to convert between standards, it is now appropriate to minimise these potential hurdles to interoperation by identifying preferred standards for the VET sector.

6. Options for Consideration for Adoption by the VET Sector

Available standards comprise formal standardsiii and non-published proprietary standards.

The formal standards for videoconferencing originate primarily from Study Group 15 (Transmissions Systems Equipment) and Study Group 8 (Terminals for Telematic Services) of the International Telecommunication Union-Telecommunication Standardisation Sector (ITU-T).

The H-series and G-series Recommendations (SG15) cover videoconferencing terminals, multipoint control units, and video and audio processing techniques. The T-series Recommendations (SG8) provide a standardised set of protocols that supports multimedia applications including fax, still image transfer, annotation and file transfer.

The overall standards for videoconferencing are defined in the following Recommendations:

- H.320 Narrow-Band Visual Telephone Systems and Terminal Equipment. (Defines how the H-series videoconferencing recommendations work together for ISDN).
- H.321 Adaptation of H.320 Terminals to B-ISDN. (Defines how H.320 Terminals should operate with a broadband ISDN network).
- H.322 Visual Telephone Systems and Terminal Equipment for Local Area Networks that Provide a Guaranteed Quality Service. (Defines how H.320 Terminals should operate when connected to an isochronous LAN).
- H.323 Visual Telephone Systems and Terminal Equipment For Local Area Networks that Provide a Non-Guaranteed Quality of Service (Defines conferencing on conventional LANs).
- H.324 Terminal for Low Bit Rate Multimedia Communication. (Analogue telephone line videophone standard).

The umbrella standard, H.320, specifies further recommendations for the components of the overall videoconferencing system. The video coding algorithm comprises analog filtering, format conversion, temporal filtering and video compression in accordance with Recommendation H.261. A newer Recommendation, H.263, has

been developed for use with high speed modems on analog phone lines. This Recommendation has superior performance to H.261 at low bit rates and will be employed in H.320 systems using ISDN and analog voice connections. Importantly, Recommendation H.324 allows for the use of H.263.

The audio compression algorithms prescribed by Recommendation H.320 are G.711, G.722 and G.728, depending on the audio bandwidth and the compressed bit rate. Recommendation G.722 is an improved audio coding technique, which uses adaptive differential pulse code modulation (ADPCM), but which is not specified by Recommendation H.320.

Within the system defined by Recommendation H.320, Recommendation T.120 covers the protocols for interworking telematic equipment. Recommendation H.221 covers multiplexing and demultiplexing of the video, audio, data and control signals into a single bit stream carried, if necessary, on two 64Kb/s channels.

Most US and virtually all European and Japanese manufacturers use the mandatory standards discussed above. Some manufacturers have, however, achieved wider functionality using proprietary standards. Videoconferencing via PCs and on the Internet is likely to be dominated by de facto standards and standards established by the Internet Engineering Task Force.

For off-campus students, approaches to the implementation of videoconferencing within the VET sector comprise

- The use of equipment compatible with standard H.320 and using 128Kb/s links comprising two ISDN B-channels.
- The use of H.320 equipment and 384Kb/s transmission
- The use of H.324.
- PC videoconferencing using proprietary standards.

Combinations with streaming video across the Internet [multicasting] are options for reaching new audiences in Internet connected spaces, such as the workplace, community centres and libraries. Other mixes of formats raise other technical and management issues as the capabilities may differ across platforms, and the additional requirement of a gateway for signal conversion may not be achievable or may increase cost.

7. Value Assessment of Possible Options

- In examining videoconferencing as an overall option for flexible delivery, there is an interaction of supply, demand, and perception of need that should be analysed. It is important to understand how important a particular program is and to ascertain whether there are other less expensive ways to deliver it. The key question is: Does videoconferencing make sense in *this* particular instance. In this regard, access and equity balance to cost may be valid justifications for a videoconferencing option, not just overall financial benefits.

The preferred standard is that which provides the best combination of value and interoperability.

Valueiv is defined as the benefits to the players in the online delivery valuev chain minus the cost. The players in the delivery chain comprise

- Content providers,
- Teacher/trainers,
- Learners and
- Institutes or Industry Training Bodies.

