

# **Personal Computer Replacement Strategy**

**Omer E. Prewett  
November 24, 2001**

**Lake Superior State University Information Technology  
We Do IT...**

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# Personal Computer Replacement Strategy

## Executive Summary

### ***There are large numbers of personal computers on campus that are obsolete.***

Lake Superior State University has approximately 900 personal computers in use on campus. About seventy-five percent of these machines are used in the instructional program and about twenty-five percent are used by the administration.

Many of these machines are old. About forty percent of them will not run current software. Although the remaining sixty percent will run current software, only fifty percent of them meet the minimum requirements to do so. Only about ten percent of the machines on campus are adequate.

There does not seem to be a substantial opportunity to reduce the numbers of computers on campus. If anything, their numbers will probably grow a few percent each year for the next several years.

### ***These personal computers need to be replaced soon.***

About forty-five percent of the machines the University uses are leased. The leases of the first group of these machines, 216 in all, expire on March 1, 2002. Within the next 2 fiscal years, the remaining 194 leased machines must be either purchased by the University or returned to the vendor. Unfortunately, most of our best machines are leased. Of the sixty percent that will run current software, about forty-five percent are leased. The remaining fifteen percent are University-owned. Between leasing and sheer obsolescence, about eighty-five percent of our current personal computer inventory must be replaced within the next 2 fiscal years.

### ***This replacement should be part of a program to replace computers every year.***

Computer processors are increasing in speed every year. For many years, they have doubled in speed every one and one-half years. This fast growth in computer processor speed has allowed increasingly robust computer software to reach the commercial marketplace. About every three years, when processor speed is about four times higher than it was when the original machine was purchased, the original machine will not be fast enough to run the software that is then being sold. Then, if new software is needed, the machine will have to be replaced. This need for replacement is particularly critical when the machines are on a network and need to communicate together. In this circumstance all the machines need to run software that is similar enough in age and functionality that information can be easily shared.

Within an organization such as LSSU, there are a number of uses that are compatible with obsolete personal computers. Probably about ten percent of these machines can be so used. These machines should be replaced on a "needs" basis. The remaining ninety percent should be replaced with a three-year replacement program. This replacement program needs to be

evaluated each year to see that only machines that truly need to be replaced are being replaced. The over-all cost of the replacement program decreases with an increase in the number of obsolete machines that can be utilized.

Either purchasing or leasing is a serviceable method to acquire computers. Purchasing has the advantage of allowing overall costs to drop as machines are used longer. Also, since purchased machines do not have to be replaced on a deadline, a lower level of staffing is required. Staff can do the replacement on a time-available basis throughout the year. Leasing, on the other hand, has capital costs that are essentially the same as purchasing, provided that the machines are returned to the lessor when the lease expires. Leasing has a higher staffing cost since there is a tight window when the machines must be returned to the lessor and replaced by new ones. Leasing cannot easily be set up so that the potential exists for overall costs to drop through the use of obsolete machines.

### ***Recommendations***

- 1) Establish and implement immediately a purchase program to replace 30% of the University personal computers every year. The outline for such a program is given in Appendix I.
- 2) Purchase these machines using a revolving fund that is repaid from operations with a nominal interest rate.
- 3) Provide for permanent Information Technology staff to implement the program.
- 4) Establish a procedure with specific criteria for users to demonstrate need before their machines are replaced.
- 5) Perform a yearly evaluation of the replacement program to see that it is meeting the needs of the campus for a realistic cost.

# Personal Computer Replacement Strategy

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## Introduction

This document outlines the current distribution of personal computers at Lake Superior State University and recommends an upgrade and replacement strategy for these machines. A replacement strategy must be implemented soon because a significant number of the University's personal computers are leased, and these leases expire in the near future.

## Survey of Personal Computers

This discussion in this section concerns the personal computers that are currently in inventory at LSSU. The inventory described here is based upon surveys that were taken by the Help Desk student staff in the early summer of 2001. It is meant to include all personal computers in use at the University. Using old purchase orders and other information, I made minor adjustments to the survey data so that the resulting corpus reflects all current information. The numbers in this document come from this adjusted data. The resulting corpus is the best inventory of personal computers currently available at Lake State University. The data are probably accurate to within 5-10%.

## University-wide Picture

The University has approximately 899 personal computers and laptops in its inventory. (See Table 1.) Most of these machines (664 or about 74%) are used in the academic program. The administration uses 224 or about 25%, and student organizations use the remaining few machines. About 179 or about 20% were purchased through grants; 410 or about 46% were leased; and about 310 or about 35% were purchased with University funds.

<b>Classification</b>	<b>Grant</b>	<b>Leased</b>	<b>University</b>	<b>Totals</b>	<b>Distribution</b>
Academic	179	287	198	<b>664</b>	<b>73.9%</b>
Administrative		119	105	<b>224</b>	<b>24.9%</b>
Student Organizational		4	7	<b>11</b>	<b>1.2%</b>
<b>Totals</b>	<b>179</b>	<b>410</b>	<b>310</b>	<b>899</b>	<b>100.0%</b>
<b>Distribution</b>	<b>19.9%</b>	<b>45.6%</b>	<b>34.5%</b>	<b>100.0%</b>	

Table 1. Classification and ownership of personal computers

Many of these machines are old. Table 2 shows that the 410 leased machines are the youngest. Of the non-leased machines, about 199 (163+36) or about 22% are 4 and 5 years old, so old that they won't run current software. Another 161 machines will run current software, but are too old to run the new generation of software that was released this fall.

Age (Years)	Speed (MHz)	Leased	Grant	University	Totals	Distribution
1	500+	75	16	8	99	11.0%
2	350-450	335	72	33	440	48.9%
3	200-266		56	105	161	17.9%
4	120-166		29	134	163	18.1%
5	50-100		6	30	36	4.0%
<b>Totals</b>		<b>410</b>	<b>179</b>	<b>310</b>	<b>899</b>	<b>100.0%</b>
<b>Distribution</b>		<b>45.6%</b>	<b>19.9%</b>	<b>34.5%</b>	<b>100.0%</b>	

Table 2. Age and speed of University computer inventory.

The need for new machines is widespread and significant. Over the next two fiscal years, the University will need to replace all of the leased machines (410), all of the 4 and 5-year-old machines (199), and most of the 3-year-old machines (161). The total of these numbers, 770, represents about 85.6 % of the University inventory.

## **Operational Picture**

### **Uses**

The uses of computer systems at LSSU are given in Table 3. Two uses predominate. The first is for the academic laboratories. They use the highest number of computers, 472, or 52.5% of the total. The second is for personal use, primarily on desktops, with 338 computers or 37.6%. These two uses account for 90% of the computer use on campus. The remaining uses, accounting for about 10% of the total number of computers on campus, are as dedicated office equipment or in office operations as machines for student workers and other general office uses. Because the major uses of these machines are primarily for personal desktops and academic laboratories, the replacement process will need to be planned to accommodate these uses.

Classification	Type of Computer Use				Totals	Distribution (Per Cent)
	Office Equipment	Office Operations	Personal	Laboratory		
Academic	12	7	173	472	664	73.9%
Administrative	20	39	165		224	24.9%
Student Organizations		11			11	1.2%
<b>Totals</b>	<b>32</b>	<b>57</b>	<b>338</b>	<b>472</b>	<b>899</b>	<b>100.0%</b>
<b>Distribution</b>	<b>3.6%</b>	<b>6.3%</b>	<b>37.6%</b>	<b>52.5%</b>	<b>100.0%</b>	

Table 3. Operational usage

Table 4 below gives the uses of the machines in the University inventory and their speeds. All uses have a mixture of slow and fast machines. In the office equipment category, about 25 (7+17+1) or 78 % of the 32 machines are obsolete. In office operations, about 36 (8+26+2) or 63% of the 57 machines are obsolete. There are 99 (36+54+9) obsolete

machines for personal use. These 99 machines account for 29% of the 338 total personally used machines. In the laboratories about 200 (110+66+24) or 42% of the machines are obsolete. Clearly, from the standpoint of replacement, significant numbers of machines need to be replaced for all uses.

		Type of Computer Use					
Age (Years)	Speed (MHz)	Office Equipment	Office Operations	Personal	Laboratory	Totals	Distribution (Per Cent)
1	500+		2	46	51	<b>99</b>	<b>11.0%</b>
2	350-450	7	19	193	221	<b>440</b>	<b>48.9%</b>
3	200-266	7	8	36	110	<b>161</b>	<b>17.9%</b>
4	120-166	17	26	54	66	<b>163</b>	<b>18.1%</b>
5	50-100	1	2	9	24	<b>36</b>	<b>4.0%</b>
<b>Totals</b>		<b>32</b>	<b>57</b>	<b>338</b>	<b>472</b>	<b>899</b>	<b>100.0%</b>
<b>Distribution</b>		<b>3.6%</b>	<b>6.3%</b>	<b>37.6%</b>	<b>52.5%</b>	<b>100.0%</b>	

Table 4. Speed of operational machines

### Funding of Operational Uses

The sources of funding for the various types of computer uses are given in Table 5 below. All of the machines acquired through grants are used in laboratories. The 179 machines funded through grants account for about 38% of the 472 laboratory machines and they account for 179 or 20% of the total number of 899 University machines. Leased machines are used predominately as desktop machines (212 out of 410 machines or 52%), and secondarily as laboratory machines (172 out of 410 machines or 42%). These two uses account for about 94% of the leased machines. University-purchased machines primarily are used in the same two ways as the leased machines—as personal desktops and as laboratory machines. There are 247 (126+121) machines used in these two ways, about 80% of the 310 University-purchased machines.

