21. Appendices

21.1. TCO drivers omitted from calculator

While this study focuses on the comparative TCO of new and refurbished computers in small organisations, there are many more factors that come into play within medium-sized and large companies.

Traditional TCO factors omitted from this study include:

Scoping total ICT infrastructure

Requires assessment of the use of notebooks, laptops, PDAs, networking equipment and peripherals such as printers and data storage networks. Reason for elimination: beyond the scope of this report which centred on new and refurbished desktop PCs exclusively.

Purchasing costs history

Requires accurate historical record keeping of IT asset procurement. Reason for elimination: disregarded because we are assuming the organisation is making the first purchasing decisions, not attempting to calculate TCO against an existing network.

Inventory management

Requires systems such as asset tagging, constant updating of a dynamic database, detailed physical inspection of the installed IT, and sophisticated sever-level remote diagnostic tools.
Reason for elimination: disregarded because we are assuming the organisation is making the first purchasing decisions, not attempting to calculate TCO against an existing network.

Outsourced IT contracts (excluding support)

Requires assessment of contracts covering many kinds of IT functions handed off to external agents, including everything from corporate web site development and business interfaces to systems and architecture consulting. Reason for elimination: disregarded because the target group doesn't typically deploy these functions in any significant or costly way.

In-house systems development (programming)

Requires dedicated programmers or contractors developing internal systems. Reason for elimination: disregarded because these costs are well beyond the means of most non-IT organisations numbering below 25 people.

Internet and connectivity

Requires assessment of all forms of wide area networking including Internet connectivity fees, external bandwidth usage etc. Reason for elimination: beyond the scope of this report which centred on new and refurbished desktop PCs.

IT staff training

Requires an accurate cost breakdown of ongoing training and up-skilling of IT staff. Reason for elimination: beyond the scope of this report, which centred on new and refurbished desktop PCs.

Other

At the same time, an organisation may need to consider factoring in other common costs, such as the costs of a UPS, air conditioner, or bricks and mortar infrastructure.

21.2. Distribution channels

Vendors

Vendors are the designers, manufacturers and marketers of the end-product. They are recognized by consumers as brand names such as HP, Dell, Mecer and others, appearing on the PC casing. Gartner predicts that a third of today's top 10 PC firms (Dell, HP, IBM/Lenovo, Fujitsu, Fujitsu Siemens, Toshiba, NEC, Apple, Lenovo Group, and Gateway) will have abandoned the PC business by 2007. This has already been suggested by IBM's sale of its PC line to Lenovo.[1]

Distributors

Distributors foster relationships with one or more vendors, purchase PCs in bulk from local branches (e.g. HP South Africa), but ship them in from overseas, usually by airfreight. PCs are then sold to resellers (dealers, retailers etc.) in lots as small as a single PC (although, in practice small purchases of this nature are rare).

Resellers

Resellers comprise a diverse group of sales agents, although the low margins on PCs have begun segmenting the market into two main groups: value-added resellers (VARs), who sell the hardware bundled with installation, services and support packages, and traditional shopfront retailers such as consumer electronics, office equipment and department stores.

21.2.1. Example of price markup

Hardware and operating system		+15% Dealer markup (general estimate)	+14% VAT
Rectron 2002	R4408	R5069	R5778
Rectron 2004	R3259	R3747	R4272
Sahara 2002	R5030	R5784	R6594
Sahara 2004	R3168	R3643	R4153
Mecer 2002	R5430	R6244	R7118
Mecer 2004	R3330	R3829	R4365
Esquire 2004	R2338	R2688	R3065
HP 2004	R5884	R6766	R7713
Dell 2004	R7416	R7416	R7416

** South African prices, 2004.*

Table 23: Price markup

21.3. Case study: Shuttleworth Foundation tuXlabs[2]

Background

[1] Second tier vendors normally manage the importing and distribution of components (Intel processors, Seagate hard drives, Hitachi CD drives etc.), the manufacture of PCs, and the redistribution of the finished PC product through separate internal divisions that buy from and sell to each other. This allows them to control most aspects of the final product price, and allows them to be more responsive to currency fluctuations and changing market conditions.

2 This case study is an extract from an as yet unpublished document capturing the experience of the Shuttleworth Foundation's schools networking project (Otter, 2004).

