Title
Sixth Annual UCLA Survey of Business School Computer Usage

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September 1989
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The authors wish to thank those individuals who took the time and care to complete the questionnaire. Without their efforts this survey would have been impossible. Thanks are also extended to the fifteen Business School Computing Center directors from around the country who reviewed the draft questionnaire, Research Assistants Su-Tsen Christine Kuo and Victoria Nomura for their assistance with data entry and SAS data analyses, and Steve Bandler for his assistance in preparing the final document.

Apple Computer, Incorporated, Digital Equipment Corporation, and International Business Machines sponsored this year's survey project. Their commitment has made this research possible.

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Los Angeles, CA 90024-1481
Executive Summary

The 1989 Sixth Annual UCLA Survey of Business School Computer Usage extends the focus of the 1987 Fourth Survey, providing the most comprehensive picture to date of the business school computing, communication, and information environment. This year, 163 schools completed the twelve page questionnaire regarding hardware, software, and resource commitments. The sample is demographically similar to samples from previous surveys.

Two words best describe the results of the Sixth survey: diversity and maturing.

Diversity: Microcomputers have become ubiquitous throughout our schools. However, this year's data indicate that there is both significant variation across all schools and within a given school. Business schools are supporting a larger variety of microcomputers, with almost every school reporting a multivendor environment with several generations of microprocessor technology. In 1987, 50% of the schools reported one or two different microcomputer models, now only 7% do; that is, 93% of the schools support between three and 14 different microcomputer models.

The list of software packages being used is extensive, with as many as 60 different packages being supported within a school. Not only were more types of software reported, but more packages appeared within each category. And, within a particular software application area, some schools are supporting multiple versions of the same software.

Maturing: The rates of growth in a number of categories have showed a decrease. For example, even though the average number of microcomputers per business school has increased between the Fourth and Sixth Surveys, it was at a slower rate than experienced between the Second and Fourth Surveys (46% vs. 63%). Microcomputer densities have also decreased slightly. The student per microcomputer ratio decreased from 37 to 29 over two years, while the faculty per microcomputer ratio decreased from 1.8 to 1.3. However, in the top quartile of schools there appears to be a leveling off at approximately one student for every ten microcomputers with faculty members having about 1.2 microcomputers available.

Another indication that maturing has occurred is the slight decrease in the number of schools which owned or supported their own mini/mainframe systems. Some of these schools indicated shifting the responsibility to the campus. Others simply did not report systems which were listed previously. It is assumed that the schools are phasing out some of their older systems and replacing them with microcomputers, in particular the high-end workstations which can support multiple users.

The use of computers in the core curriculum, both at the undergraduate and graduate levels, appears to be only about ten percent higher in 1989 than in 1985. This very slow growth may reflect the difficulty of introducing additional meaningful assignments and creating software or courseware which extends students' understanding of concepts. The barriers to introducing courseware and the overall start-up costs may be higher than our schools and faculty can afford.

Growth areas: An area of significant growth and change over the past couple of years has been the availability of data in an online format. Punched cards have all but disappeared and magnetic tape is now usually reserved for backup and storage. This shift is a direct result of the significant decrease in the cost of random access storage, both discs and CD-ROM devices.

Another area of important growth has been the connectivity of systems. There is a convergence of local and wide area networks toward single transparent communications links.
The availability of extensive electronic mail capabilities provides the basis for individuals to want to communicate electronically.

**Open Questions:** Once again the survey has provided data and information regarding what is happening in our business schools, but serious questions still remain.

Perhaps an important question is one of cost benefit. Has the tremendous investment, both human and capital, been worth it? To answer this question requires that some set of goals be identified against which the benefits can be measured. However, it is not clear that schools have established these goals, other than that of curriculum integration (which in and of itself is unclear).

We can also ask whether the massive introduction of microcomputer technology has made any difference. Have our institutions produced better students and higher quality research? It may well be that the computer is simply the typewriter and calculator of the 21st century and that our expectations for significant curriculum revision or change in the nature of instruction simply won't happen. The rhetoric and expectations of the eighties may have been unrealistic. Or, it may simply be too soon to see the long term benefits of the technology.

Clearly our schools, as well as the corporate community, believe that the investment in technology is important. There is no indication that any institution will discard the technology and return to a previous state. Thus, the real question may be how to most effectively manage these resources.

The extensive diversity of hardware and software described in this year's survey leads to several pressing issues which may become the focus of our energies and attention. Coping with the vast diversity is an increasing challenge. Some academics will want the fastest processors and latest software versions with the most advanced features. Others will be reluctant to give up their well-known software and systems which adequately meet their needs. Thus, older viable generations of hardware and software will continue to be used (frequently filtering down into the administrative offices). Support and training thus become exacerbated by problems such as different key boards, monitors, disk drives, and memory capabilities, all which constrict software options and are frequently selected based on the lowest common denominator.

Providing hardware and software is only one part of the equation for successful implementation of technology into a business school. Financial support for training, on-going consulting, and equipment maintenance is essential for a school to maximize its return on the computer investment. Additional staff are required to support the growing diversity of hardware and software inventories. Another challenge is leadership, finding individuals with the vision and management skills to integrate the constantly developing computer, communication, and information technologies, and to maintain an appropriate balance between large and small systems.

How are business schools going to pay for the high cost of technology? Or, is it a high cost? For the past six surveys, schools have allocated approximately 3.5% of their total operating budget to support computer operations. This translates into a median allocation of about $80 per student. But is this a sufficient allocation? The schools in the top quartile are spending six times this amount per student, an allocation of approximately 11% of their total school's operating budget.

What are our goals and how do we measure them? What are the benefits of the investment in information technology and are we achieving them? What technological opportunities will become incorporated into our business schools? These questions will be the focus of future UCLA Surveys of Business School Computer Usage.
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1. Introduction

The goal of this, the Sixth Annual UCLA Survey of Business School Computer Usage, is to monitor the changing nature of the business school computing environment. The purpose over the past six years has remained the same — to provide deans and other policy makers with information they can use in making allocation decisions and program plans with regards to computing. The reader is cautioned that this survey reflects what the schools report they are doing, and is not an endorsement of what they should be doing.

The First, Second, and Fourth Surveys gathered information on the hardware, software, and other computer resources of the schools, while the Third Survey addressed issues of concern to the deans. Last year’s survey, the Fifth, focused on business school computerization in terms of process, recognizing that the introduction and use of technology is ongoing and that the schools may not only be approaching computerization differently, but also at different rates.\(^1\)

This survey, the Sixth, returns to the specific focus of hardware, software, and other computer resources, allowing an update on the specifics of the business school computer environment. However, more emphasis has been given to microcomputer labs and databases, reflecting the increasing development in these areas. Additionally, the section dealing with instruction has been expanded to include specific information regarding both entrance and graduation requirements and expectations.

For several categories of the data (budget expenditures, staff support, and student and faculty microcomputer densities), the data are divided into quartiles to give a more detailed picture of the distribution across the schools. For each quartile, the median value for the variable is reported rather than the mean, to avoid the skewing problems that occur when there are extremely high or low values in the distribution. The sample size ('N' value) varies across many of the tables and figures in this report because of missing data. Additionally, throughout this report, where appropriate and available, comparable data from the Second (1985), Fourth (1987), and Fifth (1988) Surveys are also included. However, it should be pointed out that these surveys do not comprise a longitudinal study, as the same sample of schools are not being followed over a period of time. Rather, the survey samples comprise the accredited business schools which wish to add their data to the sample. Comparisons between years are therefore somewhat misleading and should not be used to conduct any trend analyses.

This report is divided into eleven sections: Introduction, Profile of Surveyed Schools, Support Resources, Mini/Mainframes, Microcomputers, Computer Labs, Communications, Software, Instruction, Databases, and Administrative Systems. Three appendices detail demographics, mini/mainframe and microcomputer systems, and computer labs by school.

2. Profile of Surveyed Schools

The population for the Sixth Survey was once again the schools currently accredited by the American Assembly of Collegiate Schools of Business (AACSB) and seven Canadian business schools which had participated in previous surveys. Of the 269 schools available for participation, 163 completed the 12 page questionnaire, a 60% response rate. The questionnaires were completed primarily by computer center directors (36%), faculty members (26%), and assistant deans (21%).

\(^{1}\)The Second, Fourth and Fifth Surveys have been published in the Communications of the ACM, Volume 29, No 1 (1986), Volume 31, No 7 (1988), and Volume 32, No 1 (1989).
The schools that participated in this survey are identified in the appendices. In comparison to the Fourth Survey, the last specifically focused on the hardware, software, and other computer resources, this Sixth Survey sample increased 27% (35 more schools). Seventy-three percent (93) of the 128 business schools in the Fourth Survey also provided data for the Sixth Survey.²

Table 1 displays general demographic information about the 163 schools in this year's sample together with data from previous survey samples. For most of the categories given in Table 1, the data has been consistent over the last five years. For example, for 1985, 1987, 1988 and 1989, participation by public versus private schools has remained approximately two-thirds public and one-third private. The level of programs, reflected in the type of degrees offered, has also stayed about the same. Similarly, the mini/mainframe facilities available at the participating schools has stayed level. Student enrollments however, continue fluctuating across the time period, yet still maintain a pretty even distribution across the full range of school sizes.

<table>
<thead>
<tr>
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<th></th>
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<tr>
<td></td>
<td>N=163</td>
<td>N=175</td>
<td>N=128</td>
<td>N=125</td>
<td>N=35</td>
</tr>
<tr>
<td>Type of School:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>68%</td>
<td>68%</td>
<td>67%</td>
<td>69%</td>
<td>49%</td>
</tr>
<tr>
<td>Private</td>
<td>32</td>
<td>32</td>
<td>33</td>
<td>31</td>
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</tr>
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<td>Degrees offered:</td>
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<td>Undergraduate only</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
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<tr>
<td>Undergraduate and Graduate</td>
<td>89</td>
<td>88</td>
<td>85</td>
<td>86</td>
<td>66</td>
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<tr>
<td>Graduate only</td>
<td>7</td>
<td>10</td>
<td>13</td>
<td>12</td>
<td>34</td>
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<td>Student Enrollment (FTE):</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Less than 1000 students</td>
<td>22</td>
<td>24</td>
<td>25</td>
<td>22</td>
<td>37</td>
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<td>Between 1000 and 2000</td>
<td>26</td>
<td>21</td>
<td>27</td>
<td>22</td>
<td>23</td>
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<tr>
<td>Between 2000 and 3000</td>
<td>20</td>
<td>23</td>
<td>24</td>
<td>26</td>
<td>20</td>
</tr>
<tr>
<td>More than 3000 students</td>
<td>31</td>
<td>32</td>
<td>24</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Mini/mainframe Facilities:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both School and University</td>
<td>31</td>
<td>34</td>
<td>29</td>
<td>27</td>
<td>54</td>
</tr>
<tr>
<td>School only</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>University only</td>
<td>59</td>
<td>56</td>
<td>60</td>
<td>64</td>
<td>40</td>
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<tr>
<td>No data</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

The schools which have joined the survey this year are a representative cross section of the study population in terms of type, degrees offered, size, mini/mainframe facilities, microcomputer density, and computer operating budget as a percent of the school's operating budget. Appendix 1 presents information on student enrollment, faculty counts, budgets, and staff ratios by school for the 1989 sample.

