Lowering IT Costs Through Defragmentation

An Executive Guide

WINTERNALS™

DEFRAG
MANAGER

Table of Contents ::

Defragmentation: A Strategic Issue? ::

As pressure on IT budgets continues to grow and security concerns take center stage, disk defragmentation may have moved off of your organization's strategic agenda. But the more challenging your IT environment, the more defragmentation software should be considered as a proven means to lower costs.

This paper will present a realistic business model that shows how different defragmenter designs can produce widely different results in terms of overall cost savings. Using this model, we'll also show how the built-in Windows defragmenters that many organizations rely upon can lower user productivity and raise IT costs.

Finally, we'll demonstrate how new defragmentation technology can deliver improved end-user productivity, faster, more trouble-free system operation, and decreased support overhead for an ROI that's unmatched by virtually any other IT investment.

About Defragmentation ::

File fragmentation is cited as a prevailing Windows system performance issue by industry research groups, software vendors, and Microsoft Corporation. [1,2] Microsoft calls fragmentation "a primary reason for the gradual degradation of system performance — and the specific cause of longer reads and extended reboots."[3]

What causes fragmentation? Windows file systems allocate the disk sectors of logical drives (e.g. C, D) in units known as clusters. When a user creates a file on a drive, the file system assigns clusters of storage for the file's data. As time passes and the file is expanded and shrunk and other files are created and deleted, both the free clusters on the drive and the clusters assigned to the files become fragmented (i.e., non-contiguous).

For example, suppose that a user creates a Word document and the file system assigns six clusters to hold the document's contents. Later, a few pages are added to the document, and the file grows by six more clusters. If another file or directory uses the clusters that immediately follow the document's original clusters, the file system assigns the document's new file clusters somewhere else on the drive. The file now consists of at least two fragments. Figure 1 shows a simplified diagram of a fragmented file; Figure 2 depicts a defragmented file.
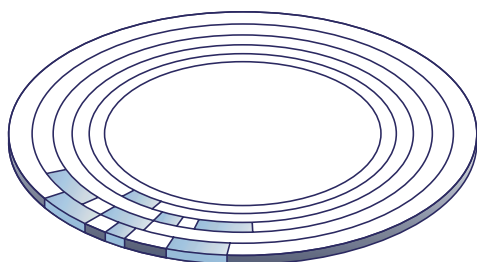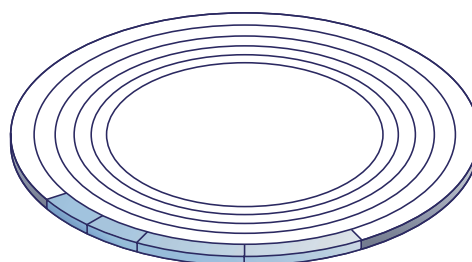
Figure 1: A Fragmented File   Figure 2: A Defragmented File

---

[1] "Optimizing NTFS Performance" (Microsoft Corporation)

[2] "Optimizing Startup Times by Using Defragmentation Tools" (Microsoft Corporation)

[3] Michael Kessler, "Maintaining Windows 2000 Peak Performance Through Defragmentation" (Microsoft Corporation)

Fragmentation can negatively affect performance. When the system reads a fragmented disk file, the disk head must move from fragment to fragment. On a disk with many fragmented files, moving the disk head across fragments can consume significant time. When the disk head reads contiguous data, the level of throughput is high.

Disk defragmenters are products that aim to optimize system performance by reorganizing a drive's clusters to make file clusters contiguous, and in some cases, to make free clusters contiguous. Defragmenters use heuristic algorithms that implement a fragment-shifting strategy to defragment the drive's files as quickly as possible. [4]

Defrag software vendors, IT analysts, and the press cite a range of observed Windows performance increases resulting from the use of commercial defragmentation products. Figure 3 below summarizes some of this data:

This paper relies on a conservative range of published data to project a return on investment (ROI) for the different types of defragmentation solutions.