In 2002 the Shuttleworth Foundation started to actively promote the use Open Source software as a computer laboratory solution for schools in the Western Cape, South Africa. The foundation initiated a pilot to prove the effectiveness of Open Source software as a school computing solution. The Linux thin client technology with diskless refurbished Pentium hardware was used to establish a viable economical solution for South African schools. Two schools, Nooitgedacht Primary School and Hydepark Primary School in the Western Cape, were selected as pilot schools to test out the viability of the thin client model. Nooitgedacht did not have an existing computer lab. Hydepark, however, offered a good computer literacy skills base and had had a Microsoft computer network for two years.

The objective of the pilot was to evaluate the ease with which learners adopted and adapted to the new Open Source technology, while at the same time evaluating the ease of migration and the required skills base needed for a successful installation. In both schools, teachers and learners participated in establishing the labs, which included initial infrastructure planning, installing networking cables, setting up hardware and installing and configuring the Open Source software. Ideally this skills transfer process was intended to create a level of self-sustainability and internal capacity for on-site support. It is a process that still exists today as a cornerstone of the tuXlab programme. It was also during these pilot projects that volunteers were encouraged to participate in the process and provide a second-level support structure for the schools.

Based on the success of these two pilot projects, the foundation established the Shuttleworth tuXlab Programme, with the idea of establishing a further 80 tuXlabs in the Western Cape over a period of a year-and-a-half. The initiation of this project provided employment opportunities for several of the volunteers that had participated in the project to date.

The foundation started the programme formally in August 2003, and by the end of 2004 will have installed more than 60 school computer laboratories in areas such as Bishop Lavis, Delft, Eersteriver, Kraaifontein, Durbanville, Grassypark, Pinelands, Rondebosch, Steenberg and Mitchells Plain.

The tuXlabs programme has two primary objectives: to provide learners with access to technology; and to prove Open Source software to be an affordable and appropriate platform for education. In addition, the programme is increasingly designed to aid the development of Open Source skills in the region, as well as growing awareness throughout South Africa of the merits and benefits Open Source software.

Schools selection

The tuXlab programme is not a donation programme. Schools that are selected to participate in the programme are from the beginning treated as partners. They are expected to commit fully to the programme and they need to meet a range of minimum requirements – some of which will require financial expenditure on their part - before they are allowed to participate.

In particular, schools are required to provide all of the necessary infrastructure for the laboratory. This includes the provision of a secure laboratory, adequate power supplies, alarm facilities as well as all desks, server cabinets and lock-up facilities. In turn the foundation ensures that hardware (if required) is procured, volunteers are available to assist with the installation, and that the future viability of the programme is managed through the establishment of local and regional structures.

Although one of the key objectives of the programme is to provide disadvantaged learners with access to computers and technology skills, the decision on whether or not a school is to be include in the programme, is not solely determined by the level of disadvantage experienced by its learners.

Sourcing hardware

Although the tuXlab programme is not strictly a hardware donation programme in most cases the foundation will need to provide hardware to the schools so they can use the software. To date the hardware has been sourced both locally and internationally. The foundation has established relationships with local hardware distributors such as Rectron, Scoop Distribution and Theko International, as well as international organisations such as Computer Aid and the CKS Group of companies.

A typical 20 workstation install will require 20 second-hand PCs with monitors, 20 network cards and a server capable of servicing the entire network. The server component and the switches for the network are purchased new. The objective of the foundation has been to procure these PCs for a maximum of R500 (US$71) each. This has not always been achievable when working with vendors within South Africa. As a result, much of the hardware required for the first installations was acquired from international agencies and donors.

Network configuration

The Shuttleworth tuXlab configuration is based on a GNU/Linux thin client solution. All applications and software are run on the high-specification server. This model offers major benefits with regard to cost of ownership of hardware as well as software. Among these is the fact that software maintenance and support is only required on the server eliminating the need to support ten or twenty individual machines for each laboratory. On the client-side faulty hardware is easily and simply replaced in the case of problems - as soon as the faulty hardware has been replaced the machine is operational again. There is no software that needs to be re-installed on the clients. Open Source software is also freely distributed and therefore incurs no licensing fees.

The foundation has found that because the workstations contain no hard drives, they are able to eliminate the possibility of hard driver failure. This also eliminates the need to maintain software on each and every hard disk.

The server for a typical tuXlab installation is a high-specification Pentium IV and the diskless units are refurbished Pentium I computers networked at 100mb/s. A minimum of 20 thin clients are installed to accommodate a approximately two learners per computer.