²The complete SAS files of the Second, Fourth, Fifth and Sixth raw data are available to interested researchers. Please contact the Information Systems Research Program, Anderson Graduate School of Management, University of California, Los Angeles, CA. 90024-1481.
3. Support Resources

Computer hardware alone is insufficient for a successful implementation of technology — support staff, software, maintenance, and communication links are all necessary components. In this section we examine the financial and staff support allocations of the business schools toward the computerization effort.

3.1 Budgets

Two budget items were requested in this year's questionnaire: the total annual business school operating budget and the total annual business school computer operating budget for 1988-89 from all sources. The computer operating budget includes staff salaries, benefits and support, equipment maintenance and services, software and data acquisition and licenses, supplies, operating overhead, and computer recharge funds. It does not include major capital acquisitions, microcomputer purchases, and faculty salaries. One hundred twenty-three (76%) of the schools reported their total school budget, 126 (77%) reported their computer operations budget, and 110 (68%) reported both. Several schools noted some changes in the inclusion or exclusions. Some of the schools not answering this question indicated that the data was confidential, not available at this time, unknown, or controlled by the university and not the business school.

For the 123 schools providing data, the total annual business school operating budgets ranged from $51,800 to $84,100,000, with a median of $5,100,000. The total annual business school computer operating budgets for the 126 schools providing data ranged from $2,000 to $4,500,000 with a median of $150,000. For the 110 business schools providing data for both budgets, on the average, the computer operating budget was approximately 3.8% of the total school budget, up from 3.3% in the Fourth Survey (1987), and 3.0% in the Second Survey (1985). Thus, this year's sample exhibits a slight increase in the overall financial commitment to computer support.

Figure 1 shows the computer operating budget as allocated into support for undergraduate, MBA, research, and administrative computing requirements for the 126 (74%) schools providing data. The undergraduate and MBA allocations were similar in aggregated percentages of the total computer operating budget.

To provide another basis of comparison of the budget data across the business schools, the annual computing operating budget was converted into a per student statistic by dividing the total student FTE by the reported computer operating budget. For the 125 schools providing data, the median quartile expenditures per student were $484, $117, $40, and $14, respectively, as shown in Figure 2.

One hundred forty-three (88%) of the schools provided data regarding their sources of funding for operations and maintenance, hardware acquisition, and software acquisition. Table 2 summarizes this data, showing the percentage of schools indicating that at least 50% of funding came from a particular source. Eighty-one percent of the schools in this year's sample indicated that they were responsible for at least half of their operational budgets, a large increase over the 64% reported by the Fourth Survey (1987) sample. Private contributions have decreased as the primary source of funding for operation and maintenance, although the schools depending on funding from student charges remained about the same. This year, the sources of funding for hardware and software acquisition were separated, making comparison with the data from the 1987 survey difficult. For hardware and software acquisition, student charges
have increased slightly as the primary source of funding. Vendor donations are now shown to be mainly for hardware, rather than for software acquisition.

Figure 1.
Business School Computer Operating Budget Allocations

Total Budgets: $43 million
N: 126
Range: $2,000-$4,500,000
Median: $150,000

- **ADMINISTRATION:** $8.7 million
  - N: 107
  - Range: $660-$2,025,000
  - Median: $20,000

- **UNDERGRADUATE:** $10.1 million
  - N: 103
  - Range: $1,400-$1,170,000
  - Median: $57,000

- **RESEARCH:** $13.5 million
  - N: 111
  - Range: $300-$1,502,000
  - Median: $36,000

- **MBA:** $10.7 million
  - N: 114
  - Range: $300-$1,575,000
  - Median: $22,500

Student charges for computer usage were clearly not a primary source of funding for many of the business schools. One hundred six (71%) of the undergraduate schools indicated that no computer usage charges were charged for their program, and 108 (69%) of the graduate schools indicated that no computer usage charges were charged for the MBA program. However, the data from the schools which did delineate their charge structures are presented in Table 3. The computer usage charges are quite similar for the undergraduate and the MBA programs. Charges other than those specifically listed in the table included per course charges for computer majors only, a one time charge for a mandatory introductory computer course, charges per course credit, charges per semester, and hourly charges. Eleven (7%) of the business schools indicated that faculty were charged for mini/mainframe or microcomputer usage, other than university provided charge-back funds.
Figure 2.
Median Computer Operating Budget Expenditure by Quartiles

Table 2.
Primary Sources of Funding
(N = 143)

<table>
<thead>
<tr>
<th></th>
<th>1989</th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operation &amp; Maintenance</td>
<td>Software Acquisition</td>
</tr>
<tr>
<td>At least 50% from:</td>
<td>81%</td>
<td>71%</td>
</tr>
<tr>
<td>B-school or Univ</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>State/Government</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Vendor</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Private Contribution</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Student Charges</td>
<td>4</td>
<td>6</td>
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Table 3.
Computer Usage Charges at Business Schools

<table>
<thead>
<tr>
<th></th>
<th>Undergraduate N = 149</th>
<th>MBA N = 157</th>
</tr>
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<tbody>
<tr>
<td>No computer charges</td>
<td>71%</td>
<td>69%</td>
</tr>
<tr>
<td>Charges per course</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Range: $1-50</td>
<td>Range: $1-50</td>
<td></td>
</tr>
<tr>
<td>Median: $15</td>
<td>Median: $15</td>
<td></td>
</tr>
<tr>
<td>Charges per year</td>
<td>7%</td>
<td>10%</td>
</tr>
<tr>
<td>Range: $10-300</td>
<td>Range: $10-345</td>
<td></td>
</tr>
<tr>
<td>Median: $60</td>
<td>Median: $90</td>
<td></td>
</tr>
<tr>
<td>Charge for output (most schools indicated for laser output only)</td>
<td>10%</td>
<td>11%</td>
</tr>
<tr>
<td>Range: $.04-.50</td>
<td>Range: $.04-.50</td>
<td></td>
</tr>
<tr>
<td>Median: $.14</td>
<td>Median: $.15</td>
<td></td>
</tr>
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</table>

3.2 Computing Staff

An extremely important dimension of a business school's computing environment is its support staff. One hundred thirty-one (80%) of the schools indicated that they had their own computing support staff, autonomous from other campus facilities and supported out of the business school computer operating budget. The total number of staff ranged from .25 to 47.5 FTE. By category, the staffs ranged from .1 to 21 FTE for technical, hardware and network staff, from .1 to 21.75 FTE for academic user support staff, from .25 to 12.75 FTE for administrative user support staff, and from .25 to 11 FTE for computer facilities management staff.

Table 4 details the business schools' staff allocations among four categories, technical (hardware and network), academic user support, administrative user support, and computer facilities management. Based on quartile medians, schools in all quartiles appear to employ approximately twice as many academic user support personnel as technical staff. Administrative support levels seem to match computing service management levels.

To provide further comparison of the computing support staff across the business schools, the ratio of student FTE to total staff FTE was calculated. Figure 3 displays this ratio by quartile for the 131 responding schools, the median ratios for each quartile being 98, 260, 592, and 1993, respectively. Compared with the previous year's data, computing staff support has decreased in all of the quartiles. In the fourth quartile, for example, each staff member now supports 1993 students, as compared to 1820 students in the 1985 data. The disparity in student computing support between the first and fourth quartiles remains dramatic.
Table 4.
Median Computing Staff Support by Category

<table>
<thead>
<tr>
<th>Category</th>
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<th>2nd</th>
<th>3rd</th>
<th>4th</th>
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<tr>
<td>Technical Support</td>
<td>5.5</td>
<td>2</td>
<td>1</td>
<td>.5</td>
</tr>
<tr>
<td>Academic Users</td>
<td>10</td>
<td>4.5</td>
<td>2</td>
<td>.5</td>
</tr>
<tr>
<td>Administrative Users</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>.5</td>
</tr>
<tr>
<td>Management</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>.5</td>
</tr>
<tr>
<td>Total Staff FTE</td>
<td>21.5</td>
<td>9.5</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Figure 3.
Median Staff Support of Computing by Quartiles

4. Mini/Mainframe Computer Systems

One hundred fifty-six (96%) of the business schools indicated that their users had access to mini/mainframe systems. Ten of these schools indicated they used only their own mini/mainframe systems, 50 schools accessed both their own and university-wide systems, and the
### Table 5.
**Mini/Mainframe Systems Installed by Model**
(Number of Systems)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AT&amp;T 3Bx</td>
<td>15</td>
<td>14</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data General</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV xxx</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAX 11/7xx</td>
<td>18</td>
<td>23</td>
<td>17</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>VAX 8xxx</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MicroVAX</td>
<td>16</td>
<td>11</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hewlett Packard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP3000s</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>IBM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4300s</td>
<td>17</td>
<td>16</td>
<td>13</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>S36,38</td>
<td>7</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NCR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8750, 9300, Tower</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PRIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7xx, 8xx, 9xxx</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>WANG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VS, OISs</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Others (1 or 2 each)</td>
<td>16</td>
<td>18</td>
<td>11</td>
<td>21</td>
<td>14</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>122</strong></td>
<td><strong>127</strong></td>
<td><strong>80</strong></td>
<td><strong>59</strong></td>
<td><strong>37</strong></td>
</tr>
</tbody>
</table>

remaining 96 schools relied exclusively on access to the university-wide systems. Appendix 2 provides detailed information on the make and models of the mini/mainframes available as reported by each school.

The 61 business schools (37%) which maintained their own mini/mainframe systems listed 122 separate computers. Table 5 displays the make, model, and number of these systems supported by at least three or more of the schools. Although 16 different vendors were represented, Digital Equipment Corporation had the largest number of systems installed, with 42 (34%) of the total 122. The VAX 11/7xx was shown to be the most installed system (18), followed closely by the IBM 4300s (17), the Digital MicroVaxs (16), the AT&T 3Bxs (15), and the Hewlett Packard HP3000s (12).

