# What Place Does Open Source Software Have In Australian And New Zealand Schools' and Jurisdictions' ICT Portfolios?

# TOTAL COST OF OWNERSHIP AND OPEN SOURCE SOFTWARE

## Research paper

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# Abbreviations

| | |
|---|---|
| ACTDEYFS | Australian Capital Territory Department of Education, Youth and Family Services |
| DoE (Tasmania) | Department of Education, Tasmania |
| DECS (SA) | Department of Education and Children's Services (South Australia) |
| DEET (NT) | Department of Employment, Education and Training (Northern Territory) |
| DET (VIC) | Department of Education and Training (Victoria) |
| DET (WA) | Department of Education and Training (WA) |
| EQ | Education Queensland |
| NSW DET | New South Wales Department of Education and Training |
| | |
| AGIMO | Australian Government Information Management Office |
| DEST | Department of Education, Science and Training |
| MCEETYA | Ministerial Council on Education, Employment, Training and Youth Affairs |
| MCEETYA ICT in Schools Taskforce | Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) Information and Communication Technologies Taskforce |
| SACSA | South Australian Curriculum, Standards and Accountability |
| | |
| HTML | Hyper Text Mark-up Language |
| ICT | Information and Communication Technologies |
| IT | Information Technology |
| ROI | Return on Investment |
| ROI | Registration of Interest |
| TCO | Total Cost of Ownership |
| SCORM | Sharable Content Object Reference Model |
| SOAP | Simple Object Access Protocol |
| SQL | Structured Query Language |
| XML | eXtensible Mark-up Language |

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| | |
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# Executive summary

This paper has been prepared as a result of research undertaken by the Department of Education and Children's Services (DECS) in South Australia investigating the question: *What place does open source software have in Australian and New Zealand schools and school jurisdictions' ICT portfolios?'* It is one of a series of papers produced through this research which includes the following:

- Review of the technical documentation accompanying open source software; and
- Report of a trial of open source software conducted at Grant High School, South Australia.

Each of these papers presents a perspective to answering the research question. While each of these papers are self-contained and can be read individually, it is also intended that they are complementary to each other. This paper addresses the research question from the perspective of total cost of ownership and open source software.

Formally constructed analyses of the costs of deploying ICT in organisations are referred to as 'total cost of ownership' (TCO) reports. This research has taken the concept of a TCO and examined the models for conducting TCOs and their underlying assumptions within the context of Australian and New Zealand school education. The components identified here for inclusion in TCO frameworks for use in schools and jurisdictions, make explicit the models and assumptions that underpin the TCO analyses.

Currently there are challenges in ICT data collection and analysis within and across Australian schools and jurisdictions. At the same time, open source software appears to be increasingly used in schools and sectors, for a wide range of reasons. This seems to be occurring with or without the support and approval of central offices. There is no research however, pertaining to Australian or New Zealand schools concerning the total cost of deploying ICT generally, nor of using open source software in school environments. This paper commences a process of examining the costs of ICT deployment in schools against this emergent backdrop, and as such, goes some way to addressing some of the current challenges in ICT data collection and analysis.

The responsibility for decisions about the deployment and use of ICT including open source software vary across the respective Australian and New Zealand jurisdictions. In some jurisdictions decisions about ICT deployment are made at the local level within a policy context while other jurisdictions take a more centralised approach. Understanding the costs of investments in technology can assist school leaders plan for the future. A TCO tool can help schools and school systems conduct technology planning in a systematic way; make informed budgetary decisions; establish a baseline for future research and analysis; and maximize benefits from their investments in technology.

The phrase 'total cost of ownership' was originally developed by Gartner Group Inc. to refer to all the costs associated with the use of computer hardware and software including the administrative costs, licence costs, deployment and configuration, hardware and software updates, training and development, maintenance, technical support and any other costs associated with acquiring, deploying, operating, maintaining and upgrading computer systems in organisations.

This paper commences with key questions, background information and the contexts for the deployment of ICT in Australian and New Zealand schools. These sections are followed by an overview of the implications of undertaking a TCO in the school education sector and a review of literature. Processes summarising how a TCO may be conducted in a school or corporate unit are then outlined. As TCOs should be undertaken drawing on real data in real contexts rather than attempting to construct them hypothetically, an overview of the trial of

the TCO Framework at Grant High School in the southeast of South Australia, is provided. Grant High School has a mixed ICT environment, deploying both proprietary and open source operating systems and applications software. This school provides a unique opportunity to look at the different costs associated with using both proprietary and open source software in a school.

Consistent with debates overseas, two distinctions in TCO components concerning the use of open source compared to proprietary software have emerged as important:

1. the costs of software licences and their associated management and compliance costs; and
2. the level of expertise required to successfully deploy open source software.

There are debates about whether the cost of licences and their associated compliance costs outweigh the costs of training and expertise. It is apparent that licence costs for open source software are lower than proprietary software, but the use of open source software is dependent on having people with the expertise to manage and support it. Whether the mix of these two components results in lower TCOs tends to be context specific. A lower budget line for 'software licences' and 'software compliance costs' using open source software can be offset against 'salaries' or 'people'. The question about the place of open source software in an ICT portfolio therefore, often becomes a policy judgement.

While TCO analyses tend to be comprehensive, there are aspects to choices about the deployment of software that do not easily get addressed in TCOs, yet are important issues for schools and Departments of Education. These issues include:

- the value placed on the educational and philosophical aspects of software use in schools;
- the applicability or degree of suitability of software for a particular organisation;
- the degree of scalability and modularity software may have;
- the capacity of integration of different pieces of software;
- the cost of 'lock in' to a vendor and the implications of this for a school over time;
- the cost of reversing 'lock in';
- the degree of reusability of software; and
- the potential for paradigm shifts over time.

Outcomes from this research have highlighted that some schools and jurisdictions around Australia and in New Zealand are choosing to make a place for open source software in their ICT portfolios. There is a complex mixture of philosophical, educational, policy, technical, budgetary and pragmatic reasons for doing so. Two broad challenges for jurisdictions concern firstly, how to respond to and manage the emerging use of open source software in schools; and secondly, how to use the emerging use of open source software as a negotiating tool with major software vendors. Responses to these challenges sit along a continuum, ranging from:

- monitoring and tracking the use of open source software;
- supporting continued research into the issues associated with the use of open source software;
- inclusion of open source software use in schools and within jurisdictions in policy and tender documents;
- active support of open source software initiatives; through to
- migration of software away from proprietary to open source software environments.

## Options for future actions

This research has been undertaken over a short period of time and as such there are further questions to ask and information to discover concerning open source software deployments in the school sector. The following options for actions then, are proposed for consideration by jurisdictions, national taskforces and agencies, and the Australian Government. These

options are presented as indicators of where gaps in our current knowledge and understanding exist.

**Total Cost of Ownership:**

The following options for future actions are proposed for consideration:

- Trialling the TCO Framework with feedback on the outcomes to be shared nationally.
- Applying the TCO Framework for different ICT deployment models using both proprietary and open source operating systems and applications software.
- Publishing case studies online of the total cost of ownership of open source software use in schools and corporate units to broaden understandings about cost, use and return on investment.
- Investigating further and developing online total cost of ownership tools similar to those available to schools in the USA.
- Documenting migration models identifying costs and benefits associated with moving from proprietary to open source software.
- Analysing return on investment from the deployment of open source software in schools, which includes both financial and educational perspectives.

**Understanding the use of open source software and standards**

The following options for future actions are proposed for consideration:

- Developing an online survey tool to map the extent and nature of the use of open source software in schools and jurisdictions.
- Identifying opportunities where interested jurisdictions can work collaboratively to leverage opportunities.
- Maintaining an open source software community website on EdNA Online.
- Recording and sharing experiences of schools and jurisdictions migrating to open source software.
- Developing and maintaining an online pool of experts in open source software in school education.
- Commissioning a ‘resource pooling’ project similar to that undertaken by the European Union where pieces of code are pooled and can then be reused by schools and jurisdictions.
- Identifying and publishing online, standards that are critical to the work of the school sector.

**Licencing Models**

The following options for future actions are proposed for consideration:

- Identifying and publishing models for licence management to minimise work required at the school level and reduce the current risk level.
- Identifying and documenting the strengths and weaknesses of proprietary and open source software licence conditions and their implications for the work of schools.
- As part of the platform for national negotiations with Microsoft, considering the possibility of unbundling specific software components within the Microsoft Enterprise Agreements, including the unbundling of operating systems from applications software.
- Continuing to collate outcomes from research, trials and deployment of open source software to create and maintain negotiating positions with proprietary vendors of software and standards.

# Introduction

The aim of this paper is to contribute to the shared understandings we have about the respective ICT costs that jurisdictions and schools invest in order to provide students, teachers and school communities with access to the necessary ICT infrastructure to support learning and to enable 'connectivity' between people and computers. Identifying costs will enable more informed discussion about what place open source software may have in schools' and school jurisdictions' ICT portfolios.

This section
1. introduces the 'key questions' being addressed in this report;
2. provides a brief overview about open source software and open standards;
3. identifies the major differences between open and proprietary software licences; and
4. outlines some recent work upon which this report builds.

This introductory section then leads into an outline of the contexts within which this report can be considered, and is followed by an overview of what is 'Total Cost Of Ownership'?

## 1. Key questions

The overall research question for this study has been '*what place does open source software have in Australian and New Zealand schools and school jurisdictions' ICT portfolios?*' The following two key questions concerning total cost of ownership (TCO) and open source software use in the Australian and New Zealand school sectors have provided the focus for this paper:

- What are the models and their underlying assumptions for identifying total cost of ownership for using open source software operating systems and applications within Australian and New Zealand schools and systems?
- What are the components for determining total cost of ownership of open source software to be used within Australian and New Zealand schools and systems?

These two questions emphasise the identification of a TCO Framework that is applicable in both schools and school systems; and that takes account of open source software use in the Australian and New Zealand school sectors. To address these two questions requires:

- Identifying the components that ought to be included in a TCO framework for use in Australian and New Zealand schools and jurisdictions;
- Making explicit the models and assumptions that underpin TCO analyses; and
- Considering the implications of these models and assumptions for the use of open source software.

## 2. Open source software and standards

Gartner predicts that '*by the end of 2004, most Australian IT organizations will knowingly or unknowingly leverage open-source software within their software solutions*.'[1] Gartner also indicates there is a more than 50% likelihood that open source software will erode Microsoft's market share and margins between 2004 and 2008.[2] Consistent with Gartner's observations, both open source software and the potential use of open standards are emerging as issues in Australian and New Zealand school sectors as well as more broadly in Australian State, Territory and Commonwealth governments.

[1] Sargent, P. (2004) The march of Linux in the enterprise: how far, how fast? Gartner audio teleconference May 13 2004, p2
[2] Ibid, p11

## Open source software

*Open source software* is software that has source code that is open, viewable, unrestricted and redistributable. It is available by downloading it from the Internet. When open source software is downloaded from the Internet the users of that software are required to adhere to the licence agreements of the software. Licences for open source software provide an unconditional right of any party to modify the software and allow unlimited distribution.[3] The 'open' in open source software is intended in the philosophical sense of 'open or free speech' rather than as a free (ie no cost) product. Open source software is developed by identifiable communities who contribute to the development of a particular piece of software. Successful open source software is produced by communities with explicit philosophical objectives and robust and rigorous development, testing and approval processes for improvements made to the software. People in the software communities participate voluntarily or are paid by employers such as government departments or companies such as IBM, Hewlett Packard and Sun Microsystems. Consistent with the philosophy of public education, open source software is made available to the public at large as a public good rather than for gain or profit. Companies achieve financial gains related to open source software from the research developed through the collaborative processes which underpin open source software development, and from associated products such as the packaging or bundling of products, associated technical services, conferences, books, and promotional materials.

## Open Standards

*Open standards* are specifications that are used to build IT infrastructures and to promote interoperability between different IT systems and software. Open standards can be considered to be '*transparent descriptions of data and behaviour that form the basis of interoperability*.'[4] Open standards are open, viewable and publicly accessible. The development of open source software enables the specification and creation of open standards by enabling the identification of common objectives that can be achieved through those standards. Open standards sit in contrast to proprietary standards which often require the adoption of proprietary technologies and may require the payment of licences to a sole or a few providers of those technologies.

The use of open standards provides the foundational requirements for IT infrastructures. Open standards offer schools and jurisdictions a number of benefits. Open standards can

- support shared understandings about standards;
- facilitate interoperability between different parts of government and non-government work;
- assist in avoiding 'lock-in' to one particular vendor; and
- increase the degree of flexibility available to an agency both in the nature of the software and the choice of vendor.

Further discussion about these benefits are outlined in Appendix One.

### Examples of open standards

Open standards underpin the construction of the World Wide Web. Internet interoperability is based on protocols such as TCP/IP, HTTP and HTML (Hyper Text Mark-up Language). The common sharing of standards like XML (the eXtensible Mark-up Language), and SOAP (Simple Object Access Protocol) has simplified the exchange of business data between administrations.[5] SQL (Structured Query Language) is an open standard that has been adopted by several vendors including Microsoft, Oracle and IBM. SCORM (Sharable Content Object Reference Model) is a collection of specifications and standards that aim to help define the technical foundations of web-based learning environments. These specifications and standards were first released early in 2000 and are under ongoing development. The purpose of using SCORM is to foster the development and use of reusable learning objects within a common technical framework.

[3] Hubley & Muller, 2002, http://asiapac.gartner.com/events/noie.cfm
[4] Dalziel, 2003, p2
[5] See Interchange of Data between Administrations (IDA), 2001c, p42

## 3. Comparison of open source and proprietary software licences

Differences between open source and proprietary software that impinge on the costs of software are the cost of the licences and the conditions for use of the licences. The copyright of open source software belongs to the author rather than the vendor. There are a variety of open source software licences but they are all premised on the author (the 'licensor') giving some fundamental freedoms to the user (the 'licensee') inside a licence agreement. These freedoms are:

- the freedom to study how the program works
- the freedom to access the software code
- the freedom to modify the code according to specific requirements
- the freedom to run the software for any purpose on any number of machines
- the freedom to redistribute copies of the software to others.[6]

The freedom to run the software for any purpose on any number of machines is a cost saving factor in the school sector as it avoids the expense to manage the wide variety of proprietary licences (with their different conditions, timeframes and renewal requirements), at either the local or jurisdictional levels.

Examples of open source software licences are

- the GNU General Public License (GPL)
- the GNU Library or 'Lesser' Public Licence
- the BSD License
- the Mozilla Public License.[7]

The Open Source Initiative (OSI) has collected copies of various open source licences,'[8] and the conditions of the use of these licences is collated on the OSI website.

In Australia, Mr Con Zymaris (CEO of Cybersource) has prepared a report that compares the GPL (which covers software such as Linux, GNOME, KDE, OpenOffice.org and MySQL), with the Microsoft Windows XP Professional End User License Agreement (EULA) licence[9]. The report specifically looks at what the similarities and differences that exist between these two licenses. The report notes that

> *a close reading of the EULA reveals that the licence explicitly removes all avenues and all recourse that a user of Microsoft's software has for legal relief of any sort.*[10]

In addition it indicates that

> *Microsoft explicitly states that you can only install and use this software on one, and only one computer. This does not allow you to install on two computers, and only use one at a time. Therefore, if you had one desktop and one laptop PC, you will only be able to install this software on one of them.*[11]

In comparison, the author notes that few user-level restrictions are evident in the GPL which mostly outlines the rights allocated to users, and specifies their responsibilities for the use of the software from the perspective of software distributors or programmers who incorporate GPL code.[12]

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[6] See P. Schimitz & S. Castiaux (2002)
[7] The Open Source Initiative is a non-profit corporation that manages and promotes open source software licences by providing certification of these licences and hosts the details of the licences on its website. See Open Source Initiative (2001) http://www.opensource.org/licenses/index.html
[8] Ibid
[9] 2003. See www.cyber.com.au/ cyber/about/comparing_the_**gpl**_to_eula.pdf
[10] Ibid, p3
[11] Ibid, p4
[12] Ibid,p2

The Australian Capital Territory Department of Education, Youth and Family Services notes however, that differences between open source and proprietary software should not simply focus on the present. They indicate that historical evidence shows proprietary software licence costs have had a tendency to increase over time, and they also note that evidence shows that the more support open source software is afforded the more useful it becomes. They suggest therefore, that focusing only on current licences and their fees ignores possible paradigm shifts overtime, that are available to the school community.

## 4. Building on recent work

The work of two MCEETYA Taskforces[13] in particular are pertinent to this paper: the MCEETYA Schools Resourcing Taskforce and the MCEETYA ICT in Schools Taskforce. Both Taskforces are concerned with the nature and cost of the provision of the components necessary to provide an ICT infrastructure to support learning in schools. The MCEETYA ICT in Schools Taskforce is also interested in developing a commonly agreed national approach to the provision of an ICT infrastructure.

### Resourcing ICT in schools

In 2003, the MCEETYA Schools Resourcing Taskforce examined questions concerning the resourcing of the *National Goals of Schooling*. This work included commissioning a report examining the costs of resourcing MCEETYA goal 1.6 which states that students should leave school able to be "*confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society"* (MCEETYA 1999). A draft report titled *National Goals of Schooling, Information and Communications Technologies for Schooling*, was prepared for consideration by the MCEETYA Schools Resourcing Taskforce. The project examined the funding implications of ICT as they relate to the capital and recurrent costs of teaching and learning in government primary and secondary schools, and excluded ICT costs at the school level. In comparison, this report focuses upon the ICT costs at the school level.

### Learning Architecture Framework: Learning in an online world

Through the MCEETYA ICT in Schools Taskforce, the Learning Architecture Framework[14] has been developed to support schools and school systems to effectively plan and deliver an ICT infrastructure. It outlines national strategic directions for ICT in school education. A major emphasis in the MCEETYA Learning Architecture Framework document is on the importance of interoperability between the respective ICT systems used in and across schools, and between schools and other agencies, as the two diagrams below illustrate.

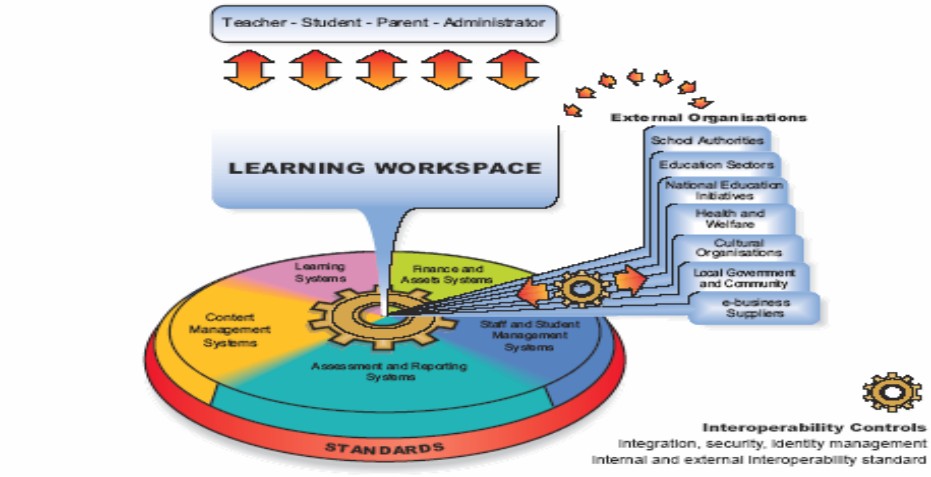


*Diagram One: MCEETYA Learning Architecture Framework overview.*[15]

[13] MCEETYA currently supports seven taskforces, of which the MCEETYA Schools Resourcing and the MCEETYA ICT in Schools Taskforces are two. During 2004 however, there is a review of the number and extent of responsibilities these Taskforces cover.
[14] This document is available at http://www.icttaskforce.edna.edu.au/documents/learning_architecture.pdf
[15] MCEETYA (2003), Learning Architecture Framework, Curriculum Corporation, p6

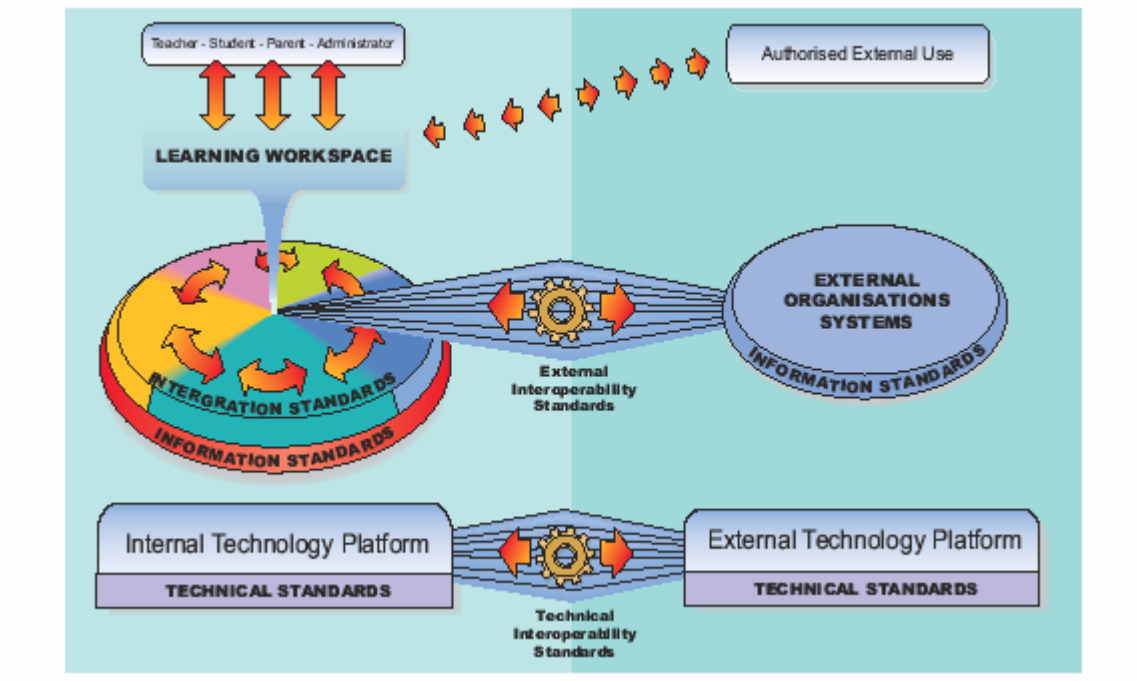


*Diagram two: Information flows based on standards*[16]

The overarching ICT considerations concerning standards identified in the MCEETYA Learning Architecture Framework are:

- interoperability;
- reusability;
- accessibility;
- durability; and
- modularity.

