Sixth Annual UCLA Survey of Business School Computer Usage

Providing the most comprehensive picture to date of the business school computing, communication, and information environment, this year's survey extends the focus of the Fourth Survey (1987) and raises the question: how to most effectively manage these resources.

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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 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 survey because of missing data. Additionally, throughout this survey, 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 that 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.

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-percent response rate. The questionnaires were completed primarily by computer center directors (36 percent), faculty members (26 percent), and assistant deans (21 percent).

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 computer resources, this survey sample increased 27 percent (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 I displays general demographic information

[1] For previous surveys, the Second, Fourth, and Fifth, see *Communications*, January 1986; July 1988; and January 1989.

[2] The 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.

TABLE I. Demographics of Participating Schools
(Percent of schools)

	Sixth 1989 $N = 163$	Fifth 1988 $N = 175$	Fourth 1987 $N = 128$	Second 1985 $N = 125$	First 1984 $N = 35$
Type of School:					
Public	68	68	67	69	49
Private	32	32	33	31	51
Degrees offered:					
Undergraduate only	3	2	2	2	
Undergraduate and Graduate	89	88	85	86	66
Graduate only	7	10	13	12	34
Student Enrollment (FTE):					
Less than 1000 students	22	24	25	22	37
Between 1000 and 2000	26	21	27	22	23
Between 2000 and 3000	20	23	24	26	20
More than 3000 students	31	32	24	30	20
Mini/mainframe Facilities:					
Both School and University	31	34	29	27	54
School only	6	6	7	4	6
University only	59	56	60	64	40
No data	4	4	4	5	

about the 163 schools in this year's sample together with data from previous survey samples. For most of the categories given in Table I, 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.

The schools that 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 percentage of the school's operating budget. Appendix 1 (not included here) presents information on student enrollment, faculty counts, budgets, and staff ratios by school for the 1989 sample.[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.

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 percent) of the schools reported their total school budget; 126 (77 percent) reported their computer operations budget; and 110 (68 percent) reported both. Several schools noted some changes in the inclusions 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 percent of the total school budget, up from 3.3 percent in the Fourth Survey (1987) and 3.0 percent 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 percent) 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 budgetary data across the business schools, the annual computing operating budget was converted into a per stu-

[3] Copies of this survey, complete with Appendices, can be obtained at $7.50 each by contacting the Information Systems Research Program, Anderson Graduate School of Management, University of California, Los Angeles, CA 90024-1481.

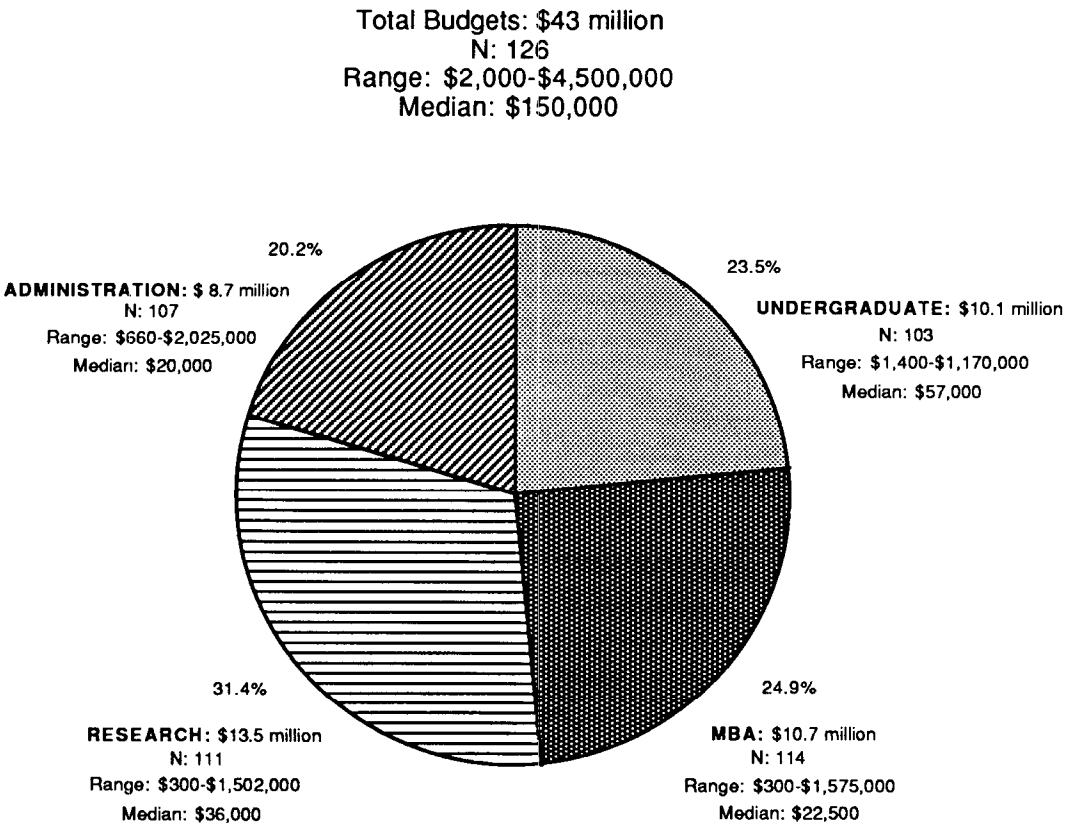

FIGURE 1. Business School Computer Operating Budget Allocations

dent 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 percent) of the schools provided data regarding their sources of funding for operations and maintenance, hardware acquisition, and software acquisition. Table II summarizes this data, showing the percentage of schools indicating that at least 50 percent 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 percent 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.