		Type of Computer Use					
Ownership	Office Equipment	Office Operations	Personal	Laboratory	Totals	Distribution (Per Cent)	
Grant				179	<b>179</b>	<b>19.9%</b>	
Leased	7	19	212	172	<b>410</b>	<b>45.6%</b>	
University	25	38	126	121	<b>310</b>	<b>34.5%</b>	
<b>Totals</b>	<b>32</b>	<b>57</b>	<b>338</b>	<b>472</b>	<b>899</b>	<b>100.0%</b>	
<b>Distribution</b>	<b>3.6%</b>	<b>6.3%</b>	<b>37.6%</b>	<b>52.5%</b>	<b>100.0%</b>		

Table 5. Funding sources for operational uses

### Funding of Machines of Various Speeds

Table 2, previously discussed, gives information on the funding of different speed machines. It shows that both grant machines and University-purchased machines have a wide distribution of speeds. Of the grant machines, 35 (29+6) out of 179 or about 20% are obsolete machines, and 56 out of 179 or about 31% won't run current software. Hence 91 (56+35) machines or about 51% of the grant machines, all of which are used in laboratories, will have to be replaced in the near future. The 310 University-purchased machines are in a

worse position. There are 164 (134+30) machines that are obsolete, about 53%, and 105 machines or about 34% that are on the borderline. Hence there are about 269 (164+105) machines out of 310 or about 87% that will have to be replaced in the near future.

Clearly, there are widespread needs for replacement computers throughout the academic and administrative users. Between the 410 (75+335, Table 2) leased computers and the 360 (161+163+36, Table 2) obsolete computers, a total of 770 (410+360) machines will need to be replaced in the near future.

## Laboratories

Academic laboratories are the single largest category of use of personal computers on campus. This section presents a summary of the kinds and sources of laboratory personal computers.

Laboratory	Grant	Leased	University	Totals
Dept-Eng	85			85
Dept-GLA	65			65
Dept-OSSAS	5			5
Dept-ISD	24			24
Dept-201SH		30		30
Dept-203SH		25		25
Dept-NatSci		10		10
Dept-CS 302 Tech		10	22	32
Dept-Native Amer			7	7
Dept-Norris Center			38	38
Dept-Nursing			10	10
Dept-303 Tech		25		25
Public-Internet		30		30
Public-Courseware		38	2	40
Public-Lib Main Floor		4	24	28
Public-PD			18	18
<b>Totals</b>	<b>179</b>	<b>172</b>	<b>121</b>	<b>472</b>

Table 6. Funding sources for laboratory machines

Table 6 gives a breakdown of the laboratories at the University. There are 12 departmental laboratories and 4 public laboratories. The 12 departmental laboratories contain a total of 356 computers and the 4 public laboratories a total of 116, making a total of 472 computers in the 16 laboratories. Four of the departmental laboratories, Computer Science-Engineering Tech, Great Lakes Academy, ISD, and OSSAS, have a total of 179 machines entirely furnished by grants.

Four departmental laboratories are composed entirely of leased machines. These laboratories are 201 South Hall, 203 South Hall, 303 Tech, and Natural Science, and they have a total of 90 (30+25+10+25) computers. Of the 32 machines in the Computer Science 302 Tech departmental laboratory, about 1/3 were acquired from leasing and 2/3 from University purchases. There are three departmental laboratories that have machines purchased entirely from University funds. These three laboratories are the Native American Center, the Norris Center, and Nursing. Together, they have 55 (7+38+10) machines.

The public laboratories are composed of leased machines and University purchased machines. They have no grant funding. One of the public laboratories, the Internet Laboratory, has a total of 30 machines, all acquired through leasing. The Courseware public laboratory has a total of 40 machines, 38 provided through leasing with the remaining 2 provided through University purchase. The public laboratory on the main floor of the library has 4 leased machines and 24 University purchased machines. The public PD laboratory is stocked entirely with machines owned by the University.

Table 7 gives the speed of the laboratory machines. Laboratories, especially public ones, tend to need faster machines than do desktops and personal machines because these machines usually run more demanding software than personal machines do.

	Age (Years) and Speed (MHz)					Totals
	1	2	3	4	5	
Laboratory	500+	350-450	200-266	120-166	50-100	
Dept-Eng	16	34	15	15	5	85
Dept-GLA		36	16	13		65
Dept-OSSAS		2	1	1	1	5
Dept-ISD			24			24
Dept-Norris Center			12	24	2	38
Dept-201SH		30				30
Dept-203SH	25					25
Dept-NatSci		10				10
Dept-CS-T302H	10	4		5	13	32
Dept-Native Amer		3		1	3	7
Dept-Nursing		3		7		10
Dept-303 Tech		25				25
Public-Courseware		40				40
Public-Internet		30				30
Public-Lib Main Floor		4	24			28
Public-PD			18			18
<b>Totals</b>	<b>51</b>	<b>221</b>	<b>110</b>	<b>66</b>	<b>24</b>	<b>472</b>

Table 7. Speed of laboratory machines

Only four of the departmental laboratories, 201 South Hall, 203 South Hall, Natural Science, and 303 Tech, and two of the public laboratories, the Courseware and the Internet laboratory, are composed entirely of machines that are currently adequate (350 MHz or faster). All but two laboratories have some machines that are currently adequate and some machines that are obsolete. The two exceptions, the public laboratory on the library main floor and the public PD laboratory, are completely stocked with machines that are too slow for laboratory use. In aggregate, there are 200 (110+66+24) laboratory machines out of 472 or about 42% that need to be replaced.

The adequate laboratory machines are predominately either leased machines or grant machines. Of the 272 (51+221) adequate laboratory machines (Table 7), 172 are leased machines (Table 6) and 88 (16+34+36+2) are grant machines (Table 7, columns 2 and 3). The number of adequate University-purchased laboratory machines is only 12 (272-172-88).

In summary, the replacement process can potentially seriously impact the laboratories. If the leased machines cannot promptly be replaced as the leases expire, or if the grant-funded laboratories cannot be replaced, large numbers of laboratory machines could potentially be affected. Furthermore, if the 200 obsolete machines aren't replaced soon, it may soon be difficult to run the software that is necessary to provide the students with a competitive educational experience.

## **Demand for Personal Computers**

It is hard to estimate the demand for personal computers on campus because we do not have any good longitudinal data or any detailed data on the number of personal computers needed for particular uses. We can, however, make an estimate of the general magnitude of potential needs by looking at the main areas of personal computer use. The result will not be a definitive number, but it can help guide our expectations. In particular, we would like to know if we could reduce the number of personal computers on campus significantly and thereby reduce our costs.

We begin by looking at the ways that these machines are used. There are primarily four ways: as personal staff computers, as departmental laboratory machines, and as public laboratory machines or as machines that support office functioning. Potential growth in each of these areas will be considered in turn below.

### ***Personal Staff Computers***

There are currently 338 machines being used as personal computers by University personnel. These machines are either on the desktops of the staff, or they are laptops being used directly by the staff. The number of these machines that are required is determined by the number of staff and by the job that each staff member does. For instance, office personnel certainly need these machines, but physical plant personnel may or may not need them.

In estimating the potential growth in the number of computers needed by the staff, probably the best measure of the maximum number of personal computers required by the staff would be the total number of employees. Probably not all personnel will need their own machine, but as the campus becomes more and more computerized, increasing numbers of staff will require them. There are 274 administrative staff and 126 faculty members, for a total of 400 people employed by the University. Since there are already 338 machines in use by University personnel, we would expect that staff needs would ultimately grow by no more than about 62 machines. This maximum growth would amount about to 18% of the 338 machines we currently have. Probably a more modest percentage of growth (say 5%-10%) in personal staff computers over the next several years would be reasonable.

### ***Departmental Laboratories***

There are 356 computers in the 12 departmental laboratories. Three of the departmental laboratories, 303 Tech, South Hall 201, and South Hall 203 are used as computer classrooms and are maintained by Information Technology. These laboratories have a public instructional function as well as being departmental laboratories.

It is reasonable that the major departments, particularly in the sciences, have their own departmental laboratories. Even colleges that require students to have their own computers have had to retain some departmental computer laboratories. These laboratories allow the

department to use specialized software and specialized laboratory configurations that are specific to the department. Personal computers are much more reliable if they are used in the controlled conditions of a department laboratory, with the minimum of software, than they are in a more public setting. The Information Technology staff estimates that there are some 28 teaching units on campus that either already have departmental laboratories or have the potential to need one. We currently have 12 departmental laboratories. Many of the remaining 16 (of the estimated 28) potential laboratories would be small. Our estimate is that over the next few years a couple of departments could reasonably be expected to need a new department laboratory of reasonable size, say 30 machines. On the basis of this estimate, it is not unreasonable to expect pressures for a total growth of about 60 machines. This growth would reflect an increase of about 17% of the 356 laboratory machines we currently have. Hence, it would be reasonable to expect the computer needs of departmental laboratories to grow in the 10%-20% range over the next several years.