Reported Performance Gains from Defragmentation	Source
60% - 150%	Defrag vendors' marketing materials[5,6]
30% - 180%	Vendor-funded, third-party research[7,8]
15% - 40%	Published corporate end-user evaluations[9,10]

Figure 3: Performance Data

---

[4] Mark Russinovich, "Inside Windows NT Disk Defragmenting" (Windows & .NET Magazine, © 1997 Penton Media, Inc. Used with permission.)

[5] Robert Nolan (Raxco), "Disk defragmentation: what to expect" (ServerWorld, July 2000)

[6] "Performance Benchmark Data" (Executive Software)

[7] Paula Sharick, "Diskeeper 4.0 for Windows NT Server" (Windows 2000 Magazine, Summer 1999) p1

[8] NSTL, Inc., "Independent Testing Helps Systems Integrators Validate their Purchases"

[9] Drew Robb, " Disk Delay " (Network World 09/18/00)

[10] Jim Middlemiss, "Fragmentation: A $50 Billion A Year Problem" (CMP Media Inc., 2000); Drew Robb, "Hidden Computer `Bottleneck Can Cost Agencies Millions" (Govt. Technology, 12/2000) p2

Defragmenters Compared ::

Disk defragmenters have been available for Windows NTFS environments since 1995. Traditional defragger designs fall into two broad categories:

⟶◦ ⟩ **Conventional Networked Defraggers** are full-featured commercial utilities designed to be permanently installed on every computer that is to be optimized.

⟶◦ ⟩ **Built-In Windows Defraggers** are bundled or freeware utilities derived from commercial defraggers, but without certain productivity features such as automatic scheduling and remote management.

We'll discuss the strengths and weaknesses of these products below, along with details about an alternative solution.

:: The Conventional Networked Defragger

Today's conventional networked defraggers share the basic characteristics of the earliest Windows NT 4.0 disk optimizers from which they evolved:

⟶◦ ⟩ **Individual deployment** on every system to be optimized.

⟶◦ ⟩ **Distributed control** with a full user interface and the ability to initiate or schedule defragmentation from the individual system. Server versions can be licensed to configure and schedule defragmentation of remote computers.

⟶◦ ⟩ **Server and client-based licensing** with different product versions depending on whether they're installed on server or workstation operating systems, along with different licensing conditions for each type of machine.

Because conventional networked defraggers are licensed, deployed, managed, and maintained in a manner that is consistent with typical PC applications, the cost of ownership follows established models for desktop software.

:: The Built-In Windows Defragger

The first built-in Windows defragmenter for NTFS was bundled with Windows 2000. These utilities are characterized by:

- › **Manual operation** with no scheduling capabilities, so administrator action is always required to initiate a defrag job. Because these utilities do not allow the administrator to initiate defragmentation on a given volume while a different volume is being defragmented, the time required to complete the job may be long. This is especially true if the administrator must access individual machines to log on, complete the defrag job, and log off.

- › **Local control** with no remote control capability. Defragmentation schedules can't be automatically deployed or monitored. This makes it far more difficult to assure that consistent optimization occurs.

- › **Multi-pass defragmentation** that's less thorough than commercial alternatives[11] and may require multiple runs to achieve results comparable to single-pass designs such as Defrag Manager.

While it's true that built-in Windows defraggers may be available at no cost beyond the investments already made in the operating system, this doesn't exactly make them "free." The time required to manually run these utilities, one system at a time, can make cost of ownership for the built-in Windows defraggers surprisingly high even under very optimistic assumptions about their use and effectiveness. We'll explore the full costs of the built-in Windows defragger in the following sections.

Even though built-in Windows defraggers are available free with some operating systems, the personnel time required to manually run these utilities can result in much higher cost of ownership than commercial alternatives.

---

[11] "Independent Testing Helps Systems Integrators Validate their Purchases," (NSTL, Inc.)

:: The Clientless Defragmentation Server

Winternals Software released the first Clientless Defragmentation Server in early 2001. Defrag Manager V2.0 is designed to provide a faster return on investment by lowering the cost to acquire, deploy, and manage defragmentation on any sized network. Features of Defrag Manager (http://www.winternals.com/defrag) include:

- ❯ **Utmost Scalability** with installation, configuration, and product upgrades deployed to every selected system by a single action on the administrator's machine. Simply install and setup Defrag Manager on a single PC. That's all that's required to deploy it to every computer in a domain.

