

# **Making Cents of Copy and Print Management**

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***“Measure what is measurable, and make measurable what is not so.”***  
***- Galileo circa 1600***

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## INTRODUCTION

This paper addresses the rising costs of printing and copying in public institutions and private companies. The impact of the digital era has not had the anticipated positive effect on paper reduction. In fact, the opposite is occurring as copy/print/office paper continues to rise in consumption. According to a recent report published in the International Herald Tribune, paper consumption is projected to double over the next 50 years. Provided herein is a brief review of the concerns over paper consumption. Following is an analysis of the cost of printing and printing in public and academic libraries. The concluding section provides an overview of some of the solutions offered to manage printing costs.

The document attempts to provide some historical data on the cost of printing, copying, cost recovery management, and the changing trends in these costs as witnessed by the digital copier revolution. Further, we will provide an overview of the solutions available and provide some specific examples that address the needs of small to mid-size installations, which account for the largest segment of the market. While this paper primarily addresses concerns of public institutions, the information can be applied to commercial installations as well. Companies have used keypads and copier counters for just as long as libraries have used coin boxes, yet they continue to allow network printing to go unmonitored.

## PAPER CONSUMPTION

Each year, the United States consumes about 4 million tons of copy paper. Using 8.5x11 inches as the standard for office paper, it closely approaches one *trillion* sheets of paper.<sup>1</sup> The average office worker uses about 10,000 sheets of copy paper per year. After printing or copying which adds to the stacked height of paper, the resulting stack is roughly equal to the height of the person that consumed all of that paper.

Some argue that paper manufacturing consumes almost half of all trees, 12,000 square miles of forest per year, and is a major contributor to deforestation of the tropical rain forests. Others suggest that wood products used in paper production are by products of other tree consumption and less than 1% of the raw material for paper is derived from this source. They suggest that wood pulp for paper comes mostly from pulp plantations. The truth lies somewhere in-between. A greater and less obvious environmental concern is the fact that the energy required to produce the paper used per hour in an office by one worker is about the same as an 80-watt light bulb. Further, the problems with waste disposal have been widely discussed and are worthy of concern. Estimates of as much as 12 million tons of office waste paper are generated each year. Directly as a result of this study, our company has implemented some changes in its marketing and publishing practices to reduce paper waste.

One way to reduce office paper consumption is duplexing (printing on two sides). Copiers have had this capability for more than twenty-five years and most major laser printer manufacturers offered duplexing options during the nineties.

Another option for consumption reduction is to use a lower weight paper.

The most significant method of effecting paper reduction is the elimination of original waste. Many individuals whether in the private or public sector regularly print electronic information from email and the Internet and fail to read or use that information again. Copies are readily made and then destroyed.

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<sup>1</sup> 200,000 sheets per ton according to ReThink Paper

Good stewardship is often sacrificed for convenience. If environmental concerns alone are not enough, then certainly the costs associated with waste must be considered.

The problem however, is that many organizations have little or no information to help them realize the costs associated with printing. While copiers provide meters and pin numbers for cost accounting, historically print costs have been ignored either because the costs were unknown or because the tools were not sufficient to effectively measure consumption and still provide a useful return on investment.

The irony of the new millennium is that many libraries continue to charge an amount to copy a book but allow free printing from the Internet. The irony exists in the penalty placed on use of print material and the fact that Internet/digital printing may be costing the institution far more than copies would cost.

## PRINT CONSUMPTION

In a study conducted by MarketTools for Hewlett Packard, the results showed that the average regular user of online resources in an office prints about 28 pages per workday from the Internet. More than half of all office workers reported that they print at least 10 pages daily. The information most often printed is as follows:<sup>2</sup>

- Reference materials 78%
- Product information 63%
- Maps/directions 46%
- Company/vendor pages 45%
- Photos 33%

What does this mean in an academic setting?