Student charges for computer usage were clearly not a primary source of funding for many of the business schools. One hundred six (71 percent) of the undergraduate schools indicated that no computer-usage charges were charged for their program, and 108 (69 percent) of the graduate schools indicated that no computer-usage charges were charged for the MBA program. However, the data from the schools that did delineate their charge structures are presented in Table III. 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 percent) of the business schools indicated that faculty were charged for mini/mainframe or microcomputer usage, other than university-provided charge-back funds.

Computing Staff

An extremely important dimension of a business school's computing environment is its support staff. One hundred thirty-one (80 percent) 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 0.25 to 47.5 FTE. By category, the staffs ranged from 0.1 to 21 FTE for technical, hardware, and network staff; from

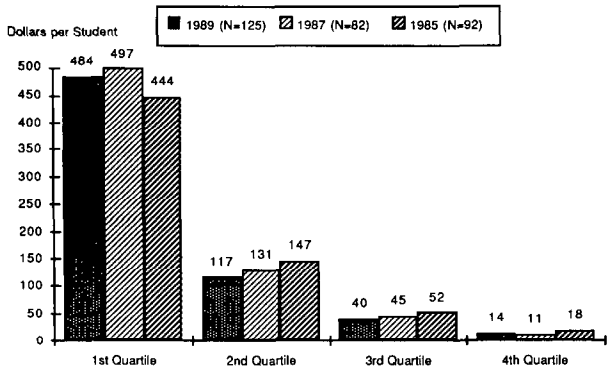

FIGURE 2. Median Computer Operating Budget Expenditure by Quartiles

0.1 to 21.75 FTE for academic user support staff; from 0.25 to 12.75 FTE for administrative user support staff; and from 0.25 to 11 FTE for computer facilities management staff.

Table IV 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 1,993, 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 1,993 students, as compared to 1,820 students in the 1985 data. The disparity in student computing support between the first and fourth quartiles remains dramatic.

MINI/MAINFRAME COMPUTER SYSTEMS

One hundred fifty-six (96 percent) of the business schools indicated that their users had access to mini/mainframe systems. Ten of these schools indicated that they used only their own mini/mainframe systems; fifty schools accessed both their own and university-wide systems; and the remaining 96 schools relied exclusively on access to the university-wide systems. Appendix 2 (not included here) provides detailed information on the make and models of the mini/mainframes available as reported by each school.

The 61 business schools (37 percent) that maintained their own mini/mainframe systems listed 122 separate computers. Table V 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

TABLE II. Primary Sources of Funding
(N = 143)

	1989			1987	
	Operation & Maintenance	Software Acquisition	Hardware Acquisition	Operation & Maintenance	Hardware & Software Acquisition
At least 50% from:					
B-school or Univ	81	71	59	64	48
State/Government	17	19	19	14	17
Vendor		3	10	2	9
Private Contribution	1	6	7	4	14
Student Charges	4	6	4	5	2

TABLE III. Computer Usage Charges at Business Schools

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

TABLE IV. Median Computing Staff Support by Category

	Quartile			
	1st	2nd	3rd	4th
Technical Support	5.5	2	1	.5
Academic Users	10	4.5	2	.5
Administrative Users	3	1	1	.5
Management	3	2	1	.5
Total Staff FTE	21.5	9.5	5	2

the largest number of systems installed, with 42 (34 percent) 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 that maintained their own mini/mainframes indicated several distinct patterns of usage, as shown in Table VI. 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.

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 1989 survey 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.

Models and Market Penetration

Table VII 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, along with 48 different microcomputer models. Eighty-six percent of the schools again reported having four or more IBM PCs or PC/XTs, 49 percent IBM PS/2s, 35 percent Macintosh Pluses or SEs, 34 percent IBM PC/ATs, and 29 percent Zeniths or Zenith 150s. All of the other models were reported by less than 20 percent of the schools.

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 VIII documents this change. For example, in 1987, about 50 percent of the respondent schools were supporting one or two different microcomputer models, yet in 1989, only 7 percent of the schools supported one or two models. In other words, 93 percent 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 IX details these

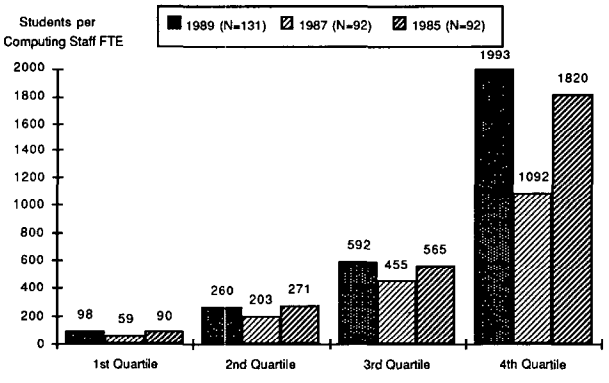

FIGURE 3. Median Staff Support of Computing by Quartiles

TABLE V. Mini/Mainframe Systems Installed by Model (Number of systems)