### ***Public Laboratories***

There are 116 (30+40+28+18, Table 6) computers in the 4 public laboratories used in the University. This is about 1 machine for every 25 students. Two others, the courseware laboratory and the Internet laboratory, are general access laboratories. The laboratory on the main floor of the library is primarily for general access. Finally, the PD laboratory on the third floor of the library is used solely for instruction. When one takes account of the instructional uses of these laboratories, only about 98 (40+30+28) of these machines (out of a total of 116) serve in a truly general access public function. This number means that for effective general access, there is about 1 machine per 30 students.

As the number of personal computers in departmental laboratories increases and the number of machines owned by students increases, the need in the public laboratories will tend to decrease. On the other hand, as instruction and administration on the campus become more computerized, students will probably need more access than they have now—a need that will tend to increase the number of public laboratories. Probably a reasonable ratio would be about 1 public laboratory machine for about every 15 students. If this demand were to materialize, we would need to add about 80 more machines to the 116 we already have, an increase of about 69%.

### ***Office Functions***

There are 89 (32+57, Table 5) machines used in office functions, either as office equipment or as support for office operations. There are 61 department offices and 650 student workers. Most likely each department will need at least one computer for the office and a fraction of one for their student workers. There are about 650 student workers campus-wide. If we assume that on average one computer is needed for every 8 students, then there would need to be about 81 personal computers to accommodate them. It then looks like a total of about 142 machines (61+81) could realistically be needed for office functions. Since we have 89, we would expect that a growth of about 51 more, or about 57%, would be reasonable.

### ***Usage Data***

It is useful to look at usage data to see if it would modify the picture that is outlined above.

We have usage data for the 2000-01 school year on the three classroom laboratories, South Hall 201, South Hall 203, and 303 Tech and on the general access laboratories, the courseware laboratory and the Internet laboratory. During that year, the classroom laboratories were the sites of 82 classes, yielding a total of 153 credit hours. During the fall of that year, South Hall 201 was used 19 hours/week for courses, South Hall 203 was used 11 hours for week for classes, and Tech was used 30 hours/week for classes. During the 2000-01 school year, the two general access laboratories had periods where they were completely full and periods of minimal usage. The average monthly peak usage during this period for the courseware laboratories was in the 70%-80% range, and the average overall usage was in the 30%-40% range, exclusive of vacation periods. The Internet laboratory had average peak usage of about 60%-70%, but an overall average usage in the neighborhood of about 20%-30%.

This sketchy data does not indicate any major changes in the picture that was developed earlier. It is not likely that we could merge any of these laboratories to produce an appreciable reduction in the number of computers required on campus. While one might think that there is excess capacity in these laboratories, a thorough analysis of the programmatic and scheduling restraints that dictate laboratory usage is unlikely to support that view. In any case, the number of machines involved is likely be relatively small in comparison with the total number of machines on campus.

### ***Demand Estimate***

If the estimates above for additional personal computers are added, the total is 253 (62+60+80+51) or about 28% of our 899 total computers on campus. While it will probably take several years to grow to this size, it seems reasonable that there will be pressures to increase the numbers of personal computers a few percent each year. It does not seem likely that we can decrease the number of computers on campus anytime in the near future.

There is an important consideration that might cause the number of computers owned by the University to rise significantly. As classroom instruction increasingly utilizes the computer, the number of computer classrooms may need to be increased beyond those contemplated in this proposal. Currently, a number of laboratories are used both as teaching classrooms and as general access laboratories. These two uses are not entirely compatible. General access typically results in the personal computers of the laboratory becoming unreliable, while classroom use requires reliable personal computers. Because of the possibility of significant changes in the instructional uses of computers, we need to periodically examine the pedagogical and cost effectiveness of the way we provide computerized classroom support.

### **Leased Computers**

About 46% (410 out of 899) of the personal computers (including desktops and laptops) of the University are provided via a series of 5 leases through the Fleet leasing company. The following discussion examines the distribution of leased computers and our corresponding costs and obligations.

## Basic Terms

The basic terms of these leases are given in Table 8. (The figures for P006236 include costs for 125 HP 722C printers that were leased at the same time as the personal computers. None of the other leases involved printers or other equipment.)

PO Number	Contract Number	Type	Term	Purchase Price	Lease Payment	Total Lease Cost	Number of Computers
P006236	1293368	Monthly	36	\$311,167.00	\$ 8,815.36	\$317,352.96	216
P007064	1515689	Yearly	3	\$102,678.00	\$ 33,084.91	\$ 99,254.73	77
P007450	1528146	Yearly	3	\$ 61,650.00	\$ 19,864.86	\$ 59,594.58	42
P008328	1560416	Yearly	3	\$ 35,325.00	\$ 11,382.42	\$ 34,147.26	25
P008910	1584671	Yearly	3	\$ 68,820.00	\$ 22,827.59	\$ 68,482.77	50
<b>Totals</b>				<b>\$579,640.00</b>		<b>\$578,832.30</b>	<b>410</b>

Table 8. Lease contract specifications

## Numbers

A summary of the number of the leased personal computers is given in Table 9 below. (As mentioned above, in addition to the computers given below, the lease from P006236 included 125 HP 722C printers. Since our concern here is personal computers, the numbers and costs of these printers are not included in all of the discussions that follow. They will, however, have to be replaced when the lease expires.)

PO Number	Speed (MHz)					Totals
	550	500	450	400	350	
P006236					216	<b>216</b>
P007064					77	<b>77</b>
P007450			2	40		<b>42</b>
P008328		25				<b>25</b>
P008910	50					<b>50</b>
<b>Totals</b>	<b>50</b>	<b>25</b>	<b>2</b>	<b>40</b>	<b>293</b>	<b>410</b>

Table 9. Leased personal computers and laptops

## Expiration

Table 10 gives the expiration dates of the leases. The expiration date is the date upon which the 410 computers are due back at the leasing company if the University does not purchase them at the expiration of each lease.

PO Number	Number of Computers	Fiscal Year 2001-02	Fiscal Year 2002-03	Fiscal Year 2003-04
P006236	216	01-Mar-02		
P007064	77		01-Jul-02	
P007450	42		01-Sep-02	
P008328	25		01-Mar-03	

P008910	50			01-Aug-03
<b>Total Number of Computers</b>	<b>216</b>	<b>144</b>		<b>50</b>

Table 10. Lease expiration dates

### **Financial Ratios**

Table 12 gives the financial ratios that determine the costs to the University. For a 3 year lease the 3 yearly payments are approximately 1/3 the computer purchase price. The first payment is made at the time the lease was signed, and the lease expires on the date of what would be the fourth payment. The net interest rate to the buyer based on the computer purchase price is approximately zero. (A zero interest rate would occur if the 3 payments were exactly equal to 1/3 of the purchase price.)

<b>PO Number</b>	<b>Payment/Price</b>	<b>Cost/Price</b>	<b>Buyout Cost/Price</b>	<b>Type</b>	<b>Term</b>
P006236	0.028329996	1.01987987	0.278555	Monthly	36
P007064	0.322220047	0.96666014	0.278103	Yearly	3
P007450	0.322219951	0.96665985	Unknown	Yearly	3
P008328	0.322219958	0.96665987	Unknown	Yearly	3
P008910	0.331699942	0.99509983	Unknown	Yearly	3

Table 12. Lease ratios. These ratios define leasing costs as a ratio of the purchase price.

The buyout ratio (also known as the residual ratio) is roughly 27.9% for the two purchase orders for which we have information (which we round to 33%, since it varies with interest rates.). The leasing and subsequent buyout of a computer is expensive. Using the information from P007064, the compound interest rate is 20.89%.

### **Payments**

Table 12 gives the costs of the leasing program. In the current fiscal year, 2001-02, we will pay \$149,211.99 for leased computers, and \$8,470.67 for HP 722C printers, making a total cost of \$157,682.66. In the 2002-03 fiscal year, leasing costs drop to \$22,827.59 as the leases expire.