Data provided by 35 of these business schools which maintained their own mini/mainframes indicated several distinct patterns of usage, as shown in Table 6. Twenty-five of the mini/mainframes were used only for a single purpose, either for coursework (12 schools), for research (8 schools), or for administration activities (5 schools). In contrast, 17 of these larger systems were shared in all three categories of use. The combination of research and administration use was the least popular.
Twenty-seven business schools indicated they had plans for acquiring a new mini/mainframe system, usually within a one year time frame.

Table 6.
Mini/Mainframe Systems Usage Patterns
N=35 Business schools
(using 61 mini/mainframes)

<table>
<thead>
<tr>
<th>Usage Categories</th>
<th>Course</th>
<th>Research</th>
<th>Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 used only for</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 used only for</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5 used only for</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>17 used for all</td>
<td>X</td>
<td>and</td>
<td>X</td>
</tr>
<tr>
<td>14 used for</td>
<td>X</td>
<td>and</td>
<td></td>
</tr>
<tr>
<td>4 used for</td>
<td>X</td>
<td></td>
<td>and X</td>
</tr>
<tr>
<td>1 used for</td>
<td></td>
<td>X</td>
<td>and X</td>
</tr>
</tbody>
</table>

5. Microcomputers

The most significant area of computer growth in recent years has been in the introduction of microcomputers. Ninety-nine percent of the schools in this Sixth Survey (1989) provided microcomputer data. The total number of microcomputers at these business schools ranged from 11 to 793, with quartile median values of 54, 114, 194, and 314. Appendix 2 presents microcomputer information detailed by school.

5.1 Models and Market Penetration

Table 7 displays the variety of microcomputers reported by the schools owning four or more of the same systems. In total, at least 31 different microcomputer manufacturers were represented, and 48 different microcomputer models. Eighty-six percent of the schools again reported having four or more IBM PCs or PC/XTs, 49% IBM PS/2s, 35% Macintosh Pluses or SEs, 34% IBM PC/ATs, and 29% Zeniths or Zenith 150s. All of the other models were reported by less than 20% of the schools.
Table 7.
Microcomputer Systems by Model
(Percent of Schools with Systems)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong> (at least 4 systems)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC, PC/XT</td>
<td>86%</td>
<td>86%</td>
<td>86%</td>
<td>82%</td>
</tr>
<tr>
<td>IBM PS/2</td>
<td>49</td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macintosh Plus/SE</td>
<td>35</td>
<td>29</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>XT Clone</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC/AT</td>
<td>34</td>
<td>35</td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td>Zenith</td>
<td>29</td>
<td>42</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>Macintosh II</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AT Clone</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP Vectra 286</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>AT&amp;T 286</td>
<td>12</td>
<td>14</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>386 Clone</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP Vectra 386</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP 150s</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Unisys</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>DEC Rainbow</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Apple II series</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Leading Edge</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AT&amp;T 386</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tandy</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>NCR</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>33</td>
<td>35</td>
<td>31</td>
<td>19</td>
</tr>
</tbody>
</table>

In general, the number of leading vendors has remained about the same, yet the diversity of separate models supported by the business schools has greatly increased. Table 8 documents this change. For example, in 1987 about 50% of the respondent schools were supporting one or two different microcomputer models, yet in 1989, only 7% of the schools supported one or two models. In other words, 93% of the schools are now supporting at least three models, in many cases extending across two or three generations of microprocessor chips. For example, a single vendor school may have IBM PCs with 8086 chips, PC/ATs with 80286 chips and PS/2s with 80386 chips.

One hundred sixty-one schools reported owning a total of 30,740 microcomputers. Table 9 details these microcomputers for the models for which at least 300 systems were reported. The total number of systems continues to grow, but at a much slower rate, 13% over the past year, in contrast to 62% and 75% between 1987-1988 and 1985-1987 respectively. The rate of growth in the average number of systems per school, however, has increased slightly, 23% compared to 18% between 1987 and 1988. The early IBM PC and PC/XT together with the XT clones remain dominant, representing 39% of the microcomputer systems, while the other contending models, except for Zenith, are very close together at just under 10%.
Table 8.
Different Microcomputer Models Supported by School
(N = 161)

<table>
<thead>
<tr>
<th>Number of different microcomputer models</th>
<th>1989</th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1%</td>
<td>17%</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>7</td>
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</tr>
<tr>
<td>9</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>11-14</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Table 9.
Microcomputer Systems by Model
(Number of Systems)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td><strong>1989</strong></td>
<td><strong>1988</strong></td>
<td><strong>1987</strong></td>
<td><strong>1985</strong></td>
</tr>
<tr>
<td>(&gt;300 systems)</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>IBM PC,PC/XT</td>
<td>9,286</td>
<td>10,149</td>
<td>7,509</td>
<td>5,120</td>
</tr>
<tr>
<td>Zenith</td>
<td>3,923</td>
<td>3,274</td>
<td>1,791</td>
<td>411</td>
</tr>
<tr>
<td>XT Clones</td>
<td>2,714</td>
<td>1,305</td>
<td>925</td>
<td>457</td>
</tr>
<tr>
<td>IBM PS/2</td>
<td>2,393</td>
<td>1,893</td>
<td>1,194</td>
<td>259</td>
</tr>
<tr>
<td>Macintosh</td>
<td>2,165</td>
<td>2,110</td>
<td>349</td>
<td>40</td>
</tr>
<tr>
<td>IBM PC/AT</td>
<td>1,827</td>
<td>2,110</td>
<td>1,194</td>
<td>259</td>
</tr>
<tr>
<td>HP Vectra 286</td>
<td>1,194</td>
<td>538</td>
<td>349</td>
<td>40</td>
</tr>
<tr>
<td>AT Clones</td>
<td>1,055</td>
<td>1,172</td>
<td>593</td>
<td>544</td>
</tr>
<tr>
<td>AT&amp;T</td>
<td>1,043</td>
<td>1,172</td>
<td>593</td>
<td>544</td>
</tr>
<tr>
<td>Unisys</td>
<td>881</td>
<td>765</td>
<td>585</td>
<td>855</td>
</tr>
<tr>
<td>HP Vectra 386</td>
<td>632</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Mac II</td>
<td>444</td>
<td>2</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>DEC Rainbow</td>
<td>409</td>
<td>557</td>
<td>855</td>
<td>9</td>
</tr>
<tr>
<td>Leading Edge</td>
<td>403</td>
<td>2</td>
<td>855</td>
<td>9</td>
</tr>
<tr>
<td>ITT</td>
<td>351</td>
<td>1</td>
<td>855</td>
<td>9</td>
</tr>
<tr>
<td>Others</td>
<td>2,020</td>
<td>5,447</td>
<td>3,779</td>
<td>1,870</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>30,740</td>
<td>27,210</td>
<td>16,725</td>
<td>9,556</td>
</tr>
<tr>
<td><strong>Average systems per school</strong></td>
<td>191</td>
<td>155</td>
<td>131</td>
<td>80</td>
</tr>
</tbody>
</table>
5.2 Microcomputer Densities

Two ratios were calculated to provide further understanding of the penetration of microcomputers in the business school computer environment. The first, a student-per-microcomputer ratio, was calculated by dividing the total student FTE by the number of the school's microcomputers available for student use. This density measure thus reflects the number of students who share access to a single microcomputer. For example, a student microcomputer density of 28 is interpreted as 28 students sharing access to the microcomputer system. The second ratio, faculty-per-micro, was calculated by dividing the faculty FTE by the number of the school's microcomputers available exclusively for faculty use. As these ratios do not take into consideration any microcomputer systems that might be owned by the students or the faculty, the ratio denominators are probably understated. Thus, the actual number of students or faculty who share access to microcomputer systems is probably lower (i.e., better) than reported.

Of the 154 schools who provided the necessary data, the median student-per-micro density, by quartiles, are 10, 22, 36, and 65, respectively, as shown in Figure 4. Of the 158 business schools providing the necessary data, the median faculty-per-micro densities are 0.8, 1.1, 1.5, and 2.6, as shown in Figure 5. These figures reflect the continuing, but slowing, growth of microcomputers into the business school computer environment.

Figure 4.
Student Microcomputer Density by Quartiles

![Bar Chart showing student microcomputer density by quartile for 1989, 1987, and 1985]
5.3 Acquisition and Ownership

All of the business schools offering graduate programs provided data regarding their requirements for MBAs to purchase their own microcomputers for the 1988-89 academic year. Eighty-two percent (130) responded that MBAs were not required to purchase a microcomputer. Four percent (6) of the schools indicated that purchase was required for some students, usually for the Executive MBA programs. The remaining fourteen percent responded either that purchase was not required, but recommended, or that required purchase was being planned for the coming year. The makes specified in these instances were IBM or a compatible, Macintosh, or a Zenith portable system.

5.4 Maintenance

One hundred fifty-four (95%) responded to the school-owned microcomputer maintenance question. Only three of these schools responded that they had no maintenance program, or that they hadn't dealt with this issue yet. Several schools employed more than one of the maintenance options provided. Seventy-eight (51%) of the schools responded that they used their own staff for maintenance, 49 (32%) contract with outside vendors, and 91 (59%) contract with university services. Fifteen (10%) of the schools provided other responses to the maintenance question, usually indicating that maintenance was provided by the university as required, without formal contract arrangements, or that the equipment was returned to the vendor directly.
With regard to maintenance and support of faculty-owned microcomputers, 57 of the total 163 responding schools (35%) indicated that their business school provided the maintenance, whereas 100 (62%) did not. Five schools provided support for faculty-owned software.

5.5 Portable Systems

Portable microcomputer systems are considered to be an area of potential growth and expansion. This year's data showed that the average number of portables per school doubled, from 17.2 in 1988 to 34.8 as reported for 1989. Tables 10 and 11 present different aspects of the portable system data. Table 10 presents information on the portable systems installed by the

<table>
<thead>
<tr>
<th>Participating Schools</th>
<th>1989 N=163</th>
<th>1988 N=175</th>
<th>1987 N=128</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zenith</td>
<td>47%</td>
<td>43%</td>
<td>23%</td>
</tr>
<tr>
<td>Compaq</td>
<td>28</td>
<td>39</td>
<td>23</td>
</tr>
<tr>
<td>IBM Convertible</td>
<td>26</td>
<td>33</td>
<td>27</td>
</tr>
<tr>
<td>Toshiba</td>
<td>17</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>HP 110, 110 Plus</td>
<td>14</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>NEC</td>
<td>6</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Tandy</td>
<td>3</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>14</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 10. Portable Systems by Schools  
(Percent of Schools)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Hewlett-Packard</td>
<td>3,226</td>
<td>69</td>
<td>990</td>
</tr>
<tr>
<td>Zenith</td>
<td>502</td>
<td>11</td>
<td>291</td>
</tr>
<tr>
<td>Compaq</td>
<td>315</td>
<td>7</td>
<td>338</td>
</tr>
<tr>
<td>IBM</td>
<td>236</td>
<td>5</td>
<td>447</td>
</tr>
<tr>
<td>Toshiba</td>
<td>153</td>
<td>3</td>
<td>149</td>
</tr>
<tr>
<td>Tandy</td>
<td>113</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>NEC</td>
<td>29</td>
<td>&lt;1</td>
<td>25</td>
</tr>
<tr>
<td>Other</td>
<td>128</td>
<td>3</td>
<td>77</td>
</tr>
</tbody>
</table>

Table 11. Portable Systems Supported by Vendor  
(Number of Systems)

Total: 4,700 100%  2,328 100%  1,627 100%

Average systems per school: 34.8 17.2 19.8
schools, by vendor. Zenith systems increased slightly, now being available in 47% of the schools, whereas both Compaq and IBM decreased slightly. Toshiba, Hewlett-Packard, and NEC stayed about the same.

