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DESKTOP MANAGEMENT

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ABSTRACT

Desktop management consists of the systematic activities performed by IS professionals to manage distributed computing resources throughout an organization. However, it does not appear that desktop management is being practiced extensively by organizations at this time. This paper, a comprehensive tutorial whose purpose is to raise awareness concerning the importance and potential of desktop management, examines the following issues:

(1) What is the significance of desktop management?
(2) What management practices constitute desktop management?
(3) What are the benefits associated with implementing desktop management practices?
(4) Why is desktop management not implemented?
(5) What is the future of desktop management?

The significance of desktop management is explored relative to total cost of ownership and the actions by the computer industry to support desktop management. Desktop management practice is described from two perspectives: (1) the software tools that enable and facilitate desktop management, and (2) the managerial activities associated with the discipline of desktop management. The benefits of desktop management covered in this paper include reduced cost of ownership, improved user productivity, and enhanced competitive advantage. However, desktop management is not widely practiced at this time, and the reasons for this state of affairs are examined briefly. Sales projections for desktop management software and interest in the topic on the Internet provide evidence that desktop management will be an important issue in the future. Issues that will impact that future include alternate ways of reducing total cost of ownership, increased use of mobile devices, and the emergence of enterprise system management tools.

KEYWORDS: Management, Asset Management, Cost of Ownership

I. INTRODUCTION

"Imagine strolling into your CIO's office and telling him you're slashing help desk calls and nearly eliminating PC downtime--all in the midst of a 1,000-PC rollout. The management packages linked to specialized corporate PCs can do this and let you monitor and maintain computers remotely. Superstar stuff, indeed. Why then, are so few companies using them?" (Behr, 2001, p. 1)

The management packages referred to in the quotation above enable corporations to practice what is commonly known as "desktop management." Desktop management consists of the systematic activities performed by IS professionals to manage the hardware and software resources associated with personal computers, mobile computing devices, and local area network servers throughout an organization.

The above scenario illustrates some of the obvious advantages of organizational desktop management: large reductions in help desk calls and PC downtime. Vendor sales projections of desktop management software suggest future increases in the practice of desktop management. Specifically, Bonasia (2001) claims the market for desktop management software will increase from $1.9 billion in 1998 to $4.9 billion dollars by 2003.

Widespread interest in desktop management is evidenced by the term's presence on the Internet. An exploration with three web search engines turned up thousands of diverse references on the term "desktop management": AltaVista (28,806 hits), Google (52,500 hits), and Lycos (56,439 hits). A small sampling of these sites is presented in Appendix A.

But, do companies actually use desktop management tools? In general, the evidence is that they do not. Losee (1996, p. 108) states that "as few as 5% of U. S. firms have complete inventories of their hardware and software". Sager and McWilliams (1995, p. 73) describe numerous anecdotal cases and conclude that "not only does Corporate America have no idea how many PCs it has, who's running them or where they are located, it also hasn't a clue what's inside them" . A survey of 500 companies in 1998 found that only 49 percent had any desktop management practices in place and 27 percent had not addressed the topic at all (Essex, 1999).

In 1997, Comdisco Inc. developed the Desktop Management Index to assess standards and practices in desktop management (Miller, 1999). The survey resulting from this exercise queried companies on a number of desktop management issues, including: written plans, senior management involvement, documented standards, centralized procurement, leasing, outsourcing, automated tools, central asset inventory, systematic desktop replacement programs, and lifecycle costs, among others. Industry response to the survey was good and it was conducted again in 1999. Although the results from both surveys are at least two years old, the indications are that desktop management was not being widely employed (Kay, 1999).

The conundrum represented by the present level of non-use, and yet the interest and expected growth of desktop management, provides the motivation for this tutorial. In particular, our aim is to provide an up-to-date summary and synthesis of the best current practitioner thinking on the topic of desktop management by addressing the following questions:

(1) What is the significance of desktop management?
(2) What management practices constitute desktop management?
(3) What are the benefits associated with implementing desktop management practices?
(4) Why is desktop management not implemented?
(5) What is the future of desktop management?

This paper should provide a comprehensive tutorial and raise awareness about the importance and potential of desktop management.

II. SIGNIFICANCE OF DESKTOP MANAGEMENT

One measure of the significance of desktop management is related to the cost of ownership. A second indication of significance is the actions by the computer industry to support desktop management.

THE COST OF OWNERSHIP

The possibility that desktop management could reduce the total cost of ownership (TCO) caught the attention of many firms. TCO is a calculation applied to desktop systems to account for both the direct and indirect costs associated with owning the hardware and software (Emigh, 1999). These costs include both the initial capital cost of acquiring the desktop systems and the ongoing costs of maintenance, technical support, training, and user operations (Emigh, 1999, O'Donnell, 1998). Liebman (1999) notes that, while acquisition costs are typically low, the ongoing support expenses vastly overshadow them.

Miller (1999) estimates that an organization with 2,400 distributed desktop computers spends between $20 and $30 million annually on the direct and indirect costs to purchase and use these assets. Simpson (1997b) reports that many consulting firms put the cost of these desktop assets in the neighborhood of $10,000 per personal computer (PC) per year, with the majority of these costs attributed to support. The Gartner Group published several studies relating to the costs of PC ownership. In one of them, they estimated that the cost of PC ownership was over $40,000 for a five-year period (Pickering, 1994; Sager and McWilliams, 1995).