<b>PO Number</b>	<b>1998-99</b>	<b>1999-00</b>	<b>2000-01</b>	<b>2001-02</b>	<b>2002-03</b>
P006236	\$ 31,026.10	\$ 93,078.31	\$ 93,078.31	\$ 62,052.21	
P007064		\$ 33,084.91	\$ 33,084.91	\$ 33,084.91	
P007450		\$ 19,864.86	\$ 19,864.86	\$ 19,864.86	
P008328		\$ 11,382.42	\$ 11,382.42	\$ 11,382.42	
P008910			\$ 22,827.59	\$ 22,827.59	\$ 22,827.59
<b>Totals for Computers</b>	<b>\$ 31,026.10</b>	<b>\$157,410.50</b>	<b>\$180,238.09</b>	<b>\$149,211.99</b>	<b>\$ 22,827.59</b>
<b>Totals for 125 HP722C Printers</b>	<b>\$ 4,235.33</b>	<b>\$ 12,706.00</b>	<b>\$ 12,706.00</b>	<b>\$ 8,470.67</b>	<b>0</b>
<b>Grand Totals</b>	<b>\$ 35,261.44</b>	<b>\$170,116.51</b>	<b>\$192,944.10</b>	<b>\$157,682.66</b>	<b>\$ 22,827.59</b>

Table 12. Costs of the LSSU computer lease program

### **Buyout Costs**

Buyout costs are given in Table 13. The buyout ratios are taken from Table 12. The purchase orders that do not have buyout ratios are assumed to have a buyout ratio of 27.9%. Property and other taxes are extra.

<b>PO Number</b>	<b>Purchase Price</b>	<b>Buyout Cost/Price</b>	<b>Buyout Cost</b>	<b>Taxes</b>	<b>Total Buyout Cost</b>
P006236	\$ 311,167.00	0.278555149	\$ 86,677.17	\$ 5,541.25	\$ 92,218.42
P007064	\$ 102,678.00	0.278102807	\$ 28,555.04	\$ 1,825.41	\$ 30,380.45
P007450	\$ 61,650.00	0.279	\$ 17,200.35	Unknown	\$ 17,200.35
P008328	\$ 35,325.00	0.279	\$ 9,855.68	Unknown	\$ 9,855.68
P008910	\$ 68,820.00	0.279	\$ 19,200.78	Unknown	\$ 19,200.78
<b>Totals</b>	<b>\$ 579,640.00</b>		<b>\$ 161,489.02</b>	<b>\$ 7,366.66</b>	<b>\$168,855.68</b>

Table 13. Costs (including printers) of purchasing lease computers at the expiration date

Actual buyout costs depend upon interest rates and other financial details. However, on the basis of this table, it appears that buyout costs can be reasonably approximated as about 1/3 of the purchase price.

### **Numbers and Costs**

In order to determine the number of personal computers LSSU should acquire each year and an estimate of their costs, it is first necessary to determine the age distribution of the computers in inventory that will meet our needs, and then determine the cost of maintaining this distribution as time passes.

### **Inventory Age Distribution**

Computers in inventory have a very definite life cycle. They come into inventory as fast new machines, and do their job for a few years, during which time newer technology surpasses them in speed and capacity. Then, when they no longer have the speed and capacity to run the newest software, they become obsolete and are replaced. The distribution of computers of specific ages (or equivalently, of specific speeds) in the University inventory is the major determinate of the overall costs of the computer inventory. This discussion is concerned with determining an appropriate age distribution for LSSU.

<b>Age (Years)</b>	<b>Speed (MHz)</b>	<b>Current LSSU Distribution</b>	<b>Current Number of Computers</b>	<b>Industry Standard Distribution</b>	<b>Industry Standard Number</b>
1	500+	11.0%	99	33.33%	300
2	350-450	48.9%	440	33.33%	300
3	200-266	17.9%	161	33.33%	299
4	120-166	18.1%	163	0%	0
5	50-100	4.0%	36	0%	0
<b>Totals</b>		<b>100.0%</b>	<b>899</b>	<b>100.0%</b>	<b>899</b>

Table 14. Current LSSU and Industry Standard age distributions

Table 14, column 3, shows the distribution of ages of our current personal computing systems and, column 5 shows the distribution that results when computers are replaced every 3 years. This latter distribution represents computer industry standard replacement expectations. Table 15, column 2, is a distribution made by estimating University computing needs using current inventory data. This ideal LSSU distribution reflects the actual situation, where there are, in fact, some uses on campus for obsolete machines. This distribution has about 10% of the machines four years and older. The current distribution with over 20% of our inventory in machines four years and older is too high a percentage. Too many people tell me that they can't use their machine the way that they need to use it.

An age distribution can, of course, be anything we want it to be. Normally, however, we purchase machines when they are new and use them as they age. Also normally, we would like to purchase the same number of machines each year to minimize budgeting problems. These two restrictions limit the kind of distributions we can use. The first restriction means that we will actually attain only distributions that come from purchasing machines and holding them. Since machines last for 3 years, we expect that an actual distribution in any single year will reflect the numbers of machines purchased that year, the previous year, and the year before that. The second restriction means that we want to purchase the same number of machines each year. The consequence of these two expectations is there will always be the same numbers of one-, two-, and three-year-old machines in inventory. Only in the fourth and fifth years will the numbers decline as machines are retired. Hence, ideally, we will want to look at distributions that are equal during the first 3 years and decline during the last 2 years of the computer life cycle. Examples of two such distributions are given in Table 15, columns 4 and 6.

Age (Years)	Ideal LSSU Distribution	Ideal LSSU Computer Numbers	Marginal Distribution	Marginal Distribution Computer Numbers	Target Distribution	Target Distribution Numbers
1	15%	135	25.0%	225	30%	270
2	55%	495	25.0%	225	30%	270
3	20%	180	25.0%	225	30%	270
4	9%	81	20.0%	180	9%	81
5	1%	9	5.0%	45	1%	9
<b>Totals</b>	<b>100.0%</b>	<b>900</b>	<b>100.0%</b>	<b>900</b>	<b>100%</b>	<b>900</b>

Table 15. Ideal, Marginal, and Target age distributions

For financial purposes, two important parameters of the distribution are the number of machines that are purchased each year, and the number of machines that are retired each year. If the inventory is neither growing nor declining, these numbers will be the same. Clearly, the most expensive of the distributions is the Industry Standard distribution (Table 14), which requires the purchase of 33.33% of its inventory each year. The least expensive distribution is the Marginal distribution (Table 15), which requires the purchase of 25% of its inventory every year. The Target distribution (Table 15) is in between, with 30% of its inventory purchased each year. Of course, as the number of obsolete personal computers in inventory increases, the cost decreases.

### ***Evolution of Different Age Distributions***

The number of computers that results for a given age distribution through repeated purchases every year is given in Tables 16, 18, and 20 below. In the first row (year one) of each table is given the number of machines that need to be purchased or leased each year to achieve the given distribution. Many such distributions can be created. The ones given here are representative sample of distributions that purchase the same number of new computers each year. (Please note that these tables are meant to explore possibilities. In actual practice, the number of machines deployed each year would be modified to take into account the specific months that the leases expire as well as other practical matters.)

These distributions are ones we have discussed earlier as the Industry Standard (Table 16), the Target (Table 18), and the Marginal (Table 20) distributions. Note that these tables show a large number of personal computers being purchased in the current fiscal year, and then the purchases taper off after several years. In Table 16, the maximum number is 576 machines, occurring this fiscal year, a number that tapers off to 300 machines in subsequent years. In Table 18, the maximum number is 486 machines in the current fiscal year, which tapers off subsequently to 270 machines per fiscal year. In Table 20, the maximum number is 406 machines, in the current fiscal year. By fiscal year 2003-04 and in the following years, the number of machines purchased each year is down to 225. This pattern of high numbers that drop in subsequent years is caused by the need to replace the leased computers that have expiring leases as well as by the need to replace obsolete computers in inventory. After several years, the number of computers that need to be purchased each year levels off as the large numbers of machines purchased to offset the lease program become obsolete and are removed from inventory. Because computers are in inventory for several years, the effect of abnormally large or small purchases in any single year lasts for several years.

Note that it takes several years before the total number of machines in inventory stabilizes. In the case of the standard distribution (Table 16) and the target distribution (Table 18), the total stabilizes in the 2004-05 fiscal year. The marginal distribution (Table 20) also stabilizes a year later, in the 2005-06 fiscal year.

### ***Costs of Different Age Distributions***

The following discussion concerns the costs of purchasing these personal computers. It is meant to compare the differences in costs of the different distributions in order to understand them.

Tables 17, 19, and 21 give the financial information concerning the distributions illustrated in tables 16, 18, and 20. Note that the effects of the computer leases cause large costs during the current budget year. These yearly costs level out during subsequent years when the machines purchased during the periods surrounding the leases become obsolete and are removed from inventory. A major determinate of total costs is the number of obsolete machines in inventory. When there are no obsolete machines in inventory, as shown in Table 16, both the maximum cost, the sustaining cost, and the average personal computer cost are the highest of any of the distributions (Table 17). As the number of obsolete machines increases to 10% in Table 18 and to 25% in Table 20 costs (and functionality, of course) go down (Tables 19, 21). The following comparison illustrates this pattern. In Table 17, with no obsolete computers, the maximum costs are \$628,196, and these occur in the 2003-04 fiscal year. Sustaining costs are \$480,762. These start in 2004-05. The average personal computer cost is \$534/machine, essentially the purchase price of the machine. The overall lowest costs are given by the distribution in Table 20, which has 25% obsolete computers. The maximum cost (Table 21) is \$480,762, which occurs in 2003-04. The sustaining cost is \$360,572, and the average personal computer cost is \$401/machine. Table 18, with 10% obsolete computers, presents intermediate costs. The maximum cost (Table 19) is \$548,069, occurring in the 2003-04 fiscal year. The sustaining cost is \$432,686, and the average cost is \$481/machine.