Table 11 presents the portable microcomputer systems by total numbers. Exactly the same number of schools reported having portable systems, yet there was a growth in overall percentages due to differences in the sample sizes between 1988 and 1989. Eighty-three percent of the business schools in this Sixth Survey (1989) reported having portable microcomputers, up from 77% in the Fifth Survey (1988). Although data was collected by model, in Table 11 the models were aggregated by vendor to summarize the data, due to the ever growing number of different models available. Hewlett-Packard clearly dominates with 69% of the systems. Zenith has taken over the second position, with 11% of the systems. IBM has dropped considerably in this past year, from 19% to now only 5%.

### 5.6 High Performance 32-bit Graphic Workstations

Another area of potential growth has been the 32-bit high performance graphics workstation. These systems filled a perceived void between the microcomputer and the mini/mainframe computer. However, with the emergence of the high performance microcomputers (e.g., IBM PS/2 Model 80 or Apple Macintosh IIx), the distinction between workstations and microcomputers is becoming a gray area. Table 12 presents the information on workstations found in this year’s sample of schools, ranked by the percentage of schools with a particular model. The table shows that there has been only a slight increase in the number of schools acquiring workstations, although the actual number of workstations has more than doubled. Sun Systems are still found in most of the schools, while Vaxstations are the most abundant, accounting for 49% of the reported systems.

<table>
<thead>
<tr>
<th>Model</th>
<th>1989</th>
<th>1988</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 33</td>
<td>N = 31</td>
</tr>
<tr>
<td></td>
<td>Percent Schools</td>
<td>Total Systems n</td>
</tr>
<tr>
<td>Sun</td>
<td>39%</td>
<td>73</td>
</tr>
<tr>
<td>Vaxstation</td>
<td>36</td>
<td>153</td>
</tr>
<tr>
<td>IBM RT</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>Xerox</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>HP Apollo</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>NeXT</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>TI Explorer</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>316</td>
<td>100%</td>
</tr>
</tbody>
</table>
6. Computer Labs

Data on computer labs was provided by 157 (96%) of the business schools. Four hundred ninety separate computer labs were identified, accounting for 12,450 microcomputers, an average of 25.4 microcomputers per computer lab. Appendix 3 details the computer lab environment for the 468 labs reported which had four or more microcomputer systems.

The 12,450 microcomputers in the labs comprise 40% of the total microcomputers reported in this study. Twenty-two percent of the schools reported having one computer lab and an additional 23% reported two labs. Eighteen percent and 16% have three and four labs respectively, while 20% of the schools have five, six or seven computer labs. One school reported 10 labs (California State University, Fresno) and one school reported 12 labs (University of Arizona). Fifty percent of the labs are used for regular classroom instruction, and 59% of the labs have a consultant available at least two-thirds of the open hours. Eight percent of the labs were reported as dedicated for faculty use only.

The labs show extensive communication capabilities, with 50% having the microcomputers networked and 48% having the microcomputers linked to a host mini/mainframe system. Every lab reported having at least one type of output device, with dot-matrix printers being reported most often, 52%. Twenty-one percent of the schools reported a laser printer in addition to the dot-matrix, and another 11% reported a plotter as well. Only 7% of the schools reported laser printers as the only output device.

7. Communications

Connectivity between microcomputers continues to increase in the business schools. In 1989, 80% of the schools provided details of local area network software, compared to 66% for 1987 and 39% for 1985.

7.1 Microcomputer Communications

Network data provided by 130 of the business schools for 25,468 microcomputers showed that 45% (11,390) of the microcomputers are stand alone, not linked to any other computer systems. Eighteen percent (4,487) are linked to a host only, 10% (2,497) are linked to other microcomputers, and 28% (7,094) are linked to both a host and other microcomputers. Figure 6 displays these data, summarized by percentage of microcomputers with connectivity, for the 130 schools providing responses to this question. In this aggregate form very little change was seen in the amount of microcomputer networking, even though the schools making up the data were not the same. The schools with greater than two-thirds of their microcomputers networked, increased slightly whereas those schools with between one-third and two-thirds of their microcomputers networked decreased by about the same amount. The other categories stayed exactly the same. The "none" category may be somewhat misleading, as the schools which did not provide data were not added into that category, even though it is likely that a great many of them did not provide any connectivity between their micros.
7.2 Local Area Networks

Information regarding the specific hardware and software approach used in their local area networks was provided by 131 business schools. The LANs mentioned at least three times and the percentage of the individual networks also linked to a host mini/mainframe system are listed in Table 13.

With regard to the LAN systems being connected to a host mini/mainframe, the Decnet, the Ungermann Bass, and the Ethernet schools all show more than 80% connectivity of their systems to a host. Of the 144 business schools which provided data regarding a data switch, port selector, or PABX, 51% (73 schools) responded that they provide this type of access to mini/mainframes, with Micom being identified thirteen times, AT&T seven, Gandolf and Rolm each six, and IBM four.

Of the 131 business schools which reported LAN software, 58 (44%) listed only one LAN software, 33 (25%) listed two different LAN software systems, 19 (15%) listed three, 14 (11%) listed four, and 7 (5%) listed five or more.
Table 13.
Local Area Networks Installed
(Percent of schools)

<table>
<thead>
<tr>
<th>Type of LAN (at least 3)</th>
<th>1989</th>
<th>1987</th>
<th>1985</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=131</td>
<td>N=84</td>
<td>N=49</td>
</tr>
<tr>
<td>Novell (Arcnet or Netware)</td>
<td>47%</td>
<td>36%</td>
<td>26%</td>
</tr>
<tr>
<td>Ethernet</td>
<td>36</td>
<td>83</td>
<td>40</td>
</tr>
<tr>
<td>Apple Talk</td>
<td>35</td>
<td>34</td>
<td>23</td>
</tr>
<tr>
<td>IBM Token Ring</td>
<td>24</td>
<td>57</td>
<td>12</td>
</tr>
<tr>
<td>IBM PCnet</td>
<td>15</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>Decnet</td>
<td>13</td>
<td>94</td>
<td>20</td>
</tr>
<tr>
<td>Starlan</td>
<td>11</td>
<td>75</td>
<td>12</td>
</tr>
<tr>
<td>Ungermann Bass</td>
<td>6</td>
<td>88</td>
<td>6</td>
</tr>
<tr>
<td>Unisys</td>
<td>3</td>
<td>75</td>
<td>4</td>
</tr>
<tr>
<td>Others</td>
<td>20</td>
<td>31</td>
<td>41</td>
</tr>
</tbody>
</table>

7.3 Network Applications

The distinction between local and wide area networks has become increasingly blurred as the software which bridges between the applications has become more transparent to the user. Table 14 summarizes the more common local area and wide area network applications by user group, ranked in order of average percent usage. Compared to data from the 1987 survey, electronic mail remained the most common network application. Five categories in this question (MCI Mail, online calendaring, print server, software distribution, and The Source), were indicated by less than one percent within all user groups. In all instances, the faculty user group shows a higher percent of usage than any of the other user groups.

Table 14.
Network Applications
(by User Group Percent)
(N = 149)

<table>
<thead>
<tr>
<th>Application</th>
<th>Avg.</th>
<th>Under Grad</th>
<th>MBA</th>
<th>Faculty</th>
<th>Sec/Admin</th>
<th>Computer Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic mail</td>
<td>52%</td>
<td>28%</td>
<td>36%</td>
<td>76%</td>
<td>60%</td>
<td>59%</td>
</tr>
<tr>
<td>Document/file transfer</td>
<td>47%</td>
<td>33%</td>
<td>38%</td>
<td>68%</td>
<td>47%</td>
<td>50%</td>
</tr>
<tr>
<td>BITNET</td>
<td>47%</td>
<td>33%</td>
<td>38%</td>
<td>68%</td>
<td>47%</td>
<td>50%</td>
</tr>
<tr>
<td>Database access</td>
<td>42%</td>
<td>32%</td>
<td>40%</td>
<td>63%</td>
<td>36%</td>
<td>40%</td>
</tr>
<tr>
<td>File server</td>
<td>42%</td>
<td>32%</td>
<td>40%</td>
<td>63%</td>
<td>36%</td>
<td>40%</td>
</tr>
<tr>
<td>Disk backup/restore</td>
<td>30%</td>
<td>16%</td>
<td>18%</td>
<td>38%</td>
<td>34%</td>
<td>43%</td>
</tr>
<tr>
<td>CompuServe</td>
<td>14%</td>
<td>9%</td>
<td>12%</td>
<td>30%</td>
<td>3%</td>
<td>17%</td>
</tr>
<tr>
<td>Electronic conferencing</td>
<td>10%</td>
<td>5%</td>
<td>9%</td>
<td>15%</td>
<td>7%</td>
<td>14%</td>
</tr>
<tr>
<td>Internet</td>
<td>9%</td>
<td>4%</td>
<td>7%</td>
<td>15%</td>
<td>7%</td>
<td>11%</td>
</tr>
</tbody>
</table>
8. Software

The participating business schools listed the principal software packages for fifteen different categories separately by mini/mainframe and microcomputer usage as well as by instruction and research usage. Table 15 summarizes the software usage as reported by the schools for each of these categories. This table is sorted by number of schools reporting microcomputer software packages and emphasizes the variety of packages in each category. For example, the first line shows that for spreadsheets, 12 business schools listed software packages for mini/mainframes and 156 schools listed software packages for microcomputers. Within the mini/mainframe category, 7 packages were identified as used for instruction and for research. Within the microcomputer category, 17 different packages were identified for instructional usage, whereas 16 were listed as being used for research.