A more recent study by the Gartner Group (Simpson, 1997a) found that the cost of ownership increased to approximately $13,200/year. This study was based on a corporation with 2500 PCs where the PCs were used for a three-year period. Almost 80 percent of the ownership costs were for labor-intensive tasks related to administration and support. Based on these figures, a firm with 2500 PCs would spend $33 million (2,500*13,200) per year with $26.4 million of this amount going for labor. Labor costs are high because much of the support activity requires the support person to visit the user's location. Consequently, desktop management initiatives that can reduce the costs of support lower the labor component of TCO.

THE COMPUTER INDUSTRY'S RESPONSE TO DESKTOP MANAGEMENT

In 1992, major players in the computer industry formed the Desktop Management Task Force (DMTF) whose purpose was to create, maintain, and support standards that would make PC systems and products more manageable (Musthaler, 1998). By 1999, the organization had grown beyond its original charter and changed its name to the Distributed Management Task Force (McConnell, 1999). The current mission of DMTF is "to lead the development of management standards for distributed desktop, network, enterprise, and Internet environments." (DMTF, 2001a). DMTF's goals are to encourage members of the computer industry to adopt management standards, unify management initiatives, and promote product interoperability among management. To achieve these goals DMTF published a series of standards such as the

- Desktop Management Interface (DMI),
- Common Information Model (CIM), and
- Web Based Enterprise Management (WBEB) (DMTF, 2001b).

Desktop Management Interface. Personal computers that are DMI compliant usually operate in a client-server environment. DMI compliant machines come with software that can collect and distribute information about the machine's hardware and software components. This information is stored in MIF (management information format) files and is available to management applications. Each MIF file contains a set of information, such as the component type, ID number, product name, version, serial number, and time and date of installation (Scott, undated), that is common to all MIF files. The information in the MIF files of a particular client can be accessed from management applications on a server and stored in a database controlled by the server. If changes are made to the client or its components, the management application on the server is notified so that the server database can be updated. The management software on the client is also capable of distributing performance data on components to the server. For example, intelligent agents can pass performance data about a client's hard drive to the management software on both the client and the server. If a disk drive failure is imminent, then an alert can be sent in the form of a pop-up screen.

From the above description, one can see how devices in a DMI-compliant environment can ease the burden of maintaining an accurate inventory of personal computers and their components. In addition, since the management software on the server permits the support

specialist to obtain information in the client's MIF files, the specialist can also remedy problems on the client without visiting the client's location.

Common Information Model. CIM is an object-oriented data model that provides a conceptual framework for describing overall management data in a network/enterprise environment. CIM was developed (Goldworm, 1999) to provide a model across several different standards/protocols (e.g., Simple Network Management Protocol (SNMP), DMI, Common Management Information Protocol (for telecom devices), and private applications). A powerful feature of CIM is that its schema provides definitions for many more objects than DMI, and the object-oriented approach permits associations between objects. CIM is a powerful model for tracking relationships between any two objects in enterprise network environments (Goldworm, 1999). CIM also enables models for applications from different developers on different platforms to describe management data in a standard format.

Web Based Enterprise Management. WBEM is a set of standards developed to unify and enable the management of the components in an enterprise-computing environment. WBEM uses CIM as a data model, XML as a way of encoding information from the CIM, and HTTP as an access mechanism. Applications that are WBEM compatible provide support personnel with Web access to management data and managed objects (Middleton, 1999).

Managed PCs. Most major producers of personal computers (e.g., Compaq, Dell, Gateway, Hewlett-Packard, and IBM) offer a line of PCs called managed PCs (Behr et al., 2001). These machines come with software compatible with DMTF standards. This software enables support specialists to use management software to inventory the PC remotely, monitor performance of the PC's components (e.g., memory, hard drive), and upgrade software. The machines also come with an easy access chassis and vendor assurance that a particular configuration will be available for 9 to 12 months (Behr et al., 2001).

Software for desktop management is available from a variety of sources. These include: computer manufactures such as Compaq and Hewlett-Packard, operating system vendors such as Microsoft and Novell, hardware companies such as Intel and Seagate, and computer leasing companies, as well as firms that specialize in management software and services such as Altiris, Tally Systems, Computer Associates, and Tivoli (Uboisy, 1996).

III. DESKTOP MANAGEMENT PRACTICES

Desktop management practice focuses on

- the software or tools that enable and facilitate desktop management.
- the managerial activities associated with the discipline of desktop management.

DESKTOP MANAGEMENT SOFTWARE

Desktop management tools perform the seven functions shown in Table 1 (inventory management, configuration management, remote software distribution, fault and performance management, help desk assistance, security management, and software metering). Unfortunately, no single tool performs all of these functions (see reviews in Coopee, 2000; Ferrill, 2001a; Ferrill, 2001b).

Inventory Management. Developing an inventory of all the hardware and software assets owned and leased by the firm is a typical starting point for desktop management. This function is one that is common in most of the desktop management tools since several of the other functions are dependent on the contents of this inventory. Black (1996) and Husselbaugh (1995) note that this function involves establishing a baseline inventory and maintaining a perpetual inventory.

The usual repository of the inventory data is a relational database. The contents of the database should include data on the assets themselves, asset ownership, and asset contracts (Kay, 1999). Data on the asset covers its physical location, its hardware configuration, and details of the specific software installed on that machine. Ownership data includes acquisition date, cost, and install date, as well as the purchasing unit and the employee to whom the system is assigned. Contract data encompasses information on warranties, leases, service agreements, and software licenses. Bowen (1998) notes that software tools for desktop management facilitate the effort to collect and

store information in these categories. Most of the desktop management tools can generate queries and reports from the database.