Network installation

All servers are pre-configured at the foundation's offices. Each server is installed with the K12-LTSP software as the basis for the thin client environment. The K12-LTSP project was initiated in the US to provide a cost-effective solution to K-12 schools to establish computer labs utilising Open Source software. K12-LTSP is based on Redhat Linux and offers a very simple installation procedure, a choice of the GNOME or KDE desktop environments, productivity suites such as OpenOffice.org and Mozilla, as well as educational software.

Installing and setting up the server typically requires around two hours. This includes time for testing the installation.

The thin client machines, however, are always set up on-site at the school. This is important because of the opportunity it offers to educate users on the workings of their new laboratory. Equally this is important in ensuring buy-in and involvement of school staff from the inception of the laboratory (i.e. the installation is hopefully seen as less a donation and more of a school project).

On the day of the installation and as part of the foundation's transfer of skills strategy, learners, teachers and volunteers are invited to prepare the refurbished computers to serve as GNU/Linux thin client terminals under the guidance of the foundation’s Open Source team and skilled volunteers. Once this process is completed, the thin clients are connected to the network. Thin

clients can either boot from a stiffy disk, a small partition from a hard drive or from a network card with a boot prom. Based on the solution selected, this process can take from one minute to ten minutes.

On completion of installation and set up phase, the foundation provides general server administration and network training as well as printed support manuals and software to each school.

Costs

The following is a breakdown of the various cost elements in establishing a tuXlab laboratory:

Hardware	**Vendor**	**Cost**
Server	Rectron	R12 000
Networking	Scoop	R 3 800
20 X thin clients (R400 each)	Refurbished	R 8 000
20 X network cards	Rectron	R 1 200
20 X Boot prom	Netday	R 700
Manual/CD's	The foundation	R 300
		R26 000 (US$3714)

Table 24: Hardware costs for tuXlab installation

Although the Shuttleworth Foundation provides most of the resources to facilitate this project, a conservative estimate of the value of these resources in commercial terms in indicated below:

Description	**Cost**	**Total cost**
Consultation	R300 X 10	R 3 000
Information brochure	R50 X 10	R 500
In-house technical resource	R250 x 30	R 7 500
Networking	R150 per point	R 5 250
Support and maintenance	R250 x 20	R 5 000
Training	R250 X 20	R 5 000
		R26 250 (US$3750)

Table 25: Support and administration costs for tuXlabs

Ideally, the cost of setting up a Shuttleworth tuXlab (excluding the foundation's costs) should not exceed a total of R30 000 (US$4285) for a 20 workstation laboratory.

21.4. Refurbished PC and second-hand component pricelists

Community Education Computer Society (CECS)

	P I	**P I**	**P I**	**P II**	**P II**	**P III**	**P III**	**P III**
CPU	P75/90	P100/133	P166/200	P266/333	P350/400	P450/500	P600/700	P800/900
Hard drive	540 MB	850 MB	1.2 GB	2.1 GB	3 GB	4 GB	6 GB	10 GB
Memory	16 MB	32 MB	32 MB	64 MB	64 MB	128 MB	128 MB	128 MB
Monitor	14" colour	14"colour	14"colour	14" colour	14" colour	14" colour	14" colour	14" colour
Sound	No	No	No	Yes	Yes	Yes	Yes	Yes
CD-ROM	No	No	No	Yes	Yes	Yes	Yes	Yes

PRICE (inc vat)	**R550** (US$79)	**R700** (US$100)	**R800** (US$114)	**R1200** (US$171)	**R1300** (US$186)	**R1450** (US$207)	**R1750** (US$250)	**R2000** (US$286)

** Prices valid September 2004.*
** PCs come with three-month warranty.*
** FOSS installed for free. Additional charge of R900 (US$129) to install MS Windows XP Home Edition and R2500 (US$357) to install MS Office XP Professional.*

Table 26: Refurbished PC pricelist

Device Global

	P II	**P II**	**P II**	**P III**	**P III**	**P III**
Brand	IBM	Compaq	HP	IBM	IBM	IBM
Clockspeed	400 MHz	450 MHz	300 MHz	500 MHz	733 MHz	1000 MHz
RAM	64 MB	64 MB	32 MB	128MB	128MB	128 MB
Video memory	4 MB	4 MB	4 MB	4MB		
Harddrive size	6400	10000 or 6400	3200	6400	10000	20000
Monitor	No	No	No	No	No	No
Price	**R832.20** (US$199)	**R889.20** (US$127)	**R592.80** (US$85)	**R997.50** (US$143)	**R1578.90** (US$226)	**R1995** (US$285)

* Prices valid December 2004.

