



North Central Regional  
Technology in Education Consortium  
at



A Report and Estimating Tool for  
**K-12 School Districts**

**Missouri District Case Study**

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Consortium for School Networking

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## Missouri District Case Study

### *Introduction*

The four 2004 Total Cost of Ownership (TCO) case studies were developed by the Consortium for School Networking, thanks to a grant from the U.S. Department of Education and the cooperation of the case study school districts. These case studies are presented in the same format as the 2003 studies, but also have a focus on additional technologies beyond the base distributed computing model. These new technologies are voice/data integration, wireless networking, and e-learning.

From a technical perspective, the scope of the project included end-user computing devices, network servers, local area network hardware, and the labor costs associated with each of these components. Software, application service providers, content and curriculum development, and staff development and training were included as well.

Data from each district were used to develop a case study that reports pertinent TCO metrics, discusses how the district approached the TCO process, and provides background information on the district and its distributed computing environment. The metrics represent a baseline for the district; and from this baseline data, a trending analysis can be performed. In addition, the process for data collection should be refined, over time, as a first-time TCO analysis often requires a great deal of manual effort. It is difficult to compare one district's TCO study to another's because there are so many potential variables.

For the 2004 case studies, indirect labor (i.e. the time users spend in performing routine system functions, dealing with system problems and receiving training) was based on user survey data. Understandably, the indirect labor cost estimates for the 2004 studies are higher than the published 2003 case studies, because the 2003 projections were based on estimates by staff in the computer services department rather than a survey of users.

There are five sections to each case study. The first is an overview of the district and the general setting of the distributed computing environment. The second section contains the TCO metrics. The third section includes an interpretation of key selected TCO metrics. The fourth section provides a review of the district's participation in the 2004 case study focus initiatives of wireless communications, voice/data integration, and e-learning technologies. The fifth and final section discusses each district's approach to performing the TCO analysis.



## ***Overview and general setting***

The Missouri district is a small rural school district with 450 students and 51 staff with a total of 210 client computers. The district consists of two schools (K-6 and 7-12) housed in a single building. The original building was built in 1955 and a large addition, in 1999.

With fewer than 1,000 students, this district reflects approximately half of U.S. public school districts in size. However, these districts face particular challenges when it comes to managing the costs of operating their computer networks. First, they may have limited resources to begin with. The Missouri district qualifies for only minimal entitlement funding from the federal government, and receives less than the state average of per-student funding. In addition, districts like this one are often limited in the kinds of resources they can bring to reviewing and managing technology issues. On the other hand, because of their small size, they can sometimes get by with more informal practices that would create issues in districts that are larger. The fact that the Missouri's district's students are all under one roof makes the management of its technology is an advantage that other, more far-flung districts do not enjoy.

Another advantage the district enjoys is that its Internet access is relatively inexpensive, compared to many other districts around the country, because the state of Missouri provides fast T1 communications for schools through the Missouri Research and Education Network (MOREnet) for a nominal annual \$1500 support fee.

Prior to 2000, the district's technology department consisted of a technology savvy superintendent, a part-time teacher and an outside services organization. This environment created network administrative inconsistencies which were not well documented, as there was no formal computer services department to coordinate or perform these functions. In 2000, a new superintendent was appointed and the technology director position was created.

The first order of business for the new technology director was to provide a consistent and cohesive server and local area network environment, which is described below ("Linux on Servers"). Other initiatives have included an upgrade of the voice infrastructure and replacement of the PBX, which was lacking in capacity. The decision to implement a voice/data integration solution is described below ("Voice/Data Integration"). Implementation of Web authoring software allows teachers and staff to create their own web pages for inclusion (by computer services) on the district's web site.

The district recently received a donation of 140 computers from the Internal Revenue Service and was able to use 110 of them. This has enabled the district to provide a ratio of 2.8 students per computer. In the past, CoSN has cautioned school districts about accepting donated computers, unless certain conditions are met. This will be discussed in depth later in this case study.



