THE JOHN E. ANDERSON GRADUATE
SCHOOL OF MANAGEMENT AT UCLA

Fifth Annual UCLA Survey of Business School Computer Usage

September 1988

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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. Ephraim R. McLean, Professor of Information Systems at Georgia State University receives special thanks, not only for his past involvement in the surveys, but also for his insight in suggesting that the surveys be conducted on an annual basis.

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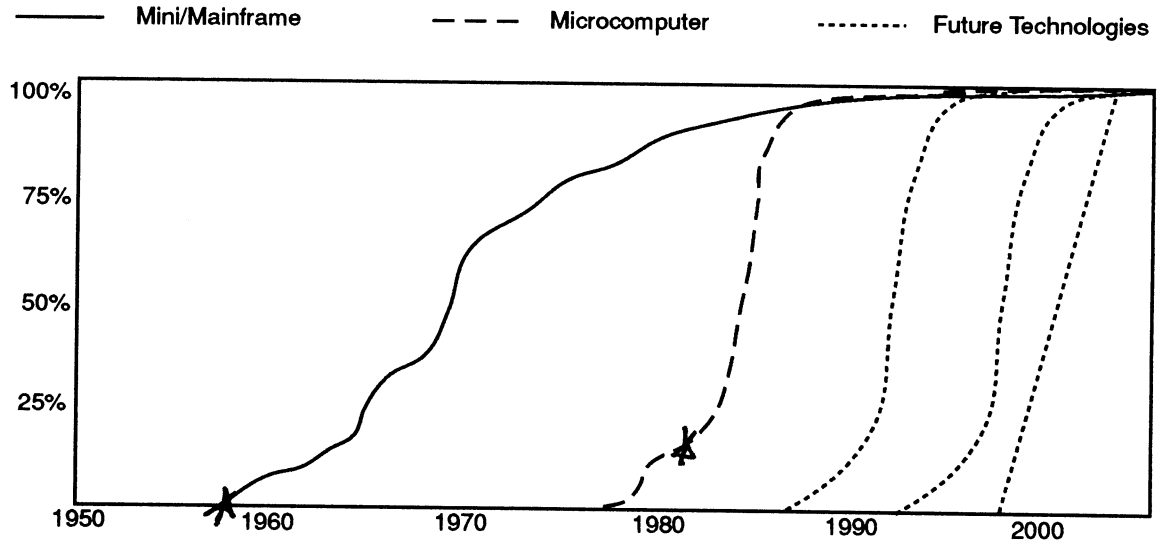
I Introduction

Where are business schools with respect to the computerization process? The decade of the eighties has seen dramatic changes in our computing resources. Faculty and student requirements and expectations have changed as they have gained experience and sophistication, and as technology has changed. Planning under stable conditions is difficult. Under constantly changing conditions, planning becomes even more challenging. Faced with significant resource constraints, business school policy and decision makers need additional information to assist with this difficult task and responsibility.

The rapid and dramatic changes in business school computing resources is illustrated in Figure 1 which shows some of the hardware milestones. This graph, taken from last year's survey, shows the pattern of mini/mainframe and microcomputer introductions into business schools from 1950, projected to the year 2000. A series of successive introductions of future, as yet unidentified, technologies is also shown. These might include CD ROM, scanners, expert systems, and the visualization of data. Even though the details of new technologies is not known, what is clear is that these technological introductions will probably occur more frequently and be integrated faster.

Figure 1: Business School Access to Hardware Technology



The goal of this, the Fifth UCLA Survey of Business School Computer Usage, is to continue monitoring the changing nature of the business school computing environment. The purpose over the past five 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 the focus of the surveys is to reflect 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 resource allocations of schools while the Third Survey addressed issues of concern to deans. This year's survey is looking at business school computerization in term of process. It recognizes that the introduction and use of technology is ongoing and that schools may not only be approaching problems differently, but at different rates.

The questionnaire for this year's survey requested four types of data: demographics, short answer, ranking, and phase. Demographic and selected hardware statistics from previous survey databases were presented for correction and update. Short descriptions of plans, strategies, and results were requested. Four categories of issues, (strategic, instructional, operational, and network), were listed for ranking.

The fourth type of data was based on the multi-dimensional aspect of the computerization process. In these questions, respondents were asked to indicate their "phase" of usage for 21 different areas of business school computerization. Each phase was delineated by points along a process continuum. The phase diagram together with a description of each phase is presented in Appendix 1. This particular phase diagram was generated based on reviews of other life cycle process type graphs and personal experience. The phases are all relative to the individual school's perception of some concept of a *stable* or *mature* environment, and each particular response is relative to the perception of the specific individual who completed the questionnaire. Furthermore, the values indicated do not represent a common starting point, say 1980 or any other specific point in time. Rather, the purpose is to capture a more subjective reflection of where the respondent views his/her business school along the process continuum. It indicates, to some extent, past accomplishments, present position, and future expectations.

Where are business schools with respect to computerization?

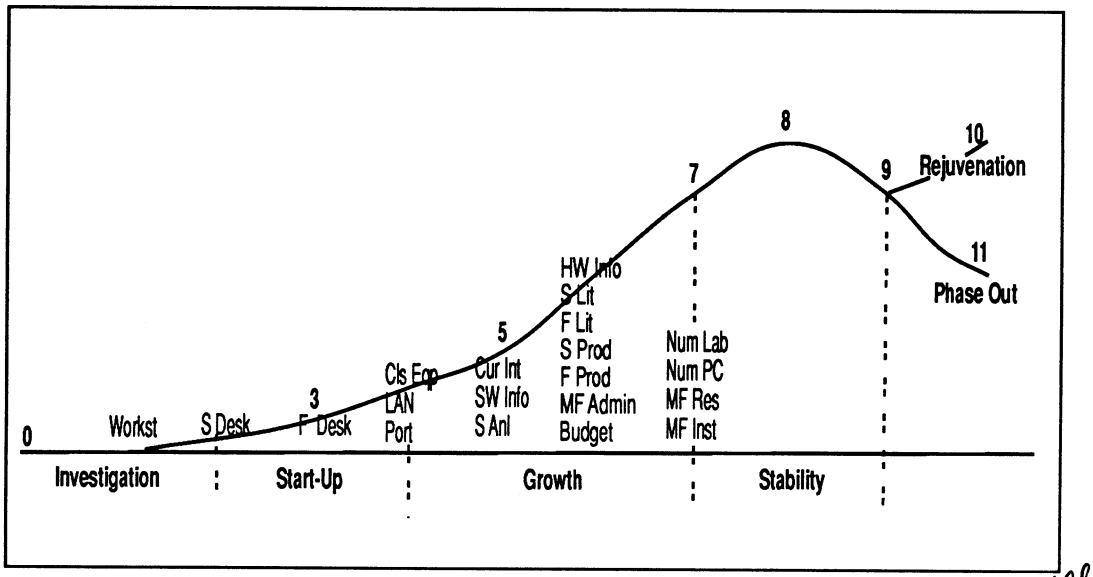
One way to answer this question is to average the responses to the 21 phase questions. This single point is 5.2 and suggests that, overall, business schools are at mid-growth. Figure 2 presents a phase diagram showing the mean for each of the 21 phases. Each phase mean is represented by an abbreviated description defined in Appendix 1. For example, collectively, business schools are at the investigation phase with respect to the number of 32-bit high performancegraphic workstations (Workst). On the other hand, the business schools collectively reflect a mature level with respect to the number of labs (Num Lab), microcomputers (Num PC), use of mainframes for research (MF Res), and instruction (MF Inst).

To better understand *where are business schools*? the data is analyzed in two ways. After a brief presentation of the sample demographics, all participating schools (large and small, public and private, early and late innovators), are combined to look at the data in terms of the separate computerization process areas. The second step looks at the data in terms of clusters of schools, grouped by the similarity of their responses to the 21 phase questions.

Profile of participating schools

The population for this year's study was once again the schools currently accredited by the American Assembly of Collegiate Schools of Business (AACSB) and the eight Canadian schools of

Figure 2: Phases of Business School Computerization
N = 175



see page 28 for Profile

business which had participated in previous surveys. Of the 264 schools invited to participate, 175 returned completed questionnaires, a 67% response rate. This represents a 40% increase in response rate over 1987 and may reflect that more business schools now have computer equipment (or at least more than in the past) and data to contribute, and share the concerns and issues addressed by the surveys. Table 1 lists the schools that participated in this survey and indicates previous participation. Eighty-one percent of the schools which participated in 1987 also participated in 1988.

Table 2 displays general demographic information about the 175 schools in this year's sample together with demographics from previous surveys. For some of the categories displayed in Table 2, the ratio of schools within each sample has been consistent for the past three surveys. For example, for 1985, 1987, and 1988, the ratio of public to private institutions has remained approximately two-thirds public and one-third private. However, differences in other areas point out significant shifts in the make up of this year's sample. Of particular impact is the shift in student enrollments, the number used in the calculation of microcomputer densities and budget per student dollar allocations. The 1988 sample has a 81% increase over the 1987 sample in schools with student enrollments of more than 3000 FTE (full-time equivalent), representing an increase from 31 to 56 schools in this category. The data seem to indicate that the schools that are now entering the study are larger, may be entering computerization at a lower cost per student than the earlier schools,and are able to move along the learning curve with fewer risks and mistakes of trial and error than the early innovators.

It should be pointed out that these surveys do not comprise a longitudinal study. We are not taking the same sample of schools and following them over a period of time. Rather our survey samples comprise the accredited business schools which wish to add their data to the sample. Comparisons between years are misleading and should not be used to conduct any trend analyses.