Table 1. Management Software for Desktop Management

MANAGEMENT SOFTWARE	EXAMPLES
Inventory management (Black, 1996; Compaq Computer Corporation, 1996; Helm, 1998; Husselbaugh, 1995; IBM 1998a; Intel, 1996; Tally Systems, 2000c)	As devices are added or removed from the firm, the inventory is updated. As hardware is upgraded the inventory is updated. When an asset changes location the inventory is updated.
Configuration management (Compaq Computer Corporation, 1996; IBM, 1998a; Intel, 1996)	When new hardware is added to a PC, configuration parameters automatically adjust. Remote retrieval of configuration data. New configurations can be automated and made repeatable.
Remote software installation (Compaq Computer Corporation, 1996; Intel, 1996; Tally Systems, 2000b)	Upgrade an OS to a new version. Install a new OS. Upgrade an application. Install a new application.
Fault and performance management (Compaq Computer Corporation, 1996; IBM, 1998a, 1998b); Intel, 1996)	Provide early warnings of an impending failure of a PC component. Automatically correct faults when they occur. Automatically identify faults and alert the appropriate person, restart systems. Performance tuning. Capacity planning
Help desk assistance (Helm, 1998; Husselbaugh, 1995; IBM, 1998a; Tally Systems, 2000b)	Track where hardware and software problems are coming from. Share solutions to problems Remote retrieval of inventory and configuration data
Security management (Compaq Computer Corporation, 1996; Helm, 1998; IBM, 1998b; Intel, 1996)	Prevent access to information by unauthorized persons. Prevent unauthorized changes in configuration. Prevent theft of the PC or any components. Monitor for the intrusion of a virus.
Software metering (Black, 1996; Compaq Computer Corporation, 1996; Helm, 1998; Tally Systems, 2000a)	Track concurrent usage so that software licenses are not violated. Track usage so that the proper number of licenses is purchased.

Configuration Management. This type of activity concerns the settings and preferences that a user has on a particular personal computer. For example, in a Windows environment, configuration management would include information in the registry. As machines are installed or moved, standard or individualized configuration settings can be remotely installed. Information about a machine's configuration is available in the inventory database or can be accessed remotely from the individual PC. Support personnel can use this information to perform remote troubleshooting without visiting the user's location.

Remote Software Installation. The installed software will change during the lifetime of a personal computer. The change could be related either to installing new software or to upgrading an existing version for either an operating system or applications software. A common

feature in desktop management tools is the ability to install or upgrade remotely either an operating system or application software. This tool works in conjunction with the inventory tool and can determine whether an individual machine contains the necessary hardware requirements (e.g., main memory, disk space) for the upgrade. Support specialists can install or upgrade software for several hundred machines in several hours without ever leaving their office. Other changes that can be supported are remote modification, repair, and removal of software.

Fault And Performance Management. Fault and performance management is related to monitoring proactively the performance of various hardware components in a computer. Through this type of activity, failures in hardware components, such as memory or a hard drive, can be predicted. This approach protects end users from catastrophic data loss or unexpected down time. When problems are detected, information can be sent to desktop management tools, which then can send an alert for display on the client or server monitor.

Help Desk Assistance. Coordination between the firm's internal help desk and desktop management software is important (Husselbaugh, 1995; Tally Systems, 2000b). The DMTF also recognizes this need and works closely with the Customer Support Consortium (CSC) to develop standards for help desk applications[1]. The latest CIM standards from DMTF include models that enable the capture and storage of data about problem incidents and problem solutions.

The help desk contributes to desktop management by enabling support personnel to troubleshoot user problems remotely. Support personnel at the help desk need access to problem incidents and solutions as well as data from the perpetual inventory that accurately describes the hardware and software environment of the user's machine. Armed with this information, the support specialist can assist a remote user more effectively.

Desktop management applications often enable the support specialist to take over the user's monitor and guide the user to a solution. In this sense, the help desk performs a training function.

Security Management. Security in today's distributed environment must be a significant part of desktop management. Major threats include viruses, accidental loss of data, unauthorized access to data, theft of personal computers or their components (e.g., memory and processors), unauthorized transfer of data, or unauthorized copying of data.

Protection from viruses can be achieved by installation of virus detection software on servers and clients. Automated backups of hard drives to a network server can protect users from accidental loss of data. Other threats can also be deterred. For example, systems can detect unauthorized intrusions to the computer's chassis, power-on passwords, disable transfers of data to portable storage mediums (e.g., a floppy), or disable transfers via a serial or parallel port so that information cannot be transferred via a modem.

Software Metering. Firms usually license application software from the software vendor. These licensing agreements come with specific restrictions and limitations on the number of copies that can be used by the purchaser. A firm that fails to manage the number of copies may be purchasing far too many licenses, or they may deploy more copies than their license permits. In the latter case, the firm could be guilty of software piracy and subject to penalties and fines if prosecuted. Mismatches in the proper number of licenses often occur as a result of the relocation of PCs to different users. The tools in this category are designed to monitor software usage so that these problems do not occur.