These requirements are consistent with the characteristics open source software and open standards are able to offer, as indicated by NASA and by research being undertaken at Berkeley University in the USA.[17] Both developers and users of open-source software indicate that open source software is robust, modular and supports stable architectures. One reason for this is that all developers in an open source project develop pieces of software that are modular because it both reduces the learning curve required for participation and allows individual participants to concentrate on the functionality that directly serves their needs. [18]

## Open source software in Australian school education

In 2003, ***education.au limited*** on behalf of the MCEETYA ICT in Schools Taskforce produced an introductory paper on the use of open source software in Australian school education.[19] This paper provides an introduction to open source software in the context of Australian schools. It was prepared to support the development of some common understandings about what open source software is; its benefits; its limitations; and to provide a brief scan of what is happening in Australian schools and sectors. The paper does not provide a total cost of ownership analysis of open source software but rather was developed as an introductory paper that could provide the basis for informing future discussions at state and national levels. This research project has taken further, issues concerning TCO and open source software foreshadowed in this earlier report.

[16] MCEETYA (2003), Learning Architecture Framework, Curriculum Corporation, p8
[17] See National Aeronautics and Space Administration (2004) http://opensource.arc.nasa.gov/
[18] See OpenOptions (2003) http://www.netc.org/openoptions/pros_cons/deployment.html; Open Source Quality (2004) http://osq.cs.berkeley.edu/
[19] See http://www.educationau.edu.au/papers/open_source.pdf

# Contexts

Contexts impinging upon the deployment and use of technologies in schools are complex. A brief outline of four contexts that impinge on the research undertaken for this paper are presented here. Firstly, an overview of the different ways in which ICT is used in Australian and New Zealand schools, is outlined. Secondly, a short summary of recent, emerging uses of open source software by agencies in Australian and New Zealand, is presented. Thirdly a brief description of the different methods of procurement and deployment of computer hardware and software in schools and school systems throughout Australia and New Zealand, is summarised. Fourthly, an overview of the current use of open source software in South Australian school education, is provided. It is against these four respective contextual backdrops that the concept of total cost of ownership has been considered within the Department of Education and Children's Services (DECS) in South Australia.

## 1. Use of ICT in schools

The MCEETYA ICT in Schools Taskforce has endorsed the development of a *Pedagogy Strategy*: *Learning in an Online World*[20], in recognition that students, teachers and schools are actively engaging with ICT as part of their everyday practices.

Digital technologies including ICT are currently being used in schools in several ways, including:

- as part of classroom practice in all year levels, in 'face to face' schools, both as an area of curriculum content in itself and as a teaching and learning methodology;
- as specific skill training and formal vocational qualifications within senior secondary state and territory accredited qualifications, and within the states' and territories' respective benchmarking strategies;
- as a communication tool to overcome barriers of demographics and geography such as that used in distance education;
- to support teacher professional development activities;
- for reference and research use by teachers and students;
- to undertake the daily administrative work of the school;
- to support individual teacher's work, whether that is curriculum development, classroom planning, student assessment and reporting, administrative responsibilities and time management requirements, or communication between staff, students and parents across the school community; and
- to provide information to the interested public and to school staff through the use of emails, websites and portals.

It can be seen from this brief summary that the different purposes to which ICT are used in schools is multiple and complex.

## 2. Current use of open source software in Australia and New Zealand

Schools around Australia and New Zealand are experimenting with and deploying open source software in a range of different ways.[21] Although there are no formal measures available, it seems from anecdotal evidence that this use is growing. Companies such as MyInternet, who provide ICT services and support to Australian schools and jurisdictions, use open source software to support the provision of their products and services.

Businesses and government are also increasingly selecting open source software for specified purposes. For example The Australian Taxation Office is investigating options for

[20] This strategy is current under development
[21] A outline of past developments in this area can be found at http://www.educationau.edu.au/papers/open_source.pdf

migration to open source software.[22] Telstra is switching to open source software using Linux on the company's web servers and applications servers and is migrating to Linux on desktops[23]. Air New Zealand is also in the process of migrating away from proprietary to open source software options. ASIO recently advertised for an open source software officer.[24]

## 3. Procurement and deployment of ICT

Decisions about the use of software, including open source software is the responsibility of individual schools and sectors. Different jurisdictions procure and deploy computer hardware and software using different models. Leaving options open to acquire hardware and software suitable for specific tasks while making purchases that represent the best value for money are challenges facing jurisdictions and schools.

Models of procurement include the following:

- Departments of Education call for registrations of interest and establish panels of suppliers from which hardware and/or software can be purchased;
- Purchases of hardware and software are made jointly by the Departments of Education and schools;
- Departments of Education provide all hardware and software to schools, usually acquired through a tender process;
- Departments of Education set policies within which purchases by schools and corporate offices are made;
- Hardware and software are leased together; and/or
- Where a new piece of software is required, tendering out for the development of that piece of software and/or associated IT services occurs through the marketplace.

Some jurisdictions, within these models are beginning to leave their options open to the possibility of acquiring products and services that enable the use of open source software and the employment of open standards. This is occurring for example, by including into tender documentation and other documentation that goes to the market, the requirement for compliance to open standards such as SCORM.

In 2001, the European Union released the outcomes from a study into the use of open source software in the European public sector. The findings are summarised in three reports.[25] The third report outlines the open source software market structure and issues related to public procurement. This report outlines how open source software can be distributed and used according to the licences with the European public sector, and indicates how legal and commercial aspects may impact on public procurement objectives, transparency and non-discrimination.[26]

The Office of the E-Envoy in the United Kingdom (UK) has developed a policy addressing the use of open source software within the UK government. This policy indicates that the UK government will consider open source software solutions alongside of proprietary ones. This policy also states that '*the UK government will only use products for interoperability that support open standards and specifications in all future IT developments*."[27]

In Australia, in 2002, at the Commonwealth 'whole of government level', the Australian Government Information Management Office (AGIMO) released the policy strategy *Better Services, Better Government.* This policy states that:

[22] See Gartner (2003) http://www.ato.gov.au/corporate/content.asp?doc=/content/42822.htm
[23] See The Australian IT Business, May 25 2004, p1
[24] See The Weekend Australian, Careers One, 22 May 2004, p3
[25] See Interchange of Data between Administrators (IDA), (2001a, 2001b & 2001c)
See: http://europa.eu.int/ISPO/ida/export/files/en/840.pdf; http://europa.eu.int/ISPO/ida/export/files/en/837.pdf; & http://europa.eu.int/ISPO/ida/export/files/en/835.pdf
[26] See Interchange of Data between Administrators, (2001c) http://europa.eu.int/ISPO/ida/export/files/en/835.pdf
[27] See Office of Government Commerce (2002) Open source software. Use within UK government version 1. 15 July 2002, http://www.ogc.gov.uk/index.asp?id=2190

*The Government will encourage trials of open source software within the framework of fit for purpose and value for money (p21);* and the
*Re-use of [IT] assets will be enhanced by greater commonality of architecture and open standards (p20)*[28]

While these examples only provide a snapshot, it can be seen that government agencies in Australia and internationally are looking at their procurement policies and procedures to enable open source software options to be considered alongside of proprietary options.

## 4. Department of Education and Children's Services, South Australia

This research paper has been prepared to examine TCO frameworks and open source software in school education. The research undertaken within DECS (SA) has included trialing the components of a TCO. DECS (SA) provides education and care to 170,000 students through almost 1000 sites comprising over 900 schools and preschools, as well as regional offices and other support services. The South Australian Curriculum, Standards and Accountability (SACSA) Framework describes the key ideas and learning outcomes upon which all learners from birth to year 12 can expect their education to be built. Students' achievements in the final years of schooling in South Australia are recognised with gaining the South Australian Certificate of Education (SACE).

The research underpinning this paper was conducted in the first half of 2004. This research built upon a South Australian whole of government survey conducted by the Department of Administrative and Information Services (DAIS) in January and February 2004. This survey was sent to all government departments, including all hospitals and schools in South Australia. It became apparent through this survey that schools across South Australia are making use of a wide variety of open source software applications, as alternatives to proprietary software, including for teaching and learning purposes. In addition, many schools in South Australia are using Squid for their proxy servers. It appears that over 20% of schools in South Australia are using open source software at either or both the back and front ends of their networks. The reasons identified by schools why they are using open source software included for security, cost and educational reasons.

Schools in DECS (SA) operate under local school management. Like most states in Australia, DECS (SA) has a department-wide licence for Microsoft products and for specific pieces of software such as virus protection software. The cost of this enterprise software is shared between corporate DECS (SA) and schools. Also like other jurisdictions around Australia and New Zealand, DECS (SA) is trialing the use of learning objects generated through The Le@rning Federation.[29] Beyond these provisions for software however, any additional software required by schools is the responsibility of individual schools in South Australia, under global budget arrangements. That is, the school community, authorised through schools' Governing Councils, determine what local priorities to place on the use of their respective global budgets. Currently, this means that most of the costs for software, hardware and other ICT costs are the responsibility of the local school and software is acquired according to individual budget constraints and local requirements. This study has focused upon the 'curriculum' use of ICT to examine the total cost of ownership, including the cost of ICT when using open source software. It is this contextual backdrop of global budget arrangements, TCO and open source software then, that has provided a focus for this study, within South Australia.

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[28] See National Office for the Information Economy (NOIE) *Better services, better government*, Commonwealth of Australia, Canberra, 2002 and National Office of the Information Economy (NOIE) *Open source software* http://www.noie.gov.au/projects/egovernment/better%5Finfrastructure/oss/index.htm

[29] The Le@rning Federation is $AUS70 million e-learning initiative of the Commonwealth of Australia, all States and Territories of Australia (government and non-government school education systems and sectors), and New Zealand. The Le@rning Federation is generating researched and evaluated online curriculum content for delivery to education sector gateways in Australia and New Zealand, for teachers' use with their students in schools. See http://www.thelearningfederation.edu.au. Management of The Le@rning Federation is through the joint ventures of the two Ministerial companies, the Curriculum Corporation and ***education.au limited.***

# What is total cost of ownership?[30]

'Total cost of ownership'[31] refers to all the costs associated with the use of computer hardware and software including the administrative costs, licence costs, hardware and software updates, training and development, maintenance, technical support and any other associated costs. Total cost of ownership analyses serve as planning tools: until you know what you own it is hard to come up with a plan to reduce costs or to make better use of the available resources. This section outlines the purposes, reasons and benefits for undertaking a TCO; and proposes some contextual issues, including the use of open source software, that ought to be considered when undertaking a TCO.

## 1. Purpose of undertaking a total cost of ownership analysis

Total Cost of Ownership analyses are undertaken for a variety of purposes including to:

- Identify the components of an IT deployment
- Enable calculations of what the total assets are worth
- Allow for the weighing up of options
- Help in the management of risk
- Enable analysis from a system or whole school perspective.

## 2. Why undertake total cost of ownership work?

Examining total cost of ownership components and frameworks is important because:

- The role of technology within classrooms and schools should be outlined
- Purchases of hardware, software, licences, professional development and other associated costs should match the roles required of the technology in classrooms and schools, and deliver a return on investment (ROI)
- Decisions about what purchases can best be handled at the school, regional and central levels can be made based on documented total cost of ownership analyses
- Schools, regions and central agencies have to budget over time according to the technology architecture and standards
- Completed total cost of ownership frameworks provide a basis upon which to monitor costs over time.

## 3. How can total cost of ownership analyses help schools, regions and central agencies plan?

Frameworks for conducting total cost of ownership operate at different levels within school education jurisdictions and have the capacity to:

- Provide leaders, managers and administrators with an oversight of expected IT costs
- Provide a basis through the use of agreed benchmarks upon which to measure changes and improvements in technology
- Enable the development of budgetary guidelines
- Support the development of informed understandings about all the costs that are required to adequately support the use of technology in schools
- Enable insights into the longer-term costs of particular models of technology deployment
- Enable identification of the direct and 'hidden' costs of technology deployment in the school sector
- Facilitate decision-making between different choices available, based upon agreed benchmarks;
- Provide the basis for the development of business cases for technology investments;
- Support decision-making about the pros and cons of centralised deployment and management versus site-based strategies.

[30] This section is informed particularly by the work of the Consortium of School Networking (CoSN): http://www.cosn.org
[31] See GartnerGroup 1998 (http://www.gartner.com)

## 4. Total cost of ownership analyses should not be undertaken in isolation

Total cost of ownership data is context or location specific, and should not be undertaken in isolation to other activities occurring within the school or jurisdiction. As such:

- Technology should be viewed as part of education and the infrastructure needs to support the teaching and learning
- Schools need to understand their educational goals and how technology supports and aligns with those goals
- The key to understanding the financial aspects of the use of software is consideration of the range of viable options for the investments to be made.
- Business case analyses of viable solutions should include the identification of both quantifiable and intangible benefits for those respective potential solutions.

## 5. Total cost of ownership and open source software

There are claims that the use of open source software has a lower TCO than proprietary software and counter-claims that open source has a higher TCO. These debates are outlined in more detail in the 'Review of literature'. The distinction between these different TCOs is that

a. A TCO using proprietary software sees an emphasis placed on the purchase of software licences; whereas
b. A TCO using open source software sees an emphasis placed on the investments being located in people rather than licences.

Rarely however, are there documented claims that propose a TCO will remain about the same level irrespective of the use of proprietary or open source software. Under such a claim however, there would be changes to the amounts of funding committed to 'people' rather than to 'software licence acquisitions and compliance' budget lines. That is, there would be a change from budget lines allocated for the purchase of proprietary software licences and maintenance agreements, to the purchase of 'expertise' and investment in 'training and professional development' to support the use of open source software. This second approach therefore requires the investment in social capital to ensure the educational use of open source software operating systems and applications are sustained and enhanced.

# Review of literature

There is no formal work currently available from Australian or New Zealand schools or school jurisdictions on either total cost of ownership per se, or on total cost of ownership and open source deployment. There is however, some recent work on both total cost of ownership and open source software in schools emerging from overseas and particularly the USA, upon which we can draw. There is also literature available addressing the advantages and disadvantages of open source software in schools.[32] This work tends to focus on the philosophical congruence between open source software and school education; and/or on the technical characteristics of open source software.

## 1. Open source software in government and schools

Governments, education systems and schools across the world are either opting for a 'vendor neutral' approach to the acquisition and use of software or are choosing to use open source software.[33] Since 2002, the state of Extramadura in Spain has deployed over 80,000 copies of LinEx (a locally developed version of Debian) to schools.[34] Training of Extramadura's 15,000 teachers has been a government priority.[35] The Shuttleworth Foundation[36] is a South African initiative that funds open source projects in education. One of these projects is to use open source software to translate Open Office, Mozilla and KDE into the eleven official South African languages.[37]

Several countries in the Asia-Pacific such as Thailand have used open source software as a negotiating tool with Microsoft. The Thai government has backed up this negotiating position with a government-supported GNU/Linux distribution for schools and government desktops. India is releasing Linux variations in local dialects from Assamese to Telugu. The growing attraction to Linux in India has convinced Microsoft to share code with specified government bodies.[38] China, Japan, and South Korea are collaborating on their own open source software to challenge Microsoft products in these countries.

The French National Education system is using open source software such as Linux, Apache, Zope, and Send Mail in educational institutions.[39] In the USA major vendors such as WalMart are selling low cost computers with Linux installed, that are aimed for the home/school market.[40] The Danish Board of Technology (a government institution and an independent body established by the Danish Parliament) has published a comprehensive report[41] on the use of open source software in the public sector. This report provides TCO calculations based on scenarios like StarOffice vs Office XP and Office 2000. Findings have informed the Danish government's moves to introducing the use of open source software into the public sector.

In 2001, the European Union released the outcomes from a study into the use of open source software in the European public sector. The findings are outlined in three reports which collectively provide an assessment of availability of open source software solutions; examine the use of open source software in public sector in selected European countries; and discuss the open source market structure and issues related to public procurement.

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[32] See Hart (2004); Sommer, E. and Strait, M. (2004); Vessels (2004)
[33] Vendor neutral approaches and numerous examples of global open source software implementations can be found in the United Nations Conference on Trade and Development report. See http://www.unctad.org/en/docs/ecdr2003ch4_en.pdf
[34] See http://www.wired.com/wired/archive/11.12/view.html?pg=4?tw=wn_tophead_3
[35] See http://www.becta.org.uk/subsections/foi/documents/technology_and_education_research/open_source_software.doc
[36] See http://www.tsf.org.za
[37] See: http://www.translate.org.za
[38] See http://www.unctad.org/en/docs/ecdr2003ch4_en.pdf, p118. For more information about Microsoft's 'Shared source initiative' see http://www.microsoft.com/resources/sharedsource/Initiative/Initiative.mspx
[39] See IDA, 2001, p34
[40] Sommer, E. and Strait, M. (2004) p7
[41] The full report available in English at http://wwws.sun.com/software/star/staroffice/whitepapers/index.html (click on Danish Government Open Source Report) and in Danish at http://sunweb.denmark.sun.com/Marketing/StarOffice/p02_open-source-rapport.pdf

The British Educational Communications and Technology Agency (BECTA) hosts pages[42] within its portal that address issues for schools concerning open source software. This site includes RSS feeds about open source software in schools and provides links to websites concerned with using open source software in schools for both technical and curriculum purposes.

The United Nations World Summit on the Information Society (WSIS) (2003-2005) has identified the following priorities in their *Plan of action*[43] concerning open source software:

> *Encourage research and promote awareness among all stakeholders of the possibilities offered by different software models, and the means of their creation, including proprietary, open-source and free software, in order to increase competition, freedom of choice and affordability, and to enable all stakeholders to evaluate which solution best meets their requirements.*[44]
>
> and
>
> *Governments, through public/private partnerships, should promote technologies and R&D programmes in such areas as translation, iconographies, voice-assisted services and the development of necessary hardware and a variety of software models, including proprietary, open source software and free software, such as standard character sets, language codes, electronic dictionaries, terminology and thesauri, multilingual search engines, machine translation tools, internationalized domain names, content referencing as well as general and application software.*[45]

While there is considerable literature of open source software deployments in governments, this review focuses on three concepts concerning the ICT deployments in Australian and New Zealand schools:

a) total cost of ownership;
b) total cost of ownership in schools (without focusing on open source software); and
c) total cost of ownership in schools using open source software.