**Cost of Ownership Metrics**

## 1. Overall Cost

Unit	Total Cost	Direct Cost	Indirect Labor Cost
Overall District Cost	\$218,592	\$81,560	\$137,032
District Cost per Client Computer	\$1031	\$385	\$646

## 2. Direct Cost by Category

Unit	Hardware	Software	Direct Labor	External Application Providers
District Cost	\$37,450	\$4,322	\$38,288	\$1,500
District Cost per Client Computer	\$177	\$20	\$181	\$7

## 3. Hardware Cost by Category

Unit	Client Computer	Server	Network	Printer	Supplies
District Cost	\$29,500	\$2,150	\$1,310	\$1,490	\$3,000
District Cost per Client Computer	\$139	\$10	\$6	\$7	\$14

## 4. Asset Metrics

Category of District Resource	Ratio
Students per Student Dedicated Client Computer	2.8
Teachers per Teacher Dedicated Client Computer	1.0
Non-Classroom Personnel per Non-Classroom Client Computer	1.0
Total Users per Total Client Computers	2.4
Client Computers per Printer	16.3
Client Computers per Server	21.2

## 4. Staffing Metrics

Direct Labor Category	Total Cost	Cost Per Client Computer (\$ US)	Client Computers per Staff
Operations and Financial	\$23,495	\$111	359
Professional Development and Training	\$14,793	\$70	624
Curriculum Development and Support	\$0	\$0	0
Total Support	\$38,288	\$181	268



## ***Interpretation of TCO Metrics***

The TCO metrics for this school district indicate particularly low costs for hardware, software, direct labor and indirect labor.

### **Software costs are only \$20 per client computer**

#### ***Linux on servers***

The first major task for the new technology director in the 2000/2001 school year was to submit plans for a cohesive distributed computing network, to be implemented in the summer of 2001. Four options with related plans and costs were submitted:

- Reinstall the current Network Operating System (NOS) with a consistent directory
- Upgrade to the current version of their Network Operating System and reinstall with a consistent directory
- Implement a Windows NT network
- Implement a Linux network

Keeping or upgrading their current NOS were tempting solutions as the cost was reasonable and disruption minimal. There was a concern at the time that their current NOS vendor may not be viable in the future. Windows NT was another option, but since the initial costs of other options were lower and the new technology director had some familiarity with Linux combined with its low cost (essentially free), Linux was chosen as the network operating system.

Beyond the initial implementation effort, Linux is essentially equivalent to their former NOS in overall support and administration requirements in this small district, and the conversion was transparent to the users.

For simplicity purposes and in efforts to keep one application from bringing down the entire network, each server supports a single application. Six Linux servers are used: Web server, file server, print server, filter/firewall, library circulation, and email. (Financial applications are on a standalone system.) All applications (including SIS) are run on client computers; shared data resides on servers. This approach allows for the use of relatively low performance desktop computers to perform their designated data server function. The typical Linux server in this district is a 300MHZ Pentium II computer with 256MB of RAM. There are some ramifications to the approach of using desktop computers as servers, regardless of server operating system. These are described briefly below under "Server Component."

#### ***Open Office***

Open Office is used on all appropriate client computers as the district standard for personal productivity applications. This free software is a multi-platform office productivity suite compatible with all major file formats. This approach, of course, burdens the district with support and viability issues.



## Hardware costs are only \$177 per client computer

### *Donated Equipment*

In 2003, the Missouri case-study district was able to obtain 140 used systems, donated by the U.S. Internal Revenue Service; 110 of these systems were deployed to classrooms and labs, and 30 held aside as replacements and spare parts. While these systems were mostly pre-Pentium II systems, typically Pentium 166, they met the district's required specifications for a donated computer, namely that it be capable of running the Windows 98 operating system. While donated computers can sometimes create additional technology support demands, in terms of inventorying software, and the time and parts necessary to upgrade the computers to the network standard, the Missouri district was able to avoid those issues, at least for the short-term because the donation of the IRS computers, met the minimum district standard.

The donation enabled the district to make strides toward a Missouri state goal of having one computer for every two students. The computers are used primarily in four computer labs and in the third- and fourth-grade classroom where there is a client computer for every two students. The donated equipment has the effect of lowering the hardware component of its TCO costs. However, because these computers are already five years old, the district will need to immediately begin planning how they will be replaced. The 30 spare computers provide a ready source of parts or, if necessary, a replacement machine. However, as time goes on, one would expect that the district would see an increase in both direct and indirect labor costs as the machines age and require more frequent trouble-shooting, or when the district chooses to implement applications requiring an upgrade of the operating system

The district is able to swap out equipment easily because all of its data is kept on servers and applications are standardized across the client computers—a good strategy for keeping costs down.

Because the computers were donated, the district had little control over the timetable on which they arrived. As it turned out, after several delays, they were made available unexpectedly just prior to the start of the school year. As a result, the school district was hard-pressed to provide adequate staff development to help teachers learn how to integrate technology into the learning environment. As a result, it is likely that the computers were not used as extensively or as well as they could have been during the first year. This is a case in which a lower TCO may not necessarily be a good thing; investments need to be made to develop utilization and value.