Age (Years) Distribution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1 33%	24	576	300	300	300	300	300	300	300	300	300
2 33%	105	24	576	300	300	300	300	300	300	300	300
3 33%	161	105	24	576	300	300	300	300	300	300	300
4 0%	163	0	0	0	0	0	0	0	0	0	0
5 0%	36	0	0	0	0	0	0	0	0	0	0
<b>Leased Computers</b>	<b>410</b>	<b>410</b>	<b>194</b>	<b>50</b>							
<b>Totals 100%</b>	<b>899</b>	<b>899</b>	<b>950</b>	<b>1176</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>

Table 16. Transition to the Industry Standard age distribution. Computers are purchased only in the year one.

Age (Years) Distribution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1 33%	\$0	\$307,688	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254
2 33%	\$0	\$0	\$307,688	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254
3 33%	\$0	\$0	\$0	\$307,688	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254	\$160,254
4 0%											
5 0%											
<b>Leased Computers</b>	<b>\$180,238</b>	<b>\$180,238</b>	<b>\$149,212</b>	<b>\$ 22,828</b>							
<b>Totals 100%</b>	<b>\$180,238</b>	<b>\$456,900</b>	<b>\$490,769</b>	<b>\$628,196</b>	<b>\$480,762</b>	<b>\$480,762</b>	<b>\$480,762</b>	<b>\$480,762</b>	<b>\$480,762</b>	<b>\$480,762</b>	<b>\$480,762</b>
<b>Average Cost/PC</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>\$ 534</b>	<b>\$ 534</b>	<b>\$ 534</b>	<b>\$ 534</b>	<b>\$ 534</b>	<b>\$ 534</b>	<b>\$ 534</b>

Table 17. Cost of the personal computer distribution given in Table 16. Each computer is assumed to cost \$1500 to be paid in installments over 3 years at 7%/year. Payments are \$534.18/year, with a total of \$102.55 paid for interest. These costs do not include the cost of HP 722C printers.

Age (Years) Distribution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1 30%	24	486	270	270	270	270	270	270	270	270	270
2 30%	105	24	486	270	270	270	270	270	270	270	270
3 30%	161	105	24	486	270	270	270	270	270	270	270
4 9%	163	81	81	24	81	81	81	81	81	81	81
5 1%	36	9	9	9	9	9	9	9	9	9	9
<b>Leased Computers</b>	<b>410</b>	<b>194</b>	<b>144</b>	<b>50</b>							
<b>Totals 100%</b>	<b>899</b>	<b>899</b>	<b>920</b>	<b>1059</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>	<b>900</b>

Table 18. Transition to the Target age distribution. Computers are purchased only in year one. The numbers of non-leased machines in the table are the sums of the numbers in columns 4 and 5 of Table 2.

Age (Years) Distribution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1 30%	\$0	\$259,611	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229
2 30%	\$0	\$0	\$259,611	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229
3 30%	\$0	\$0	\$0	\$259,611	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229	\$144,229
4 9%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
5 1%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Leased Computers</b>	<b>\$180,238</b>	<b>\$180,238</b>	<b>\$149,212</b>	<b>\$ 22,828</b>							
<b>Totals 100%</b>	<b>\$180,238</b>	<b>\$408,823</b>	<b>\$426,668</b>	<b>\$548,069</b>	<b>\$432,686</b>	<b>\$432,686</b>	<b>\$432,686</b>	<b>\$432,686</b>	<b>\$432,686</b>	<b>\$432,686</b>	<b>\$432,686</b>
<b>Average Cost/PC</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>\$ 481</b>	<b>\$ 481</b>	<b>\$ 481</b>	<b>\$ 481</b>	<b>\$ 481</b>

Table 19. Cost of the personal computer distribution given in Table 18. Each computer is assumed to cost \$1500 to be paid in installments over 3 years at 7%/year. Payments are \$534.18/year, with a total of \$102.55 paid for interest. These costs do not include the cost of HP 722C printers.

Age (Years) Distribution		2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1	25%	24	406	269	225	225	225	225	225	225	225	225
2	25%	105	24	406	269	225	225	225	225	225	225	225
3	25%	161	105	24	406	269	225	225	225	225	225	225
4	20%	163	161	105	24	180	180	180	180	180	180	180
5	5%	36	45	45	45	24	45	45	45	45	45	45
<b>Leased Computers</b>		410	410	194	50							
<b>Totals</b>		100%	899	935	899	969	923	900	900	900	900	900

Table 20. Transition to the Marginal age distribution. Computers are purchased only in year one.

Age (Years) Distribution		2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1	25%	\$0	\$216,877	\$143,694	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191
2	25%	\$0	\$0	\$216,877	\$143,694	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191
3	25%	\$0	\$0	\$0	\$216,877	\$143,694	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191	\$120,191
4	20%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
5	5%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Leased Computers</b>		\$180,238	\$180,238	\$149,212	\$ 22,828							
<b>Totals</b>		100%	\$180,238	\$366,089	\$383,399	\$480,762	\$384,075	\$360,572	\$360,572	\$360,572	\$360,572	\$360,572
<b>Average Cost/PC</b>			NA	NA	NA	NA	NA	\$ 401	\$ 401	\$ 401	\$ 401	\$ 401

Table 21. Cost of the personal computer distribution given in Table 20. Each computer is assumed to cost \$1500 to be paid in installments over 3 years at 7%/year. Payments are \$534.18/year, with a total of \$102.55 paid for interest. These costs do not include the cost of HP 722C printers.

## ***Recommended Distribution, Numbers, and Costs***

The personal computer age distribution that we recommend for LSSU is the Target distribution given in Table 15. It is a reasonable compromise between the high cost of the Industry Standard distribution, and the lack of functionality of the Marginal distribution. Under this distribution 90% of inventory is current (three years old or younger), and 10% is obsolete (older than three years). Under this distribution, each of the first three years has 30% of inventory, while the fourth year has 9% of inventory and the fifth year has 1%.

In the long run, since the current number of computers on campus is 899, the number of new computers required each year is 270 (30% of 899). The sustaining cost for these new machines each year (Table 19) is around \$144,229 using a three year loan at 7%/year interest with payments of \$534.18 /year on \$1500 computers. Total sustaining yearly payments for the new machines and the previously purchased ones would be about \$432,686. This cost represents the costs of machines only, and is not the total cost of a replacement program. (Such a program is outlined in Appendix I.) Other costs are required to attain the desired personal computer distribution starting from the distribution of machines we currently have on campus.

## **Acquisition Options**

The University has two acquisition options for personal computers—leasing or buying. Each option has its advantages and disadvantages. Both are discussed below.

### ***Leasing***

Leasing personal computers can be done two separate ways: perpetual leasing and leasing to buy. Which is which depends upon what is done at the expiration of the lease. Perpetual leasing involves continually renewing the lease at expiration. Leasing to buy involves purchasing the computer at the expiration of the lease.

There are many ways that leases can be structured. Because computers have a lifetime of about 3 years, computer leases are usually structured to expire in 3 years. Typically they have 3 yearly payments, but sometimes they are structured with 36 monthly payments. On a yearly basis, these payments are typically around 1/3 of the purchase price of the computer. Buying a lease out at expiration involves paying a fee called the residual. For LSSU computer leases the residuals have been in the neighborhood of 33% of the purchase price.

#### **Perpetual Leasing**

Some advantages of perpetual leasing computers are:

- The University inventory of personal computers is kept current
- There are no landfill or other disposal costs
- The lease contract is a fixed, recurring financial obligation that can be easily budgeted.
- The computers are under warranty throughout the term of the lease so hardware repair service is usually simple.

Some disadvantages of perpetual leasing computers are:

- A group of leased computers will not contain any machines that are completely paid for. Consequently, in any single year, the average expenditure per machine in the group will never be lower than 1/3 of the list price of the machines.
- The useful life of a leased machine is actually less than 3 years. In order to prepare to return a group of computers at expiration, some machines must be taken out of service early because of the staff time that is required to replace the machines.
- The need to have the leased machines returned by a specific date reduces staff flexibility. This lack of flexibility is especially onerous with a small staff. The process of meeting the inflexible expiration date may make it impossible for the staff to provide other needed services.
- A completely leased environment is expensive because there is no way to use cheap obsolete machines to lower the overall computer costs. Consequently every computer need must be met by another leased machine, with the consequence that more machines need to be leased than in other environments.
- In a completely leased environment, there is no inventory of obsolete machines that can be put to spur-of-the-moment low-level uses.
- There are no opportunities for cost savings by utilizing the different lifetimes of the various components of a machine. Leased machines are treated as a single unit.
- There are packaging and freight costs for returning the machines to the lessor.

Perpetual leasing is a viable option to provide personal computers to the University. The biggest hurdle is probably developing the staffing necessary to control inventory and to quickly and efficiently replace machines at the end of a lease.