## 2. Total cost of ownership

The concept of 'total cost of ownership' was originally conceived by Bill Kirwin, who was (then) vice president and research director at Gartner Group Inc. In 1987 he applied his TCO model to desktop systems. Gartner has since extended this model into a wide range of computer technologies. The TCO concept was originally developed to assist private companies determine whether it was making gains or losses from deploying specific technology implementations. More recently, public sectors have adopted the use of the TCO concept to assist in making decisions about the value for money of ICT deployments. The following diagram developed by Unisys illustrates their findings of direct and indirect costs of ICT deployment in an Australian education system conducted in late 1999-2000.

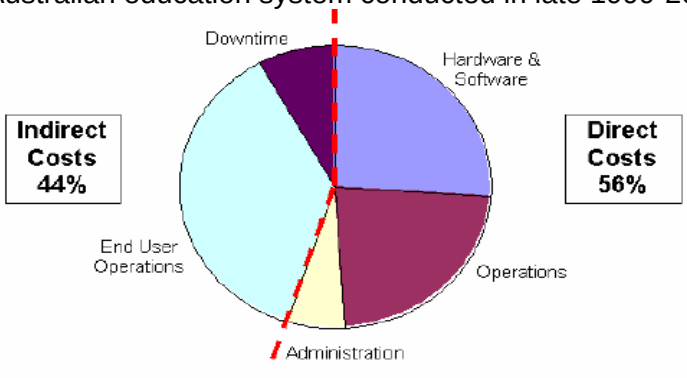



*Diagram Three: TCO analysis of an Australian public education project*[46]

[42] See http://www.becta.org/postnuke/
[43] See http://www.itu.int/dms_pub/itu-s/md/03/wsis/doc/S03-WSIS-DOC-0005!!PDF-E.pdf
[44] United Nations (2003), p4
[45] Ibid, p10
[46] See Interchange of Data between Administrations (IDA) (2001c) p42

An emerging and contested field of research for companies such as Gartner as well as for education institutions is the impact of open source software on the TCO of an ICT deployment. It is not clear from the literature whether the TCO of open source is lower than proprietary software or vice versa[47], but most proprietary companies claim their TCO is lower[48], while open source software advocates argue the opposite.[49] Proponents of open source software claim that even if open source requires more expertise, the TCO is ultimately lower. Companies selling proprietary software tend to claim that the required expertise associated with using open source software is daunting and the costs of proprietary solutions are exaggerated.

The following chart prepared by Northwest Educational Technology Consortium (NETC) in the USA illustrates these opposing concepts.[50]

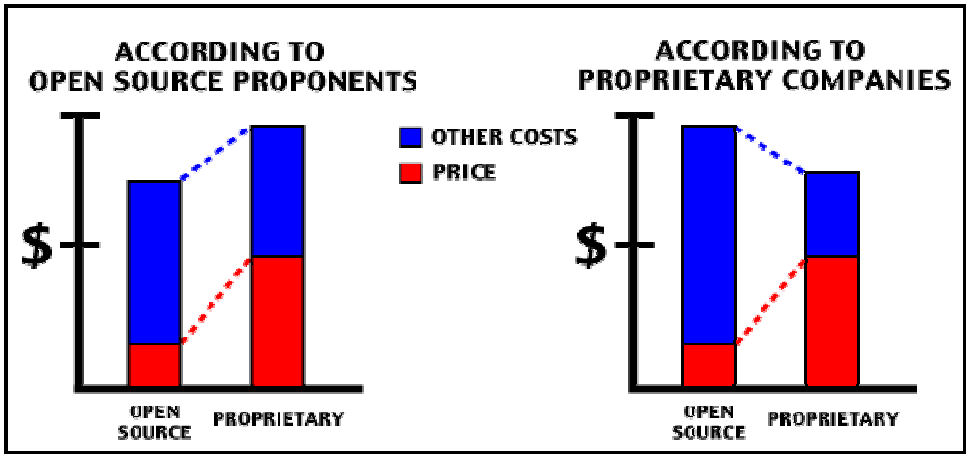



*Diagram Four: Open source proponents and proprietary companies disagree on the total cost of ownership.*[51]

As foreshadowed earlier, there is little discussion of a 'middle ground' TCO position however. Such a position would suggest that while licence costs are reduced using open source software, these savings are transferred to 'people costs' such as technical training and professional development. As such, there would not be any overall financial saving (ie a lower TCO with using open source software), but there would be an exchange of funds from the budget line for 'software licences' and 'software compliance costs' to the budget line of 'salaries' or 'people'. Making choices about software in such a context then becomes a cost-benefit/risk management question, where considerations include both the quantifiable and intangible educational benefits and risks.

## 3. Total cost of ownership in schools

Recently the concept of TCOs has been applied to schools. Both the Coalition for School Networking (CoSN) in the USA and the author and editor of the ICT in school education journal, *From Now On*, Mr Jamie McKenzie,[52] address issues around the TCO of ICT in schools.

**Coalition for School Networking** http://www.cosn.org

The application of the TCO model to school environments has been assisted through the work carried out by the US non-profit organisation Coalition for School Networking (CoSN). CoSN is sponsored by several organisations including major IT vendors, Gartner and the US

[47] See Gonzalez-Barahona (2004); Hart (2004); OpenOptions (2003); Orzech (2002)
[48] See Microsoft (2004); Microsoft (2003)
[49] See FUD Counter (2004]; Wheeler (2003)
[50] See http://www.netc.org/openoptions/pros_cons/tco.html#other
[51] Ibid. Note: these diagrams present concepts and do not draw on actual numbers.
[52] See http://fnopress.com/online.html

Federal Department of Education. This work is not directly focused upon where open source software fits but does use the TCO model and apply it to the school environment.

CoSN has proposed the following TCO checklist components:

- Professional development
- Support
- Connectivity
- Software
- Replacement costs
- Retrofitting

During 2003, with financial support from the US Department of Education and in conjunction with the North Central Regional Technology in Education Consortium and Gartner, CoSN produced a set of online tools including the development of a total cost of ownership framework for use by schools.[53] The TCO tool requires 100 pieces of data to be collected and entered into the database. The online TCO Tool is a vendor-neutral, free resource but is only available to schools within the USA.[54] These tools have been used to generate a number of case studies including the following:

- A Report and Estimating Tool for K-12 School Districts: Texas District Case Study[55]
- A Report and Estimating Tool for K-12 School Districts: Wisconsin District Case Study[56]

The outcomes from these case studies include an overview of the methods used to undertake a TCO and provide an indication per student of the total cost of providing a school education that includes the use of ICT. Appendix Two provides the cost of ownership metrics identified in the Texas and Wisconsin School Districts and some screen dumps from the online tool used to develop the TCO metrics. CoSN has also produced a school administrators guide for planning the total cost of ICT deployments in schools. This guide has been produced through the CoSN '*Taking TCO to the classroom'* program.[57]

**Jamie McKenzie** http://www.fno.org

Jamie McKenzie prefers to talk about the true cost of ownership rather than the total cost of ownership of ICT in schools. While he acknowledges the importance of undertaking a TCO for planning and evaluation, he notes that TCOs tend to leave out components that are central to planning good change. Jamie notes that TCO analyses usually cover those costs associated with the computer, technical support, depreciation and so on, but he goes on to argue that there are other factors which should also be investigated to gain a true picture of the cost of ownership of ICT in schools. He identifies the following additional broad categories as central to planning ICT deployment and use:

A. ***Learning resources not included with the boxes***
   *(eg subscription information resources such as periodical collections like New Scientist Online and other digital resources to supplement free Internet resources).*
B. ***Organizational Impacts and Management***
   *(eg taking account of the health and productivity of the organisation and management of schools and putting in place strategies to enable judgements to be made about organisational developments).*
C. ***Network Management & Development.***
   *(eg the increasing demand for bandwidth and technical support to ensure a school network remains up and running over time).*

[53] See http://classroomtco.cosn.org/gartner_intro.html.
[54] It is available online at http://www.classroomtco.org.
[55] March 2004. See: http://classroomtco.cosn.org/texas.pdf
[56] March 2004. See: http://classroomtco.cosn.org/wisconsin.pdf
[57] See: http://www.classroomtco.org.

D. ***Network Resources***
*(eg software purchases and upgrades, replacement costs and retrofitting).*

E. ***Research and development***
*(eg trialing, piloting, professional development and organisational development)*

F. ***Spirit and Support Building***
*(eg celebrating successes, marketing new innovations, seeking funding to undertake more research and development).*[58]

McKenzie argues that a true cost of ownership analysis can be used to raise awareness about the costs and responsibilities of providing ICT in schools. The importance of Jamie McKenzie's work is to acknowledge that TCO's are important for the planning and monitoring of change processes associated with the deployment of ICT in schools. As such, TCOs have to be repeated at regular intervals so that the data can inform the change processes.

## 4. Total cost of ownership, open source software and schools

Different models of conducting a total cost of ownership analysis, which take into account open source software in schools are available from sources in the USA. This TCO work to date, has tended to focus upon operating systems rather than applications software. There thus remains considerable room for further research concerning the use of open source applications software, particularly in relation to teaching and learning applications software.[59]

The following two reviews from the USA summarise the TCO frameworks used with open source software.

**Virginia School District** http://staff.harrisonburg.k12.va.us/~rlineweaver/

The author, Rob Lineweaver describes setting up a network for the Harrisonburg School District in the USA. He estimates that using open source software instead of commercial packages saved this K-12 school about $40,000 in software licence costs. A table summarising these cost savings is included in Appendix Three.

Perhaps more interestingly however, he states that the use of open source software is not only about cost. He says:

> *This [TCO] makes it apparent that not all of the benefit of open source software deployment is in the form of cost savings; much of the benefit is in terms of capabilities gained. In other words, through the use of free software, I am able to do more within my budget than I could if I only had commercial solutions available.*[60]

The main impediment to further uptake of open source software in schools the author writes, is *'Two words: "learning curve"-it was a complex task'.*[61] It is these last words that highlight the importance of developing and maintaining expertise in open source software in the school sector if it is to be deployed successfully.

**Northwest Educational Technology Consortium** http://www.netc.org

A body of work surrounding TCO in the education environment has been undertaken by the Northwest Educational Technology Consortium (NETC) Montana, Oregon, and Washington, and by the Northwest Regional Educational Laboratory in Portland, Oregon. NETC is one of a network of ten Regional Technology in Education Consortia in the US. NETC receives funding from the US Department of Education.

[58] See http://www.fno.org/mar03/truecost.html
[59] Such as Gimp and Audacity, as opposed to Office type functions
[60] I http://staff.harrisonburg.k12.va.us/~rlineweaver/
[61] Ibid

The NETC has established a comprehensive website looking at open source software and the TCO in schools[62] and a PDF document provides a summary of the financial as well as philosophical arguments on these issues.[63]

According to NETC, the TCO includes the sale price, any hardware and software upgrades, maintenance and technical support, and training (or re-training). They indicate that time and frustration are harder components to measure. The diagram below prepared by NETC provides a conceptual map to illutsrate the components of a TCO within a school or school district that they have identified. It shows the complexities and interdependencies associated with undertaking a TCO.

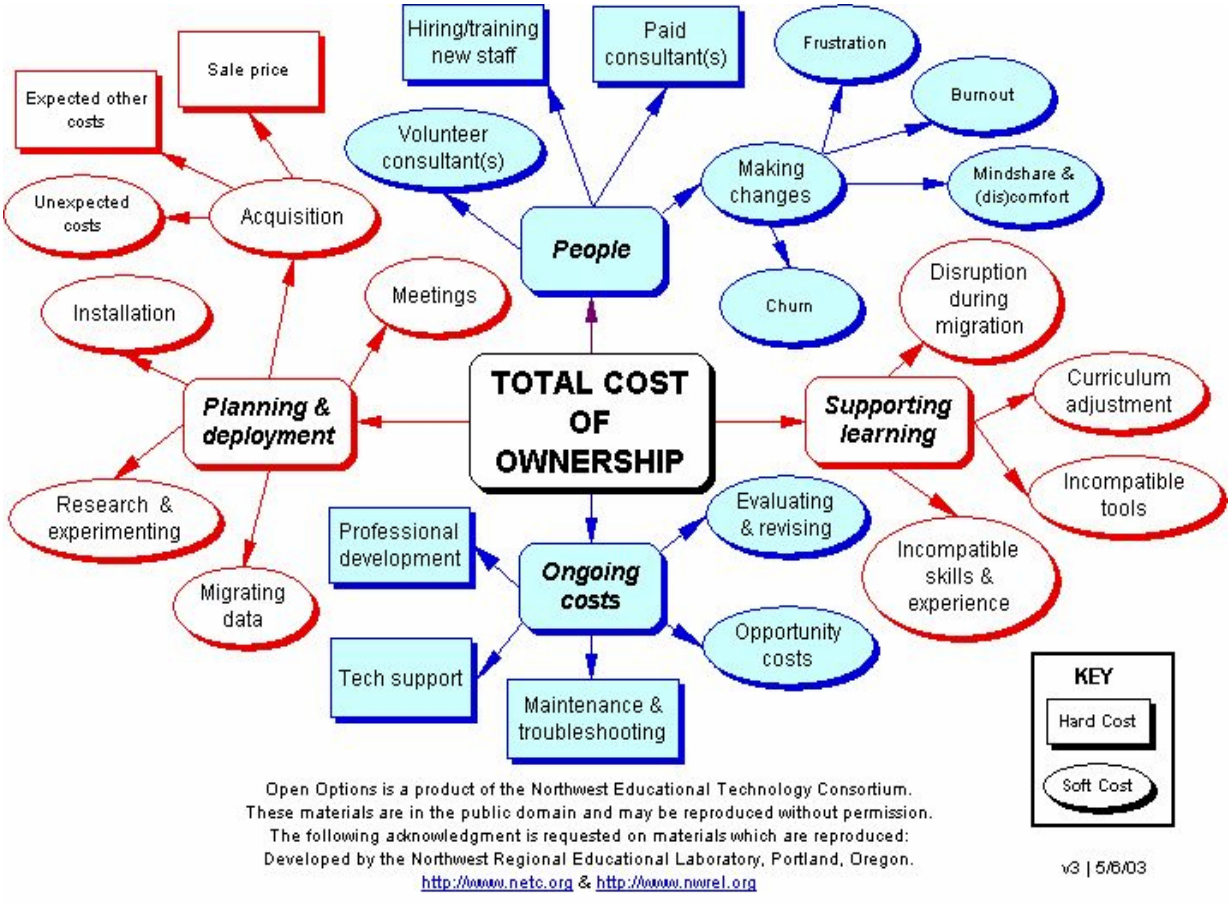



*Diagram Five: NETC conceptual map of total cost of ownership of ICT in the school sector*

NETC also highlight key issues concerning open source software and TCO and the following section summarises NETC's arguments[64]:

**Price**

NETC indicate that open source has an immediate and clear advantage in terms of the price of software in comparison to proprietary software, since users can either download the software directly from the Internet or they can pay a small fee to have a CD-ROM bundled and packaged. NETC see a strength of open source software being in its longevity: it will never expire or require licence payments. They also argue that by combining inexpensive or donated hardware with open source software, schools are able to deploy computers for less money.

[62] See: http://www.netc.org/openoptions
[63] See: http://www.netc.org/openoptions/images/pdf/netc.circuit.pdf
[64] See http://www.netc.org/openoptions/pros_cons/tco.html

**Opportunity costs**
NETC defines 'opportunity costs' as the costs in dollars and stress that occur as a result of old choices no longer being possible with upgrades of software. They indicate that 'opportunity costs' are highest when a specific, critical program is unavailable or incompatible. NETC argue however, that a school does not have to migrate exclusively to open source and may achieve incremental advantages by phasing out proprietary software. They indicate that emulation software such as WINE can also offset opportunity costs. Some open source proponents downplay this cost, arguing that such specific needs are rare, however in the school envirnonment this is an issue (eg for school administration software). The increasing use of browser based and Java applications though, may ameliorate this to some extent.

**Other costs**
NETC suggest that 'other costs' associated with the use of open source software are potentially lower than for proprietary software. NETC suggest that open source application software typically has lower hardware requirements than proprietary alternatives. On the other side of the coin however, they indicate that many of the new applications in the open source (eg the GNOME/KDE desktop environments) require well-specced computers as they have become more complex and feature-rich.

## 5. Summary
This literature demonstrates that irrespective of the model or approach taken to conduct a TCO, there is general consensus that a TCO aims to collect all the data associated with the complete deployment of ICT products and services within an organisation: whether that be a school or a Department of Education. TCOs can identify costs as a snapshot in time for any given year and/ or they can plot costs over the life cycle of an ICT deployment.

Components commonly identified to be included in a TCO include:
- hardware purchases and maintenance;
- software acquisition and upgrade costs;
- software compliance costs;
- vendor management costs;
- direct labour support costs;
- security and anti-virus management;
- service and lease costs;
- telecommunications and network costs;
- dedicated costs for housing and running ICT;
- technical training and user professional development.

Benefits identified for undertaking a TCO include consistently using a specified framework with agreed definitions and a common approach for the gathering and collation of data. Gathering data in consistent forms means that this data can be used to
- systematically inform the planning and the continuous improvement processes that underpin organisational approaches to change occurring in schools and school systems in relation to the use of ICT in education; and
- enable managers and leaders to be able to make budget decisions.

It is apparent from this review of the literature however, that the models outlined for undertaking a TCO and the current processes for budgeting for ICT used in Australian and New Zealand schools and sectors do not necessarily produce an easy match. While schools and school jurisdictions have identified people who are responsible for the ICT infrastructure, there are also costs for ICT deployment that are accommodated by other parts of the organisation. For example, in a school, individual faculties purchase software packages specifically suitable for their respective subject area. Individual units within corporate education offices sometimes purchase products and services outside of those funded through the central ICT infrastructure agency. The diversity of practices for the purchase and deployment of ICT products and services across Australia and New Zealand currently makes it difficult to ascertain the extent of these costs.

# Undertaking a financial analysis

The development of a TCO Framework and associated component definitions appropriate for use in Australian and New Zealand schools have been developed and form part of this report. The following section outlines principles and processes for collecting and analysing data for the purposes of undertaking a TCO. This Framework may assist schools and school jurisdictions who wish to commence the developmental processes associated with the collection and analysis of the total financial data required to determine what is the total cost of ownership of ICT. It is intended that the processes for using the Framework will enable financial and budgetary analysis of the costs of deploying and supporting an ICT infrastructure within school education.

## 1. Principles underpinning a Total Cost of Ownership

The following principles have been developed to inform the basis upon which total cost of ownership processes are used. Undertaking a TCO requires:

- Commonly understood definitions about each of the cost components forming the TCO
- Clarity about the assumptions underpinning the Framework components
- Clarity about the mix of these components used in the TCO
- Recognition that TCOs tend to be contested by nature and that there are no absolute truths
- The processes are intended for use in real locations with real numbers
- The processes start specifically with identifying costs for each component and build up to summaries.

### Direct and indirect costs

The Gartner approach to undertaking TCO analyses are to divide the costs for ICT into groups that enable consistent and reliable comparisons to be made. The Gartner TCO model uses two major categories to organise costs: direct or budgeted costs and indirect or unbudgeted costs.

Gartner refers to direct costs as budgeted costs (albeit that some costs may be hidden) such as the capital, software and labour costs spent by an organisation such as a school or department of education on the delivery of ICT products and services. These costs include capital expenses, IT management, IT support, maintenance and upgrade costs, communication fees, outsourcing fees, procurement costs, and training and professional development costs. The purpose of identifying the direct costs is to determine the overall costs for the provision of an ICT infrastructure.

Gartner refers to indirect costs as those unbudgeted items that are not seen as having a direct, causal relationship to the provision of IT infrastructure but nonetheless do have an impact. Indirect costs include self and peer support, and items that generate inefficiencies. These costs tend to be difficult to identify and quantify.

Here, the focus is upon the direct or budgeted and expended costs of the provision of ICT infrastructure at school and school jurisdictional levels.