- ❯ **Centralized control** with substantial cost savings made possible by placing all scheduling and control functionality in the hands of system administrators instead of with individual users. No end-user interaction is ever necessary, and this reduces personnel costs and help-desk calls.

- ❯ **Extended Manageability** with a user interface designed to handle any number of designated computers as though they were one Defrag Manager significantly reduces the time needed to administer defragmentation of networks of all sizes. Groups of computers with similar needs are monitored at-a-glance from one console to further reduce administrative overhead.

Because Defrag Manager's setup, monitoring and control reside strictly on an administrator's console instead of on individual desktops, end-user costs are greatly reduced. The ROI scenarios in the following sections demonstrate how cost-effective licensing, rapid deployment, and centralized administration contribute to a remarkably different business case for Defrag Manager compared to other solutions.

"Defrag Manager allows me to manage defragmentation throughout my entire network from my own desktop computer. The speed of the product is a tremendous benefit. It completes defragmentation in only 30% of the time required by other network defraggers, and at a much lower cost. I use Defrag Manager on my file and print server, terminal servers and SQL server and notice performance improvements of up to 20%."

Robert McMillan
IT Manager, Trail Appliances Ltd.

Cost Savings and ROI ::

The business case to deploy a defrag solution should take into account not only the positive impact that optimization can have on system performance, but also the total costs to purchase, maintain, deploy, manage, use, and support the product. Software vendors and industry analysts publish a number of competing ROI models to demonstrate the cost savings of regularly scheduled defragmentation. The analysis presented in this paper employs a Hardware Cost Model, considered to be the most reliable means for calculating ROI because:

—○ ⟩ The model relies on straightforward "what-if" analysis to compare the cost of owning hardware that employs a disk defragmentation against hardware that does not.

—○ ⟩ The Hardware Cost Model is designed to fully reflect the cost of buying, managing, maintaining, and using the defragmentation software according to guidelines established by independent analysts.

—○ ⟩ Unlike other published ROI models, [12,13] no assumptions are made about how hardware performance relates to end-user productivity, or about how use of defragmenters may change an organization's hardware trade-in habits.

—○ ⟩ All conditions and assumptions used in the model can be tailored to make a realistic business case for any organization.

The Hardware Cost Model can be used to compare the return on investment for conventional networked defraggers, the built-in Windows defraggers, and the clientless defragmentation server (Defrag Manager) versus a base case of not defragmenting systems on a regular basis.

> The business case for investing in a defrag solution should take into account not only the positive impact on system performance, but also the total costs to purchase, maintain, deploy, manage, use, and support the product.

---

[12] Raxco Software "How Much Is Fragmentation Costing You?" (Raxco Software)

[13] Steve Widen and Chris Christiansen, "Disk Defragmentation for Windows NT/2000- Hidden Gold for the Enterprise" (IDC, 2000)

The Appendix shows detailed ROI calculations for a typical deployment scenario — in this case 1,000 systems. Conditions for these calculations were selected to render a realistic case that reflects real-world conditions. The calculations were repeated over the range of 100 to 100,000 units to create the annual savings curves shown in Figure 4.

The chart below takes onto account not only the performance improvements made possible by defragmentation, but also the full cost of ownership including (where applicable) purchase and maintenance costs, and the cost of personnel to administer, support, and use each product.

Note that ROI calculations for both Defrag Manager and the conventional networked defragger assume that only 1 installation in 50 will have access to the products' interfaces for scheduling, monitoring, and ad hoc defragmentation runs. In the case of Defrag Manager this is a conservative assumption, since defragmentation of thousands of computers is often managed by a single system — resulting in a return on investment that is higher than calculated below.

By default the conventional networked defragger allows all users to access the product interface unless restricted by account privileges. Therefore ROI for the conventional networked defragger may be far lower than shown below unless access has been restricted to relatively few administrators.