Table 1
List of Schools Participating in the Fifth Survey
N = 175

2 3 4 5	UNIVERSITY OF AKRON
2 5	UNIVERSITY OF ALABAMA
2 4 5	UNIVERSITY OF ARIZONA
2 3 4 5	ARIZONA STATE UNIVERSITY
2 3 4 5	UNIVERSITY OF ARKANSAS
4 5	UNIVERSITY OF ARKANSAS, LITTLE ROCK
4 5	AUBURN UNIVERSITY
2 3 4 5	BABSON COLLEGE
2 3 5	BALL STATE UNIVERSITY
5	BAYLOR UNIVERSITY
2 5	BOISE STATE UNIVERSITY
2 3 4 5	BOSTON COLLEGE
1 2 4 5	BOSTON UNIVERSITY
2 3 5	BOWLING GREEN STATE UNIVERSITY
2 3 4 5	BRADLEY UNIVERSITY
3 5	UNIVERSITY OF BRIDGEPORT
1 2 4 5	UNIVERSITY OF CALIF, BERKELEY
4 5	UNIVERSITY OF CALIF, IRVINE
1 2 3 4 5	UNIVERSITY OF CALIF, LA (ANDERS
3 5	CALIF POLY STATE UNIVERSITY, SLO
3 5	CALIF STATE UNIVERSITY, CHICO
5	CALIF STATE UNIVERSITY, SACRAMENTO
4 5	CALIF STATE UNIVERSITY, FULLERTON
4 5	CALIF STATE UNIVERSITY, HAYWARD
2 3 4 5	CALIF STATE UNIVERSITY, LA
2 3 4 5	CALIF STATE UNIVERSITY, FRESNO
2 3 4 5	CANISIUS COLLEGE
1 2 5	CARNEGIE MELLON UNIVERSITY
1 2 4 5	CASE WESTERN (WEATHERHEAD)
3 4 5	UNIVERSITY OF CENTRAL FLORIDA
2 5	CENTRAL MICHIGAN UNIVERSITY
3 4 5	UNIVERSITY OF CINCINNATI
5	CLARK UNIVERSITY
2 3 4 5	CLEVELAND STATE UNIVERSITY (NANCE)
2 5	UNIVERSITY OF COLORADO, BOULDER
1 2 4 5	COLUMBIA UNIVERSITY
5	UNIVERSITY OF CONNECTICUT
1 2 4 5	CORNELL UNIVERSITY (JOHNSON)
2 4 5	CREIGHTON UNIVERSITY
1 2 4 5	DARTMOUTH COLLEGE (TUCK)
3 4 5	UNIVERSITY OF DAYTON
2 3 4 5	UNIVERSITY OF DELAWARE
5	UNIVERSITY OF DETROIT
5	DRAKE UNIVERSITY
1 2 3 4 5	DUKE UNIVERSITY (FUQUA)
4 5	DUQUESNE UNIVERSITY
2 3 5	EAST CAROLINA UNIVERSITY
4 5	EASTERN TEXAS STATE UNIVERSITY
2 3 4 5	EASTERN WASHINGTON U NIVERSITY
3 5	EMORY UNIVERSITY
2 3 5	UNIVERSITY OF FLORIDA
5	FLORIDA ATLANTIC UNIVERSITY
2 3 4 5	FLORIDA INTERNATIONAL UNIVERSITY
2 4 5	FLORIDA STATE UNIVERSITY
2 3 5	GEORGE WASHINGTON UNIVERSITY
2 5	UNIVERSITY OF GEORGIA
1 2 4 5	GEORGIA STATE UNIVERSITY
1 2 4 5	HARVARD UNIVERSITY
3 4 5	UNIVERSITY OF HAWAII
2 4 5	HOFSTRA UNIVERSITY
2 5	UNIVERSITY OF HOUSTON
2 4 5	MORGAN STATE UNIVERSITY (HOWARD)
2 3 4 5	UNIVERSITY OF ILLINOIS, CHICAGO
1 2 3 5	UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN
1 2 4 5	INDIANA UNIVERSITY, BLOOMINGTON
4 5	INDIANA UNIVERSITY, GARY
5	INDIANA-PURDUE UNIVERSITY, FORT WAYNE
3 4 5	UNIVERSITY OF IOWA
2 5	JAMES MADISON UNIVERSITY
2 4 5	UNIVERSITY OF KANSAS
2 3 4 5	KANSAS STATE UNIVERSITY
2 5	LOUISIANA STATE UNIVERSITY
2 3 4 5	UNIVERSITY OF LOUISVILLE
3 4 5	LOYOLA MARYMOUNT UNIVERSITY
3 4 5	LOYOLA UNIVERSITY, NEW ORLEANS
2 4 5	UNIVERSITY OF MAINE
3 5	MARQUETTE UNIVERSITY
3 4 5	UNIVERSITY OF MARYLAND
1 2 4 5	MIT (SLOAN)
2 3 4 5	MIAMI UNIVERSITY
1 2 3 4 5	UNIVERSITY OF MICHIGAN, ANN ARBOR
4 5	UNIVERSITY OF MICHIGAN, FLINT
3 5	MICHIGAN STATE UNIVERSITY
3 4 5	MIDDLE TENNESSEE STATE UNIVERSITY
1 2 4 5	UNIVERSITY OF MINNESOTA (CARLSON)
2 3 5	MISSISSIPPI STATE UNIVERSITY
2 3 4 5	UNIVERSITY OF MISSOURI, COLUMBIA
5	UNIVERSITY OF MISSOURI, ST LOUIS
4 5	UNIVERSITY OF MONTANA
3 5	MURRAY STATE UNIVERSITY
1 2 3 4 5	NEW YORK UNIVERSITY
5	NICHOLLS STATE UNIVERSITY
2 4 5	UNIVERSITY OF NORTH CAROLINA, CHARLOTTE
2 4 5	UNIVERSITY OF NORTH TEXAS
3 5	NORTHEAST LOUISIANA UNIVERSITY
2 3 4 5	NORTHERN ARIZONA UNIVERSITY
1 2 4 5	NORTHWESTERN UNIVERSITY (KELLOGG)
2 3 4 5	UNIVERSITY OF NOTRE DAME
2 3 4 5	THE OHIO STATE UNIVERSITY
2 3 4 5	OKLAHOMA STATE UNIVERSITY
5	OLD DOMINION UNIVERSITY
3 4 5	UNIVERSITY OF OREGON
3 4 5	OREGON STATE UNIVERSITY
4 5	UNIVERSITY OF THE PACIFIC
3 4 5	PACIFIC LUTHERAN UNIVERSITY
1 2 4 5	UNIVERSITY OF PENN (WHARTON)
2 4 5	PENNSYLVANIA STATE UNIVERSITY
1 3 4 5	UNIVERSITY OF PITTSBURG (KATZ)
4 5	PORTLAND STATE UNIVERSITY
1 2 3 4 5	PURDUE UNIVERSITY (KRANNER)
3 5	UNIVERSITY OF RHODE ISLAND
2 3 4 5	UNIVERSITY OF RICHMOND (ROBINS)
1 2 4 5	UNIVERSITY OF ROCHESTER (SIMON)
3 4 5	ROLLINS COLLEGE (CRUMMER)
3 4 5	RUTGERS UNIVERSITY
2 3 4 5	ST CLOUD STATE UNIVERSITY
4 5	ST JOHNS UNIVERSITY
5	UNIVERSITY OF SAN DIEGO
5	SAN DIEGO STATE UNIVERSITY
2 5	SAN FRANCISCO STATE UNIVERSITY
2 3 4 5	SAN JOSE STATE UNIVERSITY
5	SEATTLE UNIVERSITY
2 4 5	UNIVERSITY OF SOUTH CAROLINA
5	UNIVERSITY OF SOUTH DAKOTA
1 2 3 4 5	UNIVERSITY OF SOUTHERN CALIFORNIA
2 3 4 5	SOUTHERN ILLINOIS UNIVERSITY, CARBONDALE
2 3 5	SOUTHERN ILLINOIS UNIVERSITY, EDWARDSVILLE
5	SOUTHERN METHODIST UNIVERSITY
4 5	UNIVERSITY OF SOUTHERN MISSISSIPPI
1 2 3 4 5	STANFORD UNIVERSITY
2 5	STATE UNIVERSITY NEW YORK, ALBANY
2 5	STATE UNIVERSITY NEW YORK, BUFFALO
2 3 5	SYRACUSE UNIVERSITY
2 5	TEMPLE UNIVERSITY
5	UNIVERSITY OF TENNESSEE, CHATTANOOGA
3 5	TENNESSEE TECHNOLOGICAL UNIVERSITY
2 4 5	UNIVERSITY OF TEXAS, ARLINGTON
2 3 5	TEXAS A&M UNIVERSITY
2 5	TEXAS CHRISTIAN UNIVERSITY (NEELEY)
5	TEXAS SOUTHERN UNIVERSITY
3 4 5	TEXAS TECH UNIVERSITY
4 5	UNIVERSITY OF TOLEDO
2 5	UNIVERSITY OF UTAH
2 3 4 5	UTAH STATE UNIVERSITY
3 4 5	VALDOSTA STATE COLLEGE
1 2 4 5	VANDERBILT UNIVERSITY (OWEN)
5	UNIVERSITY OF VERMONT
3 4 5	VILLANOVA UNIVERSITY
5	UNIVERSITY OF VIRGINIA (DARDEN)
4 5	VIRGINIA COMMONWEALTH UNIVERSITY
2 3 5	VIRGINIA TECH (PAMPLIN)
3 4 5	WAKE FOREST UNIVERSITY (BUS & ACCNT)
4 5	WAKE FOREST UNIVERSITY (BABCOCK)
4 5	UNIVERSITY OF WASHINGTON, SEATTLE
1 2 4 5	WASHINGTON UNIVERSITY, ST. LOUIS
4 5	WASHINGTON STATE UNIVERSITY
3 5	WAYNE STATE UNIVERSITY
2 4 5	WEST GEORGIA COLLEGE
3 4 5	WESTERN CAROLINA UNIVERSITY
2 4 5	WESTERN ILLINOIS UNIVERSITY
2 5	COLLEGE OF WILLIAM AND MARY
2 3 5	UNIVERSITY OF WISCONSIN, EAUNIVERSITY CLAIRE
3 4 5	UNIVERSITY OF WISCONSIN, LACROSSE
2 3 4 5	UNIVERSITY OF WISCONSIN, MADISON
5	WRIGHT STATE UNIVERSITY
5	UNIVERSITY OF WYOMING
4 5	YALE UNIVERSITY
3 4 5	UNIVERSITY OF ALBERTA
1 2 4 5	UNIVERSITY OF BRITISH COLUMBIA
4 5	DALHOUSIE UNIVERSITY
1 4 5	MCGILL UNIVERSITY
1 4 5	MCMASTER UNIVERSITY
4 5	QUEEN'S UNIVERSITY, KINGSTON, ONT
1 4 5	UNIVERSITY OF TORONTO
1 2 4 5	UNIVERSITY OF WESTERN ONTARIO

Table 2
Demographics of Surveyed Schools
Percent of Schools

Participating Schools	1988 N=175	1987 N=128	1985 N=125	1984 N=35
Type of School: Public	68%	67%	69%	49%
Private	32	33	31	51
Degrees offered:				
Undergraduate only	2	2	2	0
Undergraduate and Graduate	88	85	86	66
Graduate only	10	13	12	34
Student Enrollment (FTE):				
Less than 1000 students	24	25	22	37
Between 1000 and 2000	21	27	22	23
Between 2000 and 3000	23	24	26	20
More than 3000 students	32	24	30	20
Mainframe/Mini Facilities Availability:				
Both School and University	34	29	27	54
School only	6	7	4	6
University only	56	60	64	40

II Strategic Level

This section reviews the data related to the planning process, budget phases, amounts spent on computing, and strategic issues.

Plans

Are there formally stated computer/information systems goals, plans, or objectives for business schools? Ninety-two schools (53%) indicated that they had no formal planning document while eleven schools (6%) were in the process of formulating them. The remaining 72 schools (41%) had plans: of which 57 provided details. Nine schools attached a copy of their plans (ranging from 3 to 22 pages in length) and another 48 schools provided a brief statement. Many of these included multiple objectives. Table 3 presents an analysis and summary of the plans of these 57 schools, divided into six categories based on their orientation: strategic, instructional, hardware, software/database, network, or support services. As can be seen from the table, the most frequently mentioned goals were instructionally oriented. Many of the statements in this area indicated an interest in increasing the use of mini/mainframe systems as well as microcomputer systems.

Table 3
Business School Computing Plans
N = 57

Strategically Oriented	5	Student computer literacy upon graduation
	2	Student competitiveness in market place
	2	Community/regional involvement
Instructionally Oriented	18	Computer integration into the classroom
	5	Better classroom support, courseware development
	3	Student understanding/management of information
	2	Development of MIS concentration
Hardware Oriented	14	Maintenance of "state-of-art" microcomputers
	10	Increased faculty access, micros in offices
	7	Increased student microcomputer access
	3	Creation of electronic classrooms
	2	Mainframe conversion and access
Software/database Oriented	4	Greater data availability and access
	3	Faculty software, increased software inventory
Network Oriented	8	Entire business school networked
	6	Student labs networked
	2	Business school networked with university system
Support Oriented	4	Research support for faculty
	4	General support for faculty, students, and staff
	4	Administrative systems support

Twelve schools indicated different plans for their graduate and undergraduate programs. There was little commonality in these differences. Several schools indicated that their MBA programs led the undergraduate program, while at the other extreme, other schools indicated there were formal goals only for the undergraduate program. The remaining 45 schools indicated no difference between the graduate and undergraduate plans.

Budgets

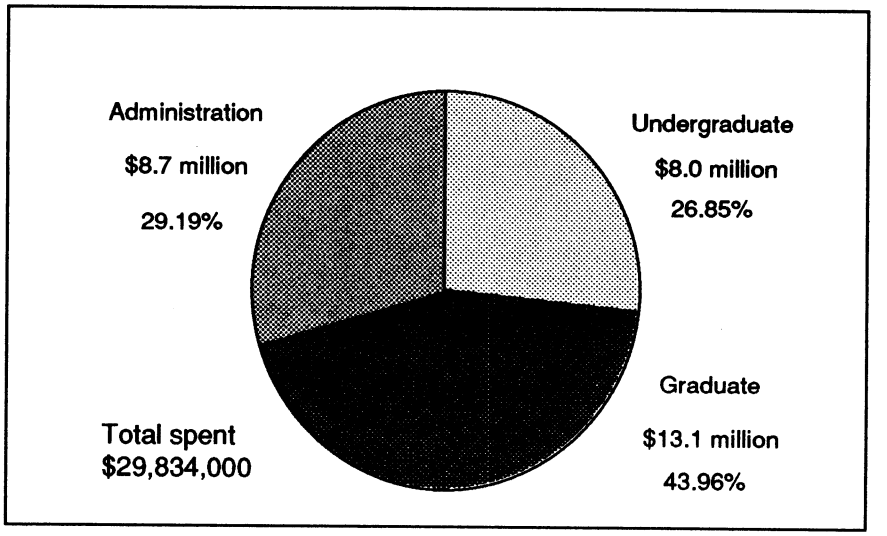
Budget information, consistently the top ranked issue in the five UCLA surveys, remained extremely difficult to capture and interpret. The respondents were asked to indicate their school's computer operating budget, the real dollars from any source designated to support academic and administrative computing within the business school. The budget estimate was NOT to include faculty salaries or computer hardware acquisitions, nor university funds allocated for recharge on university systems. Ninety-four percent of the schools provided budget data summarized in Table 4.