### Costs are present at each stage of the ICT life cycle

Costs for ICT can also be conceptualised according to the life cycle of ICT goods and services as the following diagram illustrates.

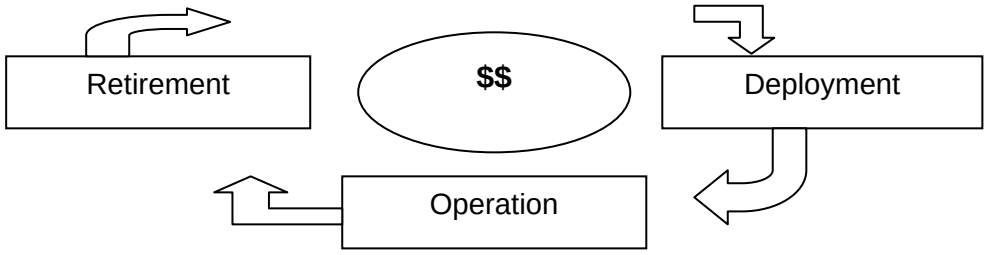



*Diagram Six: Life cycle of ICT goods and services*

## 2. Processes

To develop both a snapshot in time and a TCO which covers several years, it is suggested that the following processes are used:

- Identify and document the assumptions being made;
- Identify the timespan over which data is to be collected;
3. Select the cost components that relate to local circumstances;
4. Determine the location for the costs;
5. Determine the financial amounts for each component using a process of identifying the raw numbers, totalling these, and then turning these numbers into annual averages;
6. Summarise the costs for each category of components (ie hardware, software etc); and
7. Calculate the costs as percentages of the total costs.

Discussion about using these processes follows shortly and Appendices Four and Five provide descriptions of the TCO components and proformas to assist in following these processes.

### Assumptions underpinning a total cost of ownership analysis

While each individual or organisation undertaking a TCO should identify and document their own assumptions, the following generic assumptions should be kept in mind when undertaking a total cost of ownership analysis:

- TCOs are location specific
- TCOs should be undertaken using real numbers in real circumstances
- There is no 'right' number
- A low total cost may mean that the technology is not being used to its full advantage
- First data is likely to be incomplete or based around rough estimates
- First data helps us to focus on what we don't know
- TCO work should be repeated at regular intervals
- A TCO analysis should lead to more formal record-keeping
- Data collection over time should become easier and more accurate
- Regular TCO analyses are valuable for monitoring and tracking changes over time.

Individual organisations such as schools or corporate units should use their own data within an agreed TCO framework to enable comparisons of final figures over time within the organisation and with other agencies using the same framework.

### Timespan

It is suggested that to commence a TCO within school education, it should be conducted beginning with a one year snapshot of the costs at the school and/or central levels. This data can then become 'Year One' of data collection processes that can be planned over several years. Given that a first attempt at a TCO is likely to identify what things we don't know as well as what we do, then the first year of data collection for a TCO can also be used to determine what additional structures and information processes are required for future collections of data. That is, it can be subjected to action research processes.

## Total Cost of Ownership Framework components[65]

Identifying and defining the respective components required for the calculation of costs in a TCO is an important step in identifying the type of data required. This set of descriptions of components is accompanied by proformas (see Appendix Five) that can be used by officers both in schools and at the central level to calculate costs. It is intended that these proformas enable the gathering of information to inform school-based total cost of ownership analysis of its IT infrastructure; they can be used in central office to calculate corporate costs; and by aggregating school and central costs together, an holistic view of total cost of ownership can be constructed.

## Guide to the Total Cost of Ownership Framework components

Table Three (over the page) is a proforma designed to assist schools and school jurisdictions to identify and collect data to enable the development of financial costings that can then be analysed. The table has also been prepared separately as a spreadsheet to enable the electronic input and collation of data.

### Proforma and guidelines

Each of the components nominated for the identification of costs and a method for calculating these costs have been defined. These definitions can be found in Appendix Four and are intended to accompany the proforma over the page, and those in Appendix Five.

### Proforma column headings[66]

It is intended that with the use of the proforma (over the page), a school or jurisdiction can take a guided and systematic approach to the collection of data. The following table briefly explains the intention of each of the column headings.

**Table One: Explanation of proforma column headings**

| Components | In | Out | Open (O) or Proprietary (P) | | Locus of costs | | Total cost | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | O | P | School | Central | | |
| This column refers to components that can comprise the information technology architecture of a school or school education system | Here, users indicate (with a tick for each component) if they believe the identified component is to be included or excluded in the calculations | | Here users indicate with a tick whether the component is open source or proprietary. These columns will only pertain to software and software related issues but is included to enable analysis of the data on the basis of both proprietary and open source software | | This column is used to indicate the total costs for the identified component for a year in a school. Most school costs will be entered in this column. School TCOs however, may include some costs handled at the central level in which case these costs are entered into the next column | This column is used to indicate the total costs for the identified component for a year at a central level. Most corporate costs will be entered in this column. Corporate TCOs however, may include some costs handled at the school level in which case these costs are entered into the previous column | This is the combined total cost for the component. It comprises the school cost added to the central cost. | This column is provided for the user to make any notes about how the calculations were formulated so that they can be reproduced at a later date. |

[65] This section has drawn upon GartnerGroup (1998) *The new GartnerGroup TCO model – distributed computing chart of accounts*; and a range of online definitions including those drawn from Webopedia http://www.webopedia.com

[66] See table over the page

## 3. Table Two: Determining the costs: Total Cost Of Ownership Data Collection Proforma

This proforma is to be used for identifying costs for the components identified to be included in a total cost of ownership analysis, and to indicate whether these costs are a school or central office responsibility.

| COMPONENTS | IN | OUT | OPEN OR PROPRIETARY | | LOCUS OF COSTS | | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | O | P | $ SCHOOL | $ CENTRAL | | |
| | | | | | | | | |
| **Software acquisition** | | | | | | | | |
| Bundled operating systems software | | | | | | | | |
| Server operating systems software | | | | | | | | |
| Server operating systems software upgrades | | | | | | | | |
| Desktop operating systems software | | | | | | | | |
| Desktop operating systems software upgrades | | | | | | | | |
| Laptop operating systems software | | | | | | | | |
| Laptop operating systems software upgrades | | | | | | | | |
| Applications software | | | | | | | | |
| Applications software maintenance and upgrade costs | | | | | | | | |
| Middleware | | | | | | | | |
| Database software | | | | | | | | |
| Connectivity and communication software | | | | | | | | |
| Storage back-up software | | | | | | | | |
| Utilities software | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Software compliance costs** | | | | | | | | |
| Systems monitoring software | | | | | | | | |
| Licence management | | | | | | | | |
| Legal costs | | | | | | | | |
| ‘True up’ costs | | | | | | | | |
| Software audit costs | | | | | | | | |
| Vendor management | | | | | | | | |
| Software upgrade management costs | | | | | | | | |
| Software migration management costs | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |

| COMPONENTS | IN | OUT | OPEN OR PROPRIETARY | | LOCUS OF COSTS | | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | O | P | $ SCHOOL | $ CENTRAL | | |
| | | | | | | | | |
| **Hardware** | | | | | | | | |
| Servers | | | | | | | | |
| Clients | | | | | | | | |
| Laptops | | | | | | | | |
| Peripheral devices | | | | | | | | |
| Printers | | | | | | | | |
| Storage | | | | | | | | |
| Memory | | | | | | | | |
| Network connectivity hardware | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Hardware procurement and deployment costs** | | | | | | | | |
| Turnover | | | | | | | | |
| Legal costs | | | | | | | | |
| Vendor management | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Combined direct IT labour support costs** | | | | | | | | |
| Central management | | | | | | | | |
| Central help desk | | | | | | | | |
| Technical support officers | | | | | | | | |
| School management | | | | | | | | |
| School help desk/in-house technical support officers | | | | | | | | |
| Asset management | | | | | | | | |
| Security and virus management | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |

| COMPONENTS | IN | OUT | OPEN OR PROPRIETARY | | LOCUS OF COSTS | | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | O | P | $ SCHOOL | $ CENTRAL | | |
| | | | | | | | | |
| **Network IT access and management** | | | | | | | | |
| Caching hardware | | | | | | | | |
| Caching software | | | | | | | | |
| Bandwidth | | | | | | | | |
| Legal costs | | | | | | | | |
| Vendor management | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Services and lease costs** | | | | | | | | |
| Network service and management fees | | | | | | | | |
| Bundled telecommunication services | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Dedicated IT running and 'housing' costs** | | | | | | | | |
| Electricity | | | | | | | | |
| Airconditioning | | | | | | | | |
| Cabinets | | | | | | | | |
| Consumables | | | | | | | | |
| Downtime | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Formal training and professional development** | | | | | | | | |
| Technical training | | | | | | | | |
| Professional development of end users | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| | | | | **TOTAL** | | | | |

## Determining the costs

Table Three above has been designed to be accompanied by the following proformas[67] to assist in collecting the necessary data to determine the annual costs for each of the identified components:

1. *Total Cost Of Ownership Data Collection Proforma*
   This proforma is used to summarise all TCO costs. All other proformas feed into the completion of this proforma. The purpose of this proforma is to enable the collation of totals for each component identified as being included in the TCO calculations. Each component is added together to make a subtotal for each of the component categories and then each of the subtotals is combined to make a grand total. On the basis of each of the subtotals, then a percentage or ratio of costs can be prepared to avoid the disclosure of raw numbers.

2. *Identifying open source software servers and operating system costs proforma*
   The purpose of this proforma is to support the collection of information about open source operating systems and costs of the purchases of the associated servers. This information can then be collated and transferred onto the *Total Cost Of Ownership Data Collection Proforma*

3. *Identifying proprietary software costs for servers and operating system costs proforma*
   The purpose of this proforma is to support the collection of information about proprietary operating systems and costs of the purchases of the associated servers. This information can then be collated and transferred onto the *Total Cost Of Ownership Data Collection Proforma*

4. *Most important desktop applications*
   The purpose of this proforma is to support the collection of information about proprietary and open source desktop applications used. This information can then be collated and transferred onto the *Total Cost Of Ownership Data Collection Proforma*

5. *Costs of software purchases and maintenance agreements over time proforma*
   The purpose of this proforma is to support the collection of information about costs of software purchases (eg site licences) and maintenance agreements. As these licence agreements tend to straddle several years, this proforma is designed to enable the plotting of software costs over time to enable the creation of an annual average.

These proformas can be found in Appendix Five.

When collecting the data and determining the costs it should be remembered that the first collection of the data is likely to:

- *Be incomplete and may be based around rough estimates*;
  however this data will become more and more refined the more consistent TCO processes are followed.

- *Highlight gaps in what we know*;
  however once this lack of information is identified it can be used to inform how to improve data collection processes in the future, and this may lead to more formal record-keeping.

- *Be a time-consuming process locating and consolidating the required information*;
  however by repeating the processes in a consistent manner, over time, then the data collection should become easier and more accurate.

[67] See Appendix Five

# Testing a financial model: Total Cost Of Ownership in a school

The following scenario is based upon a real context from one jurisdiction: Grant High School in Mount Gambier, in DECS in South Australia.[68] This school is currently migrating from networked desktops to terminal services and is reducing the school's level of dependency upon proprietary software. Grant High School is aiming to improve the access to computers for students as quickly as possible. Currently the computer to student ratio is one computer per 3.4 students. The school is focusing on increasing this access to computers with a limited range of commonly used programs and will then increase the number and diversity of programs available to students.

## 1. Scenario

This total cost of ownership scenario focuses on the use of computing technologies for the purposes of teaching and learning rather than on the administration of the school. It is acknowledged that the ICT requirements in the administrative area of a school are important, however the 'core business' of schools is teaching and learning. While the ICT requirements for the school administration are reasonably defined and limited, the number of desktops and wider range of software available for teaching and learning purposes tends to be the more complex. It is for these same reasons though, that there is also greater room for innovation with ICT used for teaching and learning purposes. As such, this scenario focuses on the curriculum infrastructure costs of this school.

### School context

Grant High School is a secondary school located in a large country region. It has a student fulltime equivalent (FTE) enrolment of 770 students, 67 FTE teaching staff and 21 student support officers. Students living in poverty make up 30% of the student enrolment; 1% of the student cohort are Aboriginal and 15% of the students have identified special needs. The school runs two local area networks (LANS): one for curriculum purposes and one for administration. The school experiences 'brown outs' and 'black outs' to the electricity supply about once a week and so the power supply is protected by uninterruptible power units.

### ICT Context

The school has a large and complex ICT infrastructure that utilizes both proprietary and open source software. There are many reasons why the school is using both proprietary and open source software including the following:

- the ICT Team within the school wants to stretch the budget as far as possible;
- the school recognizes the international trend toward the use of open source software and wants its' students to be able to capitalize on this trend;
- the school identifies congruence between the philosophy underpinning open source software and the aims of the school;
- teachers at the school are attracted to the open source software/public good arguments concerning the licence costs of proprietary vs open source software;
- the school is aiming to reduce the current computer to student ratio while not increasing the level of IT labour support required;
- the ICT Team wishes to reduce the management of multiple software licences and maintenance agreements and wishes to reduce the extent of these while also increasing the range of software available for use by students;
- as a duty of care, the school wishes to reduce the risk of students using pirated software; and
- the school is seeking software solutions that enable longer life to be gained from hardware.

[68] This scenario is outlined in more detail in a separate publication of case studies of schools using open source software

Along with introducing the use of open source software, the school is reducing its computer to student ratio by minimising its per unit hardware costs for both desktops and servers. They are doing this by purchasing recycled computers and using these with carefully selected open source software to run them. The necessity for expertise to trouble-shoot and problem-solve when deploying open source software is recognised by the school leadership, and structures have been put in place at Grant to support continuous improvement of the skills and expertise required in open source software at the school.

## Budget

Schools in DECS (SA) operate under local school management budget arrangements. The school is required to manage within a global budget that comprises an allocation received from central office and is supplemented with additional funds gathered from successful grant applications and from the local community. The base-level funding available to the school is set according to a central office formula. This formula does not include any specified funding component for IT technical support hours or funding allocations for the planned, recurrent turnover or purchase of hardware or software. It is up to the school to determine whether ICT is a priority and the level of funding to be allocated from within the school's global budget.

At Grant High school, the school ICT budget is planned and approved over a three year cycle, with school approval cycle processes locking in these triennial budgets. The ICT Coordinator at the school has a base-line three-year budget of $180,000 averaged as an annual budget of $60,000. The triennial nature of the budget allocations means that the ICT Coordinator can plan and save for large cost items during the funding period. The budget covers all ICT infrastructure requirements excluding salaries which are funded from within the school's global budget, training, professional development and subject specific software which are funded by individual faculties within the school.

Grant High School has been provided with $10,000 in 2004 from central office to purchase hardware only. This grant is part of a set of 'one-off' grants provided to schools. Central office grants specifically for ICT purchases have been allocated as annual grants until 2006, and so the recurrent costs for handling ICT demands in this school are largely dependent upon the amount of funding the school is able to allocate from within the budget resources received through global budget allocations and local school fund-raising.

## Computer hardware deployment

The school has 240 desktops. The administration team has 18 desktops and 222 are deployed for use by students and staff as follows:

- Four computer labs, one with 30 computers and three with 25 computers in each;
- Clusters of 15 computers are deployed on the senior and junior floors respectively;
- Clusters of computers are deployed in the Maths (8), Science (12) and Art areas (8);
- There are 20 computers in the library;
- There is at least one computer in every classroom outside of the main building; and
- At least one computer in every office space for teacher use.

The school has access to a computer recycling company and until recently had been receiving computers through the state government's computer recycling scheme. Most servers and desktops are purchased second-hand from government agencies in the local area and from local businesses. The cost for a standard student desktop is $300.00.

The school has 14 servers for curriculum purposes. The following hardware is used for these:

- IBM PC 300PL
- AthlonXP 1800+
- Dual Athlon
- Dual Athlon 1700
- K6-500
- Dual IntelPIII/933
- Athlon XP 1600+

This range of servers is used for web servers, proxy servers, domain controllers, LAN management, print servers, library servers, terminal services, remote access servers, and back-up. The servers are connected to the LAN either via 3COM switches or equivalent Netgear switches. These servers are also recycled hardware.

All servers are located in one room which is secure and airconditioned.

Terminal services have been put into the school for student use to:
- Reduce the amount of vandalism;
- Reduce the number of moving parts in the computers;
- Reduce the amount of technical support required to maintain the computers;
- Enable increased student to computer ratios; and
- Elongate the life of the computers.

## Software deployment

The school uses both Microsoft and open source software. DECS (SA) has a three year Microsoft Schools and Campus Agreement licence which covers the following software upgrades for schools:
- Desktop operating systems: Windows '95 to Windows XP
- Office suite (any version from Office 97 to Office 2003):
  - Word
  - Excel
  - Powerpoint
  - Frontpage
  - Outlook
  - Explorer
  - Access
  - Publisher
  - Visual Studio
  - Encarta
  - Step-by-step guides

The school is required to pay about $4000 per annum to central office as a contribution to the total cost for the Microsoft Schools and Campus Agreement department-wide licence. This contribution is calculated on a per student basis.

Client access licences are purchased at a jurisdictional level for use across the agency. Licences are provided within the Microsoft Schools and Campus Agreement for Windows Server, Exchange, SMS, MS portal server, SQL server. Schools can also buy licences for products which are available as perpetual licences under Academic Select agreements. The Department also has a department-wide licence for virus software through McAfee.

Grant High School uses Windows 2000 Professional and MS Office 2000 on the front end of all the 222 'curriculum' desktops. OpenOffice is available on the desktops and all students and staff have been issued with a copy of OpenOffice to install at home so that they can use the same software both at home and at school for minimal cost to the school community.

The operating system software being used on the curriculum servers is as follows:
- 4 x SME Servers (based on Red Hat 7)
- 2 x Fedora
- 1 x RedHat 8.
- 1 Windows 2003 server operating systems
- 5 Windows 2000 server operating systems
- 1 Windows XP desktop operating system

The open source server software is upgraded only to improve the system. Apart from the XP desktop operating system, the MS server software is not covered under the jurisdiction's Microsoft Schools and Campus Agreement which means that the school purchases these licences under the Academic Select Agreement and manages these licences locally. Individual faculties purchase or acquire subject specific software that is both proprietary and open source. In addition, the school uses a wide range of open source and proprietary software including Gimp, Audacity, WinZip; Adobe and Macromedia products. Managing the number of software site and seat licences and maintenance agreements is a complex and time-consuming task for the school.

Internet browsing is available through either MS IE6; Mozilla or Opera.

A summary of the server hardware and software specifications and costs at Grant High School is included over the page in Tables Five and Six.

## Storage of data

Students are provided with 40Mbs and teachers are provided with 250Mbs of server space that is backed up regularly, first to file and then to tape. The school uses three generations of file backup because they can get back to files without having to go to tape and this lessens the support requirements and costs.

## IT support

The school is able to afford in-school technical support (level 3) for 25 hours per week and in-school technical support (level 2) for 24 hours a week. The ICT Coordinator teaches one line less than other coordinators in the school. The school also provides training through Aries A+ for computer technicians, which costs $2000 per year, per person. These trainees also contribute to the support and maintenance of the IT infrastructure of the school. All desktops are re-imaged on a weekly basis. The technical support is used for the following:

- Curriculum Support
- Teaching of ICT skills
- Network maintenance
- Administrative functions.

A centrally-funded regional technical support officer provides support for administrative functions of the school on request; this officer does not officially provide technical support for the technologies associated with the curriculum LAN or in the teaching of ICT skills. If the school requires outside technical support for 'curriculum' functions, then this support is at the cost of the school.

## Bandwidth

The available bandwidth at the school is 100mbps internally with two ISDN lines of 128kbps each. One of these ISDN lines is for curriculum use and the other is for administration. Increases in bandwidth provided centrally are anticipated shortly.

## Total Cost of Ownership

Using the proformas included in Appendix Five, the following first set of TCO figures have been prepared for the Curriculum ICT deployment at Grant High School. Tables Five, Six and Seven provide the preliminary figures that informed the development of this TCO.