### *Server Component*

The server component of the client computer hardware cost is only \$10. Using desktop technology to provide data server functions has resulted in low server costs. However, the lack of robust servers with RAID, data logging and system redundancies makes the district vulnerable to server failures. This approach does not scale well for a larger district. The district has attempted to separate servers and their data by application to



minimize the effect of a server failure. Also, regular data backup is performed to enable the district to recover to the point in time that the last backup was performed. However, database updates that occurred between the last backup and the point of failure can be lost. The “cost” of limiting spending on server redundancies would become readily apparent if and when the district experienced a server failure that increased direct and indirect labor costs to try to recreate lost data. As school districts move more and more of their critical business operations to computers, they typically increase their spending in these areas of availability.

### **Direct labor costs are only \$181 per client computer**

The computer services department consists of one person not quite full time. Efficiencies are gained with the installation of a straightforward computer network, standardized server and client operating systems and versions, and no need for departmental meetings or other coordination activities. Two-thirds of the direct labor is consumed in operations functions, including user support, planning, implementation and administration. One-third is dedicated to professional development and training. Content and curriculum development and support are currently performed on an ad-hoc basis by individual teachers that are motivated to do this. Consequently, this is a “hidden” indirect labor cost that the district would need to be careful to capture in its TCO review. In addition, the district may find that it is not giving enough attention to the instructional aspect of its technology infrastructure in order to use it most effectively. As these various ad-hoc, disparate instructional solutions are implemented by teachers, there will be a direct and indirect labor cost consequence.

### **Indirect Labor costs are only \$646 per client computer**

The Missouri school district surveyed users to assess indirect labor costs from their perspective. It should be noted that the 2004 case studies utilized user surveys, rather than computer services estimates, in an attempt to gain a more accurate understanding of these costs. However, compared to the other 2004 case-study districts, this district’s respondents reported surprisingly low levels of indirect support. This may be the result of a relatively stable computing environment, with few user interface changes and comparatively low burdened salaries in a small rural district, when compared with larger, more urban peers. Surveyed users may have also been reluctant to complain about the level of support provided by the single person in the computer services department, whom they knew personally. Another factor may be that if teachers are not yet using their computers due to less formalized training and support, they are likely not encountering as many problems that need trouble-shooting. This is an area that this district should continue to monitor as it assesses whether its technology infrastructure is achieving its intended goals.



## **2004 Focus Initiatives**

### **Voice/Data Integration**

By 2001, the school district's 16-line analog PBX for voice communications was long overdue for expansion. In 2002, an integrated voice/data solution was chosen, and the district chose a digital voice solution which would utilize their existing data network infrastructure

The school district looked at both analog voice and digital voice/data options. Since the necessary locations were already wired with Category 5 data connections, the use of the existing digital data network for voice helped avoid having to run wiring to new locations. Also, now voice mail can now be accessed with email on client computers via the district's email system.

Initial costs for implementation were about \$11,500. This compares to an estimated \$14,000 for replacing the existing PBX with a higher capacity voice-only PBX. A less-expensive Centrex system was also evaluated, but carried ongoing lease and line fees. The district has not determined any ongoing cost differences, other than some software upgrade charges, between the two approaches. The district also had to upgrade the local area network to all 100 mbps. It should also be noted that at \$335 per business phone, any major expansion of phones will be expensive; however, the per-phone cost would be offset by the fact that additional wiring required by analog or Centrex handsets is unnecessary with the digital phones. Classroom phones are not an issue with the district as current district policy is not to provide individual classroom phones.

Since the internal phone system does not have to go between campuses, the district implemented physical (MAC) addressing, as opposed to dynamic IP addresses used in Voice over IP (VoIP).

The TCO tool does not specifically capture voice communications costs; costs for a separate voice communications infrastructure would need to be collected and calculated separately. However, when voice and data are merged over the same network, the additional network costs are included in the results and show up as additional total costs, inflating per-client-computer networking costs.



## **TCO Processes**

This was the first time the Missouri district had attempted a TCO analysis. The small size and organized manual bookkeeping process at this district made data collection for direct costs a relatively easy task. A much needed physical inventory was also performed. The new user survey for collecting indirect labor resulted in some confusion on the part of responding users. Some wording in the survey has since been changed to provide clarification. This survey process did provide insight to user perceptions in the areas of system availability and support, as well as training received.