Table 27: Refurbished PC pricelist

ATEX Continental PC Wholesaler

	P3 Mid-range	**P2 Entry-level**
CPU	PIII 450-500MHZ	PII 233-266MHZ
Fan	Included	Included
Main Board	SOCKET 370/SLOT 1 M/B	SLOT 1 LX M/BOARD
Cable Set	Included	Included
Power Cable	Included for case	Included for Case
Power Extention	Included for monitor	Included for monitor
Memory	128MB SDRAM PC 100	32MB SDRAM PC66/100
HDD	4-6GB IDE	2-3GB IDE
Display	2-4MB AGP/ONB	2-4MB PCI/ONB
FDD	1.44MB STIFFY DRIVE	1.44MB STIFFY
Case	Desktop/ MiniTower(AT/ATX)	Desktop/Mini Tower(AT/ATX)
CD Rom	CD-ROM	CD-ROM
Monitor	14' SVGA DIGITAL	14' SVGA ANALOG
Keyboard	104	104
Mouse	PS/2 Scroll	PS/2 Scroll
Price (incl. 14% VAT)	**R 1264** (US$180)	**R 699** (US$99)

** Prices August, 2004.*

Table 28: Refurbished PC pricelist

Component		Wholesale	Retail
CPU only	Intel P2, 233MHz, Slot 1	R 155	R201.5
CPU only	Intel P3, 450 to 550MHz, Slot 1	R 335	R435.5
CPU + Mobo	P3, 450 to 500MHz, Slot 1	R 675	R877.5
CPU + Mobo	P3, 700 to 800MHz, Sock 370	R 750	R975
Graphics card	16Mb VGA, AGP	R 120	R156
HDD	3G - 4G, IDE	R 160	R208
HDD	20G, IDE	R 350	R455
Kboard	Keyboard, PS/2	R 15	R19.5
Memory	32Mb SIMM, 72 pin	R 64	R83.2
Memory	128Mb DIMM, 168 pin, PC 100/133	R 165	R214.5
Monitor	15" SVGA, Dgtl, A-grade	R 380	R494
Network card	10/100, UTP, PCI	R 35	R45.5
Power supply	Power Supply, ATX	R 75	R97.5

** Prices August, 2004. Include VAT @ 14%.*

Table 29: Component pricelist

21.5. PC prices in Africa

Country	New PC (local currency)	US$	Used (US$)	Notes
Cameroon	250000	507	-	
DRC	709000	1246	200	
Ethiopia	13000	1493	-	
Ghana	9000000	997	-	
Kenya	130000	1625	249	
Malawi	65010	600	-	
Namibia	5000-6000	871-1045	-	New is US$522-US$871 if bypass reseller
Nigeria	40000	300	150	
South Africa	5800	828	-	
Tanzania	365715	350	-	
Uganda	800000	463	-	Brand name=US$1000
Zambia	8000000	1719	644	
Zimbabwe	5650000	795	-	
(Denmark)	4500	806	-	
(India)	20000	453	-	

* This pricelist is suggestive only, and was developed by African programmers attending the Africa Source workshop in Okahandja, Namibia, March, 2004. PC quality varies. Prices converted using www.xe.com currency converter, December 2004.

Table 30: Price survey (Okahandja, Namibia)

21.6. Factors likely to affect future pricing trends

Since Africa imports both complete PCs and the computer components required for local manufacture, the single biggest influence on PC pricing in Africa is local currency fluctuation against the dollar.

Vendor	Price (ZAR)	CPU (GHz)	RAM (MB)	OS (Windows)	Monitor
Rectron 2002	R 5,778.89	1.3 AMD	128	XP Home	14"
Rectron 2004	R 4,272.55	2.4 Intel	256	XP Home	15"
Sahara 2002	R 6,594.33	1.3 AMD	128	XP Home	14"
Sahara 2004	R 4,153.25	2.4 Intel	256	XP Home	15"
Mecer 2002	R 7,118.73	1.3 Intel	128	XP Home	15"
Mecer 2004	R 4,365.63	2.4 Intel	256	XP Home	15"
HP 2004	R 7,713.92	2.8 Intel	256	XP Home	15"
Dell 2004	R 7,416.00	2.4 Intel	256	XP Home	17"

* Includes modem, network card, stiffy drive, speakers, keyboard and mouse
* NB: As determined by the vendor (Microsoft), software price used is only applicable if purchased together with the hardware.
* Prices from 2H04.