**Table Three: Year One: Total Cost of Ownership of ICT at Grant High School**

| COMPONENTS | COST | % OF TOTAL |
|---|---|---|
| Software acquisition | $29,000 | 13% |
| Software compliance costs | $22,000 | 9.8% |
| Hardware costs | $80,000 | 35.6% |
| Hardware procurement and deployment costs | $6500 | 2.9% |
| Combined direct IT labour support costs | $50,000 | 22.2% |
| Network management: Caching software (only)+ | $0 | 0% |
| Services and lease costs | $0 | 0% |
| Dedicated IT running and housing costs | $7000 | 3% |
| Downtime | $2500 | 1.1% |
| Consumables | $9000 | 4% |
| Formal training and professional development | $19,000 | 8.4% |
| TOTAL | $225,000 | 100% |

*+Note: Due to imminent changes to the arrangements, telecommunications costs are not included here*

## Table Four: Identifying costs: servers using open source operating system software at Grant High School (2004)

| Open Source Software Servers | Operating System | Operating system software licence costs[69] | Most important applications | Cost of acquiring important applications software[70] | Assumptions: Role of server | Server hardware | Cost of server hardware[71] |
|---|---|---|---|---|---|---|---|
| OSS 1 | SME-Server 6.0b2 | $0 | Linux, Apache, MySQL, PHP | $0 | Serves as SQL server for Schoolmation, Moodle and MRBS Booking | IBM PC300PL | $300.00 |
| OSS 2 | SME Server 5.6 | $0 | Squid, Samba | $0 | Squid Proxy Server | IBM PC300PL | $300.00 |
| OSS 3 | SME Server 6.0b2 | $0 | Apache | $0 | Open Source Software Mirror | IBM PC300PL | $300.00 |
| OSS 4 | SNS-server v1.3 | $0 | Red Hat 8 | $0 | Linux Domain Controller, testbed only | IBM PC300PL | $300.00 |
| OSS 5 | Fedora Core 1 | $0 | K12LTSP v4.0 | $0 | Linux Terminal Server | Dual Athlon 1700 | $300.00 |
| OSS 6 | Fedora Core 1 | $0 | K12LTSP v4.0 | $0 | Linux Terminal Server | Dual Athlon 1700 | $2,500.00 |
| OSS 7 | Redhat 8.0 | $0 | LTSP | $0 | Sandbox Linux Terminal Server Project server, not in 'public' use | Dual Athlon 1700 | $2,500.00 |
| **SUMMARY COST OF HARDWARE AND SOFTWARE** | | $0 | | $0 | | | $6,500.00 |

[69] Does not include labour [next step is calculate labour costs]
[70] Does not include labour next step is calculate labour costs]
[71] Purchased secondhand

**Table Five: Identifying costs: servers using proprietary operating system software at Grant High School (2004)**

| Proprietary servers | Server Operating System | Operating system software licence costs[72] | Most important applications | Cost of acquiring important applications software[73] | Assumptions: Role of server | Server hardware[74] | Cost of server hardware[75] |
|---|---|---|---|---|---|---|---|
| MS 1 | Windows 2000 | $200 | Windows applets: ADS, DHCP, DNS, | $0 | Domain Controller for our primary domain | Athlon XP1800+ | $900 |
| MS 2 | Windows 2003 | $200 | ADS, DHCP, DNS | $0 | Primary Domain Controller | Dual Athlon 1700 | $2500 |
| MS 3 | Windows 2000 | $200 | Printer Accounting Server | $495[76] | Printserver with accounting for 17 printers | K6-500 | $300 |
| MS 4 | Windows 2000 | $200 | Windows applet: ISS4, | $0 | Intranet and user files backup, virus scanner update point | Intel PIII/800 | $300 |
| | | | ArcServe 6 AE | $1000 | | | |
| MS 5 | Windows XP Pro[77] | $0 | Ghost 7.5 EE | $3000[78] | Ghost Server | IBM PC300PL | $300 |
| MS 6 | Windows 2000 | $200 | Terminal Services, RAS | $0 | Remote access server, Windows Terminal Server | Dual Intel PIII/933 | $2,500 |
| MS 7 | Windows 2000 | $200 | Amlib, | $3000[79] | Library System server with own backup | Athlon XP1600+ | $2,800 |
| | | | MS SQL | $400 | | | |
| | | | ArcServe 6 AE | $0[80] | | | |
| TOTAL | | $1200 | | $9895 | | | $9,900 |

[72] Does not include labour. Costs as per the School Select Agreement.
[73] Does not include labour. $0 costs in this column are as a result of these functions being included in the MS licence agreement.
[74] Secondhand hardware
[75] Purchased secondhand
[76] $150 per annum for server upgrades
[77] Windows XP Pro is covered under the departmental Enterprise Agreement
[78] Cost per desktop licence
[79] This price is for year one. There is an ongoing cost of $1500 per year for maintenance
[80] Included in abovementioned cost for ArcServe 6 AE

## Table Six: Desktop Applications - proprietary and open source software at Grant High School (2004)

Main desktop applications used by students and staff.

| Most important proprietary desktop applications | Applications software licence costs[81] | | Role of important applications software[82] | Most important open source software desktop applications | Applications software licence costs[83] | |
|---|---|---|---|---|---|---|
| | School | Central Office | | | School | Central Office |
| MS Word (MS Office) | $4000[84] | Not for disclosure | Word processing | Text document (OpenOffice) | $0 | $0 |
| MS Excel (MS Office) | | | Spreadsheet | Spreadsheet (OpenOffice) | $0 | $0 |
| MS powerpoint (MS Office) | | | Presentation | Presentation (OpenOffice) | $0 | $0 |
| MS Access | | | Database | MySQL | $0 | $0 |
| Frontpage | | | Web-page design tool | NVU | $0 | $0 |
| Publisher | | | Desktop publishing tool | Gimp | $0 | $0 |
| Visual studio | | | Programming | Python | $0 | $0 |
| Encarta | | | Reference materials | Online materials eg K12 Linux | $0 | $0 |
| Step-by-Step | | | Tutorials | Online tutorials | $0 | $0 |
| WinZip | Under evaluation | $0 | | GZip | $0 | $0 |
| TOTAL | $4025 | Not for disclosure | | TOTAL | $0 | $0 |

**Other proprietary software**

Licences and maintenance agreements vary for each of these licences. Each piece of software was costed per the number of licences and total entered into *the Total Cost of Ownership Data Collection proforma.* Grant High School only pays a small percentage of the total cost for their licences covered under the Microsoft Schools and Campus Agreement. The remaining licences are paid for and managed at the school level. Other software the school purchases includes:

- Photoshop
- Accelerator
- FX (Maths)
- Finale
- Sibelius
- PC Stage
- Pinnacle Studio
- Tricad
- Special education CDs
- Japanese word processor

[81] Does not include labour. Cost of Microsoft licences is shared between the school and central office. The cost of the licence includes the applications software and the desktop server software
[82] Does not include labour
[83] Does not include labour
[84] This contribution represents a small part of the total cost

### Observations from undertaking the TCO

It became apparent undertaking the TCO that the financial model used for the allocating the school's funding and that used for undertaking a TCO are different. The school allocates salaries from within its teaching and school support officer hours. Undertaking the processes required to conduct a TCO takes account of the specific costs including labour allocated to undertake individual components of the TCO, across all parts of the school.

Taking a TCO approach has highlighted how complex and expensive it is to manage the wide variety of proprietary licences (with their different conditions, timeframes and renewal requirements), at the local level. The TCO also highlighted some competing policy positions about which the school has had to make some pragmatic decisions. To illustrate: there is the policy aim to increase computer to student ratios at the local level. It is preferable to do so within a standardised IT environment where the age range of the computers is kept low. There is a limited budget however, and so recycled computers offer this school a cost effective solution in comparison to the costs of purchasing new computers to achieve the same computer to student ratios; and recycling of government and business computers is supported by government and IT industry programs. Furthermore, where there are competing demands for finances, the use of recycled computers can be seen as a defensible way of expending public funds.

Alongside of these IT infrastructure issues sit educational issues. In a TCO Framework these can be considered as 'intangibles'. Grant High School is aiming to provide a broad general education, including in the use of ICT in teaching and learning. Different faculties use subject specific software as well publishing and presentation software. Those staff at the school choosing to include open source software in their suite of software for use in teaching and learning, articulate philosophical and socially critical reasons for broadening the school's ICT environment. They see it as important that students leave school not only confident and creative in using ICT but that they have the flexibility and adaptability to be able to transfer their skills across a range of software packages. In other words, these teachers see it as more important to teach the generic skills that underpin the use of technologies in classrooms as well as the instrumental functionality of specific software programs. Teachers using open source software also talk about the importance of students learning about the impact of technologies on society: open source software provides an authentic issue about which to discuss broader issues concerning the acquisition of proprietary and open source software. Broadening the software environment however, also presents challenges for methods of standardising the software environment. Nonetheless, it is these 'intangible' educational issues that are of importance to the community at Grant High School, not only cost factors.

Finally, it is the view of the leadership and ICT teams at Grant, that irrespective of the software deployed, they require technical and ICT salaries to keep the infrastructure of the school running. They see it is a responsible approach to financial management to use open source as they believe they are getting better value from public money. The school acknowledges and manages the risks associated with such an approach by developing technical expertise in the local community.

## 2. Future plans

The IT team at Grant High School is aiming to continue to provide students with increased access to computers by reducing the computer to student ratios. Grant High School's future plans for ICT deployment are premised on the assumption that learning management systems will become the next generation of curriculum delivery tools that they will use at the school. As such the students will require increased access to computers.

Given the school sees it as critical to increase student access to computers, it is their aim to roll-out and maintain the extra computers in such a manner that they do not create additional

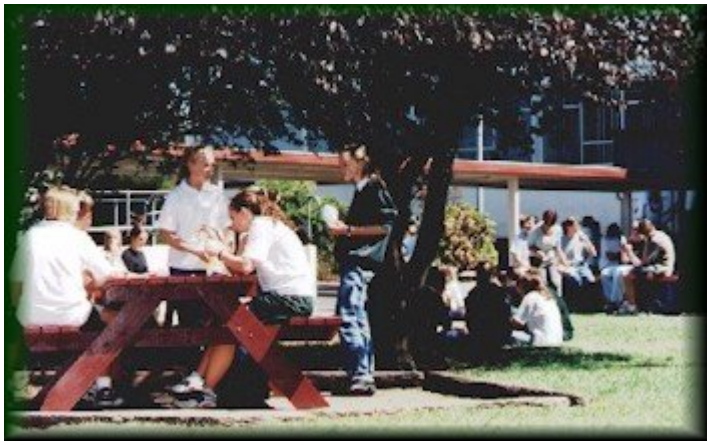
burden on the in-school IT team. Through the research and trials the school have conducted over the past few years, the IT team has learnt that they can effectively use and manage recycled computers for teaching and learning purposes and to make efficiencies in the labour required to managed these computers.

The school is currently testing the deployment of Linux terminal services. Through these processes of research and development, terminal services have emerged as a robust solution to increasing the number of computers available for use by students without making comparative increases in the staff required to manage the computers. Once the terminal services are established, the school anticipates rolling out learning management systems for use by all Year 8-10 students.

The school sees universities and TAFEs using learning management systems, and so they believe that if their students have had prior experience in using learning management software they may be more successful in their future endeavours. The school will review the use of learning management systems in the junior years and if it is successful they may broaden its' use to the senior school or use learning management systems to provide more options to students post school.

Grant High School

Educating for Excellence



# ICT deployment options

Schools and central offices sometimes have different motivations for ICT deployments. The following table[85] summarises different ends of a continuum of descriptors that can characteristise ICT deployments. Using their TCO schools and agencies will be able to identify themselves somewhere on the continuum between 'target' and 'actual' ICT deployment. A TCO can facilitate identification of where schools and corporate offices currently are on this continuum and help to determine the directions in which they would like to move. Alternatively, it is possible to challenge the assertions about what constitutes an efficient and effective deployment of ICT in school education.

**Table Seven: ICT deployment options[86]**

| Components of TCO | Continuum of characteristics of IT deployment | |
|---|---|---|
| | **IT deployment theory (target)** | **Doing the best we can (actual)** |
| **Software acquisition** | Centralised, standardised purchasing is cheaper than local purchasing | Schools stretch their local budgets by looking for options in software |
| | The greater diversity of software the more support is required | A diversity of software is supported |
| | Regular upgrading of software is necessary | Regular upgrading of software is not possible or is not seen as necessary |
| | Only centrally approved software is installed on computers | Both centrally approved software and other software are installed |
| **Software compliance** | Compliance costs are managed centrally | Compliance is managed 'as best we can' |
| | One inventory system is in place and regularly updated | Multiple inventory systems are in place in various states of accuracy |
| | Legal requirements are managed and monitored | Legal requirements are managed 'as best they can' |
| | Lock-in to one proprietor for given products and services is avoided | Lock-in occurs as IT is purchased because 'we need it now' rather than as a result of longer term planning |

[85] Adapted from CoSN: http://www.cosn.org
[86] See http://www.cosn.org

| Components of TCO | Continuum of characteristics of deployment | |
|---|---|---|
| | **IT deployment theory (target)** | **Doing the best we can (actual)** |
| **Hardware** | The age of computers is kept narrow<br>[based on asset depreciation and rollover] | Computers are turned over when they can no longer be repaired |
| | | Schools can purchase hardware to meet the specific purpose required: eg limited number of more expensive, high level machines and a lot of cheaper, smaller (including second hand) machines |
| | It is cheaper to manage the purchase and deployment of all hardware centrally [economies of scale] | Central office provides partial funding for hardware & schools make up the difference |
| | | Recycled and donated computers are used to increase the student to computer ratio |
| | Asset register is maintained and updated centrally according to standards | Asset management is the responsibility of the school and is maintained as best they can |
| **Labour support** | Support is allocated at a ratio of one support person to every 50 computers[87] | Support is allocated based on available budget rather than on number of computers requiring maintenance |
| | | Support is allocated on persons per regional area rather than person to computer ratios |
| | | Funded support only partially covers the required support, which sees informal support networks fill the void |
| | | Support relies on goodwill, local knowledge and a mixture of teachers, students and district personnel to fix problems |
| **Networks** | Fully integrated, connected, interoperable | Disparate, disconnected, local networks, locally supported without connection to a wide area network |
| **ICT Housing costs** | Required modifications to buildings to accommodate the technology (eg electrical, heating, cooling, desks) are budgeted and met | Required modifications to buildings occurs only when funding is available |

[87] Gartner assumption

| Components of TCO | Continuum of characteristics of IT deployment | |
|---|---|---|
| | **IT deployment theory (target)** | **Doing the best we can (actual)** |
| **Formal training and professional development** | 15-30% of total annual budget is devoted to staff professional development[88] | Staff professional development is provided according to what can be afforded. Majority of professional development occurs in the school. |
| | Training and professional development is included in the price of the licensing agreement | Is reliant on local knowledge and communities of practice |

[88] Proposed amount of professional development required in the US

# Managing risk[89]

Irrespective of whether the software is open or proprietary, there are risks in managing schools' and school jurisdictions' software requirements. Generally, the more decentralised an education sector is the less controls there are on software costs and the more diverse the local environments are likely to be.[90] One of the most contentious issues in distributed organisations such as school jurisdictions is deciding which ICT issues are reserved exclusively for central office and those that can be decided at the local level.[91] Similarly, the more freedom is given at the local level for the purchase of software the more expensive the total proprietary software costs are likely to be for the organisation as a whole; and it is likely that individual sites will bear higher risks in order to manage and not compromise licencing arrangements for standard operating environments and/or corporate applications.[92] The nature of the resolution concerning the degree of autonomy provided to the local level for software provision will affect the degree of risk a school and/or a system is to experience.[93]

In order to manage risk, ICT deployments in schools and jurisdictions have to:

- be financially sustainable;
- not overly time consuming to manage;
- ensure security and privacy;
- enable collaboration within and across agencies;
- accommodate uncertain futures; and
- be supportive of the reduction of risks over time.[94]

Risks for schools and sectors with proprietary software include the following:

- administrative costs of software licence compliance and maintenance of records;
- adding and deleting software to machines consistent with licence agreements;
- lack of professional development for staff concerning the regulations associated with software compliance and non compliance;
- the provision of appropriate technical support; and
- compliance with the Trade Practices Act.[95]

Risks for schools and sectors with open source software include:

- Training costs;
- Internal support costs;
- Determining which software to use; and
- External support costs.[96]

The following diagram summarises the costs and benefits that proprietary and open source software offer schools and jurisdictions.

[89] See Moyle, 2003
[90] Consortium for School Networking, Taking TCO to the classroom, 2001; Board of Technology, Government of Denmark, Open-Source Software in Digital Management in the Public Sector, Government of Denmark 2002
[91] Board of Technology, Government of Denmark, Open-Source Software in Digital Management in the Public Sector, Government of Denmark 2002L. Murphy, Curriculum software: Business Case, DECS (SA) 2003
[92] Ibid, Ibid
[93] Ibid, Ibid
[94] See Board of Technology, Government of Denmark; Board of Technology, Government of Denmark, Open-Source Software in Digital Management in the Public Sector, Government of Denmark 2002; Open-Source Software in Digital Management in the Public Sector, Government of Denmark 2002; Swedish Agency for Public Management, Free and open software, http://www.statskontoret.se/pdf/200309eng.pdf; C. Kenwood, A Business Case Study of Open Source Software, MITRE, 2001, http://www.mitre.org/support/papers/tech_papers_01/kenwood_software
[95] L. Murphy, Curriculum software: Business Case, DECS (SA) 2003
[96] Ibid

## Costs and benefits of open and proprietary software

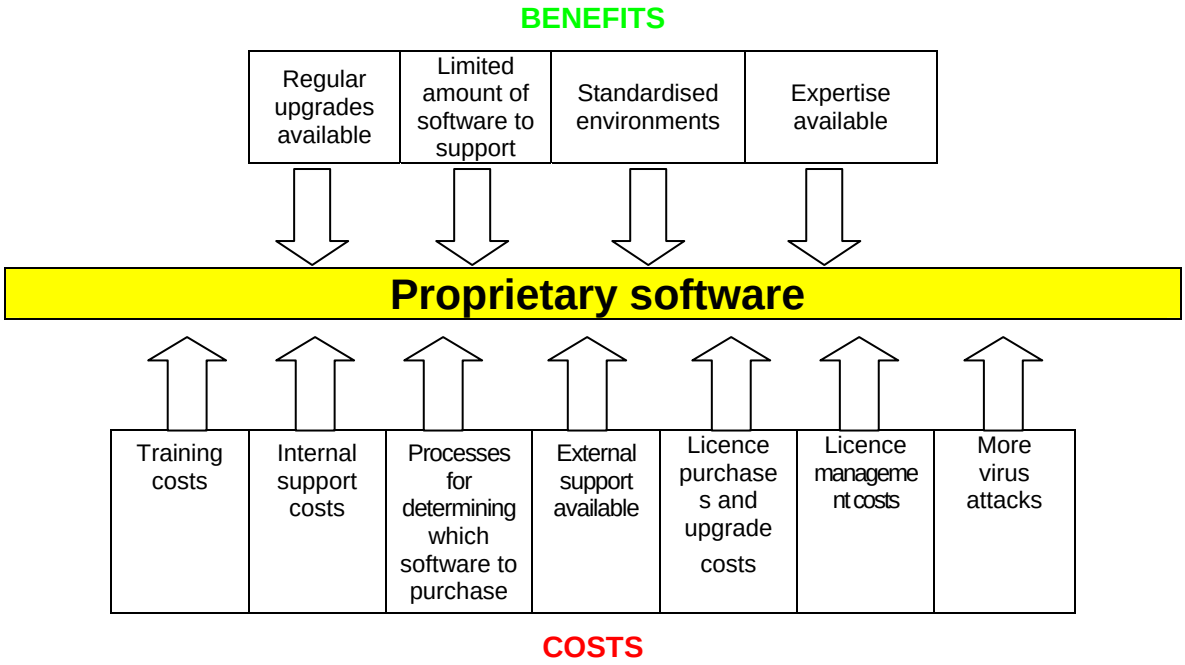



*Diagram Seven: Costs and benefits of proprietary software*

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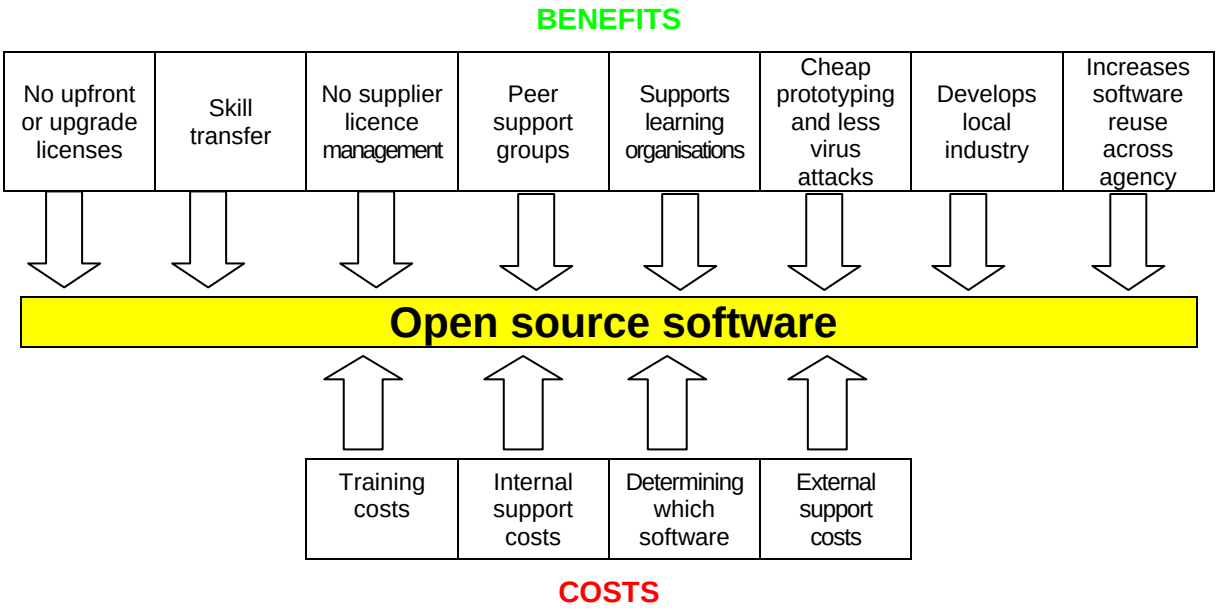


*Diagram Eight: Costs and benefits of opens source software*[97]

[97] See Moyle, 2003

# Conclusions

This research set out to address the overarching question *What place does open source software have in Australian and New Zealand schools and school jurisdictions' ICT portfolios?'* This research paper has used the following key subsidiary questions to address the major research question:

- What are the models and their underlying assumptions for identifying total cost of ownership for using open source software operating systems and applications within Australian and New Zealand schools?
- What are the components for determining total cost of ownership of open source software to be used within Australian and New Zealand school sectors and systems?