Table 4
Business School Computer Operating Budgets
N = 165

N	%	
19	11	less than 5 thousand (US)
66	38	5 - 50 thousand
39	22	50 - 150 thousand
19	11	150 - 300 thousand
5	3	300 - 500 thousand
7	4	500 - 750 thousand
5	3	750 - 1 million

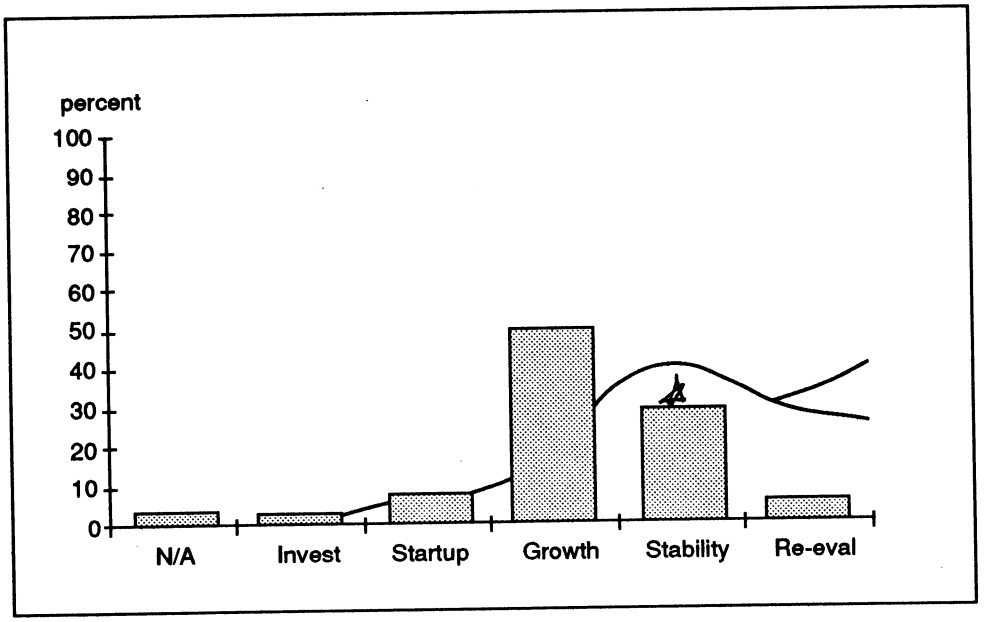
Based on the midpoints of these categories, the total computer operating budget of the business schools in this year's sample is estimated at $29,800,000, an average $181,000 per school. Figure 3 allocates this total amount across the schools for undergraduate, graduate, and administrative support, and suggests that approximately equal amounts are spent on administrative and undergraduate programs while graduate programs receive a larger portion. The mean allocation per student was $125, while the median was $27, indicating that a few schools were spending significantly more than most.

Figure 3: Where does the budget go?
N = 165



The phase diagram in Figure 4 suggests that budgets were growing for most of the schools, and stable for only 29%. A few schools were re-evaluating their budgets.

Figure 4: Phase of Computer Operating Budget
N = 153



Issues

The questionnaire presented a list of 13 strategic computing support issues from which the respondents were asked to rank the five most important. Table 5 lists the issues identified by at least one-third of the schools. As the table indicates, finding funds and appropriate curriculum development were ranked first and second. Curriculum objectives have consistently been the justification for the high costs of computerization, but yet these curriculum objectives are very elusive and difficult to quantify. Faculty incentives and courseware related issues (discussed later) confound this problem. The other issues mentioned reflect the overall findings of this survey, and link with the other areas discussed later.

Table 5
Strategic Computing Support Issues
N = 175

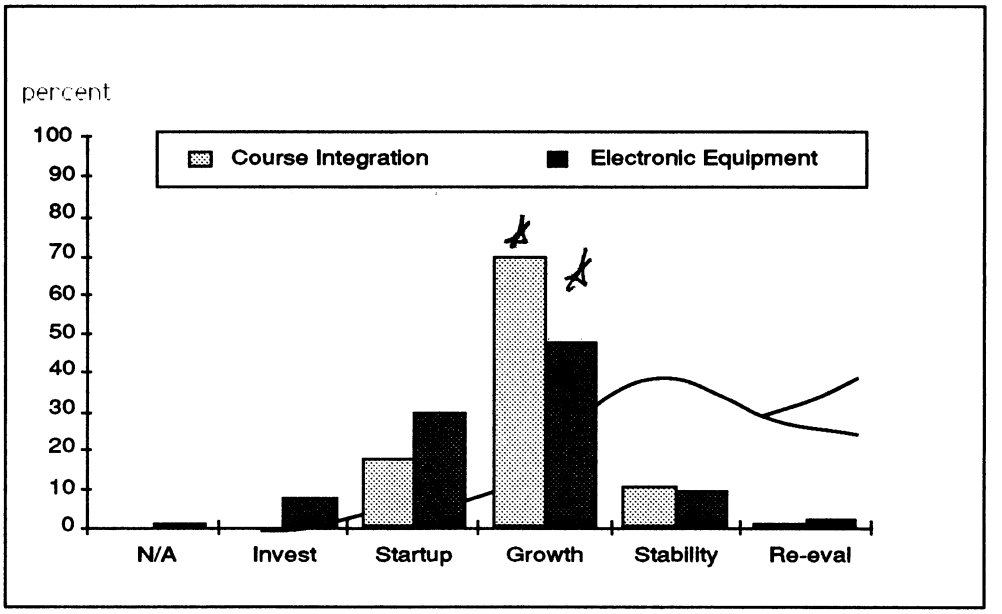
129	Finding funds for support
124	Appropriate curriculum development which utilizes computing
103	Keeping current on appropriate technology
86	Faculty incentives for courseware development or integration
79	Lack of goals and/or strategic planning
78	Schoolwide standards for hardware or software

III Instruction and Curriculum

Computers in the classroom

Where are business schools with respect to the use of computers in courses, and with respect to electronic/computer-linked equipment in the classroom? Answers to these questions are suggested in Figure 5, which shows that 70% of the schools are in a growth phase for computer integration. Fifty percent of the schools are in a growth phase for equipment in the classroom. These growth phase designations suggest a clear commitment to classroom technology on the part of the business schools. Significantly more progress is expected.

Figure 5: Phase of Computer Use in the Classroom
N = 168



Issues

Important issues challenge business schools as technology is introduced into the curriculum and classroom. Table 6 lists the eight issues identified by at least one-third of the respondents. These issues can be further divided into people issues (faculty incentives and teaching styles), content issues (defining appropriate levels and selection of courses), courseware and technology. "Appropriate curriculum development which utilizes computing" was the second ranked strategic issue in Table 5. Table 6 delineates the problems associated with curriculum development. Note that faculty incentives appears as the fourth ranked strategic issue (Table 5) and the first ranked instructional issue (Table 6). This issue will remain until the traditional criteria for promotion are revised to acknowledge time spent on courseware development and computer integration.

Table 6
Instructional and Curriculum Integration Issues
N = 175

122	Faculty incentives for developing courseware
117	Definition of appropriate integration level
112	Teaching style/motivation to use technology
96	Courseware development support
90	Selection of courses to be integrated
70	Lack of courseware
70	Inability to use computers in the classroom
58	Lack of databases for curriculum support

Innovations

This year's survey presented an opportunity for the business schools to share information on innovative and exciting uses of technology: "Do you have any projects, labs, or other features which you would care to share?" Fifty-four schools (31%) provided either a short description or attached materials (articles, proposals, or brochures) for a total of 72 different projects. Table 7 summarizes these by major category. Many of these innovations are technological combinations, or unique applications of technology. For example, Shell and McManis at Nicholls State University in Louisiana described an "electronic textbook" project which enabled students to access faculty lecture notes, outlines, and data in the form of electronic text files. Appendix 2 provides a short description of each project, together with a contact name and phone number for those wanting additional information.

IV Mini/Mainframe Computers

Forty percent (70) of the schools participating in this year's survey maintain their own minicomputer or mainframe system. Table 8 details the 127 total systems by make, model, and number of the systems when at least three schools indicated having a particular model.

As can be seen in the table, the total number of systems increased 60% (from 80 to 127 individual computers). Although nine vendors were represented, Digital Equipment Corporation had the largest number of systems installed, with 44 systems, 35% of the total. The VAX family of systems dominates, with the VAX 11/7xx models most common. The other major systems installed in the business schools are the IBM 4300 series (16), AT&T 3Bx series (14), and HP3000 series (12). A modest increase is shown in the models listed, except for the AT&T 3Bx series where a dramatic percent growth is seen, increasing 367% from 3 to 14 systems. An important question arises regarding the role and use of the mini/mainframe systems located within the business school. The phase diagram shown in Figure 6 summarizes the schools' perceptions of where they are regarding their use of the large systems for instruction, research, and administrative support. With respect to research and administrative systems, a growing or stable environment is most common. However, with respect to instruction, about one-third of the schools are re-evaluating their use of these systems, supporting the general observation that a significant portion of student instructional computing is migrating to the microcomputer environment.

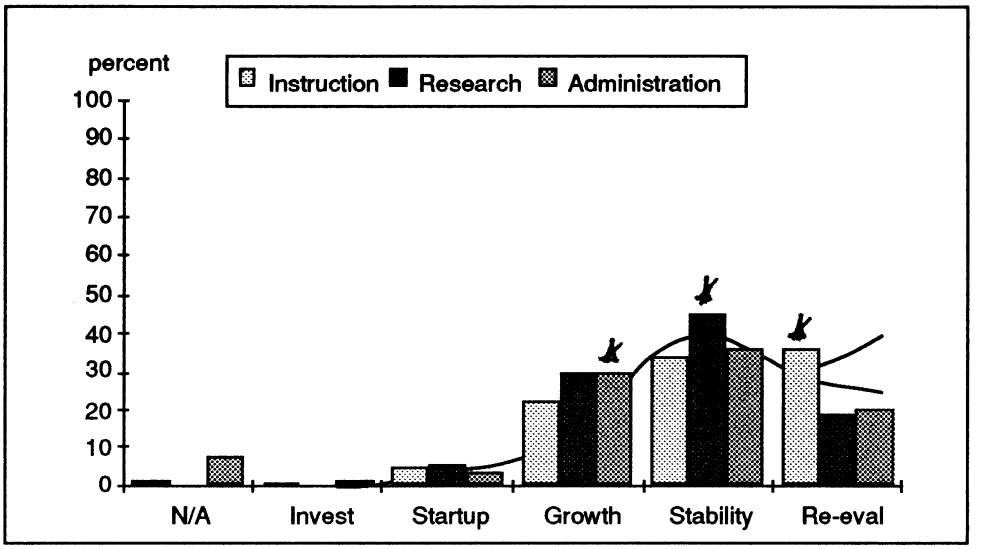
Table 7
Innovative Uses of Information Technology
N = 54

Curriculum/ Software	9	Innovative software
	3	Curriculum revisions to accommodate computers
	2	AI/expert system
Applications	3	Online databases
	3	CD ROM/video disc
	1	Mainframe e-mail including class accounts
	1	Computerized lecture notes for student access
Facilities	6	Computer-based electronic classroom
	5	Group decision making lab
	3	AT&T classroom of future
	3	Instructor-controlled image transfer of student microcomputer screens
	2	Classrooms with computer projection capability
	2	BOS lab for human factors study
	2	Student lab
	1	Combined computer center and library
Network	7	Networked pc lab
	3	Research/administration network
	3	Campus wide access
	2	Shared printing, diagnostics over network
	1	Ethernet-Appletalk bridges linking PCs, Macs, and VAXs
Organizational/ Support	2	Student required purchase of microcomputers
	2	Mini/mainframe conversions
	2	Online remote support, strong staff
	1	Laptop systems used in regular class
	1	Bar-code system for lab access and software distribution
	1	Transportable pc and overhead projection system
	1	Dial in capability to micros and mini