#### **Leasing To Buy**

Leasing to buy is a very expensive proposition. At the end of the lease, it takes approximately 1/3 of the purchase price of a new computer to purchase the obsolete four-year-old machine. For about the same cost, the first payment could be made on a new machine that would last 3 years. The interest paid on the three regular payments and the fourth residual payment are in the neighborhood of 20%/year for the leases of the University. Leasing to buy should never be done unless there is a staffing shortage or other exigency.

### **Buying**

The advantages of buying computers are:

- A group of University owned computers would contain machines that are completely paid for. Consequently, in any single year, the average expenditure per machine in the group can drop significantly lower than 1/3 of the list price of the machines.
- The useful life of a purchased machine is actually more than 3 years. The decision to retire a machine is made by the University personnel on a case-by-case basis so computers can be given appropriate uses as they age.
- The retirement and replacement of University-owned machines could be scheduled at the convenience of the University and the staff. This staff flexibility is especially valuable with a small staff, which has to provide a wide variety of services to the community.

- An environment with significant numbers of University-owned computers means that the use of a machine can be tailored to its age. Consequently, fewer machines may need to be purchased than in environments with lots of leased machines.
- The computers stay in inventory until they have to be removed so there is an inventory of obsolete machines that can be put to spur-of-the-moment low-level uses or for repairs.
- There are many opportunities for cost savings by utilizing the different lifetimes of the various components of a machine.

Some disadvantages of purchasing computers are:

- The University inventory of personal computers must be kept current by University action. Failure to replace computers on a timely basis will quickly result in an inventory that does not adequately perform.
- There are landfill or other disposal costs.
- There is no required, recurring financial obligation that can be easily budgeted.
- The computers are under warranty only for the first 3 years of their life. Hardware repair service must be provided for the older machines.

In summary, purchasing computers is a reasonable way of proceeding. Probably purchasing provides the potential for the cheapest inventory of personal computers. However, adequate staffing and funding must be provided for this alternative to be adequate. If adequate staff and funding is not provided, the flexibility that purchasing computers allows can quickly result in an inventory of machines that do not have the performance that the University needs.

## **Staff Requirements**

A successful replacement strategy needs to be implemented by an appropriate staff. An abbreviated listing of the tasks that need to be done is contained in Table 22. The result of this analysis is that it takes an average of about 5 hours to install a personal computer. At this rate, about 8 personal computers can be installed each week, or about 30 personal computers per month. Information Technology staff indicate that, based on their experiences, this rate is reasonable.

## **Recommendations**

The following are my recommendations.

- 1) Establish and implement immediately a purchase program to replace 30% of the University personal computers every year. The outline of such a program is given in Appendix I.
- 2) Purchase these machines using a revolving fund that is repaid from operations at a nominal interest rate.
- 3) Provide for permanent Information Technology staff to implement the program.
- 4) Establish a procedure with specific criteria for users to demonstrate need before their machines are replaced.

- 5) Perform a yearly evaluation of the replacement program to see that it is meeting the needs of the campus for a realistic cost.

<b>Personal Computer Replacement Project Staffing</b>					
<b>Task</b>	<b>Fixed Effort (Person- Hours)</b>	<b>Variable Effort (Person- Hours/PC)</b>	<b>Total Effort (Man- Hours) 899 PCs</b>	<b>Total Effort (Man- Weeks)</b>	<b>Labor Source</b>
<b>Project Administration</b>					
Project Management	60	0.1	150	3.7	IT
<b>Subtotal Project Administration</b>	<b>60</b>	<b>0.1</b>	<b>150</b>	<b>3.7</b>	
<b>Preparation Phase</b>					
Researching replacement computers	10	0.0	10	0.3	IT
Researching software for new computers	40	0.0	40	1.0	IT
Testing of software	40	0.0	40	1.0	IT
Preparation of Software for new computers	40	0.0	40	1.0	IT
Training IT staff	120	0.0	120	3.0	IT
<b>Subtotal Preparation Phase</b>	<b>250</b>	<b>0</b>	<b>250</b>	<b>6.25</b>	
<b>Pilot Phase</b>					
Pilot Project for new software	40	0.0	40	1.0	IT
<b>Subtotal Pilot Phase</b>	<b>40</b>	<b>0</b>	<b>40</b>	<b>1</b>	
<b>Rollout Phase</b>					
Receive computers for rollout	10	0.1	100	2.5	IT, PP
Installing Software on new computers	20	0.3	290	2.7	IT
Training users in classes	10	0.1	100	2.5	IT, Users
Installing new computers on desktops	0	0.5	450	11.2	IT
Moving user files and training	0	3.0	2697	67.4	IT, Users
Follow-up after installation	0	0.2	180	4.5	IT
<b>Subtotal Rollout Phase</b>	<b>40</b>	<b>4.2</b>	<b>3816</b>	<b>90.9</b>	
<b>Leasing</b>					
Inventory of retiring computers	15	0.1	105	2.6	IT
Return of leased computers	30	0.1	120	3.0	IT, PP
<b>Subtotal Leasing</b>	<b>45</b>	<b>0.2</b>	<b>225</b>	<b>5.6</b>	
<b>Totals</b>	<b>435</b>	<b>4.5</b>	<b>4481</b>	<b>112.0</b>	
<b>Average Hours/PC (899 PCs)</b>	<b>.5</b>		<b>5.0</b>		

Table 22. Staffing needs for personal computer replacement. PP refers to the Physical Plant staff.

# **Appendix I - Proposed Implementation Plan and Budget**

## ***Introduction***

This appendix contains an outline of a proposed plan to implement a personal computer replacement program at Lake Superior State University. The goal of this program is to replace the entire University personal computer inventory at appropriate intervals by the yearly purchase and installation of new machines and the retirement of obsolete ones.

## ***Review***

The results of the previous sections of this document are summarized here.

Currently, the University has about 899 computers that are in use, and this number is expected to increase by a few percentage points each year. The current inventory contains 410 machines that are leased; 216 of these will expire on March 1, 2002, and the others during the next two fiscal years. Of the non-leased machines, 196 are currently obsolete and 161 will become obsolete next year.

These machines become obsolete very quickly. About 3 years is their normal functional life. Considerations given earlier indicate that the purchase of about 30% (currently 270 machines) of our inventory each year is sufficient to provide the computing power that the University needs. This rate will ensure that 90% (810 machines) of our inventory is replaced every 3 years. The remaining 10% of inventory, composed entirely of obsolete machines, will be used in tasks that do not require machines meeting current standards. Our target is that no more than 9% of our inventory (81 machines) will be 4 years old, and that no more than 1% (9 machines) will be 5 years old or older.

The considerations given earlier also indicate that a single staff member can install about 8 personal computers per week, or about 30 machines per month. The installation of 270 personal computers each year will require a staff of about 1 full-time person.

## ***Plan and Budget***

This computer replacement plan envisions that the same number of machines will be purchased every year. As time passes, these machines will age and finally become obsolete and be replaced. Ultimately, we can maintain the age distribution we desire (30%, 30%, 30%, 9%, 1% for 1- to 5-year-old machines, respectively) if we purchase 270 (30% times 899) machines each year, remove all but 80 (9% times 899) machines the fourth year, and remove all but 9 (1% times 899) machines the fifth year. Our goal is to develop a replacement program to purchase enough new machines each year to provide relief to users with obsolete machines and at the same time move toward the desired overall distribution of machines.

There are some limits on the number of machines that should be purchased. Purchasing too many machines will ultimately result in discarding machines that are not obsolete. Purchasing too few machines will result in too many obsolete machines. The determination of a reasonable number of machines to purchase is most easily done by modeling several scenarios using a spreadsheet.

Below we look at four scenarios. All of these scenarios involve the purchase of the 216 leased machines whose leases expire on March 1, 2002. This purchase is required because by the time we order the replacement personal computers and have them delivered, there will not be enough time remaining to install replacement machines. It will take until about the end of February 2002 for new machines to arrive and for facilities to process these machines to be ready. In order to replace these machines in the remaining month, it will take about 7 full-time people, since each person can only install about 30 machines per month. This required number of staff is too large to make replacement a reasonable alternative.

The first scenario involves the hiring of one full-time staff member and the purchase of all of the leased machines. The purchase of all of the lease machines allows every new machine to be used to retire an obsolete computer. Since the leased machines are among the youngest machines in inventory, not purchasing the leased machines would require the use of new machines to replace machines that are not yet obsolete, while users with truly obsolete machines would have to wait. This scenario is an attempt to give those users with real needs to access to the newest computers.

The timeline and costs of this model are given in Table 27. The first year cost is \$448,604 (Table 27 and Table 23), rising each year thereafter to \$594,600 in the fourth year, and dropping to a constant \$546,540 per year thereafter. The total five year cost is \$2,618,988. The number of computers purchased the first year is 120 (See Table 31 and Table 24). This number is the number of machines that a single full-time person can install from February through June at the rate of 30 machines per month. This number rises to 360 the next year, and falls to 270 for succeeding years. The effectiveness of reducing the number of obsolete computers is given in Table 31 and Table 25. By the end of the first year, there are 240 obsolete computers in inventory, but by the end of the third year this number has been reduced to 99, 10 more than our target number of 89. Table 26 shows the number of excess machines that were purchased above those absolutely necessary. In this case there is one machine, a negligible number.