Research of this nature has not been undertaken previously in Australia or New Zealand. This was a short research project, and as a result the outcomes are introductory and exploratory. The outcomes however, do provide indicators and the basis for future research. Schools and jurisdictions around Australia and in New Zealand are choosing to make a place for open source software in their ICT portfolios. Some schools are using open source software irrespective of whether this is with the approval of their central offices or not. There is a complex mixture of philosophical, educational, policy, technical, budgetary and pragmatic reasons for this occurring that have been revealed through this research.

Generally speaking, the more complex the school, the more complex the ICT environment. Through the literature review, and through the development and trialing of the TCO Framework, the assumptions that underpin TCO analyses have been identified and outlined. This list has been designed to accommodate both simple and complex education ICT environments. A list of components that are pertinent to undertaking a TCO analysis within the Australian and New Zealand school education context have been identified and defined. These are included in Appendix Four. These components are now available for other jurisdictions and schools to examine, trial and use.

It became apparent through the research that while each individual or organisation undertaking a TCO should identify and document their own assumptions, the following general assumptions were identified as important to underpin a TCO analysis:

- TCOs are location specific;
- TCOs should be undertaken using real numbers in real circumstances;
- There is no 'right' number;
- A low total cost may mean that the technology is not being used to its full advantage;
- First data is likely to be incomplete or based around rough estimates;
- First data helps us to focus on what we don't know;
- TCO work should be repeated at regular intervals;
- A TCO analysis should lead to more formal record-keeping;
- Data collection over time should become easier and more accurate;
- Regular TCO analyses are valuable for monitoring and tracking changes over time; and
- TCOs assist in decision-making where they are based upon commonly agreed benchmarks.

It would appear that after the debate about the cost/no cost of proprietary vs open software licences has been addressed then a TCO analysis seems to be dependent upon the sort of model of ICT deployment used. The TCO Framework developed through this research now provides individual schools or corporate units with a Framework within which they can apply and test their own data. Using an agreed TCO framework will enable comparisons of final figures over time within the school or unit and with other agencies using the same framework.

Two key distinctions in TCO components concerning the use of open source compared to proprietary software emerged as important: firstly the disparity in the costs of open compared to proprietary software licences and their associated management and compliance; and secondly, the levels of expertise required to successfully deploy open source software.

This research has identified gaps in our current knowledge about both TCOs and the use of open source software. These gaps include the following:

- The extent of use in schools of open source software is unknown;
- The nature of the use of open source software has not been mapped;
- There is no Australian or New Zealand research on different ICT deployment models and their associated TCOs;
- The management of proprietary software licences in schools is a time-consuming and under-estimated task but its' extent is unknown and strategies for managing this issue require identification;
- TCO analyses according to different models of ICT deployment need to be tested;
- There is no research and associated costings undertaken in either the Australian or New Zealand school sectors about processes of migration from proprietary to open source software;
- There are potential differences in the way a central office approaches ICT deployment and management issues and the way schools approach these same issues, which should be identified and analysed.

The trial of the TCO at Grant High School provided insights into the financial model used for allocating the school's funding and that used for undertaking a TCO. It demonstrated that the underpinning model for funding schools in South Australia and the model for accounting the TCO of ICT deployment are different. Nonetheless, the research highlighted several issues pertinent to the cost of deploying ICT in schools including:

- some competing policy positions emerged as did the practical solutions chosen at Grant to resolve these;
- the view that open source software and open standards should not be seen only as a financial exercise but be viewed in the context of the role of education to educate and within the context of fostering interoperability of IT systems across the school;
- the importance of a supportive school leadership team when undertaking whole school change; and
- where properly deployed, supported and managed open source software has a place in schools' ICT portfolios.

The research confirmed that ICT deployments in schools and jurisdiction should:

- be financially sustainable and not too time consuming to manage;
- ensure security and privacy;
- enable collaboration within and across agencies;
- be supportive of the reduction of risks over time; and
- take into account the intangible educational issues as well as the costs and architecture issues associated with ICT deployments.

While TCO analyses tend to be comprehensive, there are aspects to choices about the deployment of software that do not easily get addressed in TCOs. These issues include:

- the value placed on the educational and philosophical aspects of software use in schools;
- the applicability or degree of suitability of software for a particular organisation;
- the degree of flexibility, scalability and modularity software may have;
- the capacity of integration of different pieces of software;
- the degree of 'lock in' a vendor is able to achieve and the implications for schools over time;
- the cost of reversing 'lock in'; and
- the degree of reusability of software.

As a result of this research then, while information has been gathered that can inform future work undertaken within schools and jurisdictions, it is also apparent that there remains gaps in our knowledge about the extent of use of open source software in schools and the costs associated with its use. Irrespective of any of this however, schools and jurisdictions are choosing to place open source software into their ICT portfolios. Arising from this research then, comes the challenge of how to respond to and manage the emerging use of open source software in schools.

# Options for action

This research has been undertaken over a short period of time and as such there are further questions to ask and information to discover concerning open source software deployments in the school sector. The following options for actions then, are proposed for consideration by jurisdictions, national taskforces and agencies, and the Australian Government. These options are presented as indicators of where gaps in our current knowledge and understanding exist.

**Total Cost of Ownership:**

The following options for future actions are proposed for consideration:

- Trialling the TCO Framework with feedback on the outcomes to be shared nationally.
- Applying the TCO Framework for different ICT deployment models using both proprietary and open source operating systems and applications software.
- Publishing case studies online of the total cost of ownership of open source software use in schools and corporate units to broaden understandings about cost, use and return on investment.
- Investigating further and developing online total cost of ownership tools similar to those available to schools in the USA.
- Documenting migration models identifying costs and benefits associated with moving from proprietary to open source software.
- Analysing return on investment from the deployment of open source software in schools, which includes both financial and educational perspectives.

**Understanding the use of open source software and standards**

The following options for future actions are proposed for consideration:

- Developing an online survey tool to map the extent and nature of the use of open source software in schools and jurisdictions.
- Identifying opportunities where interested jurisdictions can work collaboratively to leverage opportunities.
- Maintaining an open source software community website on EdNA Online.
- Recording and sharing experiences of schools and jurisdictions migrating to open source software.
- Developing and maintaining an online pool of experts in open source software in school education.
- Commissioning a ‘resource pooling’ project similar to that undertaken by the European Union where pieces of code are pooled and can then be reused by schools and jurisdictions.
- Identifying and publishing online, standards that are critical to the work of the school sector.

**Licencing Models**

The following options for future actions are proposed for consideration:

- Identifying and publishing models for licence management to minimise work required at the school level and reduce the current risk level.
- Identifying and documenting the strengths and weaknesses of proprietary and open source software licence conditions and their implications for the work of schools.
- As part of the platform for national negotiations with Microsoft, considering the possibility of unbundling specific software components within the Microsoft Enterprise Agreements, including the unbundling of operating systems from applications software.
- Continuing to collate outcomes from research, trials and deployment of open source software to create and maintain negotiating positions with proprietary vendors of software and standards.

# Glossary

| | |
|---|---|
| Applications software | Applications software are computer programs that perform specific tasks, such as word processing, database management, online learning or payroll functions, for example. Users directly interact with applications software. |
| Asset management | The active management of all IT assets within an organisation such as a school, office or at a jurisdictional level. Asset management includes identification and tracking of assets; making changes to records; and reconciling records. |
| Authentication | Authentication is the way the identity of parties to a transaction is established. |
| Bandwidth | Bandwidth refers to telecommunications bands of frequencies or wavelengths. The term can also be used to refer to the amount of data that can be transmitted in a specified amount of time. Digital bandwidth is usually referred to in bits per second (bps) or bytes per second. Bandwidth for analog devices is described in cycles per second, or Hertz (Hz). |
| Caching | Caching refers to high-speed storage processes and occurs in relation to both memory caching and disk caching. Two types of caching commonly used in school jurisdictions occur at the personal computer level and at the network level.<br><br>Caching can require both hardware and software. It is possible to buy the hardware with the required software already installed or existing hardware can be used and only the software can acquired. |
| Clients | The client part of a client-server architecture refers to the personal computer or desktop. These computers often rely on a server to perform some operations. |
| Component | The portion of a software system that has defined inputs, functions, processes and outputs. |
| Connectivity and communication software | Connectivity and communication software refers here to software that connects users together and enables the sharing of information across a network. |
| Hardware | Hardware refers to the physical IT objects used undertake computing activities. |
| Help Desk | A help desk generally refers to a call centre established to handle IT queries about product installation, usage or problems. |
| HTML | Hyper Text Mark-up Language |
| ICT | Information and Communication Technologies |

| | |
|---|---|
| Interoperability | Interoperability is the capability of multiple software components to work together by exchanging information in ways that allow the respective software systems to act in equivalent ways on the information, leading to equivalent user outcomes. |
| Laptops | Portable computers or laptop computers are personal computers that can be moved easily from one location to another. They include ports than enable the user to easily logon onto a network. |
| Licence management | Different pieces of software come with their respective licence requirements. Jurisdictions and schools have obligations to manage the use of software licences in order that they do not breach the licence agreement. |
| MCEETYA | Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) |
| MCEETYA ICT in Schools Taskforce | Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) Information and Communication Technologies Taskforce |
| Memory | Memory is usually referred to as 'Random Access Memory' or RAM. It is referred to as 'random access' because any memory cell can be accessed directly if the row and column that intersect that cell, are known. |
| Middleware | Middleware is the software 'glue' that enables two otherwise separate software applications or separate products, to connect. Middleware is sometimes called the 'plumbing' because it connects two sides of an application and passes data between them. (For example, some middleware products link a database system to a webserver). |
| Networks | A network is a group of two or more computers linked together. There are many types of computer networks including:<br>o Peer-to-peer: two or more personal computers linked together without a server.<br>o Local area networks (LANs): Two or more computers that are geographically close together (eg in the same building).<br>o Wide area networks (WANs): A group of computers that are connected across a geographically dispersed area eg across several schools.<br>Connections are usually made by telephone lines or radio waves. |
| Network connectivity hardware | Network connectivity hardware for a network includes network cabling, network cards, hubs, routers and if required, the addition of ports. |
| Open source software | Open source software is software that has source code that is open, viewable, unrestricted and redistributable, and is available by downloading it from the Internet. |

| | |
|---|---|
| Open standards | Open standards are specifications that are used to build IT infrastructures and to promote interoperability between different IT systems and software. Open standards are open, publicly accessible and viewable. |
| Operating system | An operating system is a large, backend piece of software that enables a computer to work. Operating systems are required to enable the simultaneous use of several applications. Both servers and desktops require operating systems. |
| Peripheral devices | Peripherals are computer devices that are not an essential part of the computer. |
| Printers | Printers are a peripheral device that enables documents prepared on the computer to be created into hardcopies. |
| Retrofitting | This term tends to be used in documents originating from the USA. It refers to the costs associated with upgrading facilities to support new ICT systems (eg electricity supplies). |
| Role-based authorisation | Role-based authorisation is a way of managing the assurance of the identify of individuals who are granted access by assignment to one or more pre-defined roles. |
| SCORM | Sharable Content Object Reference Model |
| SOAP | Simple Object Access Protocol |
| Security | Security processes protect systems from intended and unintended breaches that could result in the loss or dissemination of data, or the damage to the integrity, confidentiality or authenticity of systems. |
| Security and virus management | Managing the processes associated with monitoring, detecting and preventing security violations. It includes password management, identifying security restrictions, access management, virus control and the recovery from violations and intrusions. |
| Server | A server is a computer or device on an IT network that manages the network's resources. |
| SQL | Structured Query Language |
| Stability | When a computer does not require a reboot over an extended period of time it is seen as stable. Stability can be measured in the length of time a computer can operate before something causes a malfunction or downtime and causes a consequent loss or productivity. |
| Storage | Hard drive disks and online network storage devices store data. |

| | |
|---|---|
| Software | Software is physically untouchable. Software exists as concepts and symbols created into programs that are made available using installation disks or are downloadable from the Internet. Software is used to make computer hardware work. |
| Software licence | A software licence is a binding contract that grants the explicit rights that an individual or agency is able to exercise in relation to the use of the intellectual property encapsulated in a piece of software. |
| System | Inter-related sets of IT components arranged to accomplish particular purposes form systems. Components may include computer hardware, software, and manual business processes. |
| Systems monitoring software | Software that enables software compliance to monitored electronically. |
| TCO | Total Cost of Ownership |
| Technical support officers | Officers specifically allocated to provide technical support to a central or regional office, and whose role is different to that of an officer working on the help desk. |
| Terminal Services | A computing methodology that lets users display remotely executed applications on a terminal server. Applications run entirely on the server. The server transfers only the user interface, keystrokes, and mouse movements between the server and client. Microsoft's Terminal Server is a component of Windows 2000/2003 Server. There is also an open source equivalent (Linux Terminal Server Project). |
| Turnover | Here, turnover refers to the annual costs of retiring and disposing of out of date hardware, and the costs associated with the purchase of new computer hardware. Timelines for the turnover of computer hardware tends to vary between schools and between jurisdictions. |
| Upgrade | An upgrade is a new version of software or hardware to replace an older version of the same product. |
| Utilities software | Utilities are a wide range of different sorts of software that perform specific tasks usually related to managing IT systems resources. Utilities differ from applications mostly in terms of size, complexity and function. |
| XML | eXtensible Mark-up Language |

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# Appendices

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# Appendix One*:*
## *Brief overview of benefits of open standards in school education*

There are several benefits to using open standards to underpin school education IT infrastructures. Six of these benefits are summarised here.

**1. Reducing risk and avoiding lock-in**
Open standards increase options and can reduce risk by avoiding the implementation of proprietary standards that may be supported by only one or a small group of vendors. Open standards enable the risk of using a particular vendor over another to be spread so that if a vendor is no longer able to provide products or services, then the replacement of that vendor can occur without the dependency upon only one particular sort of standards.

Avoiding proprietary standards therefore, also avoids lock-in to one vendor and also offers the option of increased durability of options since open standards are not linked to other priorities such as profit-making. In addition, the use of open standards allows for the consolidation of competing standards and thereby also enables both large multinationals and local, smaller suppliers to compete in the marketplace, thus increasing the market pool from which products, services and support can be acquired. Such an approach can increase the probability of long-term accessibility to support and improvements available to schools and governments.

**2. Shared understandings**
Since open standards are transparent descriptions of both data and behaviour, their development and use enable processes for establishing common terminology and for sharing information about how to organise, plan and implement IT infrastructure components. Since open standards are open to peer-review, the widespread and early review processes enable the rapid identification and resolution of potential problems, leading to higher quality results.

**3. Interoperability and simpler integration**
Interoperability refers to the capability of multiple software components to work together by exchanging data in ways that allow the respective software systems to act on the data in equivalent ways. Open standards create common ways for all systems to 'talk' to each other. Since the development of open source software enables the identification of component interfaces, both open source software and open standards are able to increase interoperability. Through these processes repeatable integration efforts are possible and the degree of flexibility based around standards is increased.

**4. Increasing flexibility**
Open standards are publicly available, so they provide governments, vendors and schools with the flexibility to each base their individual and specialised IT solutions upon commonly understood standards and specifications. This approach provides schools and jurisdictions with the flexibility to build their respective infrastructure requirements within the context of shared understandings about standards.

5. Extensibility
The use of open source software provides the opportunity for interested school sites working with educational applications to form networks that can deliver community-agreed enhancements at a lower cost and within shorter timeframes.

**6.** W3C
Since it was established in October 1994 the World Wide Web Consortium or W3C, has been developing common standards that promote the Internet's evolution and ensure its interoperability. The W3C has more than 500 Member organisations from around the world.