Indiana University determined that their 260 PC's and 20 printers in the residence halls alone printed a total of 3.26 million pages in one year. This equates to an average of about 271 pages per resident. To put it in perspective, that is 6,520 reams, and stacked would reach a height roughly equal to the Sears Tower.

Cal State Hayward Lab users print 250,000 pages per semester.



Recent studies suggest that facilities that utilize a form of print management can reduce waste by 30 – 50%. In other words, users are simply printing unnecessarily. Part of the cause of this problem is the fact that users often are unaware of the number of pages they are about to print. This is particularly an issue with browsers. A simple click on the print button not only prints what is viewed on screen, it may also print the 30 or 200 pages that that are unseen. Once print has been acknowledged, there is little recourse but to allow the print job to complete. On a network where spooling<sup>3</sup> might occur, the time delay can be such that the student or patron would reprint the job before the first one prints, thinking that their first print request was not accepted.

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<sup>2</sup> HP Internet Printing Survey

<sup>3</sup> A process where the print job is first sent to a print spooler, typically a file server, managed by the server, and then sent to the printer. In a WAN (Wide area network) environment, this process can be lengthy.

The University of Maryland was spending more than \$100,000 per year to support printing in 1993. During that year, students printed an average of 400,000 pages per month. One year later, after installation of a print management system, the number of pages printed per month averaged only 75,000 pages.

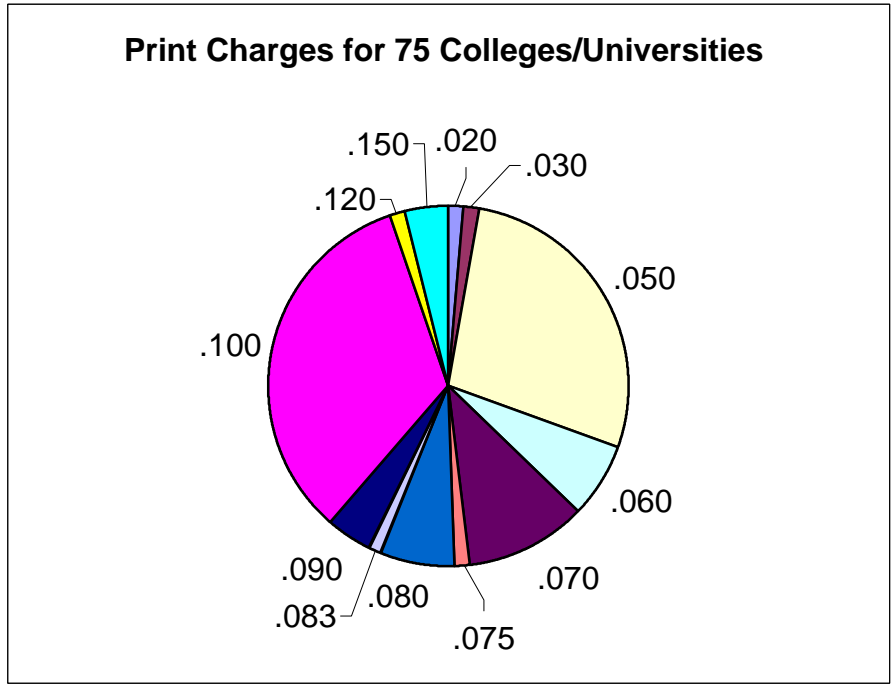
Unfortunately, we may have only scratched the surface in our exposure to print costs. While electronic databases and Internet-based information continue to explode in importance, other projects like the Gutenberg project, NetLibrary, eBooks, and initiatives that digitize classic works and documents with expired copyrights, create an even greater potential for rising print costs.

## COSTS

For over twenty-five years many public institutions have considered it 'normal' to charge from five to ten cents per copy to make a photocopy of a book or journal. Most often, the copier has an attached coin box and in some cases, a vending device that accepts a copy card. The goal has been to offset the cost of making copies but to facilitate the convenience for the student or patron in making copyright-compliant copies to take out of the library for further reading and research.