Organizations that deploy a conventional networked defragger without restricting access to the product's user interface can expect to have higher operational and support costs- and far lower ROI than presented below.

Annual Savings
Per System

© Copyright 2002 Winternals Software LP
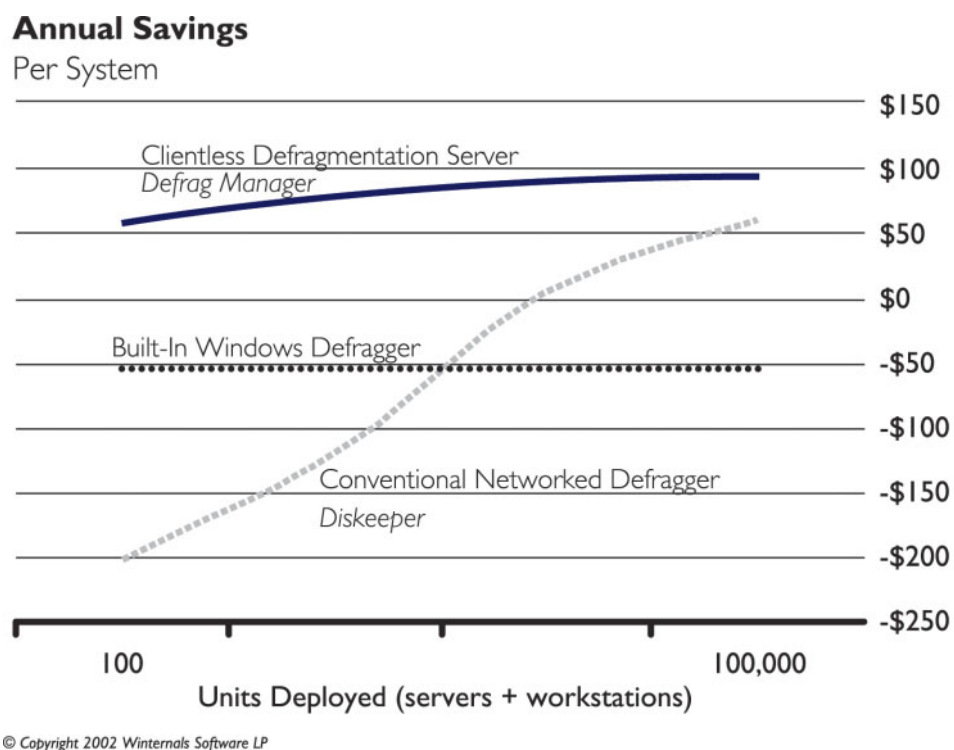
Figure 4

Notice that Defrag Manager provides consistent, positive savings regardless of the size of deployment. Use of conventional networked defragmenters can result in dramatically negative returns until large quantity discounts come into play, while the built-in Windows defragmenter renders a constant loss per system as a result of personnel costs. Figure 5 below shows example calculations in detail:

Annual Savings *(Loss)*			
Size of Deployment	**Defrag Manager**	**Conventional Networked Defragger**	**Built-in Windows Defragger**
100 nodes	$5,801	$(20,137)	$(5,441)
1,000 nodes	$78,335	$(120,529)	$(54,406)
10,000 nodes	$881,284	$44,805	$(544,055)
100,000 nodes	$9,288,334	$5,994,728	$(5,440,551)