Table 8
Mini/Mainframe Computer Systems by Model
Number of Systems

Make (at least three systems)	1988 N=70	1987 N=46	1985 N=39	1984 N=33
AT&T				
3Bx	14	3		
Data General				
MV xxx	4	2		
Digital				
DEC 10s,20s	3	3	7	7
VAX 11/7xx	23	17	10	7
VAX 8xxx	7	4		
MicroVAX	11	5		
Hewlett Packard				
HP3000s	12	11	8	6
IBM				
4300s	16	13	9	2
S36,38	6	3	1	0
NCR				
8750, 9300, Tower	4	3	3	
PRIME				
7xx, 8xx, 9xxx	5	3	4	2
UNYSIS				
Burroughs, XE-550	5	3	2	
WANG				
VS, OISs	7	5	3	6
Others	10	2	12	7
HP3000				
Total	127	80	59	37

Figure 6: Phase of Mini/Mainframe Computer Use
N = 171

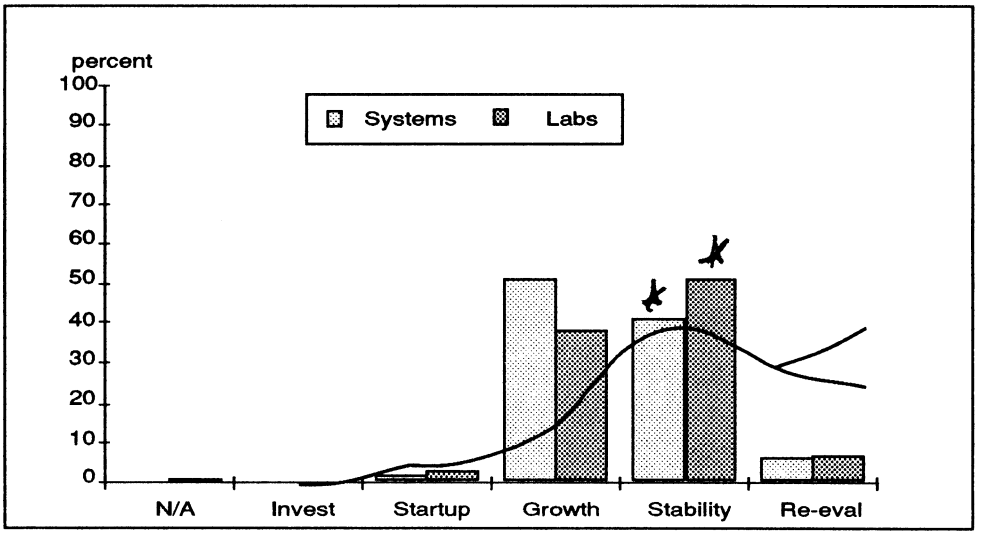


V Microcomputers

Availability and density

As was shown in Figure 1, microcomputers have been the fastest growth area in business school computer usage. The data from this year's survey suggests that this trend has not diminished. Figure 7 displays the phase of the number of microcomputers and micro labs in the schools. Fifty-one percent

Figure 7: Phase of Number of Microcomputers and Labs
N = 171



of the schools indicated an expectation that the number of systems will continue to grow. The figure also suggests growth in the number of microcomputer labs, but a slower growth, perhaps due to factors such as lack of space and funds rather than need (as per Strategic and Operational Issues).

Tables 9 and 10 display the number of microcomputers by school and model, respectively. Both of these tables suggest that IBM is dominant. Table 9 shows that 86% of the schools have at least four IBM PCs or IBM PC/XTs. Furthermore, IBM PC/ATs or PS/2 systems are present in about one-third of the schools. The other major vendors in this year's sample are Zenith, having systems in 42% of the schools, and Apple, with systems in 29% of the schools. All of the other models were in 14% or less of the schools.

Table 9
Microcomputer Systems by School
Percent of Schools with Systems

Participating Schools	1988 N=175	1987 N=128	1985 N=119
Model (at least 4 systems)			
IBM PC, PC/XT	86%	86%	82%
Zenith	42	30	10
IBM PC/AT	35	35	5
IBM PS/2	31		
Macintosh	29	26	13
AT&T	14	6	0
HP Vectra	11	9	3
Apple II series	7	10	16
HP 150s	7	10	4
Unisys	7	8	4
DEC Rainbow	6	6	13
Tandy	4	2	10

With respect to the total number of models, shown in Table 10, although IBM PCs and PC/XTs are still the most common systems, their numbers relative to other systems are decreasing as could be expected with the technological advances and price performance alternatives offered by the expanding market. In general, the total number of systems in this year's survey increased 63% over the number of systems in 1987, while the sample of schools only increased 37%. The average number of systems per school increased by 24, even with the large increase in the number of schools.

Table 10
Microcomputer Systems by Model
Number of Systems in Business Schools

Participating Schools	1988 N=175		1987 N=128		1985 N=119	
Model (at least 300 systems)	n	%	n	%	n	%
IBM PC,PC/XT	10,149	(37)	7,509	(45)	5,120	(54)
Zenith	3,274	(12)	1,791	(11)	411	(4)
IBM PC/AT	2,110	(8)	1,194	(7)	259	(3)
Macintosh	1,893	(7)	925	(5)	457	(5)
IBM PS/2	1,305	(5)				
AT&T	1,172	(4)				
Unisys	765	(3)	593	(4)	544	(6)
DEC Rainbow	557	(2)	585	(4)	855	(9)
HP Vectra	538	(2)	349	(2)	40	(0)
HP 150	313	(1)	303	(2)	230	(2)
Others	5,134	(19)	3,476	(20)	1,640	(17)
Total	27,210	(100)	16,725	(100)	9,556	(100)
Average systems per school	155		131		76	

A pervasive question is: how many microcomputers are adequate for a business school's students' needs? To answer this question the survey asked about the general sufficiency of microcomputers to meet "normal" demand (excluding exam time or end of term). The responses to this question were combined with the average microcomputer densities, (the number of students or faculty who share access to a school-provided microcomputer). As presented in Table 11, the eleven

Table 11
Microcomputer Availability vs. Student Micro Densities
N = 164

Generally sufficient microcomputers?	n	Student Micro Density (Students/micro)
Yes, never any waiting	11	23.9
Yes, but occasional waiting	116	39.4
No, usually a wait for access	37	53.3
No, always a wait for access	0	

schools that indicated "never any waiting" for students averaged about 24 students per microcomputer. One hundred sixteen schools (71%) indicated that an average microcomputer density of 39 resulted in occasional waiting for their students. In great contrast, however, were the faculty microcomputer densities which averaged just under 2 faculty sharing a system with no waiting, and about three sharing a system with some waiting. (See Table 12).

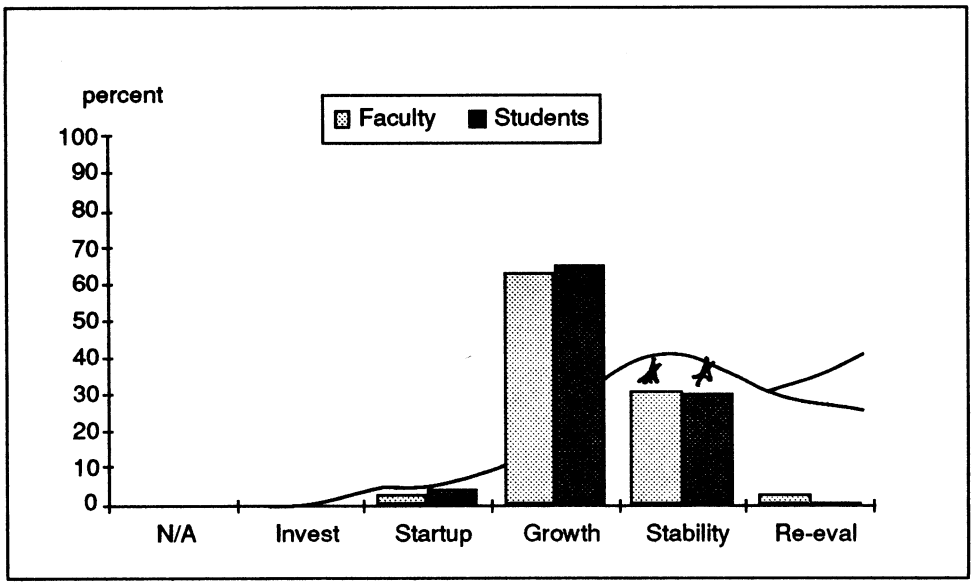
Table 12
Microcomputer Availability vs. Faculty Micro Densities
N = 160

Generally sufficient microcomputers?	n	Faculty Micro Density (Faculty/micro)
Yes, never any waiting	80	1.8
Yes, but occasional waiting	64	3.0
No, usually a wait for access	13	2.8
No, always a wait for access	3	5.1

Usage

As important as the number of microcomputers available within business schools is how these systems are being used. To capture this information, a series of phase diagrams were presented related to the use of microcomputers for personal productivity (word processing, basic spreadsheets and databases), desktop publishing and presentation graphics, and as an analytic tool (advanced spreadsheets, statistics, and modeling). The results are presented in Figures 8, 9, and 10. The

Figure 8: Phase of Microcomputer Usage as a Productivity Tool
N = 173



pattern for both faculty and students was very similar for productivity and analytic usage; in contrast, student usage lagged behind faculty usage with respect to desktop publishing. Also, even though productivity was slightly ahead of analytic use in the stable phase, both are experiencing high growth. This is once again in contrast to desktop publishing which is just getting off the ground.

Figure 9: Phase of Microcomputer Usage as an Analytic Tool
N = 173

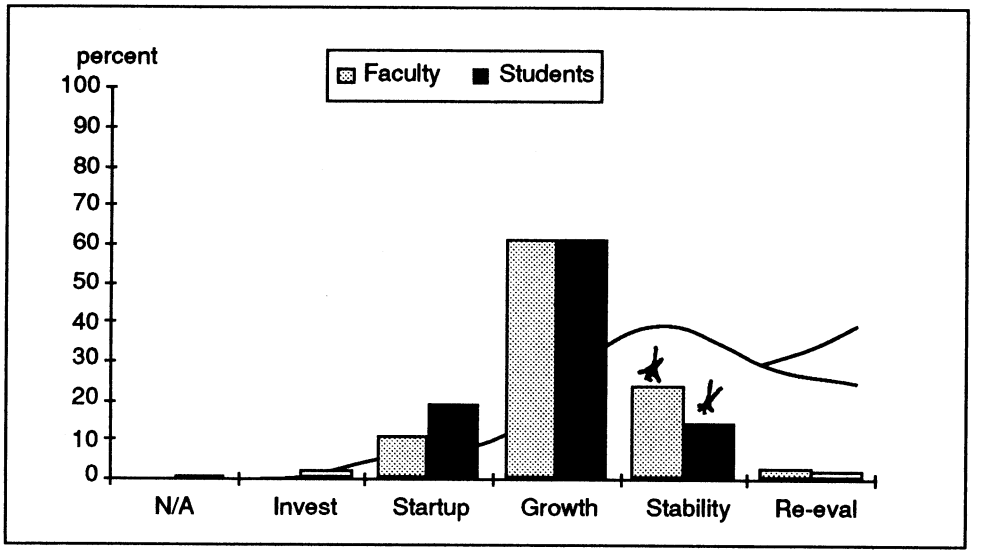
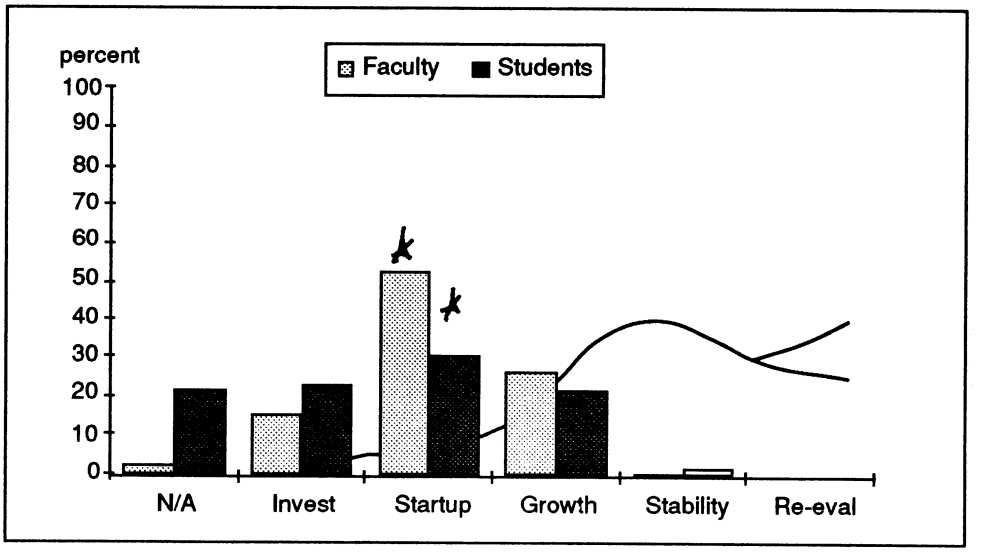