This summary table allows some interesting insights into the use of computers in the business schools. Five categories of software applications (communications, statistical packages, programming languages, modeling and optimization, and simulation) appear to be used about evenly on both the mini/mainframe and microcomputer systems although there is slightly more usage of statistical packages on the larger systems and communications on the smaller systems. The other ten categories of software applications are used predominantly on microcomputers. Among these, the most popular are spreadsheets, word processing, and database management systems.

Table 15. Summary of Computer Software Usage
(ordered by number of schools reporting microcomputer sw usage)

<table>
<thead>
<tr>
<th></th>
<th>Mini/mainframes</th>
<th>Microcomputer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># Schools</td>
<td>Instruction</td>
</tr>
<tr>
<td>Spreadsheets</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Word Processing</td>
<td>31</td>
<td>13</td>
</tr>
<tr>
<td>Database Mgmt Sys</td>
<td>84</td>
<td>32</td>
</tr>
<tr>
<td>Communications</td>
<td>102</td>
<td>22</td>
</tr>
<tr>
<td>Statistical</td>
<td>139</td>
<td>14</td>
</tr>
<tr>
<td>Prog Languages</td>
<td>117</td>
<td>19</td>
</tr>
<tr>
<td>Graphics</td>
<td>35</td>
<td>13</td>
</tr>
<tr>
<td>Modeling/Op</td>
<td>85</td>
<td>26</td>
</tr>
<tr>
<td>Desktop Pub</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Dev Tools</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Business Games</td>
<td>37</td>
<td>28</td>
</tr>
<tr>
<td>AI/Expert Sys</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Simulation</td>
<td>62</td>
<td>8</td>
</tr>
<tr>
<td>Integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Mgmt</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Several applications show a considerable number of different software packages. Within the mini/mainframe category, there were 32 and 34 different software packages listed for database management systems. For microcomputers, more than 30 different software packages were listed in five areas. In the graphics category, 60 packages were for instructional use and 56
were for research use. For business games, a wide variety of packages, 52, were given for instructional use. Communications, statistics, and modeling and optimization were the other applications with more than 30 different software packages identified. The diversity of software packages within the microcomputer domain tends to substantiate the popularity of microcomputer usage over the mini/mainframes in the business school environment.

Detailed tables are given for the software applications in the sections which follow. It should be noted that for these tables a differing number of schools is shown, since some schools did not report software for that category. The count after a particular software package name reflects the number of times that package was reported by five or more schools. "Other" reflects the number of software packages reported by less than five schools.

An interesting note is that in both the 1985 and 1987 surveys, the software packages used in three or more schools could be presented in one table. This year, the criteria was increased to five or more schools, and yet the list was so extensive that separate tables were required for each category.

8.1 Artificial Intelligence, Expert Systems

This software application area, detailed for the first time in this survey, is summarized in Table 16 and shows that more software packages are specified for microcomputers than for mini/mainframe systems. LISP was the only package identified by five or more schools for the mini/mainframes. Prolog, Exsys, Guru, LISP, and VP-Expert are listed most commonly for microcomputers, with VP-Expert especially strong for instructional use.

<table>
<thead>
<tr>
<th></th>
<th>Mini/mainframes (N=20)</th>
<th>Microcomputer (N=69)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
<td>Research</td>
</tr>
<tr>
<td>LISP</td>
<td>5</td>
<td>LISP</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Different</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

8.2 Business Games

As in the 1987 survey results, this type of application software remains stronger for instructional usage than for research, with Markstrat continuing to be the most popular package. However, as shown in Table 17, the high number of different packages for microcomputers, 52, reflects the integration of business games into the curriculum.
Table 17.
Business Games Software
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=37)</th>
<th>Microcomputer (N=71)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
</tr>
<tr>
<td>Markstrat</td>
<td>13</td>
</tr>
<tr>
<td>Other</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Different Packages</td>
<td>28</td>
</tr>
</tbody>
</table>

8.3 Communications

Communications software is another new application area detailed for the first time in this survey. Table 18 shows a very high response rate among the schools in both computing environments. KERMIT is the most commonly used communications package, although there are a large number of other packages listed.

This application category shows a significant variety in the number of software packages being used. For example, for microcomputers 39 different packages were identified by 126 schools for research support, but only 4 packages were listed by five or more schools. Thus 35 different packages were being supported by four or fewer schools.

Table 18.
Communications Software
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=102)</th>
<th>Microcomputer (N=126)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
</tr>
<tr>
<td>KERMIT</td>
<td>72</td>
</tr>
<tr>
<td>YTERM</td>
<td>10</td>
</tr>
<tr>
<td>Procomm</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>23</td>
</tr>
<tr>
<td>Different Packages</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.4 Database Management Systems

Database management systems software is one of the top three microcomputer applications identified in Table 15. As shown in Table 19, 148 business schools listed microcomputer database software, about twice as many as reported this software for mini/mainframes.

dBase was the most dominant microcomputer package, with R:BASE the clear second choice, followed by a variety of other packages. For the mini/mainframe systems, a large variety of packages were identified with Oracle, SQL, and INGRES, mentioned about the same number of times.

Table 19.
Database Management System Software
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Research</th>
<th>Instruction</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle</td>
<td>15</td>
<td>dBase</td>
<td>123</td>
</tr>
<tr>
<td>SQL</td>
<td>15</td>
<td>R:BASE</td>
<td>45</td>
</tr>
<tr>
<td>INGRES</td>
<td>14</td>
<td>Oracle</td>
<td>12</td>
</tr>
<tr>
<td>Informix</td>
<td>5</td>
<td>Focus</td>
<td>10</td>
</tr>
<tr>
<td>PowerHouse</td>
<td>5</td>
<td>INGRES</td>
<td>8</td>
</tr>
<tr>
<td>RDB</td>
<td>5</td>
<td>Other</td>
<td>30</td>
</tr>
<tr>
<td>Other</td>
<td>28</td>
<td>Paradox</td>
<td>5</td>
</tr>
<tr>
<td>Different Packages</td>
<td>32</td>
<td>28</td>
<td>23</td>
</tr>
</tbody>
</table>

8.5 Desktop Publishing

Detailed information regarding the software packages used for desktop publishing was another of the new application categories. As may be seen in Table 20, desktop publishing is primarily a microcomputer application, with four times as many schools responding with software listings for the microcomputers as for the mini/mainframes. The most popular package for the microcomputers is PageMaker, followed by Ventura, and TeX, which also appears in the mini/mainframe category.

8.6 Development Tools

Development or CASE (Computer-aided software engineering) tools are becoming an important part of the instructional environment for system analysis and design courses. Excelerato was listed by 62 of the 75 schools identifying microcomputer-based CASE software.
Table 20.
Desktop Publishing Software
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=20)</th>
<th>Microcomputer (N=85)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
</tr>
<tr>
<td>TeX</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
</tr>
<tr>
<td>PageMaker</td>
<td>37</td>
</tr>
<tr>
<td>Ventura</td>
<td>14</td>
</tr>
<tr>
<td>Ready Set Go</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
</tr>
<tr>
<td>Different Packages</td>
<td>8</td>
</tr>
</tbody>
</table>

8.7 Graphics and Presentation Software

Graphics application software, detailed in Table 21, is dominated by usage on microcomputers, with almost three times as many schools listing software than for the mini/mainframe systems. This application showed the greatest variety of different microcomputer packages with Harvard Graphics the most common. SAS Graph is the dominant graphics package for mini/mainframes.

Table 21.
Graphics and Presentation Software
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=35)</th>
<th>Microcomputer (N=97)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
</tr>
<tr>
<td>SAS Graph</td>
<td>10</td>
</tr>
<tr>
<td>SPSS</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Harvard</td>
<td>39</td>
</tr>
<tr>
<td>Lotus</td>
<td>11</td>
</tr>
<tr>
<td>MacDraw</td>
<td>8</td>
</tr>
<tr>
<td>Storyboard</td>
<td>7</td>
</tr>
<tr>
<td>Chart-Master</td>
<td>6</td>
</tr>
<tr>
<td>HP Gallery</td>
<td>5</td>
</tr>
<tr>
<td>MacPaint</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>65</td>
</tr>
<tr>
<td>Different Packages</td>
<td>13</td>
</tr>
</tbody>
</table>

8.8 Integrated Packages

Integrated packages combine spreadsheet, word processing, database, graphics and communication capabilities under one common interface. This category applies to microcomputers only and 51 schools reported using these systems. There was no clear leader with Framework,
Symphony, Works, and Enable all listed about 10 times each. Even though integrated packages were once perceived as a potential replacement for the various separate application packages, this has not happened, and in fact there has been a 13\% decrease in the number of schools listing this application between 1987 and 1989.

8.9 Modeling and Optimization

LINDO and IFPS continue to dominate this application software for both the mini/mainframe and microcomputer systems. This is one of the computer applications showing about the same amount of usage in both environments, although the microcomputer environment shows a greater number of different software packages, 38 and 29, versus 26 and 27 for the mini/mainframes, as presented in Table 22.

<table>
<thead>
<tr>
<th>Mini/mainframes (N=85)</th>
<th>Microcomputer (N=94)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instruction</strong></td>
<td><strong>Research</strong></td>
</tr>
<tr>
<td>LINDO</td>
<td>LINDO 38</td>
</tr>
<tr>
<td>IFPS</td>
<td>IFPS 27</td>
</tr>
<tr>
<td>Other</td>
<td>Other 27</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Different Packages</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>

8.10 Programming Languages

Once the only software, programming languages now share the domain, being listed sixth in Table 15. As shown in Table 23, BASIC is the preferred programming language for the microcomputer environment, while COBOL is the preferred language for instructional purposes and FORTRAN for research in the mini/mainframes environment.

8.11 Project Management

Details on project management software are another of the application areas first appearing as separate categories in this year's survey, and again like several of the others appearing for the first time, it is a microcomputer dominated application. Harvard Project Management was mentioned by 16 schools, Mac Project by 11, and Time Line by 5.
Table 23.  
Programming Language Software  
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=117)</th>
<th>Microcomputer (N=115)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instruction</strong></td>
<td><strong>Research</strong></td>
</tr>
<tr>
<td>COBOL 73</td>
<td>FORTRAN 63</td>
</tr>
<tr>
<td>BASIC 40</td>
<td>BASIC 36</td>
</tr>
<tr>
<td>FORTRAN 28</td>
<td>COBOL 32</td>
</tr>
<tr>
<td>Pascal 26</td>
<td>Pascal 27</td>
</tr>
<tr>
<td>C 17</td>
<td>C 24</td>
</tr>
<tr>
<td>PL/1 6</td>
<td>PL/1 10</td>
</tr>
<tr>
<td>Other 20</td>
<td>Other 16</td>
</tr>
<tr>
<td>Different Packages 19</td>
<td>17</td>
</tr>
</tbody>
</table>

8.12 Simulation

Simulation is another application which is now used about the same in both computing environments, a change from the 1987 report, when this application was primarily a mini/mainframe application. As presented in Table 24, note that GPSS dominates overall.