Figure 5

ROI curves for this data are shown in Figure 6 below. Notice that Defrag Manager has the potential to provide exceedingly high ROI as a result of lower licensing fees and reduced costs to deploy, manage, support, and use the software. For example, the 263% ROI shown for a 1,000-unit deployment means that Defrag Manager has the potential to pay for itself with only a few months of use.
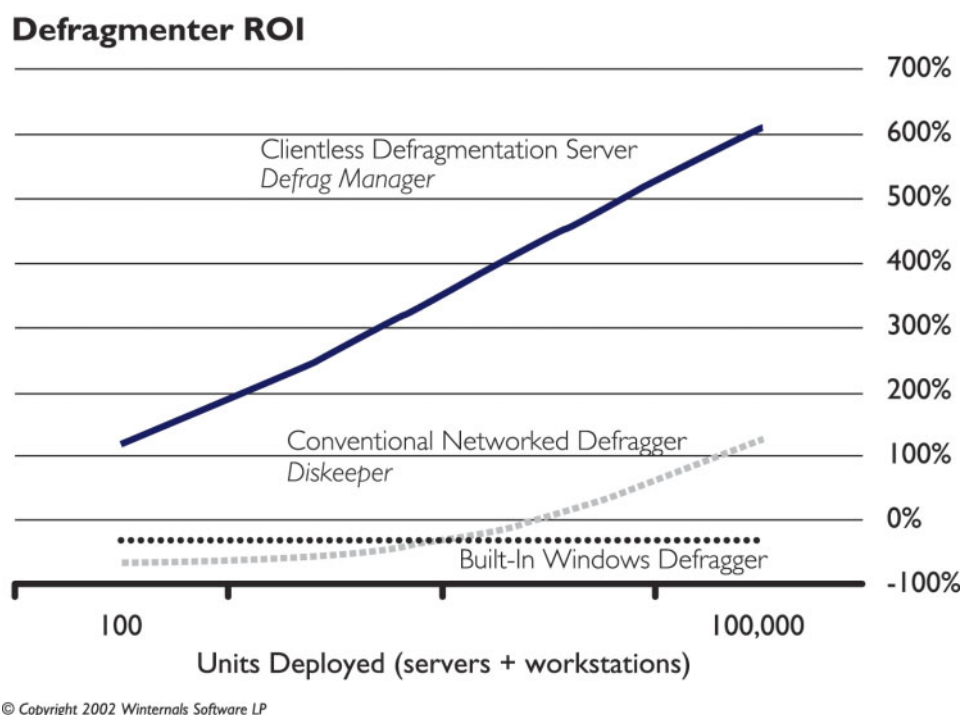

Figure 6

Regardless of the size of your organization, Defrag Manager can pay for itself with just a few months of use.

An automated version of this ROI calculator is available to create a business case that is tailored for any organization. Please contact Winternals Software for more information.

Delivering on the Promise ::

Competitive economic times require that every IT investment provide tangible cost savings with an absolute minimum of disruption to an organization's infrastructure. Defrag Manager's unmatched scalability and manageability — combined with lower costs to license, support, and use — result in a low total cost of ownership and consistently high ROI.

The potential for improved end-user productivity, faster, more trouble-free system operation, and decreased support overhead adds up to a business case that's unmatched by most other IT investments.

Bottom line: Defrag Manager provides a proven, cost-effective way to extend your systems infrastructure and enhance your competitive edge.

"During our evaluation of Defrag Manager, we discovered that a simple defrag solved most of the slow access problems that our end-users were experiencing. We were looking for something that would not take up much hard drive space and that would be easily deployable. The ease of deployment was phenomenal, and the concern we had for hard drive space was not even an issue because of Defrag Manager's installing/uninstalling service agent. The affordable price was also a deciding factor for us."

Kris Spann
ITSC, Mitsubishi Chemical America

Appendix: The Hardware Cost Model ::

The Hardware Cost Model compares the total cost of owning hardware that employs disk defragmentation versus equivalent hardware that does not. The conditions used to calculate the cost savings and ROI data presented in this white paper are listed below, but it should be noted that all conditions can be modified to create a business case analysis that makes sense for any organization. Please contact Winternals Software for a customized version of this analysis.

The following is a summary of the key parameters used in the analysis.

Speed increase due to defragmentation: in order to present a realistic business case, systems that undergo scheduled defragmentation are assumed to benefit from an overall average speed increase that equates to a similar types of hardware having 20% higher advertised performance (whether through use of a slightly faster CPU, more memory, faster disks, etc.). While this increase follows the more conservative range of published data for commercial defragmenters, it should be noted that Defrag Manager provides overwhelmingly positive ROI *even* in cases where lower performance improvements are assumed.