After conducting an informal survey of copier companies, vending equipment vendors, and libraries, we concluded that the average cost per copy of a photocopy is about 3 cents and the average cost of a laser print is about 7 cents. Page costs will be discussed in detail later in this document.

The data in this chart indicates the charges levied by seventy-five academic institutions based upon their individual analysis of printing costs.<sup>4</sup>



<sup>4</sup> <http://law.richmond.edu/general/printsurvey.htm>

The University at Buffalo charges as follows: Dot Matrix-free; Laser Print .07; Color Laser .75; PaintJet .50. Northwestern University uses the following fee schedule: Laser Print .05; Reference Laser Print.08/2-sides; Color Laser 1.00, and Plotter 3.00.

“BERTL surveys have shown that few, if any, businesses know how much it costs them to own and run printers. In fact, few larger companies even know how many printers they actually possess let alone how much it costs to run each of them. This situation is further aggravated by some promotional campaigns which paint obscure pictures of the cost of ownership of a printer by publishing theoretical comparisons of “copying v. printing” costs when such comparisons have no real grounding in like for like analysis. When such campaigns are conducted by three different industries (Fax, Printer and Copier) which operates to no agreed common standard, with some manufacturers using their own mysterious methods, it becomes nonsensical.”<sup>5</sup>

This is further complicated by the fact that there are no industry standards by which the yield of toner cartridges can be evaluated. In general, the printer industry quotes a 5% page coverage for black toner or ink cartridges but copier companies quote 6% coverage. The actual results of independent testing laboratories shows that perceived costs based upon manufacturer estimates may not be valid.

CARTRIDGE YIELD SUMMARY				
AVERAGE YIELD BY PRINTER TYPE, CARTRIDGE MANUFACTURER AND TEST PATTERN, EACH YIELD VALUE REPRESENTS THE AVERAGE OF MULTIPLE CARTRIDGES				
	HP Advertised Yield	HP Designed IDC Test Pattern)	BERTL Test Pattern	Cost Per Page (Staples \$ and BERTL test)
LASERJET 4000 / 4050 - C4127X	10,000 pages	9,043 pages	6,632 pages	2.15 cents
LASERJET 4 / 4+ / 5 - 92298X	8,800 pages	7,826 pages	5,258 pages	2.04 cents
LASERJET 5Si / 8000 - C3909A	15,000 pages	16,558 pages	13,737 pages	1.37 cents
LASERJET IIISi / 4Si - 92291A	10,250 pages	7,936 pages	5,514 pages	2.35 cents
LASERJET 4V - C3900A	8,100 pages	9,319 pages	6,838 pages	2.26 cents
LASERJET II / III - 92295A	4,000 pages	3,135 pages	1,843 pages	3.52 cents

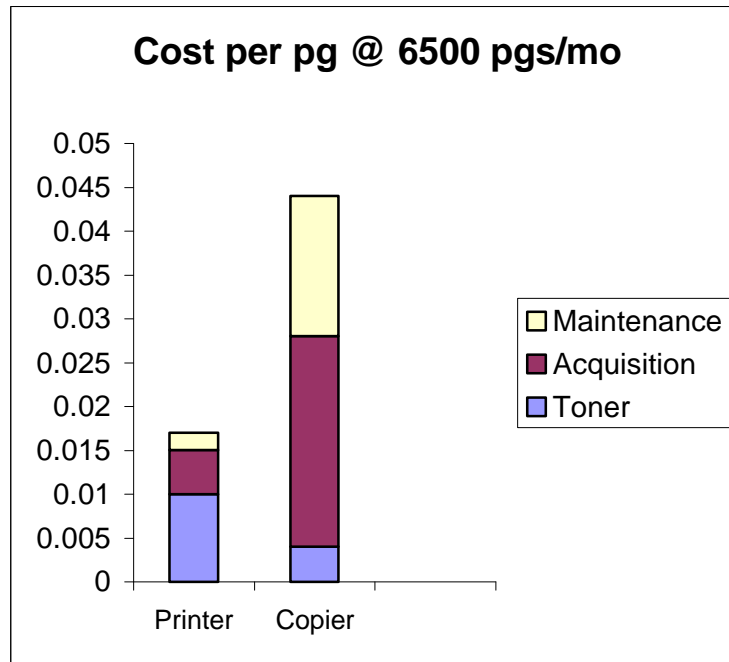
Specifically, independent testing labs have confirmed that HP4050 toner cartridges, quoted to last for 10,000 laser prints actually provide an average of 7,313 prints.<sup>6</sup>

