THE JOHN E. ANDERSON GRADUATE
SCHOOL OF MANAGEMENT AT UCLA

WHERE ARE BUSINESS SCHOOLS IN THE PROCESS OF COMPUTERIZATION?

Ninth Annual UCLA Survey of Business School Computer Usage

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The authors wish to thank those individuals who took the time to gather the extensive data necessary to complete the questionnaire. Without their efforts this survey would have been impossible. Appreciation is also extended to the Business School Computing Center directors from around the country who reviewed the draft questionnaire and report. A very special thank you is given to Research Assistant Roshan Etim for the data entry. We wish to also thank Melinda Daczynski for her ongoing assistance.

Apple Computer Incorporated, Digital Equipment Company, and International Business Machines sponsored this year's survey project. Their continuing commitments have made this research and its dissemination possible. Larisa Fong at Apple and Tom Kirk, formerly at IBM, deserve special mention as "survey champions" over the past several years. Thank you.

This report was prepared using Microsoft software, a standard at the Anderson School.

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Executive Summary

The UCLA Business School Computer Usage surveys provide summary information to deans and other computer policy decision makers to assist them in making plans and allocating computer resources. Over 60% of the AACSB-accredited business schools annually provide general information on their hardware, software, other computer resources, and use of computers in their schools, as well as bi-annually, data on more specific topics such as details of their computer operating budgets.

The focus of this year's survey is on where the schools' perceive themselves on thirty different areas of computerization. Responding on a life cycle process-oriented question format, the schools in general perceive themselves to be in moderate growth for their total processes of business schools computerization. However, specific areas reflect differing perceptions of process identifications. For instance, as could be expected, the schools perceive themselves to be earlier in the processes which involve newer technology such as multimedia, Windows, CD-ROM databases, and high performance 32-bit workstations than those processes which involve the mini/mainframes and microcomputers.

Nineteen of the areas of computerization requested in this year's survey were replications of those in the 1988 survey and a comparison of 124 business school who participated in both showed significant positive phase changes for thirteen of these areas. Additionally, although a different set of business schools responds to each year's survey, the stable demographics allow projections of some general longitudinal trends, such as the average number of microcomputers per school.

Findings

At the strategic level, the schools indicated a great deal of effort in strategic planning, with almost 60% of the schools perceiving themselves to be in a start-up or growth phase. In contrast, 46% of the schools responded that they were in a stable phase with regard to their computer operating budget, with an average budget of just over $225,000. The critical strategic issues remained about the same over the past four years, with funding and appropriate curriculum development being of most concern. A great deal of effort was also indicated regarding new computer facilities, with 59% of the responding schools involved either with new construction or extensive renovations.

Seventy-one percent of the schools responded in the start-up or growth phase, indicating expectations of more progress in the integration of computers into the business school curriculum. In spite of the physical problems involved in getting electronic/computer-linked equipment into the actual classroom, the 67% of the schools perceiving themselves to be in the start-up or growth phase confirms the expectation of continued progress in curriculum integration. Examples of innovative uses of information technology were given by 43 of the schools. These examples go beyond the development of a basic infrastructure seen four years ago, with more emphasis on creative curriculum applications using multimedia, group decision support systems (GDSS), CD-ROM databases, presentation software, and Windows-based courseware. The major curriculum integration issues seen four years ago, faculty incentives and teaching style/motivation, have remained. However, the increasing addition of computer courseware into standard business textbooks appears to have diminished concern for issues such as courseware development support, selection of courses to be integrated, and lack of courseware.

The general hardware phase perceptions of stability are indicative of the achievement of a basic technological infrastructure. Only use of the mini/mainframes as a communications server shows high response in the start-up and growth phase, with mini/mainframe use for instruction, research, and administration being perceived as stable or in re-evaluation for most of the schools, and even being phased out by some schools. The average number of microcomputers also shows little potential for growth, confirmed by 65% and 62% of the schools respectively reporting being in a stable phase with regard to their number of microcomputers and number of microcomputer

labs. The schools also report that a microcomputer density of 1.3 (one and a third faculty members sharing a single system) is sufficient to provide for "never any waiting" for 78% of their faculty and "occasional waiting" for 19% more. The provision of one system for every 27 undergraduates and for 22 graduates provides "never any waiting" for about 14% of their students, and at the density of 40 students per system only "occasional waiting" for almost 70% more.