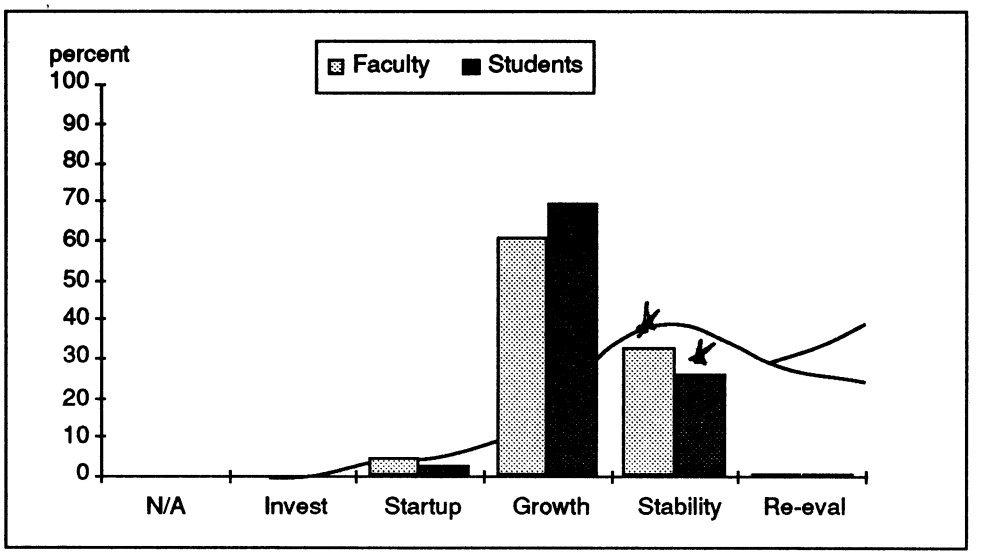
Figure 10: Phase of Microcomputer Usage for Desktop Publishing and Presentation Graphics
N = 171



The surveys also asked for an indication of general computer literacy of faculty and students. Figure 11 suggests that faculty literacy is in a more stable phase than student literacy and that the growth in literacy is primarily in the student area. This may be explained by the fact that faculty are

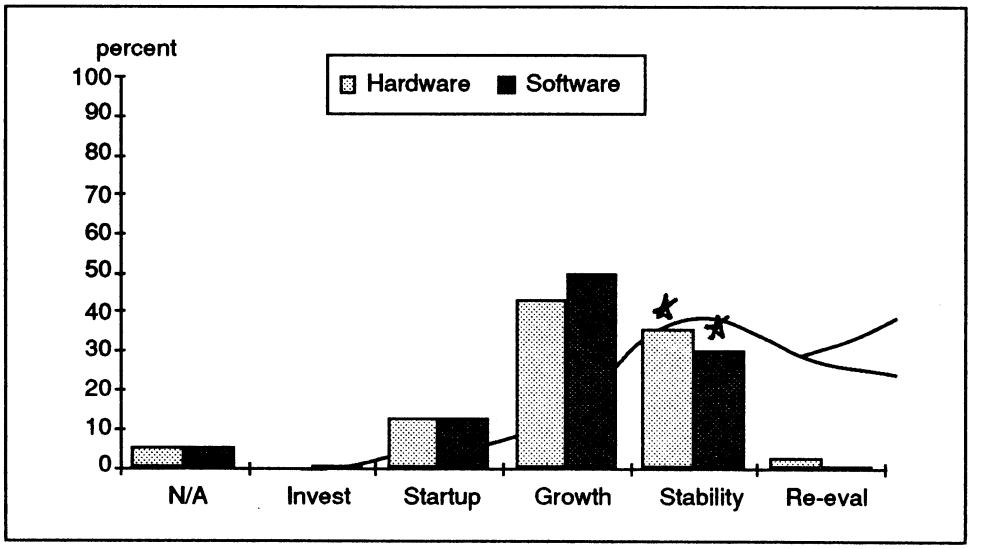
more permanent and can be trained and supported over a longer period of time than students who are constantly entering with mixed and varied backgrounds.

Figure 11: Phase of Computer Literacy
N = 172



Important to the introduction of computer technology into the educational environment is the availability of knowledgeable individuals to assist faculty and students in analyzing requirements, configuring appropriate hardware, and selecting software. The data in Figure 12 suggests that many schools are just beginning to provide this service. However, it is questionable whether this type of service should be included within the scope of responsibility of the business school, or is more appropriately the responsibility of the university or the public market place.

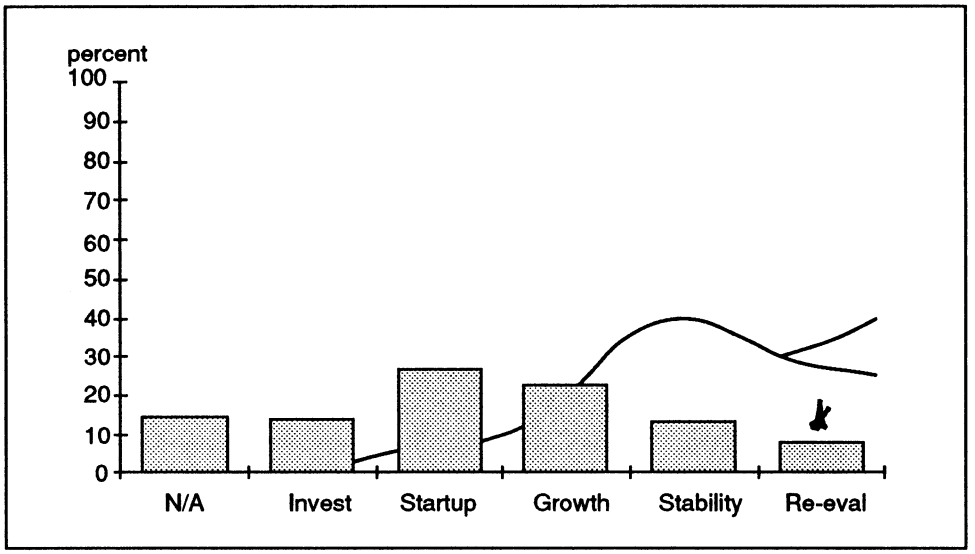
Figure 12: Phase of Providing General Micro Information
N = 172



VI Portable Computer Systems

While desktop microcomputers dominate business schools at this time, portable computer systems are an area of potential growth and expansion. Figure 13 displays the schools' current phase of the number of portable microcomputer systems. Fifteen percent of the schools indicated portable technology as not applicable, while another 14% are investigating the feasibility of this technology. One-quarter of the schools (27%) are just getting started and another quarter (23%) see the number of systems growing in their environments. Thirteen percent indicated that the number of portable systems is stable; 8% are re-evaluating this technology. This phase diagram is the "flatest" and shows the greatest variability in responses across the range of the process, perhaps reflecting confusion with respect to portable systems and controversy over their use.

Figure 13: Phase of Number of Portable Microcomputers
N = 164



Tables 13 and 14 present a different view of portable systems. Table 13 displays information on portable systems installed by school. For seven different models, there were at least four systems found in the schools, ranging from a high of 43% of the schools with Zenith systems to 4% with Tandy. This was the first year that both Toshiba and Tandy had sufficient systems in the schools to be mentioned separately.

Table 14 presents portable systems by total numbers. There was a 65% increase (82 to 135) in the number of schools which reported having portable systems available. However, there was only a 43% increase in the total number of portable systems. The net result was a decrease in the average number of portables per school from 19.8 to 17.2 . This data suggests that a large number schools have acquired a small number of portable systems for experimentation and evaluation.

Table 13
Portable Systems by School
Percent of Schools with Systems

Participating Schools	1988 N=175	1987 N=128
Model (at least 4 systems)		
Zenith	43%	23%
Compaq	39	23
IBM Convertible	33	27
Toshiba	16	
HP110, 110Plus	15	11
NEC	5	2

Table 14
Portable Systems by Model
Number of Systems in Business Schools

Participating Schools	1988 N=135		1987 N=82	
Model	n	%	n	%
HP110, 110Plus	990	(43)	1,076	(66)
IBM Convertible	447	(19)	226	(14)
Compaq	338	(15)	151	(9)
Zenith	291	(13)	77	(5)
Toshiba	149	(6)	13	(1)
NEC	25	(1)	28	(2)
Tandy	11	(<1)	7	(<1)
Other	77	(3)	49	(3)
Totals	2,328	(100)	1,627	(100)
Average portables per school	17.2		19.8	

VII 32-bit High Performance Graphic Workstations

An area of increasing interest among some faculty members is the 32-bit workstation, coming close to the provision of a desktop "mainframe". These very sophisticated and expensive systems may be appropriate for faculty whose research interests require extensive numeric calculations, very high resolution graphics, statistical and mathematical modeling, artificial intelligence, and expert systems. As the price performance ratios continue to fall, these systems may in fact become the baseline microcomputer technology of tomorrow.

Table 15 presents the information on the workstations found in the schools, together with model number data. The table shows that 31 schools have acquired these workstations, and of these schools, 42% have Sun Systems. On the other hand, IBM RTs are in higher concentrations, with more systems (59) in fewer schools (26).

Table 15
32-bit High Performance Graphic Workstations
N=31

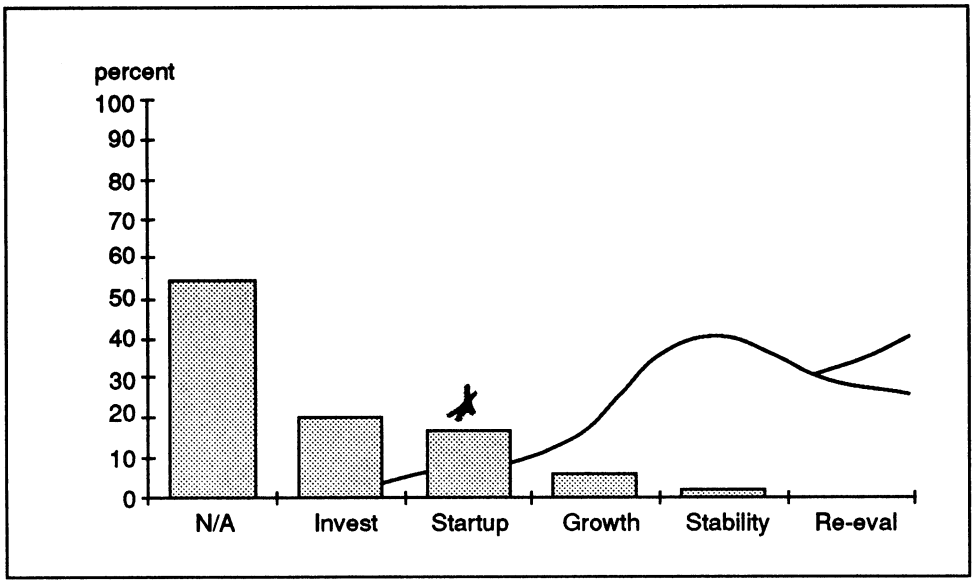
Model	Percent of Schools	Total Systems n	%
Sun	42%	50	34%
IBM RT	26	59	39
VAXstation	19	16	11
Apollo	10	13	9
TI Explorer	10	3	2
Xerox	3	4	3
Other	6	3	2
		—	—
Total		148	100%

The phase diagram shown in Figure 14 suggests that high performance graphic workstation technology may not be appropriate for a majority of business schools at this time. It is interesting to note that three schools (2%) indicated that they have reached a stable number of these systems.

VIII Operational Level

With the significant increase in computer equipment in the business schools, operational concerns and responsibilities grow. Computer staff are needed for user support and equipment maintenance. Space for labs and storage must be found. Electrical power and cabling must be provided. All in all, the introduction of microcomputers has created numerous small computer centers which require attention.