In order to determine the actual cost of printing or copying, the institution or company must analyze the total cost of ownership (TCO). Evaluation criteria include:

- Acquisition cost
- Consumables cost/yields for toner, drum, media
- Maintenance costs (vendor and staff)
- Page volumes
- Product life
- Page density (5% coverage)
- Click charges (per copy)

<sup>5</sup> “Wake up to the true cost of Printing”, Carmel Rowley, BERTL Digital Times [www.digital-times.net](http://www.digital-times.net)  
<sup>6</sup> <http://www.digital-times.net/xeroxhp4test/hp4000test.html>

The results of an extensive study prepared by International Data Corporation compares the cost of printing on a laser printer to that of an equivalent *digital* copier. The results are surprising. On average, copiers cost 2.5 times the operating cost of printers. 1.67 vs 4.4 cents per page (typical for HP4050 and 8000 series printers)



IDC further concludes the advantages of each type of device:

Criteria	Printer	Copier
TCO	Printer acquisition and service far lower	
Output quality	Printers offer 1200dpi resolution	
Connectivity	Printers always connected	
Ease of use	Inherently easier	
Paper handling/finishing		Finishing such as sort and staple are strong legacy.
Reliability	Install and forget vs. maintenance intensive	
MFP Capability Multifunction peripherals		Most copiers have multiple MFP options
Channel	Printers have far broader channel	
Service/support	Copiers are antithesis of reliability	

“Connectivity, compatibility, output quality, and reliability would continue to favor printers”<sup>7</sup>

*IDC’s TCO findings overturn the common and long-held office myth that copiers are cheaper to operate than printers.*

<sup>7</sup> The Digital Office Face-Off An IDC White Paper, International Data Corporation

## **INKJET PRINTERS - THE TWENTY-FIRST CENTURY RAZOR BLADE**

It has often been suggested that you can get the razor for free if you'll just buy the razor blades. In technology terms, the misleading low cost of an inkjet printer is substantially offset by its high cost of operation. It costs approximately \$385 to purchase a personal LaserJet like the HP1100. The cost per laser copy for paper and toner is around 2-6 cents. A state-of-the-art inkjet printer like the HP930C (commercial model) costs about \$170 but the cost per print is 14 cents.<sup>8</sup>

Using an average office analogy, 10 pages per day, 5 days per week, 45 weeks per year (accounting for vacation and holidays) equals 2,250 pages. At 4 cents per page, that's \$90. At 14 cents per page, the operating cost is \$315. Let's assume that either printer will last for two years. At the end of two years, the worker using a personal laser would have spent \$385 for acquisition and 2 X \$90 in operating costs for a total of \$ 565. The 'lower cost' inkjet would have cost the company \$170 for acquisition plus 2 x \$315 in operating costs or \$ 800 (30% more!). In a smaller institution with 150 faculty and staff members, if each person has a personal printer, that would amount to \$84,750 for a personal laser or \$120,000 for inkjet printers. Although network-based higher volume laser printers are more expensive, they last longer and have an even lower cost per print, thus, networked laser printers are the most efficient means of printing (provided that color copies are not entered into the equation). None of the above includes the full spectrum of TCO, which includes maintenance and support, printer driver installation, cost of procurement, etc.