Table 24.  
Simulation Software  
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=62)</th>
<th>Microcomputer (N=54)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instruction</strong></td>
<td><strong>Research</strong></td>
</tr>
<tr>
<td>GPSS 36</td>
<td>GPSS 22</td>
</tr>
<tr>
<td>Simscript 15</td>
<td>SLAM 15</td>
</tr>
<tr>
<td>SLAM 13</td>
<td>Simscript 12</td>
</tr>
<tr>
<td>Other 5</td>
<td>Other 9</td>
</tr>
<tr>
<td>Different Packages 8</td>
<td>10</td>
</tr>
</tbody>
</table>

8.13 Spreadsheet Packages

As indicated in Table 25, 156 schools are using 17 different spreadsheet packages with Lotus 1-2-3 continuing to dominate, being specified by about two-thirds of the schools. All of the other microcomputer software packages listed, except for SuperCalc, appear for the first time this year, with Excel making an especially prominent showing. In the mini/mainframe category, 20/20 was the only package to meet the criteria for inclusion in the table.
Table 25.  
Spreadsheet Software  
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=12)</th>
<th>Microcomputer (N=156)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
</tr>
<tr>
<td></td>
<td>20/20</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td>Different</td>
</tr>
<tr>
<td></td>
<td>Packages</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                        | Research |
|                        |          |
|                        |          |
|                        |          |

|                        | Instruction            | Research |
|                        | Lotus 1-2-3 | 104 |
|                        | Excel       | 40  |
|                        | Ovation      | 20  |
|                        | VP-Planner   | 8   |
|                        | SuperCalc    | 5   |
|                        | Other        | 13  |

8.14 Statistical Packages

Statistical software is an area in which mini/mainframes still dominate, but microcomputer versions are becoming more prevalent. Interestingly, as shown in Table 26, the major mini/mainframe packages appear to have been successfully migrated to the microcomputer environment, with SAS and SPSS dominating across both environments.

Table 26.  
Statistical Software  
(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th>Mini/mainframes (N=139)</th>
<th>Microcomputer (N=119)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
</tr>
<tr>
<td></td>
<td>SAS</td>
</tr>
<tr>
<td></td>
<td>SPSS</td>
</tr>
<tr>
<td></td>
<td>Minitab</td>
</tr>
<tr>
<td></td>
<td>BMPD</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Different</td>
</tr>
<tr>
<td></td>
<td>Packages</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                        | Research |
|                        |          |
|                        |          |
|                        |          |

|                        | Instruction            | Research |
|                        | SPSS        | 53       |
|                        | SAS         | 49       |
|                        | Minitab     | 16       |
|                        | SYSTAT      | 12       |
|                        | StatGraphics | 9     |
|                        | Microstat   | 6        |
|                        | TSP         | 6        |
|                        | RATS        | 6        |
|                        | Other       | 32       |

8.15 Word Processing

Word processing is the single most prevalent software application. As shown in Table 27, 155 business schools listed 29 different microcomputer word processing packages. WordPerfect has remained the dominant package, reported by about two-thirds of the schools. MS Word
was reported by more business schools than WordStar, reversing the positions held in the 1987 survey data.

### Table 27.

**Word Processing Software**

(N = Number of schools reporting software package)

<table>
<thead>
<tr>
<th></th>
<th>Mini/mainframes (N=31)</th>
<th>Microcomputer (N=155)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
<td>Research</td>
</tr>
<tr>
<td>Other</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>XEDIT</td>
<td>6</td>
</tr>
<tr>
<td>TeX</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PC-Write</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>DisplayWrite</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>MultiMate</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>MacWrite</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>30</td>
</tr>
<tr>
<td>Different Packages</td>
<td>13</td>
<td>22</td>
</tr>
</tbody>
</table>

### 8.16 Other Software Packages

Software packages listed in the "other" category of applications included general decision support systems, group decision support systems and conferencing software, accounting application software, CAD, bibliographic and text analysis, and utility and virus protection software. Although some of these categories of application software are situation specific, some may become presented as detailed listings as they are integrated into the general business school computing environment.

### 9. Instruction

Instructional oriented questions were expanded this year to include computer literacy entrance and graduation requirements/expectations, and the mix of mini/mainframe and microcomputer usage, in addition to the continuing questions regarding hands-on computer use in core courses, sources of courseware, classroom electronic equipment, and computer-related training.

#### 9.1 Entrance and Graduation Requirements/Expectations

This Sixth Survey requested rather extensive information regarding both computer literacy entrance and graduation requirements and/or expectations, separately for the undergraduate and MBA programs. Of the 149 business schools supporting undergraduate business programs, 81% (120) stated that there were no computer literacy entrance requirements for their students. Fifteen percent (22) of the business schools had requirements. Fourteen schools required a computer course while several schools specified that some training was necessary. Others
required a hands-on exam, basic familiarity and understanding of microcomputers, or a knowledge of DOS, problem solving, and keyboard skills.

For the 157 schools with MBA programs, 66% (104) stated that there were no computer literacy entrance requirements. Twenty-nine percent (46) of the graduate business schools specified requirements, including computer concepts, MIS, applications courses (19 schools), general computer literacy (word processing, spreadsheets and database management systems), or familiarity and experience (17 schools). Five of the graduate level schools stated that they required computer proficiency hands-on exams, using microcomputer applications software. Several others mentioned workshops or non-credit remedial courses.

Table 28 summarizes the computer requirements and/or expectations upon graduation from business school for both the undergraduate and the MBA programs. The requirements are interesting in that, although the order of importance of the requirements (as suggested by the percentage rankings) are the same in all cases but one (the computer entrance exam), a larger percent of the undergraduate schools than the MBA schools specify requirements. The emphasis on microcomputer systems in the business school environment is again seen in the requirement of mini/mainframe use by only 50% of the undergraduate programs, and by only 38% in the MBA programs.

In several instances other requirements were specified, including applications introductory and statistical package courses. Additionally, 61 undergraduate schools and 29 MBA program schools required programming languages. BASIC was the required language for 67% of the undergraduate schools and 62% of the graduate program schools, followed by Pascal (15% and 3%), COBOL (12% and 7%), and FORTRAN (2%), of the undergraduate and graduate programs respectively.

Table 28.
Computer Requirements and Expectations Upon Graduation
(Percent of schools)

<table>
<thead>
<tr>
<th></th>
<th>Undergraduate N=149</th>
<th>MBA N=157</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required</td>
<td>Expected</td>
</tr>
<tr>
<td>Computer/Info Sys course</td>
<td>91%</td>
<td>3%</td>
</tr>
<tr>
<td>Microcomputer use</td>
<td>83</td>
<td>12</td>
</tr>
<tr>
<td>Spreadsheet use</td>
<td>81</td>
<td>14</td>
</tr>
<tr>
<td>Word Processing use</td>
<td>71</td>
<td>20</td>
</tr>
<tr>
<td>Database use</td>
<td>58</td>
<td>19</td>
</tr>
<tr>
<td>Mini/mainframe use</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>Programming language</td>
<td>41</td>
<td>16</td>
</tr>
<tr>
<td>Online database retrieval</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Computer literacy exam</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>
9.2 Microcomputer/Mainframe Usage Mix

In order to better understand the role of mini/mainframes, this year's survey included questions concerning student usage of both microcomputer and mini/mainframe systems at the undergraduate and the graduate level. For the undergraduate programs, 145 of the 149 schools provided data, and indicated that, on the average, 80% of their student computing was done on microcomputers and 20% on mini/mainframes. For the MBA programs, all the schools provided data and indicated that on the average, 83% of their student computing was done on microcomputers and 17% on mini/mainframes. With regard to the appropriateness of this microcomputer and mini/mainframe usage mix, both the undergraduate and the graduate schools responded, on the average, that this usage mix was "about right." Only 5% of the undergraduate and 7% of the graduate schools responded in the extreme, indicating that there was too much emphasis on microcomputers, whereas none of the schools responded in the other extreme of too much emphasis on mini/mainframe usage. In general, it appears that there is only a slight concern regarding a possible overemphasis on microcomputer usage at the expense of the larger systems.

9.3 Penetration into the Curriculum

The business schools indicated whether hands-on use of computing was required in their undergraduate and graduate core courses, using the course descriptions as given by AACSB. Data was gathered on whether required computer use occurred in none, some, or all of the sections. Figure 7 summarizes the responses for the undergraduate core courses and Figure 8 for the graduate core courses.

Figure 7.
Required Computer Use in Undergraduate Core Courses
To see an aggregate growth of required computer usage across the curriculum, the data for Figures 7 and 8 was compared with that from both 1987 and 1985, and is shown in Table 29. The net change for each academic area between the 1989 and the 1987 data was calculated, and then

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>Undergraduate</th>
<th></th>
<th></th>
<th></th>
<th>Graduate</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>86%</td>
<td>2%</td>
<td>84%</td>
<td>62%</td>
<td>80%</td>
<td>10%</td>
<td>70%</td>
<td>55%</td>
</tr>
<tr>
<td>Business Policy</td>
<td>58</td>
<td>11</td>
<td>47</td>
<td>42</td>
<td>47</td>
<td>3</td>
<td>44</td>
<td>32</td>
</tr>
<tr>
<td>Economics</td>
<td>49</td>
<td>12</td>
<td>37</td>
<td>29</td>
<td>47</td>
<td>16</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>Finance</td>
<td>83</td>
<td>2</td>
<td>81</td>
<td>64</td>
<td>80</td>
<td>5</td>
<td>75</td>
<td>76</td>
</tr>
<tr>
<td>Info Systems</td>
<td>93</td>
<td>-1</td>
<td>94</td>
<td>87</td>
<td>83</td>
<td>5</td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>Mgt Science</td>
<td>32</td>
<td>6</td>
<td>26</td>
<td>20</td>
<td>77</td>
<td>3</td>
<td>74</td>
<td>77</td>
</tr>
<tr>
<td>Marketing</td>
<td>82</td>
<td>1</td>
<td>81</td>
<td>82</td>
<td>70</td>
<td>12</td>
<td>58</td>
<td>55</td>
</tr>
<tr>
<td>Org Behavior</td>
<td>74</td>
<td>5</td>
<td>69</td>
<td>52</td>
<td>31</td>
<td>9</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>Prod/Operations</td>
<td>77</td>
<td>3</td>
<td>74</td>
<td>78</td>
<td>70</td>
<td>-5</td>
<td>75</td>
<td>71</td>
</tr>
<tr>
<td>Statistics</td>
<td>86</td>
<td>5</td>
<td>81</td>
<td>76</td>
<td>80</td>
<td>8</td>
<td>72</td>
<td>69</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>72%</strong></td>
<td><strong>4.6%</strong></td>
<td><strong>67.4%</strong></td>
<td><strong>59.5%</strong></td>
<td><strong>66.5%</strong></td>
<td><strong>6.6%</strong></td>
<td><strong>59.9%</strong></td>
<td><strong>56.6%</strong></td>
</tr>
</tbody>
</table>
averaged into an undergraduate and graduate total for each of the years. Table 29 shows a slow, but continuing increase of computer usage for both business programs, about 5% for the undergraduate programs and 6.6% for the graduate. As can be seen in the table, the largest overall increases occurred in Economics and Business Policy at the undergraduate level and Economics and Marketing at the graduate level.