Make (at least three systems)	1989 $N = 61$	1988 $N = 70$	1987 $N = 46$	1985 $N = 39$	1984 $N = 33$
AT&T					
3Bx	15	14	3		
Data General					
MV xxx	3	4	2		
Digital					
VAX 11/7xx	18	23	17	10	7
VAX 8xxx	8	7	4		
MicroVAX	16	11	5		
Hewlett Packard					
HP3000s	12	12	11	8	6
IBM					
4300s	17	16	13	9	2
S36,38	7	6	3	1	
NCR					
8750, 9300, Tower	3	4	3	3	
PRIME					
7xx, 8xx, 9xxx	3	5	3	4	2
WANG					
VS, OISs	4	7	5	3	6
Others (1 or 2 each)	16	18	11	21	14
TOTAL	122	127	80	59	37

TABLE VI. Mini/Mainframe Systems Usage Patterns $N = 35$ Business schools (using 61 mini/mainframes)

	Usage Categories				
	Course		Research		Administration
12 used only for	X				
8 used only for			X		
5 used only for					X
17 used for all	X	and	X	and	X
14 used for	X	and	X		
4 used for	X			and	X
1 used for			X	and	X

TABLE VII. Microcomputer Systems by Model (Percent of schools with systems)

Model (at least 4 systems)	Participating Schools 1989 $N = 161$	1988 $N = 175$	1987 $N = 128$	1985 $N = 119$
IBM PC, PC/XT	86	86	86	82
IBM PS/2	49	31		
Macintosh Plus/SE	35	29	26	13
XT Clone	35			
IBM PC/AT	34	35	35	5
Zenith	29	42	30	10
Macintosh II	17			
AT Clone	17			
HP Vectra 286	13	11	9	3
AT&T 286	12	14	6	0
386 Clone	8			
HP Vectra 386	7			
HP 150s	6	7	10	4
Unisys	6	7	8	4
DEC Rainbow	6	6	6	13
Apple II series	5	7	10	16
Leading Edge	4			
AT&T 386	3			
Tandy	2	4	2	10
NCR	2			
Other	33	35	31	19

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 percent over the past year in contrast to 62 percent and 75 percent between 1987–1988 and 1985–1987, respectively. The rate of growth in the average number of

TABLE VIII. Different Microcomputer Models Supported by School ($N = 161$)

Number of different microcomputer models	1989	1987
1	1%	17%
2	6	35
3	11	24
4	15	12
5	18	7
6	14	3
7	10	
8	7	
9	8	
10	5	1
11–14	4	

systems per school, however, has increased slightly, 23 percent compared to 18 percent between 1987 and 1988. The early IBM PC and PC/XT together with the XT clones remain dominant, representing 39 percent of the microcomputer systems while the other contending models, except for Zenith, are very close together at just under 10 percent.

Microcomputer Densities

Two ratios were calculated to provide further understanding of the penetration of microcomputers into 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 reflects the number of students who share access to a single microcomputer. For example, a

TABLE IX. Microcomputer Systems by Model (Number of systems)

Model (>300 systems)	Participating Schools 1989 $N = 161$ n	%	1988 $N = 175$ n	%	1987 $N = 128$ n	%	1985 $N = 119$ n	%
IBM PC, PC/XT	9,286	30	10,149	37	7,509	45	5,120	54
Zenith	3,923	13	3,274	12	1,791	11	411	4
XT Clones	2,714	9						
IBM PS/2	2,393	8	1,305	5				
Macintosh	2,165	7	1,893	7	925	5	457	5
IBM PC/AT	1,827	6	2,110	8	1,194	7	259	3
HP Vectra 286	1,194	4	538	2	349	2	40	0
AT Clones	1,055	3						
AT&T	1,043	3	1,172	4				
Unisys	881	3	765	3	593	4	544	6
HP Vectra 386	632	2						
Mac II	444	2						
DEC Rainbow	409	1	557	2	585	4	855	9
Leading Edge	403	1						
ITT	351	1						
Others	2,020	7	5,447	20	3,779	22	1,870	19
Total	30,740	100	27,210	100	16,725	100	9,556	100
Average systems per school	191		155		131		80	

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.

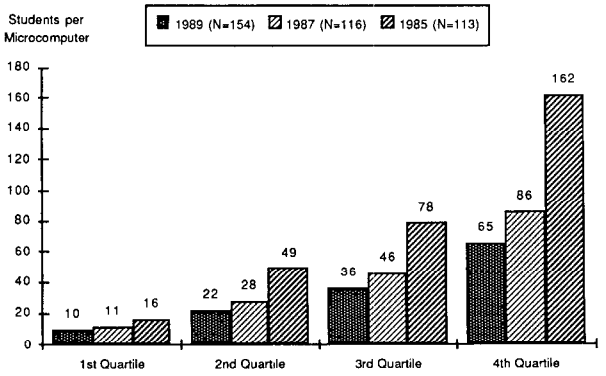

FIGURE 4. Student Microcomputer Density by Quartiles

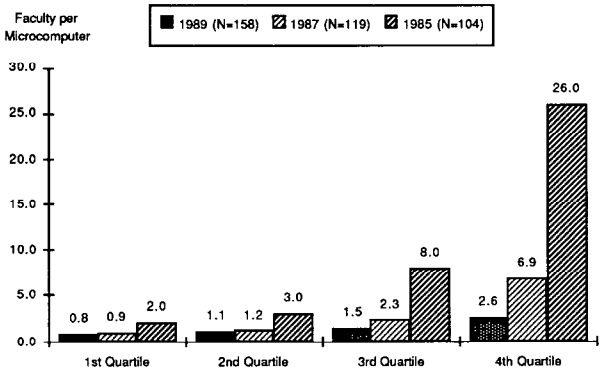

FIGURE 5. Faculty Microcomputer Density by Quartiles

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.