Privacy is often cited as a reason to justify a printer per person but print management systems are available to ensure privacy even when using shared departmental laser printers.

## **MANAGING COST**

In the public sector, libraries have used a variety of vending devices to manage the cost of producing copies. Coin boxes, bill acceptors, card readers, smart cards, and an honor payment system have been used. Although this seems mainstream to most institutions, it represents only a fraction of the total copier market and thus, equipment manufacturers have been slow to adopt any standards or direct support of coin/card devices, leaving that solution in the hands of a local vendor. This is especially true with the new multifunction copiers, which are particularly difficult to use in a pay for print/copy scenario. Vending devices, while increasingly more reliable, add an additional cost to the total cost of ownership because of acquisition costs, maintenance, and staff operation. The vending devices are used to ensure compliance and to reduce staffing requirements associated with handling funds collection. The size of the institution generally affects the collection method. In business and for institutional staff, departmental accounting systems have been utilized to allocate copy costs. Again, one item not considered in the above statistics is the local costs associated with staff support.

Many organizations have used paper supply as a means of 'managing' network printing, requiring that the student supply their own paper. In fact, the paper is the least significant part of the overall equation with respect to operating costs of inkjet or LaserJet printers, approximately *7 tenths* of a cent per page.

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<sup>8</sup> A set of inkjet cartridges costs about the same as a toner cartridge however, inkjet cartridges are designed to last for about one ream of paper (500 sheets) vs. five reams of paper (2500 sheets) for the laser toner cartridge.

A caveat not considered is the fact that lack of control over paper stock can result in increase jams and frustrations for users that may not have enough paper. The increased maintenance costs generate a detrimental effect in the overall cost management of printing.

One of the problems with cost recovery for printing has been in the hardware and software available to manage cost recovery and the potential increased support burden on an already overburdened library or lab staff. Further, the cost of implementation per printer has been far greater than the cost of adding a coin box to a copier. Little data has been available up until now to substantiate the costs of public printing. Just a few years ago, a typical cost recovery system for printing would have a base cost of thirteen thousand dollars or more. At ten cents per laser print, it would take over a hundred thousand laser prints just to pay for the cost of the hardware and software to manage printing, hardly worth the investment in smaller facilities.

## **IS IT FAIR TO CHARGE?**

Libraries are faced with concerns over interpretation of the Library Bill of Rights with respect to the perception that fees for printing could present a barrier to access. In truth, if the library has reconciled the concept of charging for copies, it could apply the same principles to printing. Access to the information is available while in the library and viewing the screen. The library typically looks for cost recovery for the extra service that may serve some of the students or patrons who need to print material for later reading and review. Regardless of the policy decision in this regard, there can be justification to the installation of a cost management system for printing – *even if the library elects not to charge a fee for printing*. The reason is simple – elimination of waste. Statistics gathered from a number of public and academic libraries around the United States indicate that the amount of waste in an uncontrolled printing environment can exceed 50%. In other words, establishing a means of controlling printing could reduce the cost to provide printing and still avoid any charges to students or patrons. The key factor in implementing this scenario is the ability to recover some of the cost of the management system from the savings in reduced waste.

Students might often question the implementation of a print cost recovery system. Some institutions levy a technology fee. In either case, some justification for a change must be provided. The documentation provided herein is provided to assist the organization in this justification. A system that supports 'free' print management can eliminate waste and at the same time compile statistics. This system can later be activated to charge for printing. A number of institutions prefer to establish a budget for printing. As such, any solution for print management would need to accommodate this feature.

## **THE TECHNOLOGY SUPPORT BURDEN**

Many libraries have discovered that the increased dependence on electronic reference has created a new level of support and management for the reference staff. In addition to the traditional roles played, librarians and staff personnel are now managing PC's, scheduling time, assisting with Windows questions, replacing printer paper, and performing typical helpdesk functions. As libraries consider print management, the added concerns over staff involvement must be considered. Any new technology will undoubtedly add a level of support burden.