9.4 Sources of Courseware

For core courses for which a school indicated that there was at least some required computer use, the source of the courseware was requested. Courseware was either developed internally, acquired with the textbook, acquired from commercial sources, or acquired from another university. Many schools indicated multiple sources for a particular course, and some listed commercial packages such as Lotus 1-2-3 as the courseware. Tables 30 and 31 summarize this data separately for the undergraduate and graduate core courses. The "N" values in the tables are the number of schools which indicated at least some required computer use. The source percent values across each line are the percent of schools in each cell based on that "N".

Both tables indicate that commercial software packages are currently the dominant source of courseware, although when compared to the 1987 data, the graduate level course shows a 14% increase (64% to 78%), whereas the undergraduate shows only about a 7% increase (from 68% to 75%). Major increases were also seen in the amount of courseware acquired with textbooks, 21% (28% to 49%) for the undergraduate level courseware and 20% (19% to 39%) for the graduate level. The internally developed and acquisitions from other university percentages remained about the same as the 1987 data.

Table 30.
Sources of Undergraduate Courseware
(Percent of schools with required computer use)

<table>
<thead>
<tr>
<th>Undergraduate Core Class</th>
<th>N</th>
<th>Internal</th>
<th>Textbooks</th>
<th>Commercial</th>
<th>Other University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>128</td>
<td>24%</td>
<td>62%</td>
<td>69%</td>
<td>7%</td>
</tr>
<tr>
<td>Business Policy</td>
<td>86</td>
<td>14%</td>
<td>47%</td>
<td>63%</td>
<td>8%</td>
</tr>
<tr>
<td>Economics</td>
<td>73</td>
<td>26%</td>
<td>41%</td>
<td>69%</td>
<td>8%</td>
</tr>
<tr>
<td>Finance</td>
<td>123</td>
<td>24%</td>
<td>52%</td>
<td>75%</td>
<td>4%</td>
</tr>
<tr>
<td>Information Systems</td>
<td>138</td>
<td>36%</td>
<td>57%</td>
<td>88%</td>
<td>8%</td>
</tr>
<tr>
<td>Management Science</td>
<td>122</td>
<td>25%</td>
<td>56%</td>
<td>80%</td>
<td>7%</td>
</tr>
<tr>
<td>Marketing</td>
<td>110</td>
<td>22%</td>
<td>47%</td>
<td>68%</td>
<td>8%</td>
</tr>
<tr>
<td>Organizational Behavior</td>
<td>48</td>
<td>25%</td>
<td>48%</td>
<td>77%</td>
<td>6%</td>
</tr>
<tr>
<td>Production/Operations</td>
<td>155</td>
<td>23%</td>
<td>51%</td>
<td>74%</td>
<td>5%</td>
</tr>
<tr>
<td>Statistics</td>
<td>128</td>
<td>20%</td>
<td>30%</td>
<td>82%</td>
<td>9%</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>24%</td>
<td>49%</td>
<td>75%</td>
<td>7%</td>
</tr>
</tbody>
</table>
Table 31.  
Sources of Graduate Courseware  
(Percent of schools with required computer use)

<table>
<thead>
<tr>
<th>Graduate Core Class</th>
<th>N</th>
<th>Internal</th>
<th>Textbooks</th>
<th>Commercial</th>
<th>Other University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>125</td>
<td>26%</td>
<td>46%</td>
<td>71%</td>
<td>7%</td>
</tr>
<tr>
<td>Business Policy</td>
<td>74</td>
<td>19</td>
<td>39</td>
<td>69</td>
<td>7</td>
</tr>
<tr>
<td>Economics</td>
<td>73</td>
<td>22</td>
<td>33</td>
<td>77</td>
<td>4</td>
</tr>
<tr>
<td>Finance</td>
<td>125</td>
<td>29</td>
<td>38</td>
<td>80</td>
<td>6</td>
</tr>
<tr>
<td>Information Systems</td>
<td>130</td>
<td>33</td>
<td>40</td>
<td>86</td>
<td>12</td>
</tr>
<tr>
<td>Management Science</td>
<td>120</td>
<td>24</td>
<td>46</td>
<td>79</td>
<td>6</td>
</tr>
<tr>
<td>Marketing</td>
<td>109</td>
<td>22</td>
<td>36</td>
<td>76</td>
<td>6</td>
</tr>
<tr>
<td>Organizational Behavior</td>
<td>49</td>
<td>27</td>
<td>37</td>
<td>80</td>
<td>6</td>
</tr>
<tr>
<td>Production/Operations</td>
<td>110</td>
<td>26</td>
<td>40</td>
<td>76</td>
<td>7</td>
</tr>
<tr>
<td>Statistics</td>
<td>125</td>
<td>22</td>
<td>33</td>
<td>83</td>
<td>7</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td>78</td>
<td>7</td>
</tr>
</tbody>
</table>

9.5 Classroom Electronic Equipment

There was an increase of 7% (83% of the business schools in the 1987 Fourth Survey to 90% in this 1989 Sixth Survey), in classrooms that are now equipped to display interactive computer output, either from terminals or microcomputers. Of the 146 schools indicating the use of interactive computer output display technology, 87 schools (60%) had permanently installed equipment; 68 schools (47%) in less than 25% of the classrooms, 10 schools (7%) in 25% to 50% of the classrooms, and 9 schools (6%) in more than 50% of their classrooms. Again, a heavy dependency was shown on mobile units which could be wheeled between classrooms. Ninety-three percent (135 schools) reported using these, with 28 schools reporting one mobile unit, 40 schools two, 20 schools three, 14 schools four, and 21 schools five or more. Most of these units were either delivered to the classroom by staff or picked up and returned by the faculty. Several of the business schools mentioned that the units were assigned or stored in the classroom, or were the responsibility of the central audio-visual department of the university.

The video projectors that were specifically mentioned included Sony (80 in 43 schools), Electrohome (35 in 18 schools), Barco (30 in 11 schools), and Sharp (8 in 3 schools). The video monitors that were specifically mentioned included Sony with 27 in 13 schools, Zenith with 14 in 8 schools and NEC with 14 in 5 schools. Datashow was the most often specified LCD device used with the overhead projectors with 119 in 72 schools, followed by Sharp with 54 in 27 schools, Magnabyte with 17 in 9 schools, and PC Viewer with 14 in 8 schools.

9.6 Training

Figure 9 displays the type of computer-related training for students for 1985, 1987, and 1989. In this table the relative position of the types of training have remained the same except for in university-provided workshops, which showed a large increase to become more popular than business school training during the academic year.

The respondents were also asked to identify the different types of computer-related training provided to their students, faculty, and staff, as well as to indicate the effectiveness of
the training program. Table 32 displays the data relating to seven different training approaches by user group. (The category "business school provided one-to-one" was inadvertently omitted from the questionnaire.) Classroom instruction is shown to be the dominate form of training for students, followed by handouts/documentation, and university-provided workshops. Documentation is the primary approach used for faculty, and university-provided workshops for staff. The table shows that business school workshops prior to the beginning of classes were reported to be the most effective approach for MBA students (3.3), while the university-provided workshops, even though most common, are perceived to be amongst the least effective of the approaches (2.3).

Figure 9.
Types of Computer-related Training for Students

<table>
<thead>
<tr>
<th>Percent of Schools</th>
<th>1989 (N=163)</th>
<th>1987 (N=124)</th>
<th>1985 (N=125)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>91</td>
<td>89</td>
<td>86</td>
</tr>
<tr>
<td>Handouts</td>
<td>79</td>
<td>69</td>
<td>60</td>
</tr>
<tr>
<td>Univ Wkshps</td>
<td>63</td>
<td>44</td>
<td>38</td>
</tr>
<tr>
<td>B-Sch During</td>
<td>46</td>
<td>36</td>
<td>32</td>
</tr>
<tr>
<td>B-Sch Prior</td>
<td>41</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td>CAI, Video</td>
<td>25</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>B-Sch Ind</td>
<td>15</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Univ Ind</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* No Data for 1989

10. Databases Available for Instruction and Research

Information regarding databases which are available for research and instruction for at least 10% of the 163 business schools in this survey is summarized in Table 33, ordered by percent of availability.

Compustat again remains the most widely used database and is available in 74% (121) of the schools. Twenty-eight percent (45) of the schools reported storing the Compustat database online, 48% (78) schools used tape storage, and 17% (27) schools reported now having Compustat available on CD-ROM. Some schools indicated that Compustat was available on all three storage media. Terminal dial-up appears to be the most common access method reported by 36% (58) of the schools. Faculty are shown to be the primary users. Continuing across Table 33, Compustat users are reported to be given "some support" by the schools, on average, and only 9% of the schools have an access charge for using the database.
Table 32.
Computer-Related Training By User Group
(Percent of Schools)

<table>
<thead>
<tr>
<th>Type of Training</th>
<th>Undergrad N=149</th>
<th>MBA N=157</th>
<th>Faculty N=163</th>
<th>Staff N=163</th>
</tr>
</thead>
<tbody>
<tr>
<td>As part of classroom instruction</td>
<td>93% 3.0*</td>
<td>89% 2.9</td>
<td>23% 2.5</td>
<td>22% 2.7</td>
</tr>
<tr>
<td>University-provided workshops</td>
<td>46 2.5</td>
<td>80 2.3</td>
<td>44 2.6</td>
<td>76 2.7</td>
</tr>
<tr>
<td>University provided one-on-one training</td>
<td>10 2.3</td>
<td>11 2.2</td>
<td>34 2.9</td>
<td>32 2.8</td>
</tr>
<tr>
<td>Business school workshops (prior to the beginning of classes)</td>
<td>16 3.0</td>
<td>40 3.3</td>
<td>22 2.8</td>
<td>20 2.8</td>
</tr>
<tr>
<td>Business school workshops (during the academic year)</td>
<td>28 2.9</td>
<td>43 3.1</td>
<td>41 2.7</td>
<td>41 2.9</td>
</tr>
<tr>
<td>Handouts, workbooks, and other documentation</td>
<td>79 2.9</td>
<td>78 3.0</td>
<td>71 2.8</td>
<td>66 2.8</td>
</tr>
<tr>
<td>CAI, video training</td>
<td>20 2.2</td>
<td>22 2.2</td>
<td>23 2.2</td>
<td>22 2.2</td>
</tr>
</tbody>
</table>

* Average effectiveness, scaled 1 (inadequate) to 5 (exceptionally effective in meeting user needs).