The need to better track and allocate direct labor costs is now recognized. One area being reviewed is the development and implementation of a help desk tool for problem and time tracking. The district also recognizes that it needs to encourage more work on curriculum development and support to improve utilization of computers while managing hidden indirect labor costs. The technology director recognizes the need for more formal technology training for teachers so that they can better leverage available computer resources.

While district officials undoubtedly will be pleased with their current, relatively low cost of ownership, they need to be preparing for the day when they will have to replace their aging client and server hardware, including the donated equipment, peripherals and printers. More than 50 percent of the district's client computers are over five years old, and 90 percent are over three years old. Also, the utilization of client computers in labs and classrooms for curriculum purposes is likely to be lower than other districts studied, as these have recently been installed, and processes to help teachers integrate technology and learn how to use software packages have yet to be implemented.

With the additional computers installed in labs and third and fourth grade classrooms, a concerted effort has started to drive utilization within the curriculum. This development and follow-on support will drive up TCO to some extent, but will leverage the value of these computers. Reliability issues with aging computers and their planned higher usage will most likely drive indirect labor costs higher, and result in frustrations on the part of many users. The district now has a tool to help the district officials better understand these costs.

The Missouri case-study district looks forward to using the TCO tool for "what if" scenarios, especially related to replacing aging client and server computers.



## **Definitions**

**Total Cost** Includes all costs within the model. It is a balanced look at what it truly takes to support a computer for the district. The metric includes both Direct and Indirect costs.

**Direct Costs** Include all technology and direct labor costs incurred by the school district during the study period (hardware, software, external application providers, and direct labor).

**Indirect Costs** Include all of the labor incurred by the user community for the study period. Indirect Labor includes the costs of users supporting one another, spent in training classes, casual learning, self support, user applications development and downtime costs.

**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.

### **Client Cost per Client Computer**

Measures the annualized cost of personal computers, and peripherals divided by the total number of client computers.

### **Server Cost per Client Computer**

Measures the annualized cost of servers divided by the total number of client computers.

### **Network Cost per Client Computer**

Measures the annualized cost of network equipment (hubs/routers/switches, etc.) divided by the total number of client computers.

### **Printer Cost per Client Computer**

Measures the annualized cost printers divided by the total number of client computers.

### **Students per Available Client Computer**

Includes the total number of students divided by the total number of client computers located in classrooms, libraries, media centers, labs, etc., along with the total number of student dedicated client computers, not including student owned equipment.

### **Teachers per Teacher Dedicated Client Computer**

Includes the total number of classroom teachers divided by the total number of client computers dedicated for use by these individuals.



**Non Classroom Personnel per Non Classroom Personnel Client Computer**

Includes the total number of non-classroom personnel divided by the number of client computers dedicated for use by them.

**Client Computers per Printer**

Includes the total number of client computers divided by the total number of printers.

**Client Computers per Server**

Includes the total number of client computers divided by the total number of servers.

**Operations and Financial Cost**

Measures the total personnel, and vendor costs associated with “hands-on” labor, and help desk support around client computers, servers, printers, and network equipment. It also includes any costs around planning and process management, finance and administration (budgeting, procurement, asset management etc.), and physical database administration.

**Professional Development and Training costs**

Includes training of personnel to provide familiarization, and proficiency with the operation of equipment and software to carry out school tasks whether instructional or administrative.

**Curriculum Development and Support costs includes**

Labor involved in integrating IT into the teaching and learning process.

**Client Computers per Staff Metrics**

The number of Operations and Financial, Professional Development and Training, and Curriculum Development and Support personnel are divided by the total number of client computers to create client computers per staff metrics. Looking at the data this way tends to normalize for high or low salaries when making comparisons.



## ***Related Documents***

Please refer to these documents (available at the [www.classroomtco.org](http://www.classroomtco.org) Web site) for additional information regarding TCO in the K-12 environment.

### ***Why Total Cost of Ownership (TCO) Matters***

Necessary reading before getting started

### ***Preparing for TCO Analysis***

Input fields required for the Web-based TCO Tool and extensions for further evaluations

### ***The Web-based TCO Tool***

A review of the Web-based TCO Tool

### ***2003 Case Studies***

#### ***California District Case Study***

An urban district with 140,000 students

#### ***Minnesota District Case Study***

A rural district with 4,000 students

#### ***Pennsylvania District case Study***

A rural district with 2,500 students

#### ***Utah District Case Study***

A suburban district with 49,000 students

### ***Other 2004 Case Studies***

#### ***Texas District Case Study***

A suburban district with 35,500 students

#### ***Virginia District Case Study***

A suburban/urban district with 165,000 students

#### ***Wisconsin District Case Study***

An urban district with 21,500 students



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