Table 31: Pricing 2002-2004

	Windows 2000	Windows XP Home	Windows XP Pro	MS Office XP Pro	Norton Antivirus
Rectron 2002	R1520	R945	R1510	R2740	R159
Rectron 2004	R975	R600	R960	R1795	R110
Sahara 2002	R1470	R899	R1450	R2590	R125
Sahara 2004	R975	R600	R960	R1739	R110

Table 32: Software pricing 2002-2004

As Tables 31 and 32 show, in South Africa this appears to have affected software and hardware equally, both showing price reductions of about 30-40% since 2002 – roughly equal to the strengthening of the Rand against the US$ over that period.[3]

While proprietary software like Microsoft Windows and Office accounts for between 30% and 50% of the purchase price of a new PC, free software has yet to gain traction and mass adoption anywhere in the developing world – although China's two biggest PC makers, Lenovo and Great Wall, ship Linux and other Open Source software as a standard option.

Legal anti-trust precedents, together with piracy and Open Source pressures in the emerging markets such as China, may pressure Microsoft into releasing cheaper, stripped down versions of Windows for these (and other) markets.[4]

At the hardware level separate components, such as graphics chips, network ports and modems,

[3] Price reductions over the past few years have also been influenced by the scrapping of the Ad Valorem tax on technology imports.

[4] Despite signs of the increasing, even if partial, adoption of Open Source technology in business operations in countries like South Africa, Microsoft's high rate of research and development means that it is unlikely to relinquish its dominance of the market easily. Proprietary software is likely to remain a key factor in PC pricing for the foreseeable future. For example, virtualisation software such as Microsoft's Virtual PC 2004, and VMWare's Workstation allows the desktop user to run several different operating systems simultaneously on the desktop, and move between them with a mouse click. This technology, designed to ease operating system migration in the corporate world, is rated by Gartner as the most disruptive technology of the next ten years (Gartner, 2004. Media Release).

are being soldered directly onto the PC motherboard, making repairs difficult and making it increasingly attractive to swap out entire PC innards rather than replace the component parts.

This may affect the refurbishment industry, as component parts become harder to source, while also becoming more expensive as 'non-standard' components manufactured in smaller quantities.

It is unlikely that the prices of refurbished PCs will go much lower than they already are, much of this being dependent on fixed costs, such as shipping and transport costs, tariffs, time and labour costs to refurbish, and floor space. Fluctuations may be seen in the market price consumers are prepared to pay, and the cost of replacement components.

A significant factor likely to affect entry-level prices generally is the trend towards mobile computing. In mid-2003 notebooks sales passed desktops in the US, with prices falling below the US$1300 mark, and Europe looks set to follow suit with year-on-year growth of between 30% and 40% (Greenspan, 2003). Vendor price wars in South Africa saw notebooks fall below the R10000 (US$1429) mark in 2002, and first tier products are now available for R6500 (US$929), about the same as a mid-range desktop (Dudley, 2003).

Already bulk supply of notebooks from Europe are being advertised by refurbishment companies such as Device and FreeCom. At around R3000 (US$429), the pricing is close to that of a new entry-level PC.

Notebook maintenance, repairs and refurbishment are technically more complex as most contain proprietary hardware components, have unique designs and configurations, and often require specialized tools.

Nevertheless, it seems likely that a greater proportion of the refurbishment industry will be given over to notebooks within two years. Besides the obvious advantage of portability, other advantages for Africa are their much more rugged construction, increased resistance to heat and dust, and protection from power fluctuations and outages.[5] (See Section 11)

21.7. TCO best practices

The application of TCO best practices are a simple way to reduce ownership costs. However, some factors have a far higher impact in terms of cost savings than others.

Management and standardization

The Gartner Group and other independent studies (such as that conducted by the University of Minnesota in 1997) concur that infrastructure management is the single biggest contributor to lowering TCO.