Figure 14: Phase of 32-bit High Performance Graphic Workstations
N = 152



The respondents ranked the ten most pressing operational issues from a list of 23. Table 16 summarizes these responses and shows that fourteen different issues emerged as important to at least one-third of the schools. This list covers most of the issues important to any computer center operation: training, maintenance, space, software, hardware acquisition, staff, and meeting user needs.

Two additional questions were asked regarding operations: equipment upgrade/replacement strategies and the role of vendor donations. Table 17 displays the ten different upgrade strategies

Table 16
Operational Issues
N = 175

112	Provision of adequate faculty training
105	Equipment maintenance
99	Sufficient space for computing facilities
99	Acquisition of software site licenses
91	Timing equipment upgrades
91	Provision of adequate student training
91	Insufficient software to meet demand
83	Insufficient hardware to meet demand
82	Matching technology to user needs
76	Finding or retaining technical staff
73	Creation of a realistic budget, real cost identification
73	Role of mini/mainframes
70	Illegal copying of software
69	School-wide standards vs. individual preferences

indicated by 81 schools. Only 17 schools had plans for replacing existing equipment, including selling, trading, giving away to others, or using the parts for other systems.

Table 17
Upgrade Strategies
N = 81

24	Upgrade existing equipment
17	Replace, phase out old with new
10	Move equipment within the school
7	Network old systems
6	Ask vendors or companies for donations
5	Implement five year replacement cycles
5	Strategy development in process
2	Request university funding
2	Wait until prices come down
2	Provide new equipment with new building

With respect to vendor donations, Table 18 summarizes the current status. Twenty-six percent of the schools indicated that vendor donations play an important to critical role in overall strategy. However, several of these schools commented on the unreliability of vendor support, indicating that this uncertainty made strategic long term planning even more difficult.

Table 18
Role of Vendor Donations
Percent of schools
N = 175

47%	Not applicable or none
5	Currently negotiating or hopeful
20	Not important or minimal
9	Important
13	Very important
4	Critical part of strategy

IX Networks

It appears that almost all schools are interested in linking microcomputers together with some kind of network. Figure 15 displays the phases of development of local area networks. As can be seen from the figure, about an equal number of schools are either investigating this technology, just getting started, or seeing the number increase within their schools. Less than 10% have reached stability, and about five percent are already re-evaluating this technology.

Figure 15: Phase of Local Area Network Development
N = 149

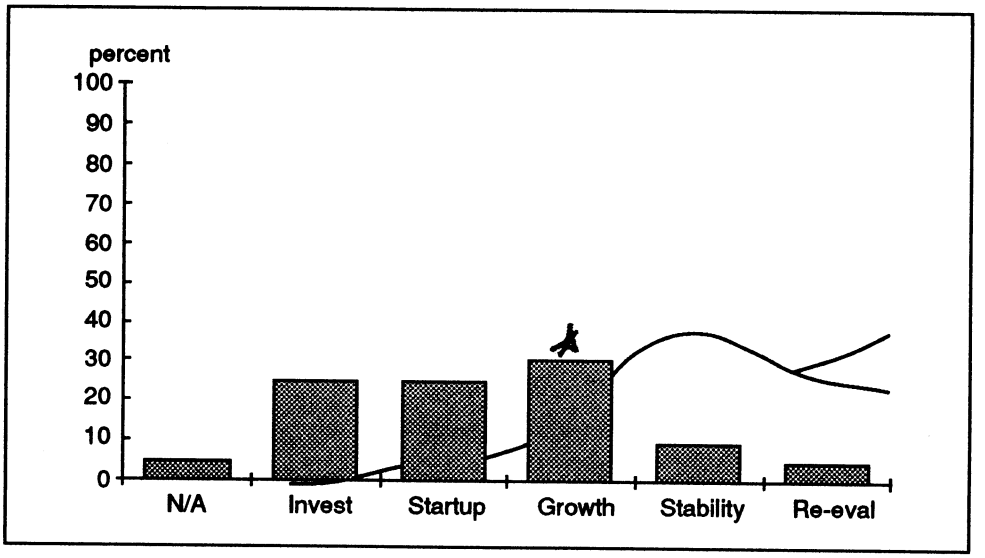


Table 19 displays the seven most frequently mentioned network issues. It appears that three of these issues are software related, three are technology related, and one is operationally oriented. The interesting point here is that unlike the strategic, instructional, and operational areas, no issue dominates.

Table 19
Network Issues
N = 175

98	Software licenses for use on a network
92	Microcomputer to mini/mainframe connections
85	Software availability for use on a network
82	Microcomputer to microcomputer connections
78	Network technology selection decisions
73	Network operations in a lab setting
62	Software not designed for use on networks

X Cluster Analysis

This year's questionnaire was designed to capture information regarding *where* business schools are in the computerization process. Recognizing that schools have started at different times, with different human and financial resources, and with different objectives, the schools could be assumed to be in different places in the process. Furthermore, the issues and concerns facing the schools may be different at different points in the process. Thus, more information might be provided to business school deans and strategic planners if the schools could be grouped according to the similarity of their phase responses. Separate issues and resource allocation decisions might emerge related to the different groups. One method for grouping schools according to their similarities is cluster analysis. Applied to 172 of the schools in this year's sample, the schools were clustered based on their individual responses to the 21 phases. Three schools were omitted because of five or more missing phase values.

Five distinct clusters emerged from the data.[1] These clusters group the business schools into those which are just getting started in the computerization process, those in early or late growth, those which have reached a general level of stability, and those which show a broad mix across all phases. For each cluster a mean value was calculated for each of the 21 phases. These means roughly summarize *where* the business schools in a particular cluster are in the computerization process. Table 20 presents summary demographics for the five clusters, organized by the overall mean for each cluster. The cluster labeled Start-Up shows a mean of 4.2 and reflects an earlier point in the computerization process than for any of the other clusters. In contrast, the Stable cluster has a mean of 6.5 and represents business schools which are more mature in the computerization process.[2] Based on the mean values, the Mixed-Phase cluster is placed between the Early and Late Growth clusters.

Although there are some general trends in Table 20 the large variance within clusters mitigates statistical relationships between the phases and type of school, student FTE, computer budget per student, and student microcomputer densities. In contrast, however, the schools in the Late Growth and Stable clusters tend to have their own mainframes, and are more involved with new uses of technology.

Figure 16 presents the phase arrangements which define each cluster. As in Figure 2, each phase mean is represented by an abbreviated description (defined in Appendix 1), enabling the reader to identify the cluster most similar to a particular school. Several patterns can be discerned in Figure 16, with the most general being a shift from top-left to bottom-right. For example, student use of desktop publishing (S Desk) is in investigation (level I) for the Start-Up cluster, in initial action (level 2) for both the Early Growth and Mixed-Phase clusters, and in start-up (level 3) for both the Late Growth and the Stable clusters. Of special interest is the use of mainframes for instruction (MF Inst) which presents a chaotic variety across the five clusters: in maturity (level 7) for the Start-Up and Late Growth clusters, in the introduction to users (level 4) for the Early Growth cluster, in the choice point (level 9) for the Mixed-Phase cluster, and in the institutionalized (level 8) for the Stable cluster. This could be interpreted as a reflection of the confusion over the role of the mini/mainframe in an environment being infused with microcomputers and networks.

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[1] School membership by cluster will not be distributed.

[2] No statistical tests were conducted between the clusters. However, the data required for such tests are included in Table 20.

Table 20
Demographics by Cluster
N = 172

	Start-Up	Early Growth	Mixed-Phase	Late Growth	Stable
Cluster size	51	19	40	36	26
Phase statistics					
mean	4.2	4.5	5.3	5.6	6.5
std error	0.4	0.3	0.5	0.3	0.4
median	5	5	5	6	7
mode	5	5	6	6,7	7
Type					
Public	69%	74%	78%	64%	54%
Private	31%	26%	22%	36%	46%
Student FTE					
mean	2631	2861	2761	2322	2660
std deviation	2165	2079	1829	2000	1909
Computer budget per student					
mean	$42	$28	$77	$203	$332
std deviation	$42	$43	$239	$328	$451
Micro density (Students/micro)					
mean	56	50	49	29	43
std deviation	48	54	38	19	50
Schools with their own mainframe	22%	37%	28%	69%	54%
Listed innovations	24%	16%	18%	47%	65%

Table 21 separates the four previous issue areas (strategic, instructional, operational, and network) by clusters, and presents the issues by rank order within each cluster. The five clusters show distinct differences. Across the Strategic Issues though, there is general agreement upon the top six issues, and some difference in rank order is seen. For example, lack of goals (Lack goals) is of more concern to the first two clusters than the last three. Short terms plans (Shrt Trm Plns) is ranked among the top six for only the Start-Up and the Early Growth clusters. Funding and curriculum development (Cur Devel) are the first or second issue for all groups except the Late Growth cluster, where it appears as third.

With respect to the Instructional Issues, more agreement among the issues is seen. Faculty incentives (F incentives) and teaching style or motivation to use technology (Teachr style) follow tightly together within the first four ranks of all clusters. Similarly, defining an appropriate level of

integration (Amt integr) and selection of course to be integrated (What integr) follow closely together across all of the clusters, except for the Stable cluster which suddenly seems to be no longer concerned with what to integrate.

Among the Operational Issues, there is less common agreement across the clusters. Insufficient hardware (Insuff HW) appears important for the Start-Up and Early Growth clusters, drops to third for the Mixed-Phase, fourth for the Late Growth and then disappears. Matching technology to user needs (User needs) appears only in the last two clusters, and development of a realistic budget (Real Budget) is only of concern to the Stable cluster.

An interesting pattern appears in the Network Issues, where a clear sequence appears, perhaps reflecting developmental changes. An example is the Start-Up cluster, which network technology to adopt (Net choice) is ranked fourth. In contrast, this issue moves to first for Early Growth, second for Mixed-Phase and then drops to third for Late Growth. It disappears entirely for the Stable cluster. Instead, more complex network issues appear, such as incompatibility of competing network technologies (Incompat net), as well as response time on network (Respons time) and software not designed for use on networks (Non net SW). Microcomputer to mini/mainframe connections are an issue for all five clusters.

XI Summary and Open Questions

The focus of the Fifth Annual UCLA Survey of Business School Computer Usage has been on *where* business schools are in the computerization process. The objective has been to take a "snapshot" along a process continuum to provide understanding about where business schools have been and where they may be going. Overall, the evidence suggests that business schools are at a stage of mid-growth with respect to the 21 phase questions this survey explored. Greater and more rapid growth is projected before business schools in general reach a mature stage of computerization.

For the past four years, the UCLA Surveys have focused on the question of *what* the business schools had in terms of computer resources. Microcomputers emerged as the area of most dynamic activity, and hence about half of the phase questions on this year's survey related to microcomputer usage. The number of microcomputer systems and the number of labs at business schools seem to be just now entering a mature phase, the beginning of a steady state. And, lagging just behind this provision of microcomputer hardware resources is the usage of these resources. Even though it has only been a few short years since microcomputers became available in large numbers, faculty and student literacy and productivity, and faculty analytic use are in the phase of late growth, suggesting a real utilization of and dependence on this technology. Tying in directly with this growth is the provision of adequate faculty training which emerged as the single most dominant operational issue in business schools.