DESKTOP MANAGEMENT AS A DISCIPLINE

Desktop management is more than employing a set of software tools. It can involve a significant amount of organizational change with respect to practices and procedures (Helm, 1998; Husselbaugh, 1995; Waltner, 1998; Wheatley, 2000). Husselbaugh (1995, p. 4) states that desktop management is "an *enabling* discipline whose benefit is derived by the development of and adherence to a set of practices and procedures." These practices and procedures can require changes that affect:

- corporate-wide policies,

[1] CSC is an alliance of technology firms who work together to shape standards for customer support including a firm's internal help desk

- end-users,
- the information systems department, and
- interactions between functional areas.

Corporate Policies. Effective desktop management can require firms to adopt and enforce hardware, software, and configuration standards; centralized purchasing; and restrictions on downloading software from the Internet. These policies have implications beyond the information systems area and require the support and cooperation of the organization's top-level executives.

End users may perceive desktop management as a loss of control of their personal computer or laptop. Desktop management tools can be very invasive from the end user's point of view and border on employee surveillance. They are more likely to succeed if end users perceive them as enhancing their productivity rather than as a "big brother" tactic.

Policies And Procedures In The Information Systems Department. Desktop management also can change responsibilities within the information systems department. For example,

- Who will be in charge of desktop management?
- Desktop management should result in significant efficiencies for support personnel. How should these efficiencies be exploited?
- Desktop management must be coordinated with the help desk function (Section II).
- Should the firm attempt desktop management with existing staff or should the task be outsourced?

Coordination With Other Functional Areas. The data in the desktop inventory contains valuable information for other functional areas. Policies and procedures are needed to ensure that this data is available to other areas. This coordination entails making sure important asset data are entered into the inventory and that inventory data are accessible. It is particularly important that the ownership data in the inventory are available to other areas such as procurement, accounting and finance, and human resources (Shoup, 2000).

IV. BENEFITS OF DESKTOP MANAGEMENT

The literature suggests that desktop management leads to major benefits in three areas:

- reduced cost of ownership,
- improved user productivity, and
- enhanced competitive advantage.

These benefits are not mutually exclusive, but all ultimately translate into tangible or intangible cost savings.

REDUCING THE TOTAL COST OF OWNERSHIP (TCO)

Overall Estimates. Recall that the Gartner Group estimated that 80 percent of TCO was determined by labor-intensive tasks related to administration and support (i.e., management). Each desktop management application discussed can reduce the labor component of administration and support. However, precise estimates of the size of the cost reductions and which applications are responsible are not available. For example, vendors of desktop management software suites claim their products reduce management costs by 30 to 40 percent (Simpson, 1997a). Estimates by the Gartner Group of savings from desktop management ranging from 5 to 35 percent appear in several sources (Comdisco, 1997; Pang, 1996; Shoup, 2000; Simpson; 1997a). Kay (1999) cited a survey of companies that found average savings of 10 percent, and Helm (1998) estimated that desktop management could cut the IT budget by 25 percent. None of these reports explicitly describe specific management tools that reduce the cost of ownership nor do they indicate the contribution of individual tools. However, the overall trend is clear: desktop management reduces TCO.

Selected Anecdotal Estimates. Numerous anecdotal reports describe how individual desktop management applications reduced TCO in a particular company.

- Fruit of the Loom reported that desktop management software reduced the number of physical trips to user's desktops by more than 50 percent (Simpson, 1997a).

- Two tests on a network of 38 PCs indicated that (a) automated inventories of hardware and software could be done in eight minutes compared to 80 hours of manual labor and (b) automated installation of Windows 95 and Office 95 took two hours compared to 33 hours for the manual process (Freeman, 1997).
- -Worldspan, a travel industry reservations network, doubled from 4,500 to 9,000 nodes while only increasing its support staff from 21 to 27. Yet it provides better service in the larger network through desktop management applications (Wheatley, 1998).

Two Empirical Studies. A study (Fobath, 2000) by NerveWire, a consulting firm hired by Microsoft, examined the cost savings resulting from using Systems Management Server 2.0 (SMS 2.0) in five firms ranging in size from 1,200 to 24,000 desktops. Fobath (2000) compared the costs of distributing software, taking an inventory, and helpdesk/troubleshooting using SMS 2.0 with the corresponding costs of doing these tasks without SMS 2.0. A summary of the savings is shown in Table 2.

Table 2. Summary of the Average Annual Savings (Fobath 2000).

APPLICATION	AVERAGE ANNUAL SAVINGS/DESKTOP
Complete software distribution (new version or new software)	$1,090
Incremental software distribution (patches, service pack, incremental version updates)	463
Software distribution subtotal	1552
Helpdesk/Troubleshooting	376
Inventory	76
(Initial Investment)	(73)
Other cost savings	379
Total Cost Savings (one year)	**$1,872**

Fobath's model assumed that only one complete software distribution, one partial software distribution, and one inventory occurred per year. The cost savings were adjusted by the initial investment ($73/desktop) that included the upfront and on-going costs of installing and maintaining SMS 2.0. The cost savings also increased with the size of the firm.

Because SMS 2.0 enabled remote control and diagnostic testing of desktops, and automatic integration of up-to-date inventory information several statistics related to the troubleshooting performance of the help desk improved significantly:

- the average length of help desk calls dropped from 23 to 7 minutes,
- the number of calls that could not be resolved at the help desk dropped from 30 to18 percent, and
- the average time to resolve calls that went beyond the help desk dropped from 76 minutes to 42 minutes.

In addition, Fobath (2000) stressed that these figures are conservative and do not include intangible benefits that improve productivity such as

- the planning value of having an accurate inventory,
- rapidly updating software to reduce periods of version incompatibility, and
- rapidly responding to bugs in software.