Benefits and costs applicable to these players are given in the Report cited.vi

To determine the best combination of value and interoperability, the value diagram shown below is used. In this diagram, the benefits and costs are semi-quantitatively plotted against the inclined axes. The value, being the difference between them, is proportional to the vertical distance above the origin. It is scaled along the left hand side of the matrix. The horizontal axis of the matrix measures the interoperability of the standards considered. This will depend on:

- the openness of the standard and
- the degree to which the standard is already deployed in the VET sector.

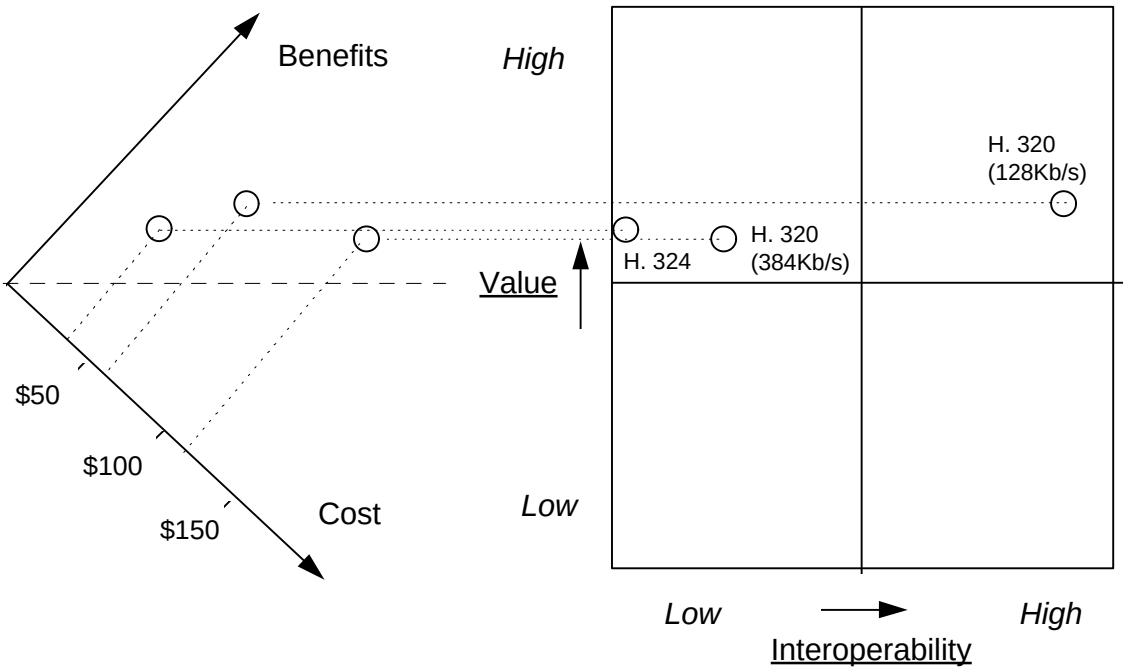


Figure 1. Value and Interoperability for Videoconferencing Standards

Off-campus Learners

Clearly, it is difficult to quantitatively determine the benefits obtained from the use of the various videoconferencing standards. Nevertheless, the following procedure attempts to semi-quantitatively determine the value of the different standards options and plot them on the diagram.

Because of the avoidance of travel costs (including time and convenience), online applications like videoconferencing tend to be relatively more valuable when deployed

over large distances.vii The model we consider assumes 4 sessions (each of 1/2 hour duration) per week over a distance of 1000km.

The effectiveness of videoconferencing depends on the support of the teachers involved. Difficulties in setting up videoconferences, malfunction of the equipment and poor perceived quality can reduce teacher commitment. The use of an assistant at the teacher's end is therefore assumed in determining the total cost. The videoconferencing and communications equipment (installation and rental) costs are annualised costs allocated on a per session basis. The transmission costs are based on Telstra's current prices of a two-site connection.

The relative costs of using the relevant standards are shown in the table below.