In contrast to the microcomputer usage patterns, the data suggests that at the beginning of this decade mini/mainframe systems were seen as integral to decentralization. Now it appears that schools are re-evaluating these systems, but at the same time, attempting to network microcomputers to provide many of the same services once only available in the time sharing mini/mainframe environment. The phase diagram showed that over one-third of the schools were re-evaluating the use of mini/mainframes for instructional support, and tending towards their replacement by micro-computers. The pattern for research and administration were similar to each other: both indicated about 30% in a growth stage, about 40% in a stable phase, and 20% re-evaluation. Business schools have a clear responsibility to provide their graduates with the microcomputer literacy demanded by the corporate community, but graduating students must also understand the distinction between the purposes and usages of mini/mainframe and microcomputer systems. The role of the mini/mainframe

Figure 16: Phase Definitions by Cluster
N = 172

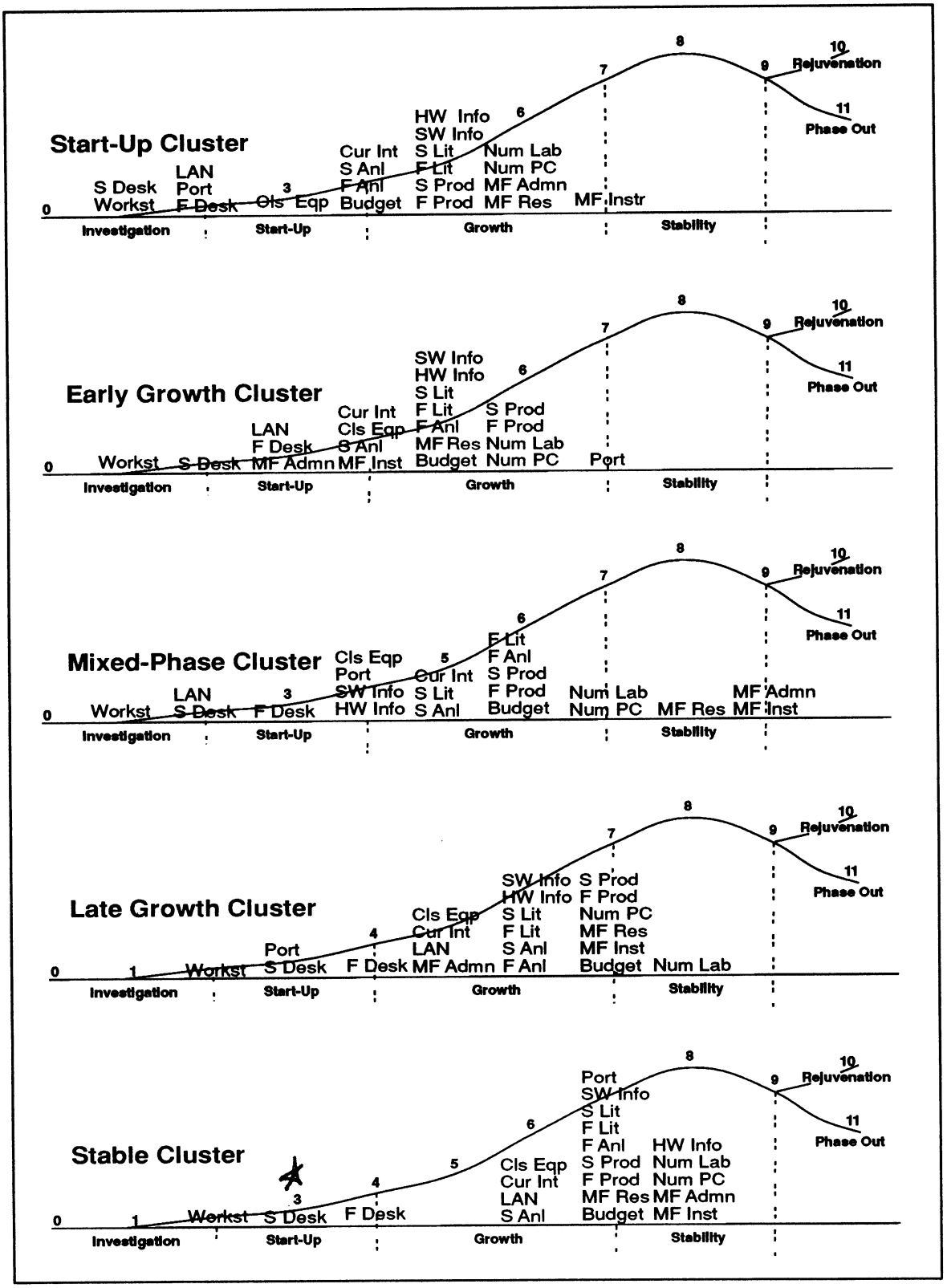


Table 21
Issues by Cluster
N = 172

Rank	Start-Up	Early Growth	Mixed-Phase	Late Growth	Stable
	STRATEGIC ISSUES				
1	Funding	Cur Devel	Funding	Technology	Funding
2	Cur Devel	Funding	Cur Devel	Cur Devel	Cur Devel
3	Lack goals	Lack goals	F incentives	Funding	F incentives
4	Technology	Technology	Standards	F incentives	Grants
5	F incentives	Standards	Technology	Lack goals	Standards
6	Shrt Trm Plns	Shrt Trm Plns	Lack goals	Standards	Lack goals
	INSTRUCTIONAL ISSUES				
1	F incentives	CW dev suppt	Teachr style	F incentives	CW dev suppt
2	Teachr style	Amt integr	Amt integr	Teachr style	Amt integr
3	Amt integr	What integr	F incentives	Amt integr	F incentives
4	Lack of CW	Teachr style	PC in clsroom	What integr	Teachr style
5	What integr	F incentives	What integr	CW dev suppt	CW design
6	CW dev suppt	PC in clsroom	CW dev suppt	Lack of CW	Lack of CW
	OPERATIONAL ISSUES				
1	F training	Insuff HW	Insuff space	SW licenses	SW licenses
2	Insuff SW	When upgrade	HW maintence	F training	Role of MF
3	Insuff HW	Insuff space	When upgrade	When upgrade	Real budget
4	HW maintence	HW maintence	F training	Illegal SW	HW maintence
5	Insuff space	S training	Insuff HW	User needs	F training
6	S training	Role of MF	Role of MF	Insuff HW	User needs
	NETWORK ISSUES				
1	Micro to MF	Net choice	SW licenses	Micro to MF	Micro to MF
2	SW licenses	MicroToMicro	Net choice	SW licenses	SW licenses
3	MicroToMicro	Net in Lab	Net in Lab	MicroToMicro	Network SW
4	Net in Lab	Micro to MF	MicroToMicro	Net choice	Respons time
5	Net choice	Network SW	Network SW	Network SW	Non net SW
6	Network SW	Data secure	Micro to MF	WAN access	Incompat net

in the corporate world is, and will continue to be, very significant. How business schools meet this challenge may emerge as a significant issue of the 90's.

Thirty-two bit high performance graphic workstations and desktop publishing were both identified as emerging areas in the business school computerization process. On the other hand, portable computer systems showed the greatest variance in phase responses. This technology in particular, however, is undergoing tremendous change and as display quality improves and lighter weight, more compact systems evolve, this may be an area of exciting growth. Portable microcomputer technology seems to be a prime example of where conceptual expectations preceded available technology.

Although a phase question was not asked about the planning process, the data indicate that 53% of the schools have no formal computerization plans. The schools recognize this as a short coming as 45% indicated lack of goals and/or strategic planning as a major issue. The other significant strategic issues were related to funding, appropriate curriculum development, keeping current with technology, and faculty incentives for courseware development. Faculty incentives and appropriate curriculum were first and second ranked instructional issues.

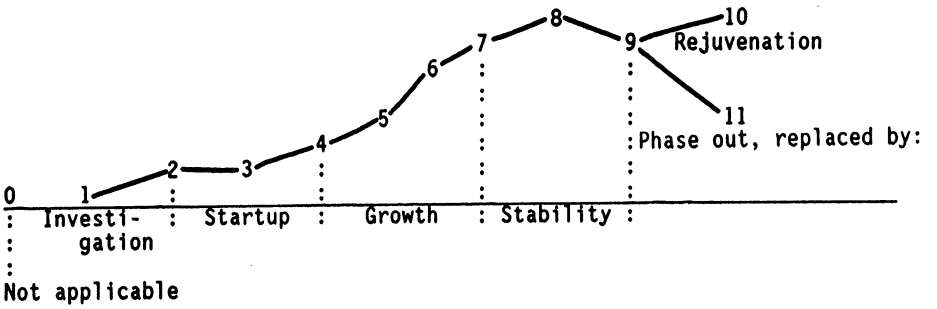
In addition to these global observations of where business schools are in the computerization process, five distinct groups of business schools emerged from a cluster analysis of the data. These groups roughly corresponded to business schools in Start-Up, Early Growth, Late Growth, and Stable phases, as well as a Mixed-Phase Cluster, which showed wide dispersion across all of the phases. In these five groups, the four issue areas (strategic, instructional, operational, and network) displayed very different patterns. Although the issues generally remained the same for all five clusters, they often ranked the issues very differently. In some cases, a concern to the cluster of schools in the earlier phases was resolved by those clusters in the later phases (e.g., insufficient hardware, space, and choice of network). On the other hand, some issues emerged only for the cluster of schools in the later phases (e.g, role of grants, development of a realistic budget, problems of incompatible networks, and network response time).

The other two areas which emerged again in this survey are curriculum integration (which is tied closely to faculty incentives) and funding issues. The cluster analysis revealed that the business schools furthest along the computerization process had in general resolved the issue of "what to integrate into the curriculum" and the selection of courses to be integrated, an issue of concern to the four earlier clusters. However, concern remained with amount of integration, courseware design and development support, teacher styles and faculty incentives for courseware development. These issues will remain until the traditional criteria for promotion are revised to acknowledge and reward time spent on courseware development and computer integration, or until the market place provides adequate courseware alternatives.

In contrast to some of the problems of curriculum integration, the problems of funding are not resolved with progress along the computerization process. However, one clue to partial resolution of the issue may be offered by the appearance of "finding grants for support" among the strategic issues of the schools furthest along the process, A more aggressive and proactive approach to alternative means of computer resource acquisition may be rewarded, especially as used microcomputer equipment becomes available with corporate upgrades.

The cluster analysis approach provided greater insight in terms of where business schools are, and suggested that, for those schools in the earlier stages, careful planning, focus on standardization, and consideration of the issues of concern to those in later stages, could, in fact, enable more efficient and effective progress along the growth curve.

Appendix 1: Business School Computerization Life Cycle Phase Definitions



0 **Not applicable:** not appropriate for our school at this time, no interest or use

1 **Investigation:** gathering information, thinking about ideas

2 **Initial action:** selection between alternatives, seeking support, grant activities, obtaining bids, general preparation, one or two experimenters

3 **Start-up:** initial installation, testing, feeling your way, working out bugs, several users

4 **Introduction to users:** developing support, identifying day-to-day needs

5 **Slow growth:** minimal expansion, initial acceptance, insufficient resources to meet demand

6 **Fast growth:** rapid expansion of resource, growing demands and expectations

7 **Maturity:** beginning of steady state, continuity of services, routine patterns emerge, stable user base, resource usually meets demand

8 **Institutionalized:** little expansion, routine replacement of obsolete technology, expectation is "this is the way it ought to be"

9 **Choice point:** technology in place is declining in use or resource is not effectively being used, prompting a review of the status quo and the consideration of alternatives

10 **Rejuvenation:** renewed interest, excitement; new expansion, applications and users

11 **Phase out:** discontinued use, replaced by new technology (e.g., typewriter basically phased out). If you circle this choice, please indicate what you have replaced it with.

Appendix 2: Abbreviations

Phase Definitions

Budget	Computer support operating budget
Cls Eqp	Electronic/computer-linked equipment in classroom
Cur Int	Computer integration into curriculum
F Anl	Faculty use of microcomputer analytic tools
F Desk	Faculty usage of microcomputer desktop publishing and presentation graphics
F Lit	Faculty computer literacy
F Prod	Faculty use of microcomputer productivity tools
HW Info	Microcomputer hardware information to users
LAN	Development of local area networks
MF Inst	Mini/mainframe use in instruction
MF Res	Mini/mainframe use in research
MFAdmn	Mini/mainframe use for administrative support
Num Lab	Number of microcomputer lab(s)
Num PC	Number of microcomputers
Port	Number of portable microcomputer systems
S Anl	Student use of microcomputer analytic tools
S Desk	Student usage of microcomputer desktop publishing and presentation graphics
S Lit	Student computer literacy
S Prod	Student use of microcomputer productivity tools
SW Info	Microcomputer software information to users
Workst	32-bit highend performance graphic workstation use

Strategic Issues

Cur Devel	Appropriate curriculum development utilizing computing
F incentives	Faculty incentives for courseware development/integration
Funding	Finding funds for support
Grants	Finding grants for support
Lack goals	Lack of goals and/or strategic planning
Shrt Trm Plns	Short term planning
Standards	Schoolwide standards for hardware or software
Technology	Keeping current on what technology is appropriate

Instructional Issues

Amt integr	Defining an appropriate level of "integration"
CW design	Courseware design issues
CW dev suppt	Courseware development support
F incentives	Faculty incentives for developing courseware
Lack of CW	Lack of courseware
PC in clsroom	Inability to use computers in classrooms
Teachr style	Teaching style or motivation to use technology
What integr	Selection of courses to be "integrated"