In another study, International Data Corporation (IDC, 1997a) examined 15 global firms each with an average of 4,500 Windows desktops and 525 servers spread over 24 sites. On average, 348 employees support the desktops and servers. The annual growth rate for new desktops and servers was 20.7 and 26.9 percent per year, respectively.

The goal of the IDC study was to determine the savings resulting from using manageable systems (i. e., a combination of manageable hardware and desktop management software from Compaq) on management efficiency, management productivity, and availability (IDC, 1997b).

The salary savings produced through the use of managed systems were the measure of efficiency. Managed systems permitted a much slower growth rate for support personnel in comparison to the growth rate for desktops and servers. Because managed systems made support personnel more efficient, salary costs were reduced since fewer support personnel were needed to accommodate growth in the user population. In addition, managed systems reduced travel costs to user sites. The average annual savings from these two sources are shown in Table 3 as management efficiency.

Table 3. Summary Results from the IDC study (1997b).

	Average Annual Cost Savings/User
MANAGEMENT EFFICIENCY	
Salary savings	$307
Travel savings	149
Subtotal	456
MANAGEMENT PRODUCTIVITY	
Desktop management	658
Server management	229
Subtotal	887
AVAILABILITY	
Lost productivity	703
Lost revenue	1,901
	2,604
TOTAL SAVINGS	$3,947
INVESTMENT FOR MANAGED SYSTEMS	($867)
NET SAVINGS	**$3,080**

Management productivity was measured through the time savings achieved by using manageable systems and the complementary desktop management software for desktops and servers. Most savings for desktops resulted from time reductions in tasks such as systems setup, configuration, and on-going maintenance while the savings for servers resulted from time reductions in tasks like OS support/tuning and server setup/configuration. The total time savings were 179.8 hours per 100 users in the first year, which led to the average annual dollar savings shown in Table 3 under management productivity.

The third measure, was availability savings that were calculated by measuring the reduction in downtime that occurred by using managed systems. Downtime was defined as the user's inability to access applications that are required for their job. Downtime can have two negative impacts: (1) reduce user productivity and (2) when users are engaged in revenue generating activities downtime results in lost revenue. Lowering downtime increased the availability of business applications by 1.6 hours per month and therefore increased productivity of users and reduced lost revenue. The average annual savings from increasing availability, which was the largest category, are shown in Table 3.

The savings found in the IDC study (IDC 1997b) were $1,208 ($3080 - $1872) higher per user than the savings in the Fobath (2000) study. The higher savings would be expected since the IDC study

- involved a wider range of desktop management applications,
- included savings for servers as well as desktops, and
- included savings for efficiency and availability.

Again, based on these studies, the potential of desktop management to reduce TCO was clearly evident.

IMPROVED USER PRODUCTIVITY

Desktop management improves end user productivity in three ways. First, the software tools reduce the time to respond to end-user problems. Second, the tools reduce downtime, i.e., the frequency and duration of events that disrupt end user activity. Third, the tools provide support personnel with information to serve end user needs better.

Responsiveness improves because support personnel can remotely access either the user's machine or information about the user's machine. This access permits support in real time and results in quicker problem resolution because the support person does not need to visit the user's machine (Simpson, 1997a). This gain is particularly true when end user support is centralized and users are widely dispersed. Software metering helps ensure that the proper number of licenses exist so that users are not denied access to software due to a shortage of licenses.

The reduction of disruptive events results mainly from configuration management, fault/performance management, remote software installation, and security management. The IDC study (1997b) linked increased productivity with decreased downtime. As noted in Section II, fault/performance management can detect and warn about impending hard drive failures. Security management can prevent disruptions that result from a virus, data loss, or theft. Remote software installation enables the scheduling of automated software installation at times that will not disrupt the end user's work schedule.

ENHANCED COMPETITIVE ADVANTAGE

Desktop computer systems, including laptops and PDAs, are typically an integral part of information systems designed to gain a competitive advantage. Although not the main reason for their success, desktop management contributes to the deployment of strategic systems (Borck, 1999; Husselbaugh, 1995; Inacom, 2000; Kay, 1999; Miller, 1999; Tally Systems, 2000b; Waltner, 1998).

Consider, for example, a firm implementing a sales force automation system that requires equipping a multinational sales force with laptop computers. The firm's ability to deploy and support this system quickly and economically can enhance the firm's chances of gaining a competitive advantage. With effective desktop management practices, the firm ensures that it is able to implement this system more quickly than its competitors.

A Comdisco study (1997) offers the only empirical evidence whether firms perceive that desktop management offers competitive advantage. In this survey, the most frequently mentioned benefits were:

- control of desktop resources 68 percent
- improved user productivity 57 percent
- improved competitive position 32 percent.

Porter's value chain model (Porter, 1985) is a second way to view desktop management as a means to enhance competitive advantage. In this model, desktop management is an administrative and management system that can reduce the costs of administering and managing desktop resources (i.e., reduce TCO). Desktop management contributes to a low-cost producer strategy if it lowers the firm's TCO compared to the TCO of competitors.

V. WHY DESKTOP MANAGEMENT IS NOT IMPLEMENTED

Evidence cited in Section I clearly indicates that desktop management is not widely practiced despite the obvious advantages described in Section IV. Although no empirical studies exist, the literature suggests the reasons are related to inadequacies of the software tools and the challenge of implementing managerial activities that determine effective desktop management practices (Section III).