This practice in turn is dependant on other best practices, such as building and maintaining an accurate inventory of IT assets, including the age, depreciation life cycle and original purchase price of technology. This has the added benefit of allowing IT staff to identify and eliminate unnecessary segments of IT infrastructure, consolidate server resources and minimize spare parts inventory.

Standardization of the desktop platform – both hardware and software - is also key to manageability. A managed Windows 2000 or XP environment can be up to 37% more economical than an unmanaged one and up to 46% more economical than an unmanaged Windows 95 environment (Silver, 2003).

[5] Due to the power brick voltage converter and battery supply.

Operating systems in particular are far less time consuming to support when IT staff develop depth of experience on a limited number of configurations rather than a more superficial knowledge of a wider range of systems. Standardized hardware also helps keep spare parts inventory to a minimum.

Standardization is most easily achieved by doing volume purchasing from a single PC vendor, and then locking down the operating environment so that users cannot easily damage the machine's core system files. Normally this precludes users from installing their own applications and also limits customization. Some analysts caution against total inflexibility in this regard, which might lead users to become consciously non-compliant and resistant to IT management measures. (O'Donnell, 1998)

In practice this level of standardization is difficult to achieve in small organisations. Most micro-businesses grow organically to become small businesses by gradually recruiting staff and consequently adding new technology ad hoc. Small businesses and organisations targeted by our study (smaller than 25 people) invariably have neither the means nor the need to do volume purchasing, although in schools networking programmes volume purchasing is practiced.

Many analysts argue that although thin client environments have a far lower per desktop maintenance overhead due to increased manageability and standardization, they simply transfer their cost centre to the server level where each virtual user session is created. Not only are extensive server resources required for this, but having a single point of failure (the server or networking hardware), makes a thin client network more vulnerable to multi-user downtime.

In practice it was found that large, corporate thin client networks only have 15-20% lower TCO than traditional fat clients.

Stabilize infrastructure

In today's highly networked environment an unstable IT infrastructure affects the greatest number of users simultaneously, from lost client server connections to data loss and application crashes. Even a small amount of downtime simultaneously affecting a large number of users can severely impact on TCO. Often removing extraneous equipment can improve network stability.

The University of Minnesota TCO study suggests that this is the single, biggest TCO saving measure possible, and that TCO cannot be adequately quantified until the operating environment is stable and reliable.

Use management tools

Many hardware and software vendors produce software tools to manage the individual assets of a company at a granular level – even in medium-sized businesses, often numbering thousands of individual items. These tools allow remote troubleshooting and repairs, which saves on labour costs since support staff work more efficiently. Speedy problem resolution saves on user downtime too. Automating IT processes, such as data processing and back-up procedures, as well as optimizing business processes to take better advantage of IT resources, also results in better TCO.

Train staff

Staff IT training can reduce the need for IT support in two ways: the user is less likely to cause applications to malfunction or to lose data, and users can quickly resolve superficial system malfunctions and other errors.

Replace legacy products

Identifying legacy hardware and software, which may be a constant drain on IT resources, can save on TCO. Often legacy hardware can be cheaply replaced with more efficient technology which is also easier to manage. Many TCO studies recommend replacing homegrown legacy applications with industry standard applications wherever possible.

Open systems

Deploying open systems wherever practical in order to avoid lock-in with one or other proprietary platform controlled by one or two vendors is recommended by Stefano Matielo, formerly of Sun Microsystems (Weideman, 2002). According to Matielo, The so-called 'cost of exit' (moving from one established, proprietary computing platform to another system) has had undue influence on cost-effective IT decision-making. Moving to open systems allows companies to more easily migrate from one vendor's products to another's with minimal disruption and expense. He maintains that companies should work to a longer term blueprint, and not simply buy to satisfy a short-term need.

21.8. Mozambique and South Africa - ICT comparison

	Mozambique	South Africa
Population (millions)	18.4	43.6
Literacy rate	46.5	86
Gross national income per capita	210	2600
TVs per 1000 people	5	152
Radios per 1000 people	44	338
Telephone mainlines per 1000 people	4	112
Mobile phones per 1000 people	8	252
Personal computers per 1000 people	3.5	68.5
Internet users (thousands)	15	3068

Source: Association for Progressive Communications (www.apc.org) Statistics (2001 and 2002) from the World Bank, International Telecommunications Union and UNDP.