Mix of workstations and servers: the calculations assume that 10% of an organization's computers are servers and 90% are workstations. A greater percentage of servers generally increases the ROI for Defrag Manager, while it decreases ROI for the conventional networked defragger under many conditions.

Timeframe: the duration of the ROI calculation impacts software cost, and in general should correspond to an organization's software amortization practices.

Hardware costs: the server and workstation hardware costs and net trade-in values are empirical 2002 values, and may be modified to reflect user experience.

Ownership costs: product administrative overhead, technical support, and end-user operation costs are taken from analyst estimates.[14] For enterprise deployments it is estimated that the annual costs of administrative support, technical support, and end-user operation equal 100%, 121%, and 393%, respectively, of product acquisition costs.

---

[14] D. Cappuccio, W. Kirwin, L. Pawlick, S. Namasivayam, "Total Cost of Ownership: Reducing PC/LAN Costs in the Enterprise" (Gartner Group)

User costs: the ROI models for both Defrag Manager and the conventional networked defragger assume that only 1 installation in 50 will have access to the products' user interfaces. For Defrag Manager the real-world ratios are likely to be much lower (i.e., 1 to 1,000 or more), with a higher ROI as a result. However, because the conventional networked defragger provides a user interface on every system where deployed, there is the potential for greatly increased end-user operating costs (and ROI that is significantly lower than shown below) in the event that the product's user interface is not restricted to a few administrators.

User costs for the built-in defragmenter can be calculated directly as shown below. The assumed time of 10 minutes to defrag a system is considered to be extremely optimistic regardless of whether the task is performed by an IT staff member (who must access each system, log on, manually defrag, and log off) or by a power user with administrative privileges (who may be able to access the system more quickly but is likely to perform the job far more often, thereby costing more in personnel time).

Product pricing: Pricing shown is current volume pricing as of September 2002. Pricing for products other than Defrag Manager are reseller volume prices as of that date as reflected in GSA contract pricing schedules.