Standard	Administrative & Technical Support	Video conferencing Equipment	Communications Equipment	Transmission Cost	Total
H.320 128Kb/s	$25	$4	$4	$26	$60
H.320 384Kb/s	$25	$4	$13	$79	$120
H.324 PSTN	$25	$4	$1	$10	$40

Table 2. Costs for Videoconferencing Standards

The analysis assumes that the central site is used much more intensively than the remote site and that the cost of terminal, communications and gateway equipment is therefore relatively small when allocated on a per session basis.

Videoconferencing is providing benefits in the VET sector by improving communication between administrative staff in Institutes and teachers and clients. H.320 at 128Kb/s is most commonly used. When the teacher is supportive, 128Kb/s quality is judged to provide adequate fidelity for clients. This is particularly so when the audio quality is high, as H320 provides. In fact, there is an opinion that higher video quality leads to expectations of broadcast quality production standards, which could not usually be cost-justified in the VET sector.

We assume therefore that H.320 (128Kb/s) has a positive but small value. The standard is therefore located approximately in the region shown on the diagram. The use of H.324 would, presumably, result in slightly lower quality, but with the advantage of slightly reduced cost. Its location can be estimated as shown in the diagram. It can be seen that these two standards appear to have roughly the same value.

The use of H.320 with 384Kb/s transmission would result in slightly better video quality, but at more than double the cost. It would seem doubtful that the resulting value is positive.

In terms of interoperability, H.320 (128Kb/s) would score highly because of the extent to which it is already deployed,. Other standards would require gateways to allow interoperability. In the case of H.324, this equipment is not yet commercially available.

CU-SeeMe desktop videoconferencing, an informal standard, could offer comparable benefits and costs, but would have much lower interoperability because of the smaller amount of equipment already deployed.

The technical quality of current videoconferencing on the Internet suffers due to low quality audio and less reliable video connections. Care should be taken when making assumptions about the appropriateness of incorporating an Internet option at this point in time.

Interworking between H.320 and proprietary standards is possible via a gateway. Significant operating charges are, however, incurred.

The various standards can therefore be located on the value diagram as shown above. It is seen that H.320, using a transmission rate of 128 Kb/s provides the best combination of value and interoperability.

There are considerable benefits, in learning via online delivery, of being able to transmit graphics, including material on whiteboards. The ability to share data and programs between the source and the desktop is also of benefit in certain learning situations. Standard T.120 provides this capability.

Their may however be additional costs involved in implementing the standard as not all vendors include the this standard in their normal product range. Interoperability will also, therefore, be correspondingly low.

On-campus Learners

In the case of videoconferencing conducted within campuses or institutions, transmission will usually occur over a LAN or WAN. In this case, the video quality (i.e., the predominant component of benefits in the value analysis above) will usually be adequate.

Value will therefore be maximised by minimising the cost of operations. This may involve the exploitation of available capacity on the LAN or WAN. Networking via a privately owned microwave network can provide low cost connections within a single institution.

In terms of interoperability, the emerging open standard H.323 forms the best basis for videoconferencing on campus. To maximise interoperability to other sites - including off-campus learners - the implementation of gateways to H.320 systems will be required.

The value and range of applications of the relevant standards may be summarised as follows:

Factor/Standards	H320	H323(emerging)	T120
Scope	ISDN	LAN/WAN	Whiteboards, datasharing, programs, desktop units
Value	Highest	Low cost if owned and bandwidth is available; internal uses; if no extra cost to get, add now to new equipment	Unknown at this point; some vendors charge extra to add this

Factor/Standards	H320	H323(emerging)	T120
		purchases	capability
Operating Guidelines	See above	Problems with audio, microphone and multimedia speaker combinations; bandwidth implications means need for IT network manager to be involved in any rollouts; gateway required to interoperate with other standards	Unknown
Transmission rate	128Kb/s for general use; 384Kb/s for special event and higher resolution quality requirements	128Kb/s(depends on bandwidth impact)	Unknown
Interoperability	Yes, high	Need for gateways	Low - implementations of this standard vary by vendor

Table 3. Videoconferencing Standards

8. Recommendations

Standards

The following are recommended:

- H.320 operating at 128Kb/s. References:
  http://www.imtc.org/standards.htm

  http://www.imtc.org/h320.htm
- H.323 on campus including gateways to H.320 systems. Reference:
  http://www.imtc.org/h323.htm
- T.120. Reference:
  http://www.imtc.org/t120.htm

Operating Guidelines

In addition to the general technical communication protocols required for videoconference interoperability, there are other technical and non-technical elements that facilitate best practice use of videoconferencing in an education and training environment.