Table 33: Mozambique and South Africa ICT comparison

21.9. Average temperatures in Africa

Average maximum temperatures													
Windhoek													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
°C	30.7	29	28	26	23	21	21	24	27	29	30	31	26.6
Johannesburg													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
°C	25.3	25	24	21	18.5	16	16	19	22	24	24	25	21.6
Lagos													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
°C	30.9	32	32	31	30.6	29	28	28	28	29	31	31	30
Dar es Salaam													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
°C	31	31	31	29	28.5	28	27	28	28	29	29	30	29.1

Average temperatures													
Bamako													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
°C	25	28	31	32	31.5	29	27	26	26	28	27	25	27.9

Table 34: Average temperatures in Africa

21.10. Advantages and disadvantages of thin client

The advantages of the thin client network include:

1. Less client maintenance and support is required compared to a fat client;
2. Security breaches including theft of data and virus outbreaks can be controlled from a single source (the server);
3. New applications and updates can be made simultaneously available to all users from the server side;
4. Will work on much lower specification hardware, since processing and memory requirements are off loaded onto the server;
5. Significant reductions in licensing fee if using Linux/FOSS products;
6. Lower hardware replacement costs over time;
7. Tend to be more convenient in the educational or training environment.

Some of the inhibitors are:

1. The purchase of a costly, high specification network server;
2. In some countries problems with sourcing support (for both thin client and Linux)[6];
3. Change management in moving from the familiar Windows desktop environment hampers productivity;
4. Most networks grow organically and moving to a thin client environment may involve disposing of pre-existing, fat client software assets;
5. Single point of failure for the entire network of users. Anything affecting the thin client server, including downtime, will impact all users simultaneously.

21.11. NGO support

	Pros	**Cons**

[6] Most support organisations interviewed servicing the small organisation had not recently deployed a thin client network, nor did they expect to do so in the foreseeable future.

Unpaid staff		
Volunteer/intern	• Low cost option; • Passion for mission; • If project can be clearly defined, can be a source of substantial help for a small nonprofit.	• Reliability; • Accountability; • Availability.
Paid staff		
Accidental techie	• Can generally troubleshoot; • Needs support; • Growth opportunity for staff; • Low budget solution for basic needs; • Passion for mission.	• Lacks formal training; • Sometimes not welcome addition to job responsibilities; • Pulls person away from other job duties.
General staff technologist	• Dedicated to organisation; • Customized attention and understanding of non-profit's needs; • Always on-site; • Specialized skills.	• Cost including benefits; • Supervision; • Support during vacations; • May specialize in one area but not able to 'go deep' in other areas; • May be overwhelmed with routine IT tasks; • Organisation may still require; specialized technologists depending on technology project; • Less control.
Outsourced Support		
Consultant or Firm	• Reduced IT overhead: space, staff, upgrading; • Diversity of skills available; • Less hassle for non-profit staff who want to focus on mission.	• Not on-site; • Security of information; • No knowledge transfer to current staff; • Availability over the long term.

Source: TechAtlas tools by NPower (www.npower.org/tools/index.htm)

Table 35: Typical roles played by IT support staff in an NGO

21.12. Example application of the comparative TCO calculator

A South African-based training organisation provided us with the following data:

Hardware	
Number of PCs in network	21
Workstation price	R2500
New or refurbished PCs	New
A-Brand or B-Brand	B-Brand
Thin or fat client	Fat
Server price	R 2500 (PC used for server)
Software	
Total software purchase price for PCs	R32 900 (Windows 98se, R14000 in total; Office 2000, R900 per machine).
Software purchase price for server	Free (FOSS installed)

Software licence fees (clients)	R200
Software licence fees (server)	R400
Support and maintenance	
Cost of network installation	R7350
Hourly support rate	R350
Standardization factor	N/a
Services Inflation rate (%)	3
Productivity losses	
Estimated income per PC at 100% productivity.	R32
Environment and infrastructure	
Is dust a serious problem (i.e. resulting in malfunctioning PCs)?	No
Are the PCs blown regularly?	No
Have you installed an air conditioner?	Yes
Unstable electricity?	No
Is a UPS installed?	No
Is lightning a serious problem?	No
Warranty	
Warranty years (per client PC)	1 Year
Does your warranty cover failures from lightning strikes?	No

Table 36: Sample cost data

The following assumptions were made:

Driver	Assumption
Hardware deflation/inflation (%)	-5
Average maximum temperature	29
PC productivity (%)	50%

Table 37: Assumptions

Below are the results of the five-year comparative TCO calculation:

	Year 1	Year 2	Year 3	Year 4	Year 5
Hardware					
Server procurement	2500	0	0	0	0
Workstation procurement	52500	0	0	0	0
Replacements	0	1636	2640	2368	3627
Repairs labour	0	1400	2100	2800	3500
Sub-Total	**55000**	**3036**	**4740**	**5168**	**7127**
Software					
Cost of software	32900	0	0	0	0
Client licence fees	4200	3990	3801	3612	3423
Server licence fees	400	380	361	343	326
Sub-Total	**37500**	**4370**	**4162**	**3955**	**3749**
Support and maintenance					

Installation	7350	0	0	0	0
Client support	88200	92372	95844	99316	102788
Sub-Total	**95550**	**92372**	**95844**	**99316**	**102788**
Disposal					
Disposal value/residual value	0	0	0	0	2625
Sub-Total	0	0	0	0	**-2625**
Productivity losses					
Downtime	256	512	768	1024	1280
Sub-Total	**256**	**512**	**768**	**1024**	**1280**
Total	**188306**	**100290**	**105514**	**109463**	**112319**

Table 38: Comparative TCO calculation results

Total comparative costs of owning the network over five years:
R615 892 (US$87985)

If the training organisation had installed A-Brand refurbished PCs (assuming the refurbished PCs are preloaded with Windows according to Microsoft's COA licence and that Open Source is used for productivity software), the total comparative cost over five years would be: **R568 846 ($81264)**. This represents a savings of R47046 (US$6721).

As the table below suggests, the savings on the initial hardware and software purchase prices using A-Brand refurbished PCs is not overtaken by the effective ongoing costs over the five years. However, the higher failure rate of A-Brand refurbished PCs would need to be weighed up against the objectives of the organisation, and its support capacity (i.e. the failure rate may be unsuitable for training).

	Year 1	Year 2	Year 3	Year 4	Year 5
B-Brand (new) total	188306	100290	105514	109463	112319
A-Brand (refurbished) total	128106	102266	107965	113063	117446
Savings (-)/ Cost (+)	-60200	+1976	+2451	+3600	+5127

Table 39: Savings using A-Brand refurbished PCs

21.13. Minimizing risk with refurbished PCs

The TCO of refurbished PCs is minimized by reducing exposure to their cost risks. The table below summarizes key ways in which these risks can be minimized.

Issue	Best practices
Purchasing decision	Only buy A-Brand PCs.
	Insist on end of lease PCs.
	PCs must preferably be standardized.

	Understand the environment where the PCs have come from. This should preferably be a stable environment, such as a large corporation which is likely to have air conditioning, have performed regular maintenance on the PCs and where micro-environmental factors, such as dust have been minimized.
	Choose PCs where the usage patterns are likely to be the lightest. Have they been used for training? Or for processing banking transactions? Or for standard office use?
	Understand the level of refurbishment done (light or full refurbishment?).
	Go with vendors that offer a warranty or distribution/implementation organisations that offer support.
	Consider ordering 20-30% more PCs than you need, to minimize replacement costs and counter spares availability issues should they arise. Faulty PCs can simply be swapped out or spare PCs cannibalized for parts.[7]
Support	Access a support organisation that is prepared to work with you on your project. Involve them in the purchasing decision if possible, and negotiate preferential rates if you can.
Implementation	Consider the pros and cons of a thin client network for your purposes.
	In areas with excessive temperatures, an air conditioning unit must be installed (for all the PCs).
	If poor or unstable electricity is a problem, a UPS must be installed and regularly maintained and tested to protect all the PCs.
	If in areas at high risk of lightning strikes, a UPS or appropriate lightning protector must be installed.
Software	Consider the pros and cons (both from a cost and practical perspective) of FOSS.
	Use FOSS for a thin client solution.
Maintenance	Keep accurate records of hardware and software (minimizes support time).
	Record break-fix data (this will help you properly inform your next purchasing decision, and keep a tally of ongoing costs).
	In dusty areas, blow PCs regularly.
	Keep PCs out of direct sunlight.
	Make sure PCs aren't in an area where they could be frequently bumped or damaged.
	Regularly back-up data in case of failure.

Table 40: Minimizing risk with refurbished PCs

[7] Some SchoolNets, for instance, orders 2-3 extra PCs for this purpose (SchoolNet Africa Workshop, 2004).