The ROI calculations below reflect a single quantity of deployed servers plus workstations. The calculations were run over a range of 10 through 100,000 total systems to provide curves shown in Figures 4 and 5 above.

```
                    Defrag Manager - ROI Calculation
Number of Workstations:                                                    900
Number of Servers:                                                         100
Total number of systems that will have a defragmenter installed:         1,000

Projected average system speed-up from scheduled defragmentation:        20.0%
ROI calculation timeframe (years):                                         3.0
Average system trade-in life (years):                                      3.5

Average cost of a business Workstation with monitor, applications,   $    3,200
network, setup labor, etc.:
Cost to purchase a Workstation having 20% lower performance (required for $  2,800
what-if analysis):
Trade-in value of each Workstation after 3.5 years:                       9.9%
Average cost of a business Server with monitor, applications, network, $  4,600
setup labor, etc.:
Cost to purchase a Server having 20% lower performance (required for what- $ 4,000
if analysis):
Trade-in value of each Server after 3.5 years:                            9.9%

                      Defrag Manager Pricing:
License fee for 1,000 units of Defrag Manager:                       $7,100.00
Defrag Manager annual maintenance cost (%):                              20.0%


          Defrag Manager ROI is calculated to be 263% as follows:
Average unit license fee:                                            $    7.10
Average unit defrag maintenance fee, cumulative over 3 years:        $    4.26
Product administrative costs (equals 100% of product costs x 3 years): $ 34.08
Technical support costs (equals 121% of product costs x 3 years):    $   41.24
End-user operating costs (equals 393% of product costs applied to 2% of $ 2.68
systems with user interface x 3 years):
     Total unit cost over 3 years:                                   $   89.36

Defrag Manager total annual cost per system:                        $   29.79

                      ROI Calculation:
Average annual system cost if traded every 3.5 years:               $  859.61
Estimated annual cost of systems with 20% lower performance if traded in $ (751.51)
every 3.5 years:
Less annual unit cost of Defrag Manager, maintenance, and overhead:  $  (29.79)
Annual savings per system from Defrag Manager:                       $   78.31

Defrag Manager ROI:                                                       263%
Total Annual Savings per 1,000 systems:                              $   78,309
```

```
                     Diskeeper - ROI Calculation
Number of Workstations:                                          900
Number of Servers:                                               100
Total number of systems that will have a defragmenter installed: 1,000


Projected average system speed-up from scheduled defragmentation: 20.0%
ROI calculation timeframe (years):                               3.0
Average system trade-in life (years):                            3.5


Average cost of a business Workstation with monitor, applications,  $    3,200
network, setup labor, etc.:
Cost to purchase a Workstation having 20% lower performance         $    2,800
(required for what-if analysis):
Trade-in value of each Workstation after 3.5 years:                      9.9%
Average cost of a business Server with monitor, applications,       $    4,600
network, setup labor, etc.:
Cost to purchase a Server having 20% lower performance (required for $   4,000
what-if analysis):
Trade-in value of each Server after 3.5 years:                           9.9%


                    Published Diskeeper Pricing:
License fees for 900 units of Diskeeper Workstation:               $   27,895
... plus license fees for 100 units of Diskeeper Server:          $   16,850
Diskeeper annual maintenance cost (%):                                31.6%


        Diskeeper ROI is calculated to be -53% as follows:
Average unit license fee:                                         $    44.74
Average unit defrag maintenance fee, cumulative over 3 years:     $    42.45
Product administrative costs (equals 100% of product costs  x 3   $   261.59
years):
Technical support costs (equals 121% of product costs x 3 years): $   316.52
End-user operating costs (equals 393% of product costs applied to 2% $  20.56
of systems with user interface x 3 years):
    Total unit cost over 3 years:                                 $   685.87

Diskeeper total annual cost per system:                           $   228.62


                      ROI Calculation:
Average annual system cost if traded every 3.5 years:             $   859.61
Estimated annual cost of systems with 20% lower performance if    $  (751.51)
traded in every 3.5 years:
Less annual unit cost of Diskeeper, maintenance, and overhead:    $  (228.62)
Annual savings (loss) per system from Diskeeper:                  $  (120.53)


Diskeeper ROI:                                                       -52.7%
Total Annual Savings (Loss) per 1,000 systems:                    $ (120,529)
```

```
             Built-In Windows Defragger - ROI Calculation
Number of Workstations:                                                    900
Number of Servers:                                                         100
Total number of systems that will have a defragmenter installed:         1,000


Projected average system speed-up from scheduled defragmentation:        20.0%
ROI calculation timeframe (years):                                         3.0
Average system trade-in life (years):                                      3.5


Average cost of a business Workstation with monitor, applications,    $   3,200
network, setup labor, etc.:
Cost to purchase a Workstation having 20% lower performance (assumed  $   2,800
possible by defrag performance improvements):
Trade-in value of each Workstation after 3.5 years:                       9.9%
Average cost of a business Server with monitor, applications,         $   4,600
network, setup labor, etc.:
Cost to purchase a Server having 20% lower performance (assumed       $   4,000
possible by defrag performance improvements):
Trade-in value of each Server after 3.5 years:                            9.9%


Built-In Windows Defragger ROI is calculated to be -33% as follows:
Fully burdened hourly IT personnel cost:                              $37.50
Hours required to visit one system, log in, initiate and complete       0.167
defragmentation, and log off (equals 10 minutes):
Minimum number of defrag runs per year:                                   26


Built-In Windows Defragger total annual cost per system:             $    162.50


                     ROI Calculation:
Average annual system cost if traded every 3.5 years:                $    859.61
Estimated annual cost of systems with 20% lower performance if       $   (751.51)
traded in every 3.5 years:
Less annual unit operating cost of Built-In Defragger:               $   (162.50)
Annual savings (loss) from built-in Windows defragmenter:            $    (54.41)


Built-In Windows Defragger ROI:                                           -33%
Total Annual Savings (Loss) per 1,000 systems:                       $  (54,406)
```

Winternals

3101 Bee Caves Road

Suite 150

Austin, TX 78746

www.winternals.com

Ph 512.330.9130

Fax 512.330.9131