If a self-service system is utilized (one that uses vending devices) then some staff intervention may be reduced. Again, the reduced waste has the potential of reducing printing support problems in half.

## COMMON CRITERIA USED FOR EVALUATING A PRINT MANAGEMENT SYSTEM

1. Is there a potential to reduce waste?
2. Can the organization cost justify the investment?
3. Will the solution be reliable? What similar organizations can attest to the reliability? Does the vendor's design appear to utilize interoperable principles?
4. Is the patron/student/user interface easy to understand? If signs and instructions are required, it's not the right solution.
5. Can the vendor provide hardware and software that is compatible with existing systems?
6. Can the library benefit from establishing a control system for other than waste reduction?
7. Will the patrons be confused, intimidated, or reject the idea of a print management system?
8. How much increased staff intervention will be required (or reduced)?
9. Are there additional costs besides acquisition fees such as additional hardware (server), annual licensing, special installation, or other software components?
10. Would staff-assisted or self-service be the best choice in terms of cost/benefit? Does the vendor support both software only and software/hardware solutions?
11. Will the system allow for configuration changes if the library decides to implement the system in a different model? (Example local printers vs. network printers, or budget-based accounting vs. pay per print.)
12. How efficiently will the system operate with remote campuses or branches? Does the system increase or decrease bandwidth utilization on the network?
13. Can the system integrate with all current and planned client platforms?
14. Does the vendor require interface to a file server and if so, does the vendor support more than one server platform. What are the potential costs if a change is planned in the future?
15. How does the vendor's software interoperate with other applications and security packages?
16. How do the feature sets of various vendors compare with one another?
17. Does the vendor provide the flexibility to add or change functionality of an existing installation easily? Can I start small and add more features as budget allows?
18. If client software is installed, does it require regular updating or does it update automatically?
19. Does the company have a history of regular updates that indicate responsiveness to my community's needs?
20. What is the support reputation of the company?
21. Can software or hardware be supported by telephone?
22. Does the vendor provide same-day or next day on-site service?
23. Is any special training required to support the system? Are there other components that require training to support the system?
24. Will the system support a variety of printer manufacturers?
25. Can the system support different prices per printer so that color and black and white can be charged differently?
26. Is it possible to provide free printing system wide (so that the system controls waste without actually charging)?
27. Can the system charge different prices for different documents so that catalog citations can be free and Word documents can be a different price?
28. Will the software interoperate with a variety of vending devices?
29. Are updates available by email or web site?
30. Will the vendor provide an unconditional guarantee for return if I am not satisfied in 30 days?



# LPT:One Cost Recovery Summary Report for Oconee Regional Library

Generated: 10/23/2000 3:33:40 PM

## Report Parameters

Date Range: (All Dates)

Release Station: (All)

Client Name: (All)

Printer Name: (All)

Patron ID: (All)

## Summary Information

	Jobs	Pages	\$ Printed	\$ Overrides	\$ Not Printed
Printed	5144	10502	\$2100.60		
Overrides	2529	5991		\$1200.00	
<b>Total Printed</b>	<b>7673</b>	<b>16493</b>	<b>\$2100.60</b>	<b>\$1200.00</b>	
Deleted	64	135			\$27.00
Cancelled	1891	12770			\$2554.69
Expired	489	1086			\$218.82
Too Many Pages	0	0			\$0.00
<b>Total Not Printed</b>	<b>2444</b>	<b>13991</b>			<b>\$2800.51</b>

<b>Printed</b>	+	<b>Not Printed</b>	-	<b>Overrides</b>	=	<b>Total Recovery Value</b>
\$2100.60		\$2800.51		\$1200.00		\$3701.11