Maintenance

One hundred fifty-four (95 percent) responded to the school-owned microcomputer maintenance question. Only three of these schools responded that they had no maintenance program or that they had not dealt with this issue yet. Several schools employed more than one of the maintenance options provided. Seventy-eight (51 percent) of the schools responded that they used their own staff for maintenance, 49 (32 percent) contract with outside vendors, and 91 (59 percent) contract with university services. Fifteen (10 percent) 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 percent) indicated that their business school provided the maintenance whereas 100 (62 percent) did not. Five schools provided support for faculty-owned software.

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 X and XI present different aspects of the portable system data. Table X presents information on the portable systems installed by the schools by vendor. Zenith systems increased slightly, now being available in 47 percent of the schools, whereas both Compaq and IBM decreased slightly. Toshiba, Hewlett-Packard, and NEC stayed about the same.

Table XI 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 1989 survey reported having portable microcomputers, up from 77 percent in the Fifth Survey (1988). Although data was collected by model, in Table XI 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 percent of the systems. Zenith has taken over the second position with 11 percent of the systems. IBM has dropped consider-

TABLE X. Portable Systems by Schools (Percent of schools)

Model	Participating Schools 1989 N = 163	1988 N = 175	1987 N = 128
Zenith	47%	43%	23%
Compaq	28	39	23
IBM Convertible	26	33	27
Toshiba	17	16	—
HP 110, 110 Plus	14	15	11
NEC	6	5	2
Tandy	3	4	—
Other	—	14	16

TABLE XI. Portable Systems Supported by Vendor (Number of systems)

Model	Participating Schools 1989 N = 135 n	%	1988 N = 135 n	%	1987 N = 82 n	%
Hewlett-Packard	3,226	69	990	43	1,076	66
Zenith	502	11	291	13	77	5
Compaq	315	7	338	15	151	9
IBM	236	5	447	19	226	14
Toshiba	153	3	149	6	13	1
Tandy	113	2	11	>1	7	>1
NEC	29	<1	25	1	28	2
Other	126	3	77	3	49	3
Total	4,700	100	2,328	100	1,627	100
Average systems per school	34.8		17.2		19.8	

ably in this past year, from 19 percent to now only 5 percent.

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 IIcx), the distinction between workstations and microcomputers is becoming a gray area. Table XII 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 percent of the reported systems.

COMPUTER LABS

Data on computer labs was provided by 157 (96 percent) 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 (not included here) details the computer lab environment for the 468 labs reported that had four or more microcomputer systems.

The 12,450 microcomputers in the labs comprise 40 percent of the total microcomputers reported in this study. Twenty-two percent of the schools reported having one computer lab, and an additional 23 percent reported two labs. Eighteen percent and 16 percent have three and four labs, respectively, and 20 percent 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 percent 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 percent having the microcomputers networked and 48 percent 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 percent. Twenty-one percent of the schools reported a laser printer in addition to the dot-matrix, and another 11 percent reported a plotter as well. Only 7 percent of the schools reported laser printers as the only output device.

TABLE XII. High-Performance 32-bit Graphic Workstations

Model	1989 N = 33 Percent Schools	Total Systems n	%	1988 N = 31 Percent Schools	Total Systems n	%
Sun	39	73	23	42	50	34
Vaxstation	36	153	49	19	16	11
IBM RT	30	33	10	26	59	41
Xerox	9	30	9	3	4	3
HP Apollo	9	21	7	10	13	9
NeXT	9	3	1			
TI Explorer	9	3	1	10	3	2
Total		316	100		145	100

COMMUNICATIONS

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

Microcomputer Communications

Network data provided by 130 of the business schools for 25,468 microcomputers showed that 45 percent (11,390) of the microcomputers are stand alones, not linked to any other computer systems. Eighteen percent (4,487) are linked to a host only; 10 percent (2,497) are linked to other microcomputers; and 28 percent (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.

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 XIII.

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 percent connectivity of their systems to a host. Of the 144 business schools that provided data regarding a data switch, port selector, or PABX, 51 percent (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 that reported LAN software, 58 (44 percent) listed only one LAN software, 33 (25 percent) listed two different LAN software systems, 19 (15 percent) listed three, 14 (11 percent) listed four, and 7 (5 percent) listed five or more.

Network Applications

The distinction between local and wide area networks has become increasingly blurred as the software that bridges between the applications has become more transparent to the user. Table XIV 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.