Operational Issues

F training	Providing adequate faculty training
HW maintence	Equipment maintenance
Illegal SW	Not enough software to meet demand
Insuff HW	Not enough hardware to meet demand
Insuff space	Sufficient space for computing facilities
Insuff SW	Not enough software to meet demand
Real budget	Creating a realistic budget, identifying the real costs
Role of MF	Role of mainframes
S training	Providing adequate student training
SW licenses	Acquiring software site licenses for school
User needs	Matching technology to user needs
When upgrade	When to upgrade equipment

Network Issues

Data secure	Data security
Incompat net	Incompatibility of competing network technologies
Micro to MF	Microcomputer to mini/mainframe connections
MicroToMicro	Microcomputer to microcomputer connections
Net choice	Which network technology to adopt
Net in Lab	Operating network in lab setting
Network SW	Software availability for use on a network
Non net SW	Software not designed for use on networks
Respons time	Response time on network
SW licenses	Software licenses for use on a network
WAN access	Access to wide area networks

Appendix 3: Innovations

U OF ALABAMA DOROTHY LOTT DIR,INSTR & ADMIN COMPUTING 205-333-9730	BAR CODE SYS FOR LAB ACCESS/SW DIST, NETWORK PRINT SPOOLER
U OF ARIZONA EILEEN DENNIS COMPUTER OPERATIONS SPECIALIST 602-621-2748	PLEX CENTER, A COMPUTERIZED GROUP NEGOTIATING & DECISION FACILITY
U OF ARKANSAS DAVID DOUGLAS CHAIR, CIS & QUANT ANALYSIS 501-575-4500	30 STATION TOKEN-RING LAB
BABSON COLLEGE GEORGE RECCK DIR, ACADEMIC COMPUTER SERVICES 617-239-4423	CLASSROOM W/25 IBM XTS & SONY COLOR PROJECTOR
BAYLOR U C G WILLIS DIR, CASEY COMPUTER CENTER 817-755-2258	4 CLSROOMS W/SONY FOR COMPUTER & VCR DISPLAY, PS2 LAB
BOSTON U CHRISTINE M LENTZ DIR, INFORMATION RESOURCES 617-353-9858	FACULTY LAN, ONGOING SW DEVELOPMENT, LAB ACCESS TO ANY OTHER CAMPUS SYSTEM
BRADLEY U ANTONE F ALBER ASSOCIATE DEAN 307-677-2256	AT&T CLASSROOM OF THE FUTURE, 21 AT&T 6300S W/30 MB HARD DISKS
U CALIF, BERKELEY KIRK P BREAULT MGR, COMPUTING SERVICES 415-642-6879	ETHERNET APPLETALK BRIDGE LINKING MACS, IBMS, & VAXS
U CALIF, LOS ANGELES (ANDERSON) TOM KOZLOWSKI MGR, TECHNICAL SERVICES 213-206-6807	PC VIDEO SWITCHING NETWORK; HP9000 UNIX ENVIRONMENT
CALIF STATE U, HAYWARD MIKE CAVANAGH COMPUTING COORDINATOR 415-881-3532	WRITER'S WORKBENCH, ADMINISTRATIVE COMMUNICATION COURSE SW
CALIF STATE U, LOS ANGELES RALPH S SPANSWICK MICRO FACILITIES COORDINATOR 213-224-2908	PC VIDEO SWITCHING NETWORKING FOR TEACHER-STUDENT INTERACTION
CANISIUS COLLEGE ALAN I DUCHAN CHAIR, MIS DEPARTMENT 716-883-7000	STRONG STAFF
CASE WESTERN (WEATHERHEAD) MILES KENNEDY ASSOC PROF, MGMT INFO SYSTEMS 216-368-2094	UNUSUALLY USER FRIENDLY & EFFICIENT NETWORK OPERATING SYSTEM
COLUMBIA U ANTONIO G D'AMATO DIR, COMPUTING ACTIVITIES 212-280-4750	INSTRUCTOR-CONTROLLED IMAGE TRANSFER OF STUDENT PC SCREENS
CORNELL U (JOHNSON) GENE ZIEGLER DIR, COMPUTING SERVICES 607-255-3217	MANUFACTURING DESIGN SW SYSTEM
CREIGHTON U VASANT RAVAL ASSOCIATE PROFESSOR 402-280-2602	THOROUGH, WELL DEVELOPED PLAN FOR INTEGRATION OF COMPUTERS INTO ACCOUNTING CURRICULUM (28 PP)
U OF DAYTON SAM GOULD DEAN 513-229-3736	BOS LAB FOR HUMAN FACTORS STUDIES
DUKE U (FUQUA) PAULA ECKLUND MGR, COMPUTING SERVICES 919-684-6947	DATABASE ACCESS VIA NETWORKED MINI COMPUTERS

EAST CAROLINA U RICHARD KERNS DIR,COMPUTER SERVICES 919-757-6350	NEW TOKEN-RING & APPLETALK NETWORKED LAB
FLORIDA ATLANTIC U PAUL J GUGLIELMINO DIR, STUART-JAMES RES CENTER 407-393-3177	STUART-JAMES RESEARCH CENTER
GEORGIA STATE U NINA H WALTON ASST DIR, ACADEMIC COMPUTING 404-651-3778	MGMT SIMULATION GAMING, LOTUS 1-2-3
U OF HAWAII HIRAM K TOMPKINS DIR, COMPUTER RESOURCES 808-948-8064	CONVERSION TO IBM VM SYSTEM
U OF ILLINOIS, CHICAGO JEFF P WOODWARD DIR, COMPUTER SERVICES 312-996-0939	AT&T SHOWCASE LAB, RESEARCH/ADMIN NETWORK
U OF ILLINOIS, URBANA-CHAMPAIGN JOHN S CHANDLER DIR, OFFICE FOR INFO MMGT 217-244-0812	PC/AT TOKEN-RING NETWORK, CD ROM BUSINESS DATABASES, SYS 36 PRODUCTION & CASH MANAGEMENT SW
U OF IOWA WARREN J BOE DIR, ACADEMIC COMPUTING 319-335-0889	NETWORKED PC LAB, OB EXPERIMENTAL LAB, COMPUTER CLASSROOM
KANSAS STATE U JEANETTE HAROLD COMPUTER INFO SPECIALIST 913-532-6296	"FACTS": INTERACTIVE SW ACCESS TO EXTERNAL FINANCIAL DATABASES
U OF LOUISVILLE PEGGY A GOLDEN ASSISTANT PROFESSOR 502-588-7830	GROUP DECISION SUPPORT SYSTEM; MF E-MAIL INCLUDING CLASS ACCOUNTS
MARQUETTE U ELIZABETH MAGALSKI INSTRUCTOR, MIS 414-224-6866	MERIDIAN SYSTEM ALLOWING FOR GROUP DECISION SUPPORT SYSTEM
U OF MICHIGAN, ANN ARBOR NICHOLAS HADWICK USER SERVICES COORDINATOR 313-764-5607	"CSMIL": PLANNING COLLABORATIVE DECISION-MAKING SYSTEM
U OF MINNESOTA (CARLSON) STEVEN HUNSTED COORDINATOR, INFO SYSTEMS 612-625-3391	COMPUTERIZED ECON MARKETS TRADING GAME & AI SW FOR SYSTEMS ANALYSIS
MISSISSIPPI STATE U ELIAS R CALLAHAN HEAD, DEPT OF BISQA 601-325-3812	5 NOVELL/TWISTED PAIR NETWORKED LABS BRIDGED TOGETHER & TO OUTSIDE; ELECTRONIC CLASSROOM
NICHOLLS STATE U BRUCE L MCMANIS DIR, CENAC COMPUTING CENTER 504-448-4188	COMPUTERIZED LECTURE NOTE SYSTEM FOR STUDENT ACCESS
NORTHWESTERN U (KELLOGG) CHRIS MICHAEL DIRECTOR 312-491-3378	EXECUTIVE AT&T PC CLASSROOM, ELECTRONIC LIFT TO RAISE MONITOR FOR NON-LAB APPEARANCE
THE OHIO STATE U MARJORIE BRUNDAGE DIR OF COMPUTING SERVICES 614-292-1741	CAMPUS-WIDE COMPUTER ACCESS FROM FACULTY OFFICES
OREGON STATE U CLIFF DALTON DIRECTOR OF ADMINISTRATION 503-754-2551	EXTENSIVE NETWORK SOFTWARE, SHARED PRINTING & DIAGNOSTICS
U OF PITTSBURG (KATZ) LAWRENCE P MELBERG DIR OF INFORMATION SERVICES 412-648-1574	INTRO FINANCE MODULES USING CRSP & COMPUSTAT DATABASES
ROLLINS COLLEGE (CRUMMER) MARTIN SCHATZ DEAN, GRAD SCHOOL OF BUSINESS 305-646-2249	ELECTRONIC CLASSROOMS, LAPTOP SYSTEMS USED IN REGULAR CLASSROOMS

U OF SAN DIEGO EUGENE J RATHSWOHL ASSOC PROFESSOR 619-260-4861	MEDIA CENTER PROJECT ON MACINTOSH & CD ROM USAGE
SAN FRANCISCO STATE U SULTAN A BHIMJEE PROFESSOR 415-338-2138	GOOD LANS, GOOD USE OF MACS & PC/XTS DEDICATED COMPUTER CLASSROOMS
U OF SOUTH CAROLINA WILLIAM J KETTINGER DIR, DIV OF INFO RESOURCES 803-777-3595	VIDEO DISC-BASED COMPUTER ASSISTED INSTRUCTION SYSTEM, IBM TOKEN RING
SO. ILLINOIS U, EDWARDSVILLE DAVID E AULT ACTING DEAN 618-692-3823	ADVANCED USE OF COMPUTERS IN ACCOUNTING
SOUTHERN METHODIST U DANIEL E COSTELLO ASSOC DEAN 214-692-2546	ENTIRE SCHOOL NETWORKED; COMBINED LIBRARY & COMPUTER CENTER
STANFORD U SPENCER NASSAR ACTING DIRECTOR OF COMPUTING 415-723-6855	STATE OF ART NETWORKED ENVIRONMENT
TEMPLE U JEFFREY S VANHULLE ASST TO THE DEAN 215-787-5231	NETWORKED MICROCOMPUTER LABS
U OF TEXAS, AUSTIN BOB BROBST ASSOC PROF OF INFO SYSTEMS 817-272-3577	CENTRALLY CONTROLLED INTEGRATED COMPUTER CLASSROOM
TEXAS TECH U F DAVID BERTRAM DIR ACADEMIC COMPUTING 806-742-1532	COMPUTERS & AV TECHNOLOGY TO TEACH MANAGERIAL COMMUNICATION
U OF TOLEDO DAVID A LINDSLEY ASSOC DEAN 419-537-4611	ZENITH PORTABLE PCS W/KODAK DATASHOW VIDEO DISPLAY
U OF UTAH KENT L GRANZIN CHAIR, COLLEGE COMPUTER COM 801-581-7489	DIAL-IN SUPPORT TO MICROS & MINI; WIDE-AREA NETWORK
U OF VERMONT REQUIRED CHAIR, COMPUTER RESOURCES COM 802-656-0498	STUDENT MICROCOMPUTER PURCHASE JIM KRAUSHAAR
VIRGINIA TECH (PAMPLIN) SAM A HICKS DIR OF COMPUTING 703-961-6591	STUDENT PURCHASE OF HW & SW; BROAD B& MF/PC COMMUNICATION
WESTERN CAROLINA U JOHN F MCCREARY DEAN, SCHOOL OF BUSINESS 704-227-7401	HIGHLY SOPHISTICATED IN GRAPHICS & PROJECT MANAGEMENT
YALE U CHRISTOPHER L KIELT DIRECTOR OF COMPUTER SERVICES 203-432-5923	NOVELL NETWORK USED FOR DISTRIBUTING COURSEWORK
DALHOUSIE U DONALD P. SHERIDAN DIR, COURSEWARE DEV PROJECT 902-424-7080	COURSEWARE DEVELOPMENT PROJECT
MCMASTER U MARVIN RYDER ASST TO THE DEAN (COMPUTING) 416-525-9140 X3997	MANAGEMENT OF TECHNOLOGY INSTITUTE
QUEEN'S U JOHN MCKURDY CHAIRMAN, COMPUTER COMMITTEE 613-545-2365	DECISION LAB, 6 MICROS USING DECISION SUPPORT SYSTEM SW
U OF WESTERN ONTARIO ANDREW GRINDLAY DIR OF COMPUTING RESOURCES 519-661-3751	"SAGE": VISUAL INTERACTIVE MODELING, EXPERT SYSTEM DEVELOPMENT