INADEQUACIES OF THE SOFTWARE TOOLS

Comprehensive desktop management requires the deployment of all the software tools described in Table 1; however, a number of factors may contribute to low usage or dissatisfaction with these tools.

- First, no single product performs all of the functions in Table 1 and mixing tools can be problematical (Ferrill, 2001).
- Second, comprehensive implementation is difficult because of overlapping standards (Behr, 2001). In addition to the various DMTF standards, there are other standards such as Wired for Management (Wfm) from Intel and Windows Management Instrumentation (WMI) from Microsoft.
- Third, although the desktop management tools collect enormous amounts of information, the best way to utilize this information is not always clear (Behr, 2001).
- Fourth, desktop management tools work best in homogeneous environments, but many corporate environments are heterogeneous with respect to hardware, operating systems, or network protocols (Waltner, 1998). As a result, the effectiveness of the desktop management tools is diminished.
- Fifth, desktop management tools can hog bandwidth and compete for other network resources (Waltner, 1998). These conditions certainly contribute to a Gartner analyst's estimate that only 15 to 20 percent of the companies that purchase managed PCs use the management software that accompanies these PCs (Behr, 2001).

THE CHALLENGE OF IMPLEMENTING EFFECTIVE DESKTOP PRACTICES

Implementation of effective practices and policies for managing desktop assets is particularly difficult because of the distributed nature of these assets (desktop PCs, laptops, and PDAs). These assets exist in all functional areas and at every level of management. Consequently, effective management practices and policies must be implemented throughout the entire enterprise. Another contributing factor is that these assets are usually not owned by the IS function, yet corporate management expects the IS function will manage these assets.

Since desktop management tools work best in homogeneous environments, IS management often needs to promote policies that are corporate-wide and centralized (e.g., centralized purchasing, standards for hardware/software, and standard machine configurations). Instead of seeing desktop management policies as a way to increase productivity, many end users view desktop management as an impediment to their work because the policies often restrict or interfere with their options for using their computing assets. Thus, implementing corporate-wide policies often needs to be done without the cooperation of the end user population. Behr (2001) even mentions an incident where an IT manager was fired as a result of an end user revolt.

The relative importance of desktop management tools versus desktop management practices is also mentioned frequently. Numerous authors (Helm, 1998; Husselbaugh, 1995; Waltner, 1998; Wheatley, 2000) state that desktop management is far more than a set of tools. Wheatley (2000) quotes a practitioner who argues that dealing effectively with desktop management is 75 percent management practice versus 25 percent tools. In essence, the tools are useful, but without good management they are ineffectual.

VI. THE FUTURE OF DESKTOP MANAGEMENT

The sales projections for desktop management software (Section I) suggest that desktop management will be an important issue in the future. Important ideas include:

- alternate ways to reduce TCO,
- increased use of mobile computing devices, and
- continued development of enterprise system management tools that will change the scope and position of desktop management within organizations.

ALTERNATE WAYS TO REDUCE THE COST OF TCO

The large support costs that dominate TCO result from the complexity of the hardware and software in the current desktop environment. One way to reduce TCO is to simplify the desktop environment through "thin clients" and application service providers. This approach saves money spent on managing configurations, software distribution, software metering, and calls to the help desk, but it requires more powerful servers and higher network capacities whose costs can offset the savings (Blodgett, 1998; Wheatley, 2000).

INCREASED USE OF MOBILE COMPUTING DEVICES

Companies are moving employees from desktop computers to mobile computing devices such as laptops and PDAs (Blodgett, 1999; McDougall, 2001; Wagner, 2001). The TCO per worker for mobile computing devices can be up to 60 percent more than the TCO for desktops. (Blodgett, 1999). If this trend continues, TCO for firms using these technologies will rise sharply.

THE EMERGENCE OF ENTERPRISE SYSTEM MANAGEMENT TOOLS

In many large firms four IT infrastructures coexist today (Laudon and Laudon, 2000):

- legacy systems
- client/server
- Internet/intranets/extranets
- wireless/cellular communications

This environment is also characterized by (a) heavy reliance on networked personal computers, (b) the extension of the desktop via laptops and PDAs, and (c) the emergence of the Internet as a vehicle for electronic commerce. Virtually all internal transactions between employees as well as all external transactions with trading partners are heavily dependent on the seamless integration of the four IT architectures (Laudon and Laudon, 2000).

To respond to these changes, enterprise system management tools evolved that aid the management of this complex infrastructure. These tools integrate or provide links to several, but not all, of the typical desktop management functions (Simpson, 1997a). Enterprise tools also extend the range of managed objects beyond desktops, servers, and laptops (the new CIM standards from DMTF are a reflection of this trend). For example, Hewlett-Packard's enterprise system management product (OpenView) contains modules that help manage availability, applications, service, and networks. These tools also provide management support for electronic commerce. Through this integration, desktop management becomes a part of the management of the total IT infrastructure of the firm.

VI. CONCLUSION

This paper addressed the following questions:

1. What is the significance of desktop management?
2. What management practices determine desktop management?
3. What are the benefits associated with implementing desktop management practices?
4. Why is desktop management not implemented?
5. What is the future of desktop management?

The significance of desktop management is its potential for reducing TCO. The establishment of the Desktop Management Task Force (Section II) demonstrates the computer industry's recognition of this potential.

There are two aspects of desktop management practice. The first focuses on the software tools that enable and facilitate desktop management:

inventory management	configuration management	remote software installation	fault and performance management
help desk assistance	security management	software metering	

The second addresses the idea that desktop management is a discipline that requires substantial organizational change.