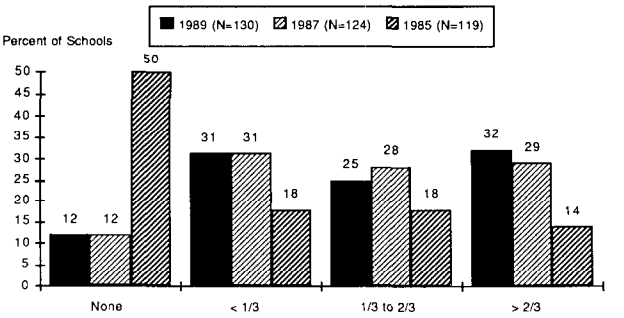

FIGURE 6. Microcomputers with Communications Connectivity

TABLE XIII. Local Area Networks Installed (Percent of schools)

Type of LAN (at least 3)	1989 N = 131	1989 Networked to host	1987 N = 84	1985 N = 49
Novell (Arcnet or Netware)	47%	36%	26%	
Ethernet	36	83	40	12%
Apple Talk	35	34	23	24
IBM Token Ring	24	57	12	6
IBM PCnet	15	22	20	
Decnet	13	94	20	4
Starlan	11	75	7	6
Ungermann Bass	6	88	6	
Unisys	3	75	4	
Others	20	31	41	4

TABLE XIV. Network Applications (by user group percents) (N = 149)

Application	Avg.	Under Grad	MBA	Faculty	Sec/ Admin	Computer Staff
Electronic mail	52	28	36	76	60	59
Document/file transfer	47	33	38	68	47	50
BITNET	47	22	37	85	30	59
Database access	42	32	40	63	36	40
File server	42	40	44	46	35	44
Disk backup/restore	30	16	18	38	34	43
CompuServe	14	9	12	30	3	17
Electronic conferencing	10	5	9	15	7	14
Internet	9	4	7	15	7	11

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 XV 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.

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 packages 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. Since the list was so extensive, separate tables were required for each category.

Artificial Intelligence, Expert Systems

This software application area, detailed for the first time in this survey, is summarized in Table XVI 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.

Business Games

As in the 1987 survey results, this type of application

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

	Mini/mainframes			Microcomputer		
		# of Packages			# of Packages	
	# Schools	Instruction	Research	# Schools	Instruction	Research
Spreadsheets	12	7	6	156	17	16
Word Processing	31	13	22	155	28	29
Database Mgmt Sys	84	32	34	148	28	23
Communications	102	22	26	126	35	39
Statistical	139	14	11	119	34	34
Prog Languages	117	19	17	115	18	16
Graphics	35	13	19	97	60	56
Modeling/Opt	85	26	27	94	38	29
Desktop Pub	20	8	7	85	13	13
Dev Tools	9	11	9	75	22	13
Business Games	37	28	4	71	52	9
AI/Expert Sys	20	10	11	69	28	24
Simulation	62	8	10	54	20	14
Integrated Project Mgmt	3	2	2	51 48	17 17	12 10

TABLE XVI. Artificial Intelligence, Expert System Software (N = Number of schools reporting software package)

Mini/mainframes (N = 20)				Microcomputer (N = 69)			
Instruction		Research		Instruction		Research	
LISP	5	LISP	7	VP-Expert	22	Prolog	15
Other	16	Other	18	Prolog	15	Exsys	8
				Exsys	13	Guru	8
				Guru	12	LISP	8
				Prsl Cnlt	6	VP-Expert	8
				Other	32	Prsl Cnlt	5
						Other	22
Different Packages	10		11		28		24

TABLE XVII. Business Games Software (N = Number of schools reporting software package)

Mini/mainframes (N = 37)				Microcomputer (N = 71)			
Instruction		Research		Instruction		Research	
Markstrat	13	Other	4	Markstrat	16	Other	11
Other	27			Bus Adv	7		
				Marketing Game	6		
				Other	67		
Different Packages	28		4		52		9

software remains stronger for instructional usage than for research, with Markstrat continuing to be the most popular package. However, as shown in Table XVII, the high number of different packages for microcomputers, 52, reflects the integration of business games into the curriculum.

Communications

Communications software is another new application area detailed for the first time in this survey. Table XVIII 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.

Database Management Systems

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

The most dominant microcomputer package was dBase, 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.

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 XX, 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.

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. Excelerator was listed by 62 of the 75 schools identifying microcomputer-based CASE software.

Graphics and Presentation Software

Graphics application software, detailed in Table XXI, is dominated by usage on microcomputers with almost three times as many schools listing software 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 XVIII. Communications Software (N = Number of schools reporting software package)

Mini/mainframes (N = 102)				Microcomputer (N = 126)			
Instruction		Research		Instruction		Research	
KERMIT	72	KERMIT	80	KERMIT	76	KERMIT	80
YTERM	10	YTERM	15	Procomm	33	Procomm	37
Procomm	6	Procomm	7	YTERM	16	YTERM	20
Other	23	Other	25	Other	40	Crosstalk	7
						Other	48
Different Packages	22		26		35		39

TABLE XIX. Database Management System Software (N = Number of schools reporting software package)

Mini/mainframes (N = 84)				Microcomputer (N = 148)			
Instruction		Research		Instruction		Research	
Oracle	15	INGRES	12	dBase	123	dBase	73
SQL	15	Oracle	11	R:BASE	45	R:BASE	33
INGRES	14	SQL	9	Oracle	12	Oracle	11
Informix	5	Focus	6	Focus	10	Focus	9
PowerHouse	5	Other	37	INGRES	8	INGRES	8
RDB	5			Other	30	Paradox	5
Other	28					Other	23
Different Packages	32		34		28		23

TABLE XX. Desktop Publishing Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 20)				Microcomputer (N = 85)			
Instruction		Research		Instruction		Research	
TEX	7	TEX	14	PageMaker	37	PageMaker	35
Other	7	Other	6	Ventura	14	Ventura	19
				TEX	6	TEX	17
				Ready Set Go	5	Other	14
				Other	11		
Different Packages	8		7		13		13

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-percent decrease in the number of schools listing this application between 1987 and 1989.