The remaining three scenarios involve the return of all the leased machines except those 216 whose leases expire March 1, 2002. The benefit in these remaining scenarios is that the leased machines, which are a year from obsolescence, will be replaced by new machines that have three-year life ahead of them. The problem, however, is that since the lease machines being returned are not yet obsolete, additional machines above the number of machines required for lease replacements must be provided to help those users with truly obsolete machines. The number of machines that can be replaced is limited to about 30 computers per month per staff member. Hence the remaining scenarios below explore the changes in the number of obsolete machines resulting from changes in the number of auxiliary staff members.

The second scenario involves the hiring of one full-time person, but no other staff members. The initial 120 machines (Table 28 and Table 24) go to reducing the number of obsolete computers the first year because the 216 leased machines are assumed to already have been purchased. The next year 360 machines are purchased, most of which go to replacing leased machines. As a result, there are 345 obsolete machines remaining at the end fiscal year 2002-03 (Table 32 and Table 25). In order to reduce the number of obsolete machines, during the third year 360 new machines are purchased. The result is that the number of obsolete machines decreases to 59 at the end of 2003-04. Unfortunately, this purchase of 360 machines results in an oversupply of machines during the fourth year (2004-05). Table 26 shows an oversupply of 91 machines that year. Over a five-year period the cost is \$2,677,572 (Table 23). This scenario results in the purchase of 1380 machines (Table 24) over the five years, which are 90 more than were purchased under the previous scenario.

The third scenario involves the hiring of one full-time person and one extra staff member only during the spring of 2002. Having these two staff allows the installation of 240 machines during the first year (Table 29 and Table 24). As a result, the number of obsolete machines drops to 120 by the end of that year (Table 33 and Table 25). During the following year (2002-03), the number of obsolete machines drops to 225 and then to 29, the year following that (Table 25). Costs, of course, go up. More computers are purchased (1410 from Table 24) than in previous scenarios, and staff costs are higher, so the resulting total five-year costs are higher (\$2,756,632 from Table 23). However, only 1 extra machine is purchased (Table 26), a result that is the same as the first scenario.

The last scenario involves the hiring of one full-time person and two extra staff members only during the spring of 2002. These three staff members allow the installation of 360 machines during the first year (Table 30 and Table 24). The result is that the number of obsolete computers drops to 0 by the end of that year (Table 34 and 24). In subsequent years 270 machines are added each year with the number of obsolete computers rising to 195 by the end of the second year, dropping to 0 the next year, and then stabilizing to 89 thereafter (Table 25). The five-year cost is \$2,835,692 (Table 30 and 23). The cost of this scenario is the highest of all of the scenarios. It also results in the installation of the most personal computers (Table 24).

The consequences of the four above scenarios (Tables 23-26) are reasonably clear. The first scenario is the cheapest and requires the least staff. The last scenario is the most expensive and requires the most staff. The other scenarios are in between. However, it is not a reasonable possibility to hire extra staff for the spring semester of 2002. This means that for our replacement program the first two scenarios are the only realistic possibilities. Both alternatives require only one full-time staff member. However, the second alternative is the more costly of the two. It involves a high number of obsolete machines at the end of the second year, and the compensating purchase of a large number of machines the third year. This purchase results in extra machines at the end of the fourth year. This alternative is the least desirable of the two because it leaves the users with the most numbers of obsolete machines.

This analysis indicates that the first scenario, the hiring of one full-time staff member and the purchase of all of the leased computers, is the best one. This scenario is the cheapest of the alternatives, requiring the minimum staff, and having only 10 more obsolete machines at the end of 3 years than the target number. The cost of this plan is 448,604 this fiscal year, \$488,044 next fiscal year, \$594,600 the fiscal year after that, \$546,540 each subsequent fiscal year.

## ***Recommendations***

We recommend the first scenario for our replacement plan. A summary of the requirements of the replacement plan is given below.

- 1) Hire one full-time staff person to run the replacement program starting this year.
- 2) Purchase of all leased machines as their leases expire.
- 3) Purchase 120 new computers this fiscal year, 360 new computers next fiscal year, and 270 new machines each fiscal year after that.
- 4) Investigate the creation of a revolving fund to finance this program.

A detailed timeline and budget for this scenario is given in Table 27.

Scenario	Yearly Costs					Totals
	2001-02	2002-03	2003-04	2004-05	2005-06	
One FTE Staff, Purchase All Lease Machines	\$ 448,604	\$ 488,044	\$ 541,200	\$ 594,600	\$ 546,540	\$ 2,618,988
One FTE Staff, Purchase 216 Lease Machines	\$ 448,604	\$ 411,148	\$ 580,560	\$ 642,660	\$ 594,600	\$ 2,677,572
Two FTE Staff, Purchase 216 Lease Machines	\$ 561,684	\$ 475,228	\$ 578,580	\$ 594,600	\$ 546,540	\$ 2,756,632
Three FTE Staff, Purchase 216 Lease Machines	\$ 674,764	\$ 473,248	\$ 594,600	\$ 546,540	\$ 546,540	\$ 2,835,692

Table 23. Yearly costs of each scenario.

Scenario	Number of New Personal Computers Purchased					Totals
	2001-02	2002-03	2003-04	2004-05	2005-06	
One FTE Staff, Purchase All Lease Machines	120	360	270	270	270	1290
One FTE Staff, Purchase 216 Lease Machines	120	360	360	270	270	1380
Two FTE Staff, Purchase 216 Lease Machines	240	360	270	270	270	1410
Three FTE Staff, Purchase 216 Lease Machines	360	270	270	270	270	1440

Table 24. Number of new personal computers purchased

Scenario	Number of Obsolete Computers Remaining At End of Period					Totals
	2001-02	2002-03	2003-04	2004-05	2005-06	
One FTE Staff, Purchase All Lease Machines	240	201	99	0	89	629
One FTE Staff, Purchase 216 Lease Machines	240	345	59	0	0	644
Two FTE Staff, Purchase 216 Lease Machines	120	225	29	0	89	463
Three FTE Staff, Purchase 216 Lease Machines	0	195	0	89	89	373

Table 25. Number of obsolete computers remaining

Scenario	Number of Non-Obsolete Computers Available for Early Retirement					Totals
	2001-02	2002-03	2003-04	2004-05	2005-06	
One FTE Staff, Purchase All Lease Machines	0	0	0	1	0	1
One FTE Staff, Purchase 216 Lease Machines	0	0	0	91	1	92
Two FTE Staff, Purchase 216 Lease Machines	0	0	0	1	0	1
Three FTE Staff, Purchase 216 Lease Machines	0	0	1	0	0	1

Table 26. Number of non-obsolete computers available for early retirement.