# Appendix Two: *TCO Case Studies from the USA*

## Texas School District: 2004 TCO Case Study[98]

### *Cost of Ownership Metrics*

1. Overall Cost

| Unit | Total Cost | Direct Cost | Indirect Labor Cost |
|---|---|---|---|
| Overall District Cost | $34,320,397 | $10,833,682 | $23,486,715 |
| District Cost per Client Computer | $2,341 | $739 | $1,602 |

2. Direct Cost by Category

| Unit | Hardware | Software | Direct Labor | External Application Providers |
|---|---|---|---|---|
| District Cost | $5,819,472 | $1,576,647 | $3,270,783 | $166,780 |
| District Cost per Client Computer | $397 | $108 | $223 | $11 |

3. Hardware Cost by Category

| Unit | Client Computer | Server | Network | Printer | Supplies |
|---|---|---|---|---|---|
| District Cost | $3,827,405 | $806,400 | $502,286 | $300,000 | $383,381 |
| District Cost per Client Computer | $261 | $55 | $34 | $20 | $26 |

4. Asset Metrics

| Category of District Resource | Ratio |
|---|---|
| Students per Student Dedicated Client Computer | 3.46 |
| Teachers per Teacher Dedicated Client Computer | 0.76 |
| Non-Classroom Personnel per Non-Classroom Client Computer | 1.17 |
| Total Users per Total Client Computers | 2.70 |
| Client Computers per Printer | 3.47 |
| Client Computers per Server | 76.35 |

5. Staffing Metrics

| Direct Labor Category | Total Cost | Cost Per Client Computer ($ US) | Client Computers per Staff |
|---|---|---|---|
| Operations and Financial | $2,677,179 | $183 | 308 |
| Professional Development and Training | $296,802 | $20 | 2,443 |
| Curriculum Development and Support | $296,802 | $20 | 2,443 |
| Total Support | $3,270,783 | $223 | 246 |

[98] CoSN (2004) A report and estimating tool for K-12 School Districts: Texas District Case Study, http://classroomtco.cosn.org/texas.pdf, p4

## Wisconsin School District: 2004 TCO Case Study[99]

### *Cost of Ownership Metrics*

1. Overall Cost

| Unit | Total Cost | Direct Cost | Indirect Labor Cost |
|---|---|---|---|
| Overall District Cost | $21,266,938 | $6,648,890 | $14,618,048 |
| District Cost per Client Computer | $2,664 | $833 | $1,831 |

2. Direct Cost by Category

| Unit | Hardware | Software | Direct Labor | External Application Providers |
|---|---|---|---|---|
| District Cost | $3,449,582 | $191,490 | $2,928,515 | $79,303 |
| District Cost per Client Computer | $432 | $24 | $367 | $10 |

3. Hardware Cost by Category

| Unit | Client Computer | Server | Network | Printer | Supplies |
|---|---|---|---|---|---|
| District Cost | $2,799,154 | $266,700 | $236,000 | $29,100 | $118,628 |
| District Cost per Client Computer | $351 | $33 | $30 | $4 | $15 |

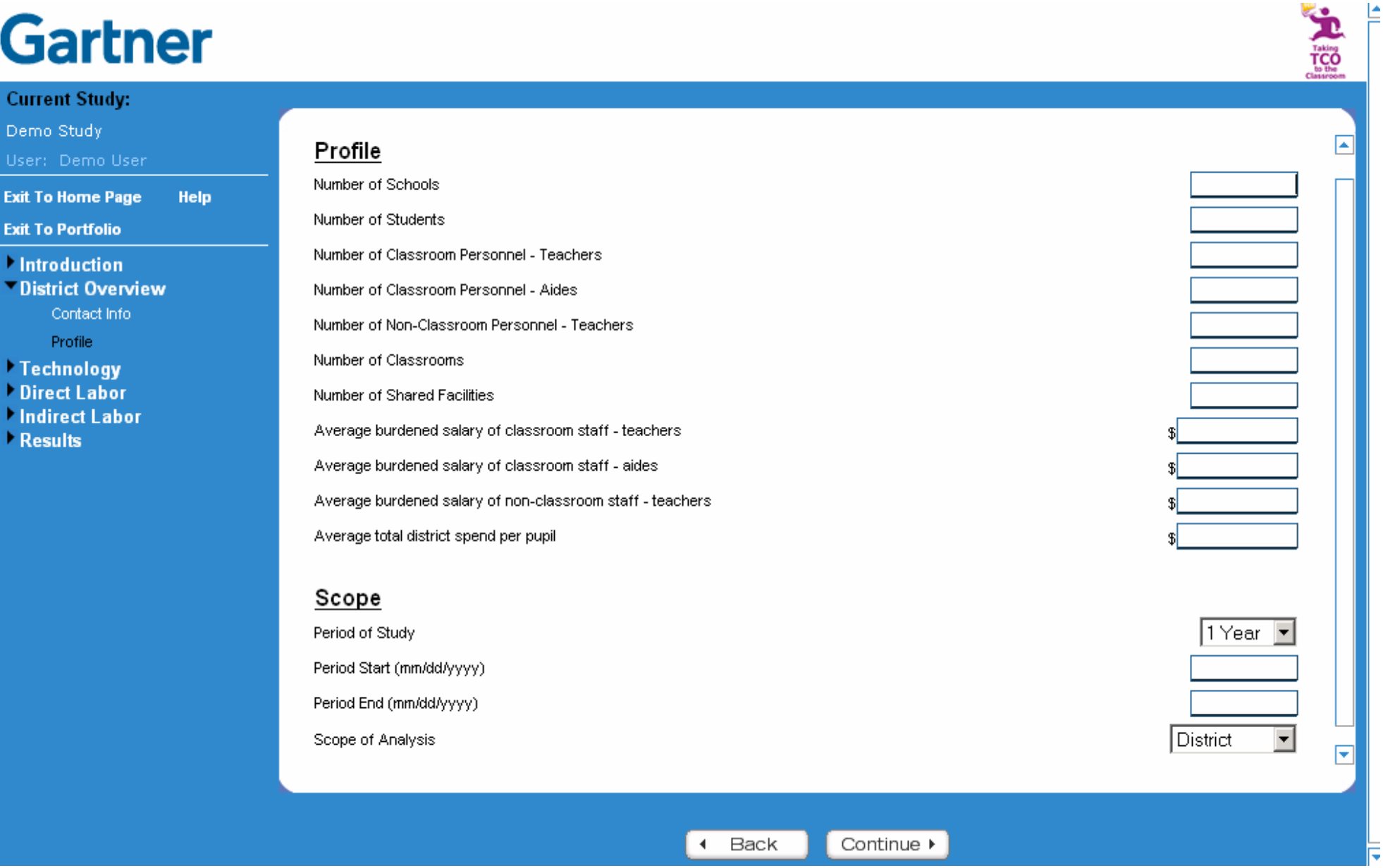
4. Asset Metrics

| Category of District Resource | Ratio |
|---|---|
| Students per Student Dedicated Client Computer | 3.22 |
| Teachers per Teacher Dedicated Client Computer | 2.00 |
| Non-Classroom Personnel per Non-Classroom Client Computer | .97 |
| Total Users per Total Client Computers | 3.00 |
| Client Computers per Printer | 3.20 |
| Client Computers per Server | 78.26 |

4. Staffing Metrics

| Direct Labor Category | Total Cost | Cost Per Client Computer ($ US) | Client Computers per Staff |
|---|---|---|---|
| Operations and Financial | $2,598,653 | $326 | 129 |
| Professional Development and Training | $164,931 | $21 | 3,471 |
| Curriculum Development and Support | $164,931 | $21 | 3,471 |
| Total Support | $2,928,515 | $367 | 120 |

[99] CoSN (2004) A report and estimating tool for K-12 School Districts: Wisconsin District Case Study, http://classroomtco.cosn.org/wisconsin.pdf, p3


Gartner
Taking TCO to the Classroom
Current Study:
Demo Study
User: Demo User
Exit To Home Page
Help
Exit To Portfolio
Introduction
District Overview
Contact Info
Profile
Technology
Direct Labor
Indirect Labor
Results
Profile
Number of Schools
Number of Students
Number of Classroom Personnel - Teachers
Number of Classroom Personnel - Aides
Number of Non-Classroom Personnel - Teachers
Number of Classrooms
Number of Shared Facilities
Average burdened salary of classroom staff - teachers
Average burdened salary of classroom staff - aides
Average burdened salary of non-classroom staff - teachers
Average total district spend per pupil
Scope
Period of Study
1 Year
Period Start (mm/dd/yyyy)
Period End (mm/dd/yyyy)
Scope of Analysis
District
Back
Continue

This screen shows the breakdown of direct costs in Total, on a per client computer basis. Case study highs and lows are also indicated.

Gartner

Current Study:

Test version from March 24

User: Eric Stegman

Exit To Home Page

Exit To TCO Analysis Page

- Introduction
- District Overview
- Technology
- Direct Labor
- Indirect Labor
- Results
  - Total Costs
  - Asset Metrics
  - Asset Cost Metrics
  - Direct Labor Cost Metrics
  - Direct Labor Staffing Metrics

Print This Page

| Cost Type | Total District Cost per Client Computer | Total District Cost | Case Study Low | ase Study High |
|---|---|---|---|---|
| Hardware | $254.65 | $1,250,855.00 | $217.00 | $430.00 |
| Software | $127.24 | $625,000.00 | $30.00 | $108.00 |
| Direct Labor | $374.29 | $1,838,501.00 | $242.00 | $451.00 |
| External Application Providers | $80.42 | $395,000.00 | $22.00 | $93.00 |
| **Total Costs** | $836.60 | $4,109,356.00 | $511.00 | $1,082.00 |

Direct costs include costs for hardware, software, external application providers, and direct labor.

Hardware includes the annual costs for client computers, peripherals, servers, network equipment, and printers.

Software includes the annual costs for all software running on client computers and servers. This would include infrastructure software, educational administrative software and personal productivity software, as well as content and curriculum specific software.

Direct Labor includes burdened salaries from personnel whose job role includes operations and financial support, professional training and development or curriculum development.

External application provider includes all costs associated with organizations that provide the use of applications, and associated services to customers.

These metrics are useful for planning purposes. In order to better understand drivers of Total Costs it is necessary to analyze the sub-components of these metrics shown further in these reports.

Definitions of Key metrics are also included.

# Appendix Three:
## *TCO for server room costs using open source software*

**Table Eight: Software costs identified to run a server room in a K-12 school in the USA.**[100]

| Software | Estimated cost | |
|---|---|---|
| **Linux distributions** | | |
| Red Hat Linux<br>Linux distribution for i386 (PC) hardware | $150 x 17 = | $2550 |
| YellowDog Linux<br>Linux distribution for PowerPC (Macintosh) hardware | $130 x 5 = | $650 |
| **Web server software** | | |
| Apache<br>The most widely used web server on the internet | $500 x 6 = | $3000 |
| PHP<br>Server-side web scripting language | $700 x 6 = | $4200 |
| MySQL<br>Structured Query Language database server | $500 x 4 = | $2000 |
| phpMyAdmin<br>Powerful web-based database administration tool | $100 x 4 = | $400 |
| DataMiner<br>User-friendly web-based interface for managing database content | $50 x 12 = | $600 |
| ht://Dig<br>WWW Search Engine Software | $200 x 1 = | $200 |
| Outreach Project Tool<br>Web-based group project collaboration environment | $500 x 1 = | $500 |
| Claroline<br>Web-based course management system | $5000 x 1 = | $5000 |
| Phorum<br>Web-based forum/message board software | $100 x 2 = | $200 |
| phpWiki<br>Web-based knowledge collaboration tool | $100 x 1 = | $100 |
| **Mail server software** | | |
| Sendmail<br>Internet standard MTA (Mail Transfer Agent) | $150 x 1 = | $150 |
| Postfix<br>Mail Transfer Agent | $150 x 1 = | $150 |
| UW IMAP<br>University of Washington IMAP/POP3 mail server | $150 x 1 = | $150 |
| OpenLDAP<br>LDAP server for intregrated authentication and directory services | $200 x 2 = | $400 |
| MailMan<br>Full-featured mailing list manager | $150 x 1 = | $150 |
| Horde Groupware<br>Web-based email, address book, and calendaring software | $1000 x 2 = | $2000 |
| eL DAPo | $50 x 1 = | $50 |

[100] See http://staff.harrisonburg.k12.va.us/~rlineweaver/

| | | |
|---|---|---|
| Web interface for administering an LDAP directory | | |
| DBmail<br>Database-based email system | $150 x 1 = | $150 |
| Bogofilter<br>Bayesian (statistical) spam filtering tool | $500 x 1 = | $500 |
| **Firewalling/Routing software** | | |
| netfilter/iptables<br>Stateful IP filtering system | $1000 x 2 = | $2000 |
| **Cross-platform file server software** | | |
| Samba<br>File server for Windows clients | $800 x 4 = | $3200 |
| Netatalk<br>File server for Macintosh clients | $500 x 7 = | $3500 |
| **Other network server products** | | |
| ISC BIND (Berkeley Internet Name Daemon)<br>Internet standard DNS server | $100 x 9 = | $900 |
| ISC DHCP<br>Dynamic Host Configuration Protocol server | $100 x 8 = | $800 |
| WU-FTPD<br>FTP server software | $50 x 3 = | $150 |
| NTPd<br>Network Time Protocol server for synchronization of computer clocks | $50 x 4 = | $200 |
| Squid<br>HTTP caching proxy server | $200 x 2 = | $400 |
| rsync<br>Incremental backup solution | $50 x 12 = | $600 |
| **Network management and monitoring** | | |
| Snort<br>Powerful network intrusion detection system | $5000 x 1 = | $5000 |
| ACID (Analysis Console for Intrusion Databases)<br>Web interface for monitoring and querying Snort alert database | Bundled with commercial products | |
| NISCA (Network Interface Statistics Collection Agent)<br>Monitors traffic on switches and routers | $2000 x 1 = | $2000 |
| Nagios<br>Monitors servers and routers and notifies me of outages via email | $300 x 1 = | $300 |
| Ethereal<br>Network analysis and packet sniffing tool | $1000 x 1 = | $1000 |
| sntop<br>Monitors network connectivity | $30 x 1 = | $30 |
| LanLord<br>Monitors leases on DHCP servers | Bundled with commercial products | |
| Webalizer<br>Web server statistics reporting tool | Bundled with commercial products | |

# Appendix Four: Total Cost of Ownership Framework components

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| **Software acquisition** | **'Software acquisition' refers to the annual cost of purchase of licences in order to use particular pieces of software for client computers (desktops and laptops), servers, printers, peripherals, and network communication software.**<br><br>**Software acquisition costs can be determined by examining purchasing records, budget reports, lease records and the like. Software costs can be covered both at central and school levels.** | **Microsoft Schools and Campus Agreement; Microsoft Select Agreement; Red Hat Enterprise Agreement; Sun Microsystems agreements; WebCT; Blackboard, other licensing agreements such as the Adobe Corporate Licensing Program** | **Software is an annual expense and is not depreciated each year. Where a cost for a software licence is allocated over the term of a contract then this cost is averaged for the life of that contract. Eg if a licence is $1.2 million over three years then this is represented as $400,000 annually.**<br><br>**Where software and hardware are bundled together in the initial cost of hardware then this cost is covered as a total in 'hardware' rather than artificially disaggregating it here.**<br><br>**Where software maintenance includes upgrades in the price of the licence, these costs are allocated here. If software maintenance mainly includes human support services then these costs are allocated in 'combined IT labour support costs' (see below).** |
| Bundled operating systems software | Microsoft Schools and Campus Agreement bundle upgrades to server, desktop and applications software (ie MS Office) together into one price. | MS Windows 98/XP Professional; MS Windows NT Workstation; MS Windows 2003 Server; Macintosh OSX; Linux; Unix variants such as Sun Solaris or HP-UX | The Microsoft Schools and Campus Agreement bundle software's aggregated price is used here for the purposes of a TCO. |
| Server operating systems software | The annual expenditure on new server operating systems. The Microsoft Select Agreement enables schools to purchase additional server licences. | MS Windows 2003 Server; MS Exchange Server 2003, Novell Netware; Windows NT; RedHat; Mac OS X Server | The cost of new software only is included here if it is not included in the original price of the hardware and software. Where software is included in the initial price of server hardware, then the cost of the software is not included here but is incorporated into the price of the hardware. |
| Server operating systems software upgrades | The annual expenditure on upgrades to server operating systems. | | The cost of annual server operating system upgrades is included here. The cost of software only is included. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| Desktop operating systems software | The annual expenditure on new desktop operating systems. | Windows 98; Windows 2000 Professional; Windows XP Home; Mandrake Linux; Mac OS X | The cost of new software only is included here if it is not included in the original price of the hardware and software. Where software is included in the initial price of server hardware, then the cost of the software is not included here but is incorporated into the price of the hardware. |
| Desktop operating systems software upgrades | The annual expenditure on upgrades to desktop operating systems. | | The cost of annual server operating system upgrades is included here. The cost of software only is included. |
| Laptop operating systems software | The annual expenditure on new laptop operating systems. | Windows 98; Windows 2000; Windows XP Professional; RedHat Linux; Mac OSX | The cost of new software only is included here if it is not included in the original price of the hardware and software. Where software is included in the initial price of server hardware, then the cost of the software is not included here but is incorporated into the price of the hardware. |
| Laptop operating systems software upgrades | The annual expenditure on upgrades to laptop operating systems. | | The cost of annual server operating system upgrades is included here. The cost of software only is included. |
| Applications software | The annual cost of all applications software (other than those included under department-wide Microsoft Agreements). | Adobe Photoshop; Janison Toolbox; iMovie; AppleWorks Moodle; WebCT | A list of applications software used in a school, office or workgroup is prepared and then collated. The costs of purchasing each piece of software is summarised as an annual expense. The annual capital expenditure for new applications software does not include the costs for the development of software. |
| Applications software maintenance and upgrade costs | Costs for additional software maintenance and upgrades to the base software licence. | WebCT; Adobe Photoshop; Janison Toolbox | A list of software maintenance agreements and upgrades not listed elsewhere (eg routine upgrades, enhancements) is prepared. The costs are added together and an annual average is collated. The annual capital expenditure for maintenance agreements and upgraded applications software does not include the costs for the development of software. |
| Middleware | Annual expenditure costs for middleware. | ODBC; Corba; tcAccess; Java | A list of middleware software used is prepared plus annual licence fees, and then the costs are collated. The costs are added together and an annual average is collated. The annual expense is used here. |
| Database software | Annual expenditure costs for database software | SQL databases such as Oracle, MS SQL, Paradox, Access, | A list of database software used is prepared plus annual licence fees, and then the costs are collated. The costs of purchase of each piece of software is averaged and |