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 XXII.

Programming Languages

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

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.

Simulation

Simulation is another application that 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 XXIV, GPSS dominates overall.

Spreadsheet Packages

As indicated in Table XXV, 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.

Statistical Packages

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

Word Processing

Word processing is the single most prevalent software application. As shown in Table XXVII, 155 business schools listed 29 different microcomputer word-

TABLE XXI. Graphics and Presentation Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 35)				Microcomputer (N = 97)			
Instruction		Research		Instruction		Research	
SAS Graph	10	SAS Graph	14	Harvard	39	Harvard	42
SPSS	5	SPSS	6	Lotus	20	Freelance	17
Other	11	Telegraf	3	FreeLance	11	Lotus	15
		Other	19	MacDraw	8	MacDraw	10
				Storyboard	7	Chart	8
				Chart-Master	6	HP Gallery	6
				HP Gallery	5	SAS Graph	6
				MacPaint	5	Other	62
				Other	65		
Different Packages	13		19		60		56

TABLE XXII. Modeling and Optimization Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 85)				Microcomputer (N = 94)			
Instruction		Research		Instruction		Research	
LINDO	47	LINDO	38	LINDO	59	LINDO	30
IFPS	38	IFPS	27	IFPS	34	IFPS	18
Other	26	Other	27	What's Best!	11	What's Best!	5
				Storm	9	Other	31
				QSB	5		
				Other	36		
Different Packages	26		27		38		29

TABLE XXIII. Programming Language Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 117)				Microcomputer (N = 115)			
Instruction		Research		Instruction		Research	
COBOL	73	FORTRAN	63	BASIC	84	BASIC	58
BASIC	40	BASIC	36	Pascal	30	FORTRAN	38
FORTRAN	28	COBOL	32	C	25	C	31
Pascal	26	Pascal	27	COBOL	25	Pascal	29
C	17	C	24	FORTRAN	18	COBOL	9
PL/1	6	PL/1	10	Prolog	8	Prolog	8
Other	20	Other	16	Other	12	LISP	5
						Other	15
Different Packages	19		17		18		16

TABLE XXIV. Simulation Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 62)				Microcomputer (N = 54)			
Instruction		Research		Instruction		Research	
GPSS	36	GPSS	22	GPSS	12	STELLA	10
Simscript	15	SLAM	15	STELLA	8	GPSS	9
SLAM	13	Simscript	12	SLAM	7	Simscript	8
Other	5	Other	9	Simscript	6	SLAM	5
				Other	23	Other	10
Different Packages	8		10		20		14

TABLE XXV. Spreadsheet Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 12)				Microcomputer (N = 156)			
Instruction		Research		Instruction		Research	
20/20	5	20/20	7	Lotus 1-2-3	141	Lotus 1-2-3	104
Other	6	Other	5	Excel	38	Excel	40
				Ovation	21	Ovation	20
				VP-Planner	17	VP-Planner	8
				SuperCalc	6	SuperCalc	5
				Other	17	Other	13
Different Packages	7		6		17		16

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.

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.

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.

Entrance and Graduation Requirements/Expectations

This year's survey requested rather extensive information regarding both computer-literacy entrance and

TABLE XXVI. Statistical Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 139)				Microcomputer (N = 119)			
Instruction		Research		Instruction		Research	
SAS	85	SPSS	98	SPSS	37	SPSS	53
SPSS	80	SAS	96	SAS	32	SAS	49
Minitab	39	BMPD	15	Minitab	26	SYSTAT	16
BMPD	10	Minitab	13	SYSTAT	13	Minitab	12
Other	12	LISREL	5	StatGraphics	12	RATS	9
		TSP	5	Microstat	6	Gauss	6
		Other	8	TSP	5	StatGraphics	6
				RATS	5	TSP	6
				Other	33	Other	32
Different Packages	14		11		34		34

TABLE XXVII. Word Processing Software
(N = Number of schools reporting software package)

Mini/mainframes (N = 31)				Microcomputer (N = 155)			
Instruction		Research		Instruction		Research	
Other	22	Script	6	WordPerfect	114	WordPerfect	101
		XEDIT	6	MS Word	38	MS Word	41
		TEX	5	WordStar	35	WordStar	36
		Other	27	PC-Write	13	PC-Write	10
				DisplayWrite	9	DisplayWrite	8
				MultiMate	7	MultiMate	7
				MacWrite	5	PFS Write	5
				PFS: Write	5	TEX	5
				Other	30	Other	28
Different Packages	13		22		28		29

graduation requirements and/or expectations separately for the undergraduate and MBA programs. Of the 149 business schools supporting undergraduate business programs, 81 percent (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 percent (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 XXVIII 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 percent of the undergraduate programs and by only 38 percent 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 percent of the undergraduate schools and 62 percent of the graduate program schools, followed by Pascal (15 percent and 3 percent), COBOL (12 percent and 7 percent), and FORTRAN (2 percent), of the undergraduate and graduate programs respectively.