The major benefits of desktop management are reduced TCO, improved user productivity, and enhanced competitive advantage. Despite these benefits desktop management is not widely practiced due to shortcomings with respect to the desktop management tools and inherent challenges in implementing enterprise management policies and procedures.

Three new ideas will impact the nature of desktop management. First, thin clients and application service providers reduce the complexity of the desktop environment and reduce TCO. Second, moving employees from desktop computers to mobile computing devices increases TCO. Third, enterprise system management tools are evolving to aid the management of complex infrastructures and integrate or provide links to the typical desktop management functions

Implementation of a comprehensive desktop management program will not be quick or easy for most firms (Waltner, 1998). IS managers must realize that desktop management is much more than a set of software tools. As noted in Section V, IS managers must be prepared to deal with a number of enterprise-wide policies and procedures. Further, resistance to a comprehensive strategy may come from users who feel that this approach is intrusive and conjures up images of "big brother." However, despite these obstacles, the benefits are powerful incentives for firms to pursue a comprehensive desktop management strategy.

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REFERENCES

EDITOR'S NOTE: The following reference list contains the address of World Wide Web pages. Readers who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

1. these links existed as of the date of publication but are not guaranteed to be working thereafter.
2. the contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. the authors of the Web pages, not CAIS, are responsible for the accuracy of their content.
4. the authors of this article, not CAIS, is responsible for the accuracy of the URL and version information.

Behr, M. E. (June 10, 2001) "Analysis", *PC Magazine,* http://www.zdnet.com/products/stories/reviews/0,4161,2771283,00.html (October 15, 2001)

Behr, M. E., J. M. Bales, J. R. Delaney, A. Graven, and J. M. DeFeo (June 26,2001) "Managed PCs: Look like a hero", *PC Magazine*, pp. 145-156.

Black, G. (April 1, 1996) "Save money through asset management", *Datamation*,pp.62-64.

Blodgett, M. (1998) "NC or not NC?", *CIO Magazine,* http://www.cio.com/archive/031598_network_content.html (January 20, 2001).

Blodgett, M. (1999) "The road rage", *CIO Magazine*, http://www.cio.com/archive/011599_mobil_content.html (January 20, 2001).

Bonasia, J. (2001) "Services give firms a better picture of tech assets", *Investor's Business Daily*, http://www.acm.org/technews/articles/2001-3/0302f.html#item7 (March 3, 2001).

Borck, J. R. (1999) NetCensus automates systems inventory",*InfoWorld*,21(39),pp.39-44.

Bowen, T. S. (1998) "Exploiting asset management", *InfoWorld*, 20(44), pp. 69-70.

Comdisco (1997) "Summary of findings", www.comdisco.com/am/findings.html (August 8, 1998).

Compaq Computer Corporation (1996) "Intelligent management for Deskpro PCs", ftp://ftp.compaq.com/pub/supportinformation/papers/ 186a0796.pdf (May 24, 1999).

Coopee, T. (2000) "Building a strong foundation", *Network World Fusion,* http://www.nwfusion.com/reviews/2000/0131rev.html (May 24, 2001).

DMTF (2001a) "About the DMTF", http://www.dmtf.org/about/index.php

DMTF (2001b) "Standards and inititiatives", http://www.dmtf.org/standards/index.php (January 2, 2002).

Emigh, J. (1999) "Total cost of ownership", *Computerworld*, 33(51), p. 52.

Essex, D. (1999) "Cover your assets", *Computerworld*, 33(25), pp. 92-95.

Ferrill, P. (2001a) "Bulking up your desktop toolbox", *Network World Fusion*, http://www.nwfusion.com/reviews/2001/0409bg.html (May 24, 2001).

Ferrill, P. (2001b) "Desktop management tool time", *Network World Fusion,* http://www.nwfusion.com/reviews/2001/0409rev.html (May 24, 2001) .

Fobath, T. (2000) "Investing in desktop management productivity", NerveWire, http://www.nervewire.com/pdf/SMS_Report.pdf (July 15, 2001).

Freeman, E. (1997) "Jackpot: How to win the migration game", *Datamation* [Online],http://www.datamation.com/PlugIn/issues/1997/march/03migrat.html (August 8, 1998).

Goldworm, B. (1999) "From software to services–making management work", *Network World Fusion*, http://www.nwfusion.com/newsletters/nsm/0920nm2.html (June 14, 2001).

Helm, E. F. (1998) "Desktop asset management may be the key to managing the rising costs of corporate computing", http://www.techassetmgmt.com/ papers.htm (August 8, 1998).

Husselbaugh, W. B. (1995) "Total asset management benefit analysis and implementation guide", http://www.tobek.cfom/astmgt1a.htm (August 8, 1998).

IBM (1998a) "Desktop management interface", http://www.pc.ibm.com /us/infobrf/dmia.html (August 11, 1998).

IBM (1998b) "IBM AssetCare", http://.pc.ibm.com/us/infobrf/asetcrf.html(August 11, 1998).

Inacom (2000) "Asset management", http://www.inacom.com/resourcecenter/lifecycleservices/assetmanagement.asp (February, 17, 2000).

Intel (1996) "Wired for management", http://developer.intel.com /support/desktopmgmt/9608.htm (June 17, 1999).

International Data Corporation (IDC) (1997a) "The return on investment approach", http://www.compaq.com/products/servers/management/idc/applyROI.html (July 20, 2001).