| | | | |
|---|---|---|---|
| | | MySQL, Postgres | summarised here as an annual expense. |
| **COMPONENTS** | **DEFINITIONS** | **EXAMPLES** | **PROCESSES** |
| Connectivity and communication software | Annual expenditure costs for software such as email, messaging software, groupware, and remote connectivity software where this software has not been bundled elsewhere. | Groupwise, Sendmail, KdeMail, Evolution | The cost listed here is for the annual connectivity and communications software only. The costs of purchase of each piece of software is averaged and summarised here as an annual expense. Fees for communication access costs are entered separately in 'Network Access' costs'. |
| Storage back-up software | The annual expenditure costs for backup software. | ARC Serve; Backup Exec | Cost of the acquisition of backup software is listed here. The costs of purchase of each piece of software is averaged and summarised here as an annual expense. |
| Utilities software | The annual expenditure costs for utilities software. | WinZip, Virus protection software | A list of utilities software used (and not listed elsewhere) is prepared and then collated. The costs of purchase of each piece of software is averaged here as an annual expense. |
| **Software compliance costs** | **Support costs associated with ensuring that the use of software is consistent with the contract for the licences of the software.** | **Software and people costs.** | **These costs include both human labour costs and costs for software used for system monitoring of the use of licences. The human costs are often hidden labour costs but are necessary to calculate to gain an accurate TCO.** |
| Systems monitoring software | Cost of the purchase and maintenance of systems monitoring software is included here. | Zenworks; SMS; LAN desk manager; McAfee; IPEX software compliance | The costs of purchase of each piece of software is averaged and summarised here as an annual expense. |
| Licence management | Costs of licence management. | Senior officers within a school jurisdictional office or in a school. Depending on the size of the contract it may involve officers from the Minister and Chief Executive. | Calculations require identification of the different pieces of software; the licences associated with them; and who has responsibility for managing them. Then the amount of human time as a percentage of an officer's salary, for the work taken to manage licences is calculated. The cost is averaged here as an annual expense. |
| Legal costs | Costs associated with periodically gaining legal advice over time about compliance with contractual requirements | Crown solicitor costs | Labour hours can be tracked and calculated by asking the relevant officers to track the time they take on these tasks. The number of hours at identified salary levels is calculated and then averaged as an annual expenditure. |
| 'True up' costs | The licence costs associated with adding more computers to annual software licence agreements. | Microsoft Schools and Campus Agreement | The costs of adding additional licences to a software contract. There are no 'true down' refunds or amendments included in the Microsoft Schools and Campus Agreement. Costs for calculating the labour costs of 'true up' processes are included in the 'software audit costs'. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| Software audit costs | Costs associated with determining how many computers and therefore how many software licences are required each year. Also includes costs associated with annually checking compliance with contracts for the use of software licences. | Annual audits conducted by central, regional and school based officers (eg surveys) of total eligible computers requiring licences. | Labour hours can be tracked and calculated by asking the relevant officers to track the time they take on these tasks. This may include both school time as well as central officer time to collate responses from schools. The number of hours at identified salary levels is calculated and then averaged as an annual expenditure. |
| Vendor management | Costs involved in preparing documentation, negotiating software contracts and then ensuring that the vendor meets the agreed contract outcomes within the specified timelines. Can also include the costs associated with liabilities incurred as a result of contract deliverables not being met. | Senior officers within a school jurisdictional office or in a school. | A list of personnel involved is developed. Labour hours can be tracked and calculated by asking the relevant officers to track the time they take on these tasks and make an annual average calculation. |
| Software upgrade management costs | Human costs of migrating from one version of a piece of software to another version of essentially the same software (eg MS Server 2000 to MS Server 2003) | Time to organise the distribution and management of upgrades | A list of who is involved and how much time they would each spend on this task is made and the cost of their time is calculated on the basis of labour hours. The totals are summarised here. |
| Software migration management costs | Human costs of migrating from one piece of software to different software. | Time to organise the distribution and management of software. | A list of who is involved and how much time they would each spend on this task is made and the cost of their time is calculated on the basis of labour hours. The totals are summarised here. Costs for professional development of staff in the changeover of software is calculated in ‘Formal training and professional development’. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| **Hardware** | **Hardware costs involve annual expenditures on new and upgraded equipment. Where hardware and software are bundled together the total cost of the items are included here.** | **Hardware includes servers, desktops, laptops, peripherals and network communication hardware (eg hubs, bridges, routers and switches).** | **Servers and clients (desktops and laptops) are purchased with the acquisition price depreciated usually over three years. Other hardware items such as memory, storage and peripherals are considered as expenditure only, without depreciation.** |
| Servers | The cost of a server depends on the size of the memory, storage and required functionality it has to perform eg the size of the network it is to support | Servers often have dedicated tasks: eg a file server is a computer and storage device dedicated to storing files; a print server manages one or more printers; a network server manages the traffic on the network; and a database server is a computer system that processes database queries. | The initial purchase costs of servers usually includes the computer box, memory, storage and installed options. Where an operating system is installed as part of the purchase price of the hardware, this total cost is included here.<br><br>A list of all servers is prepared and then the total cost is calculated as an annual cost.<br><br>Servers are a capital expenditure which is amortized using a straight line depreciation, usually over three years. |
| Clients | The costs for desktops. | The computer box, memory, storage and installed options. | A list of the purchase costs for clients or desktops is collated and an annual total is prepared for use here. The initial purchase costs of clients usually include the computer box or outer casing, memory, storage and installed options. Where software is installed as part of the purchase price of the client hardware, this total cost is included here.<br><br>The purchase of clients or desktops can involve purchases from government panel contracts and/or schools make their own individual arrangements. The costs for establishing and managing panel contracts is not included here but is included in ‘Hardware procurement and deployment costs’. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| Laptops | The costs for laptops | The outer casing, memory, storage and installed options. | A list of the purchase costs for laptops is collated and an annual total is prepared for use here. The initial purchase costs of laptops usually include the computer box or outer casing, memory, storage and installed options. Where software is installed as part of the purchase price of the client hardware, this total cost is included here.<br>The purchase of laptops can involve purchases from government panel contracts and/or schools make their own individual arrangements. The costs for establishing and managing panel contracts is not included here but is included in 'Hardware procurement and deployment costs'. |
| Peripheral devices | Costs for additional parts that may be purchased over time. | Mouse<br>CD-ROM drive<br>Keyboard<br>Computer screen<br>Modem | These items are not normally purchased separately at the outset but additional parts may be purchased over time. Only document a summary of annual peripheral costs here if they are purchased separately. Do not include 'printers' here. |
| Printers | Costs of the purchase of printers | Printers are produced by a wide range of companies. | As printers are central to the work in the education sector, although a 'peripheral device', here they have been disaggregated out from the other peripherals associated with the use of computers. |
| Storage | The costs of hard drive disks for back-up or storage or online storage devices. | Hard drive disks | Hard drive disks for back-up or storage or online storage devices are included here. Offline or nearline storage such as tape drives are not included here. They are included in the 'consumables' line (below). |
| Memory | The purchase price of additional memory. | RAM | The purchase price of memory is used for calculations and is not depreciated. Where memory is included in the original purchase price of a computer, then it is not included here. Include only additional memory costs. |
| Network connectivity hardware | The costs of purchasing additional or upgraded connectivity hardware for a network. | Includes network cabling, network cards, hubs, routers and if required, the addition of ports. | Network connectivity hardware is calculated on the cost of purchase and is not depreciated. Network connectivity hardware purchased in the original price of a computer is not included here; upgrades are, however. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| **Hardware procurement and deployment costs** | **Human support costs associated with ensuring that the procurement of hardware is consistent with the contract for its purchase.** | **Senior officers within a school jurisdictional office or in a school. Depending on the size of the contract it may involve officers from the Minister and Chief Executive down throughout the organisation.** | **Identify the human labour costs involved in procuring hardware requires identifying who is involved in each of the steps of the procurement process and then determining how many salary hours each person contributes to the process. These costs are then averaged across a year in order to calculate an annual cost.**<br><br>**These are often hidden labour costs but necessary to calculate within a TCO analysis.** |
| Turnover | The annual labour costs of retiring and disposing of out of date hardware, and the costs associated with the purchase of new computer hardware. | IT coordinator, IT support staff and the bursar within a school, and/or IT policy officers or infrastructure management officers within a corporate office. | The annual human costs of retiring and disposing of out of date hardware, and the costs associated with the purchase of new computer hardware. This line does not include the costs for the purchase of the hardware; it only includes the costs associated with managing the turnover processes. |
| Legal costs | The annual costs associated with gaining legal advice over time about compliance with contractual requirements | Crown solicitor costs | To calculate the legal costs involved in the hardware procurement and deployment, identify who is involved in each of the steps of the procurement and hardware deployment process, and then determine how many salary hours each person contributes to the process. These costs are then averaged across a year in order to calculate an annual cost. |
| Vendor management | Costs involved in preparing tender documentation, negotiating hardware contracts and then ensuring that the vendor meets the agreed contract outcomes within the specified timelines. Can also include the costs associated with liabilities incurred as a result of contract deliverables not being met. | Preparation of tender documentation; determining any liquidated damages; submissions to school finance committees; proposals to Governing Councils of schools | To calculate the costs involved in vendor management, identify who is involved in each of the steps of the procurement and hardware deployment process, and then determine how many salary hours each person contributes to the process. These costs are then averaged across a year in order to calculate an annual cost. Vendor management is required at both the central and the school level. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| **Combined direct IT labour support costs** | **The direct cost of human work required to undertake the day to day support of software and hardware management.** | **Central IT infrastructure officers; senior management; school IT staff; help desk** | **Human labour costs are calculated by determining the direct labour costs for identified day to day functions to support the operation of an IT enterprise architecture.** |
| Central management | Costs associated at a central, jurisdictional level, with the day to day management and usage of software and hardware including networks, but does not include the help desk. | Depending on the nature and size of the work it may involve officers from Chief Information Officer, down throughout the organisation. | Direct labour costs (only) for managing the networks, desktop and mobile computers, servers, applications, and storage infrastructure, are included here. Do not include help desk, asset management or virus/security management here as these are dealt with separately. For the purposes here, determine the headcount and average the costs of staff directly performing network, desktop, storage and infrastructure tasks across one year, to gain an average annual cost. If any of this work is outsourced then these details are not included here but are included below in the 'Services and lease' section. |
| Central help desk | Salary costs to staff a central help desk, responding to corporate enquiries and queries from technical support officers in schools. | Help desk IT trained staff | If annual costs are available, these should be used. If the help desk function is leased out to an outside agency, include these costs in the 'Services and lease' section below. Management costs are not included here. To calculate help desk costs the number of officers employed can be multiplied by the officers' salary rates, for a period of a minimum of three months. An average can be calculated to form the annual baseline costs of the help desk. |
| Technical support officers | Salary costs for officers specifically allocated to provide technical support to a central or regional office, and whose role is different to that of officers on the help desk. | Centrally funded, district IT support officers | Annual labour costs for technicians identifying, troubleshooting and repairing support issues such as failures, faults and access issues. Do not include help desk salary costs here. |
| School management | Costs associated with the day to day management of hardware and software, including networks, at a school level | IT Coordinator, School administration team | The annual labour costs of user administration within a school. Tasks include adding and deleting new and old users, managing groups, password management and changing user profiles. |
| School help desk/ In-school technical support officers | The salary costs of providing technical in-school support, responding to teachers' other staff, students' and parents' enquiries and queries from within the school | In school technical officer | In-school technical support can be provided by technicians, teachers and IT coordinators. To calculate the total cost, make a list of who is involved, determine the hours and the salary rate |

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| | community. | | appropriate for each person undertaking the respective tasks; and then calculate the annual average costs for these functions. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| Asset management | The labour costs to actively manage all IT assets within an organisation such as a school, office or at a jurisdictional level. Asset management includes identification and tracking of assets; making changes to records; and reconciling records. | Bursar or other administrative officer | To identify the annual labour costs of ongoing documentation and management of assets (hardware, software, peripherals, human), identify who is involved and determine how much time per year is required to undertake this task. |
| Security and virus management | The annual labour costs for monitoring, detecting and preventing security violations. It includes password management, security restrictions, access management, virus control and the recovery from violations and intrusions. | Central office IT officer; infrastructure manager; in school IT coordinator. | To identify the annual labour costs of for the management of security and virus control, identify who is involved and determine how much time per year is required to undertake this task. Summarise as an annual total figure. |
| **Network IT access and management** | **Network IT access and management refers to the costs for hardware and software to access and manage data flow over a network.** | **Caching and broadband facilities** | **These are the costs for specifically enabling access and management of networks of computers.** |
| Caching hardware | The cost of high-speed storage processes. Caching can require both hardware and software. It is possible to buy the hardware with the required software already installed or existing hardware can be used and only the software can acquired. | Servers | Where hardware only is purchased for caching purposes or where hardware with caching software already installed is purchased, include this cost here as an annual hardware cost. |
| Caching software | | Proxy server<br>Squid (OSS)<br>MS (ISA internet security and acceleration server) | Where caching software is acquired separately, include the cost of the software here. Do not include labour costs here. These costs are included in the section 'Combined IT labour support costs' or if outsourced, these costs are included in the 'Services and lease' section. |
| Bandwidth | Costs associated with the purchase of bandwidth. | Satellites, landlines and radio waves are used to provide bandwidth | The annual cost for the purchase of bandwidth. Where a range of network services includes the provision of bandwidth bundled together with other software solutions, this cost is not entered here but in the 'lease' section below. |
| Legal costs | Costs associated with gaining legal advice over time about network telecommunications costs | Crown solicitor costs | To calculate the legal costs involved in purchasing network telecommunications services, identify who is involved in each of the steps of the procurement process, and then determine how many salary hours each person contributes to the process. These costs are then averaged across a year in order to calculate an annual cost. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| Vendor management | Costs involved in preparing documentation, negotiating contracts and then ensuring that the vendor meets the agreed contract outcomes within the specified timelines. Can also include the costs associated with liabilities incurred as a result of contract deliverables not being met. | Officers involved in the preparation of tender documentation; monitoring outcomes; trouble shooting and determining any liquidated damages | To calculate the costs involved in vendor management, identify who is involved in each of the steps of the procurement process, and then determine how many salary hours each person contributes to the process. These costs are then averaged across a year in order to calculate an annual cost. |
| **Services and lease costs** | **Annual costs for any outsourced infrastructure services and lease costs for computer equipment including hardware, software, peripherals, network and communication costs.** | **Companies provide outsourced services for one or more parts of a school jurisdictions' IT architecture** | **Identification of what parts of an enterprise architecture are leased and summarised here as an annual cost.** |
| Network service and management fees | The costs for the bundled services and management of an IT network or part thereof; including mainframe and help desk support, where these functions have been outsourced. | Cost of the outsourced provision of WAN services and helpdesk support | The fees charged for the bundled products, services and management of an IT network or part thereof. These costs can include outsourced help desk support. The costs are added together as a total cost and then averaged as an annual cost. |
| Bundled telecommunication services | A range of network services which include the provision of bandwidth with other software solutions. | Telecommunications vendors | The total annual cost for the bundling of networked telecommunications and software services is included here. |
| **Dedicated IT running and 'housing' costs** | **The costs associated with physically locating computers in schools and offices.** | **Electricity, Airconditioning Cabinets Physical security** | **Costs include the room, airconditioning, desks, cabinets, security requirements to house the IT equipment. This section does not include human labour.** |
| Electricity | Schools, regional and central offices require electricity to run computers. In some remote locations generators are used to produce electricity. | Electricity | Identify an annual electricity cost for ICT here. The annual cost of electricity required to power the computing equipment in a given location can be determined either as a percentage of the overall cost of electricity, or it may be possible to isolate the complete cost, depending on the way offices received their electricity bills. |
| Airconditioning | Airconditioning is required in many locations to ensure that the IT equipment does not overheat | Airconditioning | Identify the capital expenditure required for airconditioning specifically for computing equipment, only. This cost is averaged to annual cost. The cost of airconditioning units are depreciated. |
| Cabinets | Computer cabinets are required to appropriately house computing equipment. | Cabinets | Identify the capital expenditure required for specifically housing computing equipment. This cost |

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| | | | is averaged to annual cost. The cost of cabinet units are depreciated. |

| COMPONENTS | DEFINITIONS | EXAMPLES | PROCESSES |
|---|---|---|---|
| Consumables | Annual costs for expendable computer supplies. | Diskettes, CDROMs, toner cartridges for printers, backup tapes and other consumables. | List the consumable items used and their cost over a three month period. This can then be used to make an annual average calculation. Existing order forms or past expenditures can be used to inform the calculation of this figure. |
| Downtime | Downtime refers the total annual costs incurred associated with an IT service or component not being operational. It results in lost productivity. The less downtime an IT configuration has, the less expensive it is, as the costs associated with downtime are kept low. | When a school server crashes and makes students' final year of work unavailable | Downtime can be calculated as annual planned and unplanned downtime hours calculated as a percentage of the affected end-user's salary plus the costs of the salary of the officer rectifying the causes for the downtime.[101] |
| **Formal training & professional development** | **Costs of conducting training and professional development to use and apply the use of software to given work contexts** | **Courses and programs provided by both government & private providers** | **Much professional development and training occurs at the school level. These lines account for formal training rather than indirect or informal peer-to-peer training.[102]** |
| Technical training | Costs for training technical officers (eg IT support officers) in the use of the software including troubleshooting | Specific technical training in how to troubleshoot and solve problems in both proprietary and non-proprietary products. | A list of all the types and costs of technical training undertaken and by whom, is developed. Include the cost of technical training required for migrations and upgrades. The cost of this training plus the cost of the loss of labour for the time of the training are added together, and then an average annual cost is developed from these raw figures. |
| Professional development of end users | Costs for conducting professional development with the people going to use the software in their day to day work but not those providing IT support | Professional development for end-users about particular aspects of using technology for identified purposes. | A list of all the types and costs of professional development undertaken and by whom, is developed. Include the cost of professional development required for migrations and upgrades. The cost of this professional development plus the cost of the loss of labour for the time of the training are added together, and then an average annual cost is developed from these raw figures. |

[101] Calculations for students' loss of work do not tend to be incorporated into TCOs. Where downtime occurs in a school and it affects students' work, an additional amount should be added where there are consequences such as students not meeting a required summative assessment requirement. A sliding scale of 'cost' could be developed depending on the severity of the downtime and the consequences for students' studies.

[102] It is noted that while it is more difficult to allocate a value or cost to informal or indirect peer-to-peer training or professional development, Gartner has indicated that this form of professional learning is the most expensive and the most valuable. It is likely that only focusing on formal training and professional development, considerable but albeit a difficult cost to identify is being missed.

# Appendix Five: *Proformas*

## 1. Total Cost Of Ownership Data Collection Proforma

| COMPONENTS | IN | OUT | OPEN OR PROPRIETARY | | LOCUS OF COSTS | | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | O | P | $ SCHOOL | $ CENTRAL | | |
| | | | | | | | | |
| **Software acquisition** | | | | | | | | |
| Bundled operating systems software | | | | | | | | |
| Server operating systems software | | | | | | | | |
| Server operating systems software upgrades | | | | | | | | |
| Desktop operating systems software | | | | | | | | |
| Desktop operating systems software upgrades | | | | | | | | |
| Laptop operating systems software | | | | | | | | |
| Laptop operating systems software upgrades | | | | | | | | |
| Applications software | | | | | | | | |
| Applications software maintenance and upgrade costs | | | | | | | | |
| Middleware | | | | | | | | |
| Database software | | | | | | | | |
| Connectivity and communication software | | | | | | | | |
| Storage back-up software | | | | | | | | |
| Utilities software | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Software compliance costs** | | | | | | | | |
| Systems monitoring software | | | | | | | | |
| Licence management | | | | | | | | |
| Legal costs | | | | | | | | |
| 'True up' costs | | | | | | | | |
| Software audit costs | | | | | | | | |
| Vendor management | | | | | | | | |
| Software upgrade management costs | | | | | | | | |
| Software migration management costs | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |

| COMPONENTS | IN | OUT | OPEN OR PROPRIETARY | | LOCUS OF COSTS | | TOTAL COST | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | O | P | $ SCHOOL | $ CENTRAL | | |
| **Hardware** | | | | | | | | |
| Servers | | | | | | | | |
| Clients | | | | | | | | |
| Laptops | | | | | | | | |
| Peripheral devices | | | | | | | | |
| Printers | | | | | | | | |
| Storage | | | | | | | | |
| Memory | | | | | | | | |
| Network connectivity hardware | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Hardware procurement and deployment costs** | | | | | | | | |
| Turnover | | | | | | | | |
| Legal costs | | | | | | | | |
| Vendor management | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Combined direct IT labour support costs** | | | | | | | | |
| Central management | | | | | | | | |
| Central help desk | | | | | | | | |
| Technical support officers | | | | | | | | |
| School management | | | | | | | | |
| School help desk/in-house technical support officers | | | | | | | | |
| Asset management | | | | | | | | |
| Security and virus management | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **COMPONENTS** | **IN** | **OUT** | **OPEN OR PROPRIETARY** | | **LOCUS OF COSTS** | | **TOTAL COST** | **REMARKS** |
| | | | **O** | **P** | **$** | **$** | | |

| | | | | | SCHOOL | CENTRAL | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Network IT access and management** | | | | | | | | |
| Caching hardware | | | | | | | | |
| Caching software | | | | | | | | |
| Bandwidth | | | | | | | | |
| Legal costs | | | | | | | | |
| Vendor management | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Services and lease costs** | | | | | | | | |
| Network service and management fees | | | | | | | | |
| Bundled telecommunication services | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Dedicated IT running and 'housing' costs** | | | | | | | | |
| Electricity | | | | | | | | |
| Airconditioning | | | | | | | | |
| Cabinets | | | | | | | | |
| Consumables | | | | | | | | |
| Downtime | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| **Formal training and professional development** | | | | | | | | |
| Technical training | | | | | | | | |
| Professional development of end users | | | | | | | | |
| | | | | | | **SUBTOTAL** | | |
| | | | | | | | | |
| | | | | **TOTAL** | | | | |

## 2. Identifying open source software servers and operating system costs proforma

List all servers and the open source operating systems being used. Calculate as an annual cost.

| Open Source Software Servers | Operating System | Operating system software licence costs[103] | Most important applications | Cost of acquiring important applications software[104] | Assumptions: Role of server | Server hardware | Cost of server hardware[105] |
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[103] Does not include labour [next step is calculate labour costs]
[104] Does not include labour next step is calculate labour costs]
[105] Purchased secondhand

## 3. Identifying proprietary software costs for servers and operating system costs proforma

List all servers and the proprietary operating systems being used. Calculate as an annual cost.

| Server operating systems | Server Operating System | Operating system software licence costs[106] | Most important applications | Cost of acquiring important applications software[107] | Assumptions: Role of server | Server hardware[108] | Cost of server hardware[109] |
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[106] Does not include labour. Costs as per the School Select Agreement.
[107] Does not include labour. $0 costs in this column are as a result of these functions being included in the MS licence agreement.
[108] Secondhand hardware
[109] Purchased secondhand

## 4. Most important desktop applications

List here all the important applications software used across all faculties within the school. Calculate as an annual cost.

| Most important desktop applications | Applications software licence costs[110] | | Proprietary or open source software | | Role of important applications software[111] | Desktop hardware | Remarks |
|---|---|---|---|---|---|---|---|
| | School | Central Office | Open | Proprietary | | | |
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[110] Does not include labour. Cost of Microsoft licences is shared between the school and central office. The cost of the licence includes the applications software and the desktop server software

[111] Does not include labour

## 5. Costs of software purchases and maintenance agreements over time proforma

This proforma is designed to assist determining annual costs of software that take into account purchase of site licences as well as annual costs and maintenance agreements

| NAME OF SOFTWARE | YEAR ONE[112] $ | | YEAR TWO[113] $ | | YEAR THREE $ | | YEAR FOUR $ | | YEAR FIVE $ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | School | Corporate | School | Corporate | School | Corporate | School | Corporate | School | Corporate |
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[112] Initial purchase cost
[113] Software maintenance costs after first year or annual licence cost