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/

TABLE XXVIII. Computer Requirements and Expectations Upon Graduation (Percent of schools)

	Undergraduate N = 149		MBA N = 157	
	Required	Expected	Required	Expected
Computer/Info Sys course	91%	3%	75%	10%
Microcomputer use	83	12	76	17
Spreadsheet use	81	14	72	21
Word Processing use	71	20	51	37
Database use	58	19	41	29
Mini/mainframe use	50	25	38	30
Programming language	41	16	19	15
Online database retrieval	18	25	17	29
Computer literacy exam	11	10	12	11

mainframe systems at the undergraduate and graduate level. For the undergraduate programs, 145 of the 149 schools provided data and indicated that on the average 80 percent of their student computing was done on microcomputers and 20 percent on mini/mainframes. For the MBA programs, all the schools provided data and indicated that on the average 83 percent of their student computing was done on microcomputers and 17 percent 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 percent of the undergraduate and 7 percent 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.

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.

To see an aggregate growth of required computer usage across the curriculum, the data for Figures 7 and 8 were compared with that from both 1987 and 1985 and is shown in Table XXIX. The net change for each academic area between the 1989 and the 1987 data was calculated and then averaged into an undergraduate and graduate total for each of the years. Table XXIX shows a slow, but continuing, increase of computer usage for both business programs, about 5 percent for the undergraduate programs and 6.6 percent 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.

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 XXX and XXXI summarize these data separately for the undergraduate and graduate core courses. The *N* values in the tables are the number of schools that 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-percent increase (64 percent to 78 percent) whereas the undergraduate shows only about a 7 percent increase (from 68 percent to 75 percent). Major increases were also seen in the amount

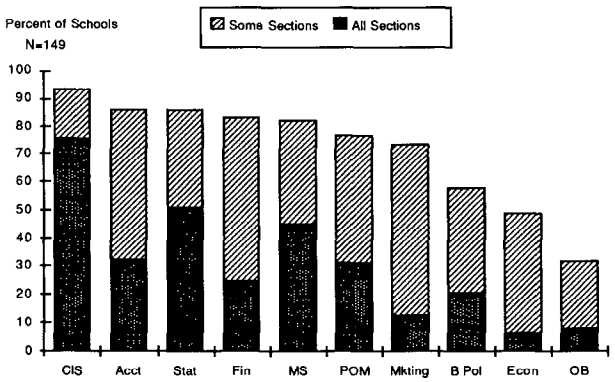

FIGURE 7. Required Computer Use in Undergraduate Core Courses

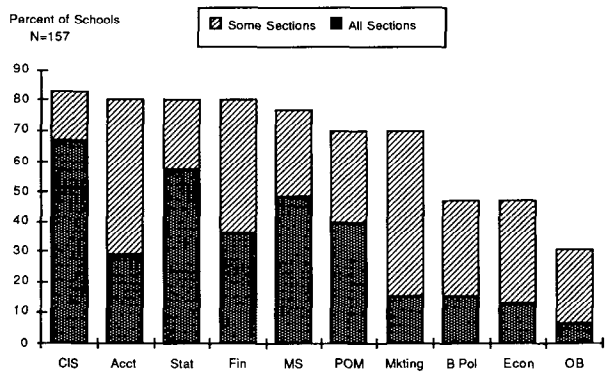

FIGURE 8. Required Computer Use in Graduate Core Courses

TABLE XXIX. Growth in Required Computer Usage in Core Courses

	Undergraduate				Graduate			
Core Courses	1989	Change	1987	1985	1989	Change	1987	1985
Accounting	86%	2%	84%	62%	80%	10%	70%	55%
Business Policy	58	11	47	42	47	3	44	32
Economics	49	12	37	29	47	16	31	32
Finance	83	2	81	64	80	5	75	76
Info Systems	93	−1	94	87	83	5	78	78
Mgt Science	32	6	26	20	77	3	74	77
Marketing	82	1	81	82	70	12	58	55
Org Behavior	74	5	69	52	31	9	22	21
Prod/Operations	77	3	74	78	70	−5	75	71
Statistics	86	5	81	76	80	8	72	69
Average	72%	4.6%	67.4%	59.5%	66.5%	6.6%	59.9%	56.6%

TABLE XXX. Sources of Undergraduate Courseware (Percent of schools with required computer use)

Undergraduate Core Class	*N*	Internal	Textbooks	Commercial	Other University
Accounting	128	24%	62%	69%	7%
Business Policy	86	14	47	63	8
Economics	73	26	41	69	8
Finance	123	24	52	75	4
Information Systems	138	36	57	88	8
Management Science	122	25	56	80	7
Marketing	110	22	47	68	8
Organizational Behavior	48	25	48	77	6
Production/Operations	155	23	51	74	5
Statistics	128	20	30	82	9
Average		24	49	75	7

TABLE XXXI. Sources of Graduate Courseware (Percent of schools with required computer use)

Graduate Core Class	*N*	Internal	Textbooks	Commercial	Other University
Accounting	125	26%	46%	71%	7%
Business Policy	74	19	39	69	7
Economics	73	22	33	77	4
Finance	125	29	38	80	6
Information Systems	130	33	40	86	12
Management Science	120	24	46	79	6
Marketing	109	22	36	76	6
Organizational Behavior	49	27	37	80	6
Production/Operations	110	26	40	76	7
Statistics	125	22	33	83	7
Average		25	39	78	7

of courseware acquired with textbooks, 21 percent (28 percent to 49 percent) for the undergraduate level courseware and 20 percent (19 percent to 39 percent) for the graduate level. The internally developed and acquisitions from other university percentages remained about the same as the 1987 data.