International Data Corporation (IDC) (1997b) "The case for manageable systems: Preparing for rapid growth", http://www.compaq.com/products/servers/management/idc/casemanage.html (July 20, 2001).

Kay, A. S. (August 30, 1999) "Life-cycle management", *Information Week*, pp. 120-124.

Laudon, K. C. and J. P. Laudon (2000) *Management Information Systems* (6th ed.), Upper Saddle River, NJ: Prentice Hall.

Liebman, L. (1999) "The TCO myth", *Communications News*, 36(1), p. 92.

Losee, S. (September 9, 1996) "Burned by technology", *Fortune*, pp. 105-112.

McConnell, J. (June 7, 1999) "DMTF tweaks its name and refines its charter", *Internetweek*, p. 27.

McDougall, P. (2001) "Will notebooks force out desktops", *Information Week,* http://www.informationweek.com/838/notebooks.htm (May 31, 2001).

Middleton, G. (1999) "Enterprise management gets web standards", *TechWeb News*, http://content.tchweb.com/wire/story/TWB19990907S0017 (June 14, 2001).

Miller, J. (1999) "Desktop management saves IT dollars", *Midrange Systems*, 12(7), pp. 1-13.

Musthaler, L. (1998) "A round of applause for the DMTF", *Network World*, 15(48), p. 41.

O'Donnell, D. (1998) "TCO", *Software Magazine*, 18(11), pp. 20-29.

Pang, A. (May 13,1996) "DMI aims to reduce cost of PC ownership", *Computer Reseller News*, p. 141.

Pickering, W. (March 15, 1994) "It's 5:00 PM: Do you know where all of your PCs are?", *Datamation*, pp. 56-60.

Porter, M. (1985) *Competitive Advantage*, New York:Free Press.

Sager, I. and G. McWilliams (March 6, 1995) "Do you know where your PCs are?", *Business Week*, pp. 73-74.

Scott, R. L. (No date) "Desktop management interface", http://192.195.23.219/~cisg1/papers/text/rhonscot.html (August 11, 1998).

Shoup, L. (2000) "IT asset management", http://www.intraware.com/bindocs/argis/the_big_picture.pdf (July 15, 2001).

Simpson, D. (1997a) "Cut desktop management costs", *Datamation*, 43(1), pp. 102-105.

Simpson, D. (1997b) "PC management is no. 1 issue", *Datamation*, 43(7), p. 55.

Tally Systems (2000a) "Using desktop asset management tools to stay legal and save money", http://www.tallysystems.com/tally/whitepapers/wpllus.html (March 10, 2000).

Tally Systems (2000b) "What PC inventory can do for your organization", http://www.tallysystems.com/tally/whitepapers/wp16us.html (March 10, 2000).

Tally Systems (2000c) "Why desktop asset management matters", http://www.tallysystems.com/tally/whitepapers/wp14us.html (March 10, 2000).

Uboisy, J. (1996) "Tending computer assets", *CFO Magazine ,* http://www.cfonet.com/html/Articles/CFO/1996/96Jnasst.html (August 8, 1998) .

Wagner, M. (2001) "Handhelds nudge PCs', *Internet Week,* http://www.internetweek.com/newslead01/lead051401.htm (May 22, 2001).

Waltner, C. (1998) "Keeping track of asset management", *Datamation*, [Online], pp 1-7, http://www.datamation.com/PlugIn/issues/1998/ april/04desk.html (August 8, 1998).

Wheatley, M. (1998) "The cutting edge", *CIO Magazine*, http://www.cio.com/archive/060198_tco_content.html (January 20, 2001).

Wheatley, M. (2000) "Every last dime", *CIO Magazine*, http://www.cio.com/archive/111500_dime_content.html (January 20, 2001).

APPENDIX I. SELECTED URLS RESULTING FROM USING THE PHRASE "DESKTOP MANAGEMENT" IN THREE MAJOR SEARCH ENGINES (ALTAVISTA, GOOGLE, AND LYCOS)

Table A1. Selected Search Engine Results from Using the Phrase "Desktop Management"

TOPIC	URL
Vendors of desktop mgt. software	www.microsoft.com/windows2000/techinfo/howitworks/management/grouppolicy.asp
	www.auroranet.com/desktop.htm
	www.landesk-maestro.com/
	www.tivoli.com/products/demos/desktop.html
Helpdesk product	www.magicsolutions.com/solutions/desktop/default.asp
Buyer's guide	www.nwfusion.com/research/2001/0409bgtoc.html
Distributed Management Taskforce	www.dmtf.org
Desktop mgt. interface	www.networkcomputing.com/netdesign/desk1.html
Desktop mgt. services	www.miworld.com/deskmgntserv.asp

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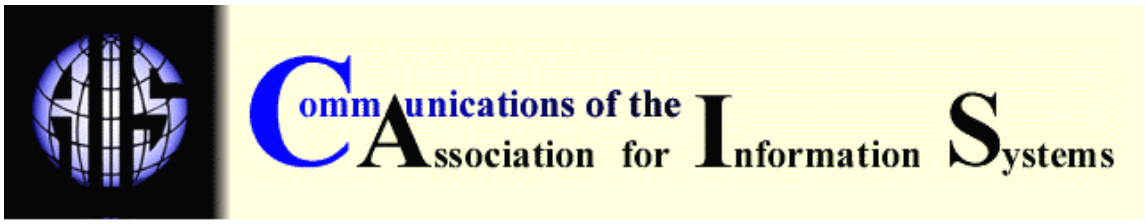

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