Workshop participants agreed that the design of a videoconferencing delivery system should be driven by the needs of users, rather than technologists. Pedagogical issues must take priority over IT issues: the educational integrity must be maintained first. The technical aspects must support solid teaching and learning rather than insisting that the teaching and learning submit to the expediency of the technology decisions.

The implementation of videoconferencing is most successful when it occurs in a trusting environment where experimentation is valued and participants learn from mistakes.

Although each implementation may need to make decisions based on its overall situation and capabilities, the areas identified in this section should be considered in the design of videoconferencing systems.

Technical

The choice of technology needs to match the application. Desktop or PC based videoconferencing is a personal space while room systems are generally for groups.

The user interface device also needs to match the situation. A keyboard device that requires extensive text can only really be efficiently managed by a single person. A keypad device with minimal switching actions could be managed by a leader in a larger group. This person should also be charged with mic muting if the individual participants do not have individual press-to-talk microphones.

Peripherals

Recommended peripherals are:

- Scan converter for computer based information such as presentation graphics
- Document/graphics camera for showing real objects and writing
- Videotape recorder
- Monitors : 1 – 4
- External speakers preferred
- Phillips fluorescent tube for colour balance: TLD 83, SS
- Teacher preview monitor
- Echo cancellor
- Desktop units should be equipped with earpiece rather than open speakers to avoid echo problems

General Environment

- Help desk access should be available through a speed dial telephone in the room for assistance in case of technical failure.
- Booking facilities should not be located in the videoconferencing room
- For heavy use facilities, the furniture should be arranged for good viewing angles to the monitors and avoidance of reflections from lights
- Room lighting levels should be 50% above office lighting levels. This can be achieved by the use of 3 tube fixtures with plastic diffusers at the normal light fitting spacing
- Electrical and communications cables and wires should be installed in conduits to avoid safety hazards in pathways within the room
- In multipoint conferences, microphones should be muted unless speaking
- Carpet should be installed for better acoustic
- Avoid castors on chairs to discourage unnecessary movement

Staffing

A thin, but coordinated videoconferencing management structure is required within the Registered Training Organisation. It should comprise

- Manager – member of executive
- Program coordinator (education) partial
- Site coordinator (booking)
- Task force of coordination across institute

Position descriptions need to be modified to address these new demands and skill expectations for both teaching and support staff.

General Issues

The VET sector should participate in bulk buy contracts and industry initiatives in approaching the carriers to reduce ISDN prices.

Issues to be Investigated

The following issues should be reviewed. July 1999 is an appropriate date.

- H323 - IP and LAN developments, is it yet viable for a production option?
- H324 - viability for analog access to homes on narrower bandwidth devices
- T.120 for datasharing and whiteboarding
- Internet and hybrid delivery of videoconferencing
    - Web based quality of service
    - Virtual private circuits
- WAN trends in owned networks and use of excess capacity for videoconferencing applications
- Techno-economic aspects of metropolitan videoconferencing
- Polling systems - multiple choice keypad devices