## Jobs Printed by Time of Day

	Jobs	Pages	\$ Printed	\$ Overrides
<b>Morning</b>	869	1951	\$212.00	\$178.20
<b>Afternoon</b>	3251	6916	\$885.20	\$498.60
<b>Evening</b>	3553	7626	\$1003.40	\$523.20
<b>Night</b>	0	0	\$0.00	\$0.00

*This report generated with the LPT:One Print Tools Reporting Module from Interface Software, Inc.*

During the 7 month period, the patrons:

- Would have printed 30,484 pages
- Actually printed 16,493 pages (5991 staff overrides so patrons printed 10,502 pages)
- Electively cancelled 12,770 pages (saw the page count and elected to cancel printing)
- Failed to pick up 1,086 pages (Not actually printed because they expired at the Release)

Without a cost recovery system in place, at 6 cents per page cost, the library would have spent \$1,829.04 for printing. Because over half of the jobs were unwanted, the *most* they would have recovered at 20 cents per page using the *honor* system would have been \$ 2100.60 with a “net” of \$271.56. Because of print management, the library actually spent \$630.12 for patron jobs and netted \$1470.48. It is important to note that the ‘net’ amount is used partially to offset the investment cost of the print management hardware and software. It should also be noted that this is a self-service system, which significantly eliminates staff requirements for patron printing assistance. More than half the cost of the print management system was for self-service hardware. At a slight increase in print volume, the library will recover its entire investment in three years and then can use the cost recovery to replace or expand equipment. Had the library elected to purchase only software to manage printing, the recovery for the investment would have been less than 2 years.

### **SMALL LIBRARY SCENARIO - Inkjet vs. Laser**

The library has 4 public PC's, each with an Inkjet printer.

On average, patrons print 125 pages per month per printer at this library. At 14 cents per page, the library spends \$70 per month or \$840 per year on operating costs for printing. This does not account for the cost of the printer, maintenance, and staff support. Assuming patrons only claim 50% of what they print, at 15 cents per page, the library would recover \$37.50 per month or \$450 annually. The library *loses* \$390 per year on direct printing costs.

The library installs a print management system.

Client Modules	4 x \$79	\$316
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Patrons now print 50% less because they are able cancel unwanted jobs

Patrons now print 62 pages per month per printer. At 14 cents per page, the library spends \$34.72 per month or \$416.64 per year. Since the library recovers for all that is printed at 15 cents per page, the revenue for the year is \$446.40, a ‘net’ of 29.76 per year.

If the library had used a networked laser printer, the operating cost would drop to around 5 cents per page. 4 workstations printing 62 pages would send a total of 248 pages to the laser for a total monthly cost of \$14.88 (178.56 annual). If the library only charges 10 cents per page, the recovery is \$24.80 (\$297.60), a net of 119.04. The library offsets the print management cost in 3 years.

If you parallel this to a typical Gates Library scenario where the Foundation provides a 4050 LaserJet and typically 6 workstations, the costs are recovered faster.

## FIRST PHASE INSTALLATION – GREENWICH LIBRARY

The Greenwich Library in Greenwich, CT installed a print management system with the initial concept of providing free print services. The library installed the system to make the patrons aware of the costs incurred on their behalf and to accumulate statistical information about the overall print volume and cost in the absence of a print charge policy.

In February 2001, the patrons printed a total of 60,809 pages. The library set a maximum limit on the number of pages per job of 20 pages. More than 15% of all the print jobs submitted exceeded the maximum page limit and were not printed. In addition, patrons elected to cancel 2,871 pages before submitting to the network. The net result was elimination of more than 17% of their printing costs in an environment where there is no charge for printing. Analyzing these statistics on an annual basis indicates that the library will save almost \$4,000 in print costs, offsetting their investment in print management software in less than three years, and significantly reducing paper waste.