Although usage changes by database for user group, averaging across all of the databases, the faculty were shown to be the primary users (29%), followed by the MBA students (16%), and the PhD students (14%). ABI Inform showed the highest level of support at 3.9.

Table 33.
Databases Available for Research and Instruction
N=163
(Ordered by availability)
(Percent of schools)

<table>
<thead>
<tr>
<th>Availability</th>
<th>Database</th>
<th>Storage format</th>
<th>Access method</th>
<th>Primary users</th>
<th>Level of support for users</th>
<th>Access charge</th>
<th>Funding available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>online tape</td>
<td>stand-alone system</td>
<td>terminal dialup</td>
<td>via network</td>
<td>Faculty</td>
<td>PhD</td>
</tr>
<tr>
<td>73</td>
<td>Compustat</td>
<td>28% 48% 17%</td>
<td>17% 36%</td>
<td>26% 67%</td>
<td>34% 29%</td>
<td>3.0 (1.3)</td>
<td>9%</td>
</tr>
<tr>
<td>63</td>
<td>CRSP</td>
<td>26 42</td>
<td>7 33</td>
<td>28 58</td>
<td>31 20</td>
<td>3.0 (1.3)</td>
<td>7</td>
</tr>
<tr>
<td>37</td>
<td>Library catalog</td>
<td>34 1 4</td>
<td>6 18</td>
<td>23 35</td>
<td>18 28</td>
<td>3.0 (1.2)</td>
<td>3</td>
</tr>
<tr>
<td>26</td>
<td>Dow Jones</td>
<td>21 4</td>
<td>4 28</td>
<td>5 25</td>
<td>7 17</td>
<td>3.0 (1.3)</td>
<td>12</td>
</tr>
<tr>
<td>24</td>
<td>Citibase</td>
<td>12 13</td>
<td>4 10</td>
<td>13 22</td>
<td>11 9</td>
<td>3.1 (1.2)</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>Compact Disclosure</td>
<td>4 2 17</td>
<td>17 3</td>
<td>2 14</td>
<td>7 13</td>
<td>2.9 (1.1)</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>ABI Inform</td>
<td>8 11</td>
<td>11 7</td>
<td>1 12</td>
<td>6 11</td>
<td>3.9 (1.3)</td>
<td>4</td>
</tr>
<tr>
<td>17</td>
<td>Lexis</td>
<td>17</td>
<td>1 16</td>
<td>1 14</td>
<td>4 7</td>
<td>2.8 (1.4)</td>
<td>8</td>
</tr>
<tr>
<td>13</td>
<td>Value Line</td>
<td>6 6</td>
<td>4 4</td>
<td>4 13</td>
<td>4 8</td>
<td>3.2 (1.3)</td>
<td>1</td>
</tr>
</tbody>
</table>

34
11. Administrative Systems

Table 34 presents the computer-related administrative systems supported or developed by the business schools, ordered by percent of staff usage. Note that even though word processing is not a true administrative system, it is the most commonly occurring computer-related activity among business school staffs, reported by 62% of the schools in this survey.

For many of the administrative activities, end-user micro-based systems were reported more commonly than business school mini/mainframe or campus-supported systems, especially for budget preparation, faculty records, and faculty course assignment systems. The respondents indicated that most of these systems were developed in Lotus or dBase. The single most common use of business school mini/mainframes was electronic mail systems, which also has the largest number of primary users, other than word processing.

The table suggests that there are relatively few databases shared between the systems, with the possible exception of student records, admissions, and registration and enrollment, reported by approximately 22% of the schools. Very few schools listed commercial mini/mainframe administrative system software, rather that most systems were developed in-house.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Computer system (check one)</th>
<th>Primary users (check one)</th>
<th>Common database with other systems</th>
<th>Level of support for users</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>business school micro</td>
<td>campus</td>
<td>faculty</td>
<td>students</td>
</tr>
<tr>
<td>Word processing</td>
<td>69%</td>
<td>13%</td>
<td>45%</td>
<td>34%</td>
</tr>
<tr>
<td>Student records</td>
<td>13</td>
<td>20</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Budget preparation</td>
<td>41</td>
<td>8</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>Admissions</td>
<td>20</td>
<td>20</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Alumni and development</td>
<td>22</td>
<td>15</td>
<td>3</td>
<td>46</td>
</tr>
<tr>
<td>Class scheduling</td>
<td>25</td>
<td>12</td>
<td>10</td>
<td>42</td>
</tr>
<tr>
<td>Registration and enrollment</td>
<td>10</td>
<td>18</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Electronic mail</td>
<td>12</td>
<td>27</td>
<td>39</td>
<td>14</td>
</tr>
<tr>
<td>Room scheduling</td>
<td>15</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Faculty records</td>
<td>24</td>
<td>5</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>Faculty course assignment</td>
<td>20</td>
<td>7</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>Publications</td>
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<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Placement services</td>
<td>18</td>
<td>13</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Contracts and grant administration</td>
<td>9</td>
<td>3</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>School catalog</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Event listings</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Student class bidding</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>INSTITUTION</td>
<td>TYPE</td>
<td>UGRAD (FTE)</td>
<td>MBA (FTE)</td>
<td>PHD (FTE)</td>
</tr>
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<td>----------------------------------------------</td>
<td>------</td>
<td>-------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
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<td>U OF AKRON</td>
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<td>1880</td>
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<td>4282</td>
<td>202</td>
<td>119</td>
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<td>PUB</td>
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<td>3500</td>
<td>110</td>
<td>.</td>
</tr>
<tr>
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<td>PUB</td>
<td>5599</td>
<td>330</td>
<td>136</td>
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<td>PUB</td>
<td>8850</td>
<td>794</td>
<td>145</td>
</tr>
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<td>PUB</td>
<td>3222</td>
<td>171</td>
<td>74</td>
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<td>AUBURN U</td>
<td>PUB</td>
<td>3582</td>
<td>163</td>
<td>26</td>
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<td>BABSON COLLEGE</td>
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<td>1546</td>
<td>194</td>
<td>218</td>
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<tr>
<td>BALL STATE U</td>
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<td>105</td>
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<td>BRADLEY U</td>
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<td>64</td>
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<td>BRIGHAM YOUNG U</td>
<td>PRIV</td>
<td>4000</td>
<td>600</td>
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<tr>
<td>U CALIF, BERKELEY (HAAS)</td>
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<td>530</td>
<td>457</td>
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<td>U CALIF, IRIVINE</td>
<td>PUB</td>
<td>.</td>
<td>239</td>
<td>38</td>
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<tr>
<td>U CALIF, LOS ANGELES (ANDERSON)</td>
<td>PUB</td>
<td>.</td>
<td>900</td>
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<tr>
<td>CALIF STATE U, BAKERSFIELD</td>
<td>PUB</td>
<td>450</td>
<td>84</td>
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<tr>
<td>CALIF POLY STATE U, SLO</td>
<td>PUB</td>
<td>1650</td>
<td>133</td>
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<tr>
<td>CALIF STATE U, FULLERTON</td>
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<td>6715</td>
<td>554</td>
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<tr>
<td>CALIF STATE U, HAYWARD</td>
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<td>3835</td>
<td>604</td>
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<tr>
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<td>PUB</td>
<td>3586</td>
<td>238</td>
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<td>PRIV</td>
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<td>65</td>
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<td>843</td>
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<td>U OF DELAWARE</td>
<td>PUB</td>
<td>1988</td>
<td>263</td>
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<td>DUKE U (FUQUA)</td>
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<td>1505</td>
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Appendix 1-2
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<th>113</th>
<th>640000</th>
<th>476</th>
<th>10.7</th>
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U OF VERMONT
35 AT&T 6300
30 AT&T 6300
5 AT&T 6300

VILLANOVA U
26 ZENITH 286 LP
16 ZENITH 159
16 IBM MOD 20-286
4 IBM XT (2). ZENITH 159(2).

U OF VIRGINIA (DARDEN)
36 IBM PS/2 MOD 50. IMB PC. IBM PC/XT.
11 APPLE MACINTOSH + APPLE MACINTOSH II.
4 IBM PC
8 WIN AT 286

VIRGINIA TECH (PAMPLIN)
20 IBM PC
21 ZENITH 248
25 IBM PS/2. ZENITH 248, 386. AST. AT&T.

WAKE FOREST U (BABCOCK)
26 ZENITH 159

U OF WASHINGTON
38 IBM PC
38 HP VECTRA
21 MAC II
43 HP 150

WASHINGTON U (OLIN)
30 IBM
7 286-CLONES

WASHINGTON AND LEE U
31 PS/2

WAYNE STATE U
24 IBM PC/XT/AT
24 ZENITH 158
22 IBM PS/2. ZENITH. MACINTOSH.
21 IBM PS/2. ZENITH.

WESTERN CAROLINA U
42 IBM PC/AT, ZENITH, EPSON EQUITY III+
12 EPSON EQUITY III, ZENITH 286.

WESTERN ILLINOIS U
17 ZENITH 150+
32 IBM PC

COLLEGE OF WILLIAM AND MARY
42 WIN

U WISCONSIN, EAU CLAIRE
25 IBM PC
25 PS/2
20 ZENITH 158
30 ZENITH 158

U WISCONSIN, LA CROSSE
24 ZENITH 238
24 ZENITH 238

NET LINK 2 0 1 U 1/3-2/3
NET LINK 2 1 0 U 1/3-2/3
NET LINK 1 1 0 U G <1/3

NET LINK 7 2 0 G <2/3
NET 1 1 0 G <2/3
NET LINK 1 0 0 G <2/3
NET LINK 0 0 0 F <2/3

NET 1 2 0 G <1/3
NET LINK 0 0 0 U >2/3
NET LINK 19 0 0 U G >2/3
NET LINK 3 1 0 U G >2/3
NET LINK 40 2 6 U >2/3

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NET 0 0 0 U G >2/3
NET 1 0 0 U G >2/3
NET 9 4 1 U G >2/3
NET 13 0 0 U G >2/3

NET 10 0 0 U G >2/3
NET 12 0 0 U

NET 3 0 0 U >2/3
NET 8 0 0 U >2/3

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NET LINK 3 1 0 U G 1/3-2/3
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