Classroom Electronic Equipment

There was an increase of 7 percent (83 percent of the business schools in the 1987 survey to 90 percent in this 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 percent) had permanently installed equipment; 68 schools (47 percent) in less than 25 percent of the classrooms; 10 schools (7 percent) in 25 percent to 50 percent of the classrooms; and 9 schools (6 percent) in more than 50 percent of their classrooms. Again, a heavy dependency was shown on

mobile units that 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.

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 XXXII 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 dominant 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 among the least effective of the approaches (2.3).

DATABASES AVAILABLE FOR INSTRUCTION AND RESEARCH

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

Compustat again remains the most widely used database and is available in 74 percent (121) of the schools. Twenty-eight percent (45) of the schools reported storing the Compustat database online; 48 percent (78) schools used tape storage; and 17 percent (27) schools reported now having Compustat available on CD-ROM.

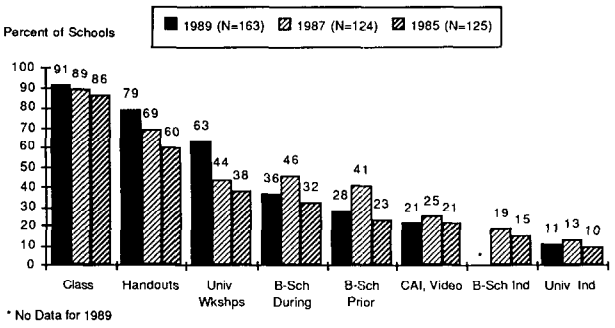

FIGURE 9. Types of Computer-Related Training for Students

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 percent (58) of the schools. Faculty are shown to be the primary users. Continuing across Table XXXIII, Compustat users are reported to be given "some support" by the schools, on average, and only 9 percent of the schools have an access charge for using the database.

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

ADMINISTRATIVE SYSTEMS

Table XXXIV 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 percent 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 percent of the schools. Very few schools listed commercial mini/mainframe administrative system software, rather that most systems were developed in-house.

CONCLUSIONS AND OPEN QUESTIONS

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

TABLE XXXII. Computer-Related Training by User Group (Percent of schools)

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

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

TABLE XXXIII. Databases Available for Research and Instruction $N = 163$ (Ordered by availability) (Percent of schools)

		Storage format			Access method			Primary users			Level of support for users		
Availability	Database	online	tape	CD-ROM	stand-alone system	terminal dialup	via network	Faculty	PhD	MBA	1 = users on own 3 = some support 5 = extensive support	Access charge	Funding available
74%	Compustat	28%	48%	17%	17%	36%	26%	67%	34%	29%	3.0 (1.3)	9%	17%
63	CRSP	26	42		7	33	28	58	31	20	3.0 (1.3)	7	14
37	Library catalog	34	1	4	6	18	23	35	18	28	3.0 (1.2)	3	5
26	Dow Jones	21	4		4	28	5	25	7	17	3.0 (1.3)	12	10
24	Citibase	12	13		4	10	13	22	11	9	3.1 (1.2)	1	3
21	Compact Disclosure	4	2	17	17	3	2	14	7	13	2.9 (1.1)	1	4
17	ABI Inform	8		11	11	7	1	12	6	11	3.9 (1.3)	4	4
17	Lexis	17			1	16	1	14	4	7	2.8 (1.4)	8	9
13	Value Line	6	6		4	4	4	13	4	8	3.2 (1.3)	1	1

TABLE XXXIV. Administrative Systems Supported/Developed by Business Schools ($N = 163$) (Ordered by percent of staff usage)

	Computer system			Primary users				Level of support for users
	business school							
Activity	micro	mini/mainframe	campus	faculty	students	staff	Common database with other systems	1 = users on own 3 = some support 5 = extensive support
Word processing	69%	13%	10%	45%	34%	62%	5%	3.5 (1.1)
Student records	13	20	36	7	3	52	24	3.4 (1.2)
Budget preparation	41	8	17	6		50	6	2.8 (1.2)
Admissions	20	20	27	4	2	49	23	3.4 (1.4)
Alumni and development	22	15	25	3		46	14	3.2 (1.2)
Class scheduling	25	12	20	10	3	42	13	3.0 (1.2)
Registration and enrollment	10	18	29	6	9	40	21	3.5 (1.2)
Electronic mail	12	27	29	39	14	36	8	3.5 (1.1)
Room scheduling	15	7	15	6	2	31	6	2.9 (1.3)
Faculty records	24	5	11	8		27	9	2.9 (1.2)
Faculty course assignment	20	7	10	9		26	8	2.9 (1.2)
Publications	29	7	5	15	1	24	3	2.8 (1.3)
Placement services	18	13	5		14	23	6	3.5 (1.3)
Contracts and grant administration	9	3	19	7		21	7	2.7 (1.1)
School catalog	9	1	13	2	2	16	6	2.6 (1.2)
Event listings	6	6	10	6	7	13	4	3.0 (1.3)
Student class bidding	3	6	7	1	11	7	8	3.7 (1.1)

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 will not 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 keyboards, monitors, disc 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 percent 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 percent 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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CR Categories and Subject Descriptors: K.1 **[Computing Milieux]**: The Computing Industry—*markets*; K.2 **[Computing Milieux]**: History of Computing—*hardware*; K.3.0 **[Computers and Education]**: General; K.6.0 **[Management of Computing and Information Systems]**: General

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