  Video streaming: one-way, – return chat text

Videoconferencing Infrastructure in Victoria							
Institution	**Recent Amalgam**	**Campuses**	**Application/s**	**Hpw**	**Equipment**	**Contact**	***Comments***
University of Ballarat (Regional)	Ballarat (SMB) Wimmera Uni of Ballarat	5 (vc)	Admin/minimal Classes (some Specialty classes)	10-25 - two main camps	Mixture VTEL & CLI. 4 PTel DVC. Changeover to PictureTel begun.	Alison Lanigan 0417 383 437	768K 2Mbps Micro & bridge 1999; ISDN gate ; Bllt 384kbps; others 128; usual 128. Some classes 1997. More training & begin classes again 1998.
Bendigo (Regional)		No VC					Occasional use of equipt at LaTrobe Uni, Bendigo
Box Hill (Metropolitan)		5			Hires in for rare use	Ray McKenna	128kbps. Studio with interactive tv via satellite. Rarely used.
Chisholm (Metropolitan)	Barton Casey Peninsula	2 (vc) 2 (1 vc) 2	Not used Not used (new 1998)		VTEL rollabout VTEL AMX touch Screen	David Mackleheeny 9212 5285 (Casey, Cranbourne)	128 kbps 384 kbps / mwave link planned (Looked at NetMtg – too slow - w/o highspeed link)
East Gippsland (Regional)		3 (vc) 12-14 (ac)	Not used		PictureTel DVC	Jeff Joy 018 516 500	128 kbps. Microlinks all sites. (telematics 7-9 sites 1 class pw)
Gordon, Geelong (Regional)		2 (vc)	Not used		VTEL LC	Directorate	128 kbps.
Goulburn Ovens (Regional)	Goulburn Valley Wangaratta	8 (vc)	Admin Some classes	10-15 2-4	PictureTel rollabouts	Craig Matheson 5833 2684	Microwave link (768 kbps – used At 384). Bridge planned
Kangan Batman (Metropolitan)	Kangan John Batman	6-7 No VC					
RMIT (Metropolitan)	Phillip Melb Coll Textiles	2 (vc)	Admin No classes	3mtgs mth	CLI	Chris 9662 0611	128kbps; microwave link

Videoconferencing Infrastructure in Victoria							
Institution	**Recent Amalgam**	**Campuses**	**Application/s**	**Hpw**	**Equipment**	**Contact**	***Comments***
South West (Regional)		3 (vc)	Admin/classes	10-15	CLI	Alan Conway (Dep Dir) 5564 8907	Y2K compliant; 384kbps – used At 128 kbps; microlink proposed with SW Hlth Care Network &Water Bd
Sunraysia Mildura (Regional)	(LaTrobe campus – not amalgamated)	4+ (2 vc)	Some admin No classes 1998	2-4	VTEL LC	Carol Inglis/Jill Sparks 5022 3666	384 kbps (128kbps use)
Swinburne University (Metropolitan)	Prahran Outer Eastern	6 (4 vc)	Admin for Higher Ed only No TAFE usage		VTEL incl Lecture theatre—mtg room patching; 1 rollabt; 1 DVC	Nelson Vargas (Lilydale) (H Ed Tech) 9215 7160	Range 256 - 385kbps – used at 128kbps. Looking at more rollabout units - PictureTel?
Uni Melb Inst Land & Food Res (Metrop)	Prev VCAH (Vic Coll Agric & Hort)	8 (4-8 vc)	Currently only admin	1-2 ea site	PictureTel Rollabouts?	Peter Cox 5362 2222 (Jeff Trewelly)	128kbps
VUT (Metrop)	Western Melb / VUT	6-8 (?) No VC					Looking at systems but no firm commitment to vc
Wodonga (Regional)		4+ (vc)	Some admin & 1998 to Army at Bonegilla	7-8 2-4	PictureTel Swiftsite & DVC	Robert Morrison (02) 6055 6304	128kbps
Army Bonegilla (Regional)		5-6 (vc)	Some admin	?	?	?	Microwave link

References

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i Computer Managed Learning Users Group of Australia, http://www.opennet.net.au/cmluga/cmldesc.htm
ii Centre for International Research on Communication and Information Technologies (CIRCIT), *Standards to Support National Cooperation in Applying Technology to VET*, November 1997, available at http://www.vicnet.net.au/~neptune/
iii Centre for International Research on Communication and Information Technologies (CIRCIT), *Standards to Support National Cooperation in Applying Technology to VET*, November 1995, Section 4.2, Available at http://www.vicnet.net.au/~neptune/.
iv Ibid, Section 5.
v Ibid, Section 4.4, Figure 1.
vi Ibid, Section 4.4, Table 1.
vii Centre for International Research on Communication and Information Technologies (CIRCIT), *Applications Access and Interworking*, Report in preparation.