### Summary Information

	Jobs		Pages		
Month	Feb 2001	Mar 2001	Feb 2001	Mar 2001	%Change
<b>Total Printed</b>	<b>23383</b>	<b>22644</b>	<b>60809</b>	<b>59575</b>	<b>-2</b>
Cancelled	943	865	2741	2734	-.26
Too Many Pages	214	205	8064	9766	17
<b>Total Not Printed</b>	<b>1157</b>	<b>1070</b>	<b>10805</b>	<b>12500</b>	<b>13.5</b>

*This report generated with the LPT:One Print Tools Reporting Module from Interface Software, Inc.*

## CONCLUSION

The actual costs to make a copy or a print continue to be elusive. Studies now suggest that it costs at least twice as much to make a copy as it does to make a laser print. That said, the implication is that institutions and companies should more closely evaluate the use of greater numbers of printers over copiers and that laser printers are actually more efficient and less costly at producing quantities of documents. The ability to install an affordable and scaleable print management system is the key to allowing printers to parallel some of the services of copiers.

Most organizations that are not presently using a print management system may be unaware of the extent of the costs and in particular, the amount of waste. If 30-50% of an organization's printing can be eliminated by relatively inexpensive hardware and/or software solutions, then cost recovery systems can pay for themselves in anywhere from nine months to three years. The expansion of the number of vendors entering this market suggests an expanding need as well as expanding choices. Because of increased functionality and decreased costs of some solutions, all organizations regardless of size can take advantage of print management solutions.

**For further information about vendors offering software solutions, visit these web sites:**

LPT:One (server independent), Interface Software, Inc.	<a href="http://www.interfacesw.com">www.interfacesw.com</a>
Print Pilot	<a href="http://www.xcp.com">www.xcp.com</a>
Printer Accounting Server (NT), Software Metrics	<a href="http://www.metrics.com">www.metrics.com</a>
GoPrint NT/NW, Linux, GoPrint Systems	<a href="http://www.goprint.com">www.goprint.com</a>
Qview Pro (NW), Secure Design	<a href="http://www.sdesign.com">www.sdesign.com</a>
Flexicard Print Manager (NT, NW), TDSI Group	<a href="http://fp.tdsiaccess.f9.co.uk">http://fp.tdsiaccess.f9.co.uk</a>
UnipriNT (NT), Pharos/IKON	<a href="http://www.pharos.com">www.pharos.com</a>
Pcounter, A.N.D Technologies	<a href="http://www.pcounter.com">www.pcounter.com</a>
OCS, XCP, Inc.	<a href="http://www.xcp.com">www.xcp.com</a>
Print Queue Manager, ITC Systems	<a href="http://www.itcsystems.com">www.itcsystems.com</a>
Paper Cut, Oscura	<a href="http://www.printcharger.com">www.printcharger.com</a>

**For further information about vendors offering vending devices, visit these web sites:**

Interface Electronics Inc.	<a href="http://www.interface.com">www.interface.com</a>
Jamex Vending	<a href="http://www.jamexvending.com">www.jamexvending.com</a>
XCP, Inc.	<a href="http://www.xcp.com">www.xcp.com</a>
Access Control Technologies	<a href="http://www.actontheweb.com">www.actontheweb.com</a>
Digital Access Control	<a href="http://www.dacinc.com">www.dacinc.com</a>
Debitek, Inc.	<a href="http://www.debitek.com">www.debitek.com</a>
ITC Systems	<a href="http://www.itcsystems.com">www.itcsystems.com</a>
Hecon	<a href="http://www.hecon.com">www.hecon.com</a>

**For further reading:**

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*"Lab Printing Policy"*, Northwestern University, [www.at.nwu.edu/ctg/labs/policy/printing.ssi](http://www.at.nwu.edu/ctg/labs/policy/printing.ssi)

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*"University at Buffalo"*, [www.geog.buffalo.edu/gial/prt\\_cost.html](http://www.geog.buffalo.edu/gial/prt_cost.html)

*"Warren Lab Print Services"*, [www.csu Hayward.edu/ics/itreport001a/sld016.htm](http://www.csu Hayward.edu/ics/itreport001a/sld016.htm)