Date	Action	Num PCs Purchased	Lease Payment	PCs Installed
<b>2001-02</b>				
July 1, 2001	Lease Payment-PO 06236-\$8,815, PO 07064-\$33,085		\$ 41,900	
August 1, 2001	Lease Payment-PO 06236-\$8,815, PO 08910-\$22828		\$ 31,643	
September 1, 2001	Lease Payment-PO 06236-\$8,815, PO 07064-\$19865		\$ 28,680	
October 1, 2001	Lease Payment-PO 06236-\$8,815		\$ 8,815	
November 1, 2001	Lease Payment-PO 06236-\$8,815		\$ 8,815	
December 1, 2001	Start Preparation Phase		\$ 15,000	
December 1, 2001	New Staff Member to install PCs (Including Fringes)		\$ 25,000	
December 1, 2001	Purchase 60 PCs @ \$534/year for 3 years -Year 1	60	\$ 32,040	
December 1, 2001	Purchase Software for 60 PCs @ \$200/ PC		\$ 12,000	
December 1, 2001	Lease Payment-PO 06236-\$8,815		\$ 8,815	
January 1, 2002	Lease Payment-PO 06236-\$8,815		\$ 8,815	
February 1, 2002	End Preparation Phase			
February 1, 2001	Receive Personal Computers From December 1, 2001			
February 1, 2001	Start Installing Personal Computers			
February 1, 2002	Lease Payment-PO 06236-\$8,815		\$ 8,815	
March 1, 2002	Finish Installing 30 new PCs For Pilot			30
March 1, 2002	Purchase Leased PCs-PO 06236	216	\$ 115,344	
March 1, 2002	Purchase Leased HP722C Printers-PO 06236	125	\$ 37,500	
March 1, 2002	Lease Payment-PO 08328-\$11,382		\$ 11,382	
March 1, 2002	Purchase 60 PCs @ \$534/year for 3 years -Year 1	60	\$ 32,040	
March 1, 2002	Purchase Software for 60 PCs @ \$200/ PC		\$ 12,000	
April 1, 2002	Finish Installing 30 new PCs For General Use			30
May 1, 2002	Finish Installing 30 new PCs For General Use			30
June 1, 2002	Finish Installing 30 new PCs For General Use			30
June 1, 2002	Reserve for contingencies		\$ 10,000	
<b>Total 2001-02</b>		<b>120</b>	<b>\$ 448,604</b>	<b>120</b>
<b>2002-03</b>				
July 1, 2002	Finish Installing 30 new PCs For General Use			30
July 1, 2002	Help Desk Staff Member to install PCs (Including Fringes)		\$ 50,000	
July 1, 2002	Purchase 120 PCs @ \$534/year for 3 years -Year 1	120	\$ 64,080	
July 1, 2002	Purchase Software for 120 PCs @ \$200/ PC		\$ 24,000	
July 1, 2002	Purchase Leased Personal Computers-PO 07064	77	\$ 41,118	
August 1, 2002	Finish Installing 30 new PCs For General Use			30
August 1, 2002	Lease Payment-PO 08910-\$22,828		\$ 22,828	
September 1, 2002	Finish Installing 30 new PCs--For General Use			30
September 1, 2002	Purchase Leased Personal Computers-PO 07450	42	\$ 22,428	
October 1, 2002	Finish Installing 30 new PCs--For General Use			30
October 1, 2002	Purchase 120 PCs @ \$534/year for 3 years -Year 1	120	\$ 64,080	
October 1, 2002	Purchase Software for 120 PCs @ \$200/ PC		\$ 24,000	
November 1, 2002	Finish Installing 30 new PCs--For General Use			30
December 1, 2002	Finish Installing 30new PCs--For General Use			30
December 1, 2002	Payment for 60 PCs purchased December 1, 2001 -Year 2		\$ 32,040	
January 1, 2003	Finish Installing 30 new PCs--For General Use			30
February 1, 2003	Finish Installing 30 new PCs For General Use			30
March 1, 2003	Finish Installing 30 new PCs--For General Use			30
March 1, 2003	Purchase 120 PCs @ \$534/year for 3 years - Year 1	120	\$ 64,080	
March 1, 2003	Purchase Software for 120 PCs @ \$200/ PC		\$ 24,000	
March 1, 2003	Purchase Leased Personal Computers-PO 08328	25	\$ 13,350	
March 1, 2003	Payment for 60 PCs purchased March 1, 2002 -Year 2		\$ 32,040	
April 1, 2003	Finish Installing 30 new PCs--For General Use			30
May 1, 2003	Finish Installing 30 new PCs--For General Use			30
June 1, 2003	Finish Installing 30 new PCs For General Use			30
June 1, 2003	Reserve for Contingencies		\$ 10,000	
<b>Total 2002-03</b>		<b>360</b>	<b>\$488,044</b>	<b>360</b>
<b>2003-04</b>				
July 1, 2003	Finish Installing 30 new PCs For General Use			30
July 1, 2003	Help Desk Staff Member to install PCs (Including Fringes)		\$ 50,000	
July 1, 2003	Payment for 120 PCs purchased July 1, 2002 - Year 2		\$ 64,080	
July 1, 2003	Purchase 135 PCs @ \$534/year for 3 years - Year 1	135	\$ 72,090	
July 1, 2003	Purchase Software for 135PCs @ \$200/ PC		\$ 27,000	
August 1, 2003	Finish Installing 30 new PCs--For General Use			30
August 1, 2003	Purchase Leased Personal Computers-PO 08910	50	\$ 26,700	
September 1, 2003	Finish Installing 30 new PCs--For General Use			30
October 1, 2002	Payment for 120 PCs purchased October 1, 2002 - Year 2		\$ 64,080	
October 1, 2003	Finish Installing 30 new PCs--For General Use			30
November 1, 2003	Finish Installing 30 new PCs--For General Use			30
December 1, 2002	Payment for 60 PCs purchased December 1, 2001-Year 3		\$ 32,040	
December 1, 2003	Finish Installing 30 new PCs--For General Use			30
January 1, 2004	Finish Installing 30 new PCs--For General Use			30
January 1, 2004	Purchase 135 PCs @ \$534/year for 3 years -Year 1	135	\$ 72,090	

Table 27. One full time staff member assigned to the project. Includes the purchase all leased machines.

Date	Action	Num PCs Purchased	Lease Payment	PCs Installed
January 1, 2004	Purchase Software for 135PCs @ \$200/ PC		\$ 27,000	
February 1, 2004	Finish Installing 30 new PCs--For General Use			30
March 1, 2004	Payment for 120 PCs purchased March 1, 2002 - Year 2		\$ 64,080	
March 1, 2004	Payment for 60 PCs purchased March 1, 2002 -Year 3		\$ 32,040	
March 1, 2004	Finish Installing 30 new PCs--For General Use			30
April 1, 2004	Finish Installing 30 new PCs--For General Use			30
May 1, 2004	Finish Installing 30 new PCs--For General Use			30
June 1, 2004	Finish Installing 30 new PCs--For General Use			30
June 1, 2004	Reserve for Contingencies		\$ 10,000	
<b>Total 2003-04</b>		<b>270</b>	<b>\$ 541,200</b>	<b>360</b>
<b>2004-05</b>				
July 1, 2004	Finish Installing 30 new PCs--For General Use			30
July 1, 2004	Help Desk Staff Member to install PCs (Including Fringes)		\$ 50,000	
July 1, 2004	Payment for 120 PCs purchased July 1, 2002 - Year 3		\$ 64,080	
July 1, 2004	Payment for 135 PCs purchased July 1, 2003 -Year 2		\$ 72,090	
July 1, 2004	Purchase 135 PCs @ \$534/year for 3 years -Year 1	135	\$ 72,090	
July 1, 2004	Purchase Software for 135 PCs @ \$200/ PC		\$ 27,000	
August 1, 2004	Finish Installing 30 new PCs--For General Use			30
September 1, 2004	Finish Installing 30 new PCs--For General Use			30
October 1, 2004	Payment for 120 PCs purchased October 1, 2002 - Year 3		\$ 64,080	
October 1, 2004	Finish Installing 30 new PCs--For General Use			30
November 1, 2004	Finish Installing 15 new PCs--For General Use			15
December 1, 2004				
January 1, 2005	Payment for 135 PCs purchased January 1, 2004 -Year 2		\$ 72,090	
January 1, 2005	Purchase 135 PCs @ \$534/year for 3 years -Year 1	135	\$ 72,090	
January 1, 2005	Purchase Software for 135 PCs @ \$200/ PC		\$ 27,000	
February 1, 2005	Finish Installing 30 new PCs--For General Use			30
March 1, 2005	Payment for 120 PCs purchased March 1, 2002 - Year 3		\$ 64,080	
March 1, 2005	Finish Installing 30 new PCs--For General Use			30
April 1, 2005	Finish Installing 30 new PCs--For General Use			30
May 1, 2005	Finish Installing 30 new PCs--For General Use			30
June 1, 2005	Finish Installing 15 new PCs--For General Use			15
June 1, 2005	Reserve for Contingencies		\$10,000	
<b>Total 2004-05</b>		<b>270</b>	<b>\$ 594,600</b>	<b>270</b>
<b>2005-06</b>				
July 1, 2005	Finish Installing 30 new PCs--For General Use			30
July 1, 2005	Help Desk Staff Member to install PCs (Including Fringes)		\$ 50,000	
July 1, 2005	Payment for 135 PCs purchased July 1, 2003 -Year 3		\$ 72,090	
July 1, 2005	Payment for 135 PCs purchased July 1, 2004 -Year 2		\$ 72,090	
July 1, 2005	Purchase 135 PCs @ \$534/year for 3 years -Year 1	135	\$ 72,090	
July 1, 2005	Purchase Software for 135 PCs @ \$200/ PC		\$ 27,000	
August 1, 2005	Finish Installing 30 new PCs--For General Use			30
September 1, 2005	Finish Installing 30 new PCs--For General Use			30
October 1, 2005	Finish Installing 30 new PCs--For General Use			30
November 1, 2005	Finish Installing 15 new PCs--For General Use			15
December 1, 2005				
January 1, 2006	Payment for 135 PCs purchased January 1, 2004 -Year 3		\$ 72,090	
January 1, 2006	Payment for 135 PCs purchased January 1, 2004 -Year 2		\$ 72,090	
January 1, 2006	Purchase 135 PCs @ \$534/year for 3 years -Year 1	135	\$ 72,090	
January 1, 2006	Purchase Software for 135 PCs @ \$200/ PC		\$ 27,000	
February 1, 2006	Finish Installing 30 new PCs--For General Use			30
March 1, 2006	Finish Installing 30 new PCs--For General Use			30
April 1, 2006	Finish Installing 30 new PCs--For General Use			30
May 1, 2006	Finish Installing 30 new PCs--For General Use			30
June 1, 2006	Finish Installing 15 new PCs--For General Use			15
June 1, 2006	Reserve for Contingencies		\$ 10,000	
<b>Total 2005-06</b>		<b>270</b>	<b>\$ 546,540</b>	<b>270</b>
<b>Total Cost</b>			<b>\$ 2,618,988</b>	
<b>Total Number of PCs Purchased.</b>			<b>1290</b>	

Table 27 cont. One full time staff member assigned to the project. Includes the purchase all leased machines.