Phase of faculty and student microcomputer usage closely follows the introduction of both the software applications and the hardware technological advances. Productivity utilizing word processing and simple spreadsheets are farthest along the growth curve with an average near the mature phase. More advanced spreadsheet usage shows an average at the end of slow growth for students and an average just entering fast growth for faculty. Desktop publishing and presentation graphics follow behind by several phases with an average in the introduction to users for both faculty and students. E-mail is entering slow growth for the faculty and introduction to the students, and CD-ROM, a later technological application, is at the start-up phase with initial installation and testing. Phase responses to computer literacy, a general measure of microcomputer usage, show that the schools perceive almost 40% of their faculty to be in a stable phase, with another 46% in a growth phase. Student computer literacy follows, with only about 30% of the students perceived to be in a stable phase, and 58% in growth. The higher percentages of both faculty and students in the growth phase implies expectations of continuing change towards even more sophisticated uses of microcomputers.

The general trend in average number of portable systems per school shows almost no change since 1989. However, this apparent stagnation and business school disinterest in portables is contradicted by the phase projections, which show 66% of the 158 business schools providing responses perceiving their school to be in an investigation and/or start-up phase, and another 18% in a growth phase. However, the 1988 phase data showed just about the same distribution implying high expectations of growth, which obviously didn't occur. Thus, the positioning of portables within the business schools remains unclear.

The positioning of workstations within the business schools also remains unclear, in spite of significant longitudinal positive changes in the use of high performance 32-bit graphic workstations. Forty-four percent of the 121 responding schools suggest they are in a start-up or growth phase and 55% perceived themselves in an investigation phase. Only 62 business schools of the total sample of 178, reported workstation ownership.

At the operational level, equipment obsolescence and maintenance ranked as the most critical issues, which is reasonable given the stability in the number of microcomputers. The central problem involves the realities of cost/benefit analyses, constrained by a stable (i.e. non-growth) computer operating budget and upgrades necessitated by the latest software developments such as Windows. Another critical operational area is training for both the faulty and the students, with 60% of the schools reporting a perception of being either in start-up or growth for user support. All of the new technology phase diagrams (i.e. workstations, Windows, and multimedia implementation) show high percentages of the schools in the investigation phase and emphasize the time and effort required for information gathering, selection between alternatives, seeking support, obtaining bids, creating the hardware platform, and other general preparatory activities that must take place under the auspices of the computer operations before the start-up phase can even begin.

Implementation of local area networks is the area of greatest change for the longitudinal schools, with almost two phases increase within the last four years. Sixty-nine percent of the schools in this survey reported being in either the growth or stability phase, with 42% of these schools reporting all of their faculty, student, and administrative LANs being bridged together. It is not surprising, therefore, that the most critical network and communication issue is management of the networks (including network reliability and response time, as well as software licenses and availability) instead of the basic connectivity and network selection issues of concern four years ago.

Recognizing that the business schools have started their computerization processes at different times, with differing resources and goals and objectives, the aggregate view of where the schools are in the process of computerization presented thus far could be considered naive.

Therefore, an analysis grouped the schools into clusters based upon the similarity of their responses to the thirty phase questions. A basic structure consisting of five clusters emerged from the data. The overall means and profiles of these five clusters led to their identification as a Start-Up cluster, an Early Growth cluster, a Mixed Phase cluster, a Late Growth cluster, and a Stable cluster. Even though the clustering was based on a different set of schools and a different number of phase questions, the five groups were very similar to the set of five clusters found four years earlier, providing validation for the process and the basic structure emergent from the data. Further, the strategic, instructional, operational, and communications and network issues were shown to differ by cluster. Analysis of these differences showed two types of issues - those common across all of the clusters and thus independent of the computerization process and those unique to the separate clusters and thus dependent on the computerization process.

Open Issues

The data collected by the Annual UCLA Surveys of Business School Computer Usage over the past nine years suggests that the decade of the 1980s be characterized by the phrase "gaining access." The emphasis has been on acquiring equipment and software and making it available to faculty, students, and staff. This year's survey suggests that schools have reached equilibrium with respect to the number of microcomputer systems and the allocation of lab space.

The decade of the 1990s may be characterized by the phrase "gaining value." The Ninth Survey results suggest that there is plenty of room for growth in how computer systems are used, in the need for general computer literacy, and training. The perceived value of linking computers is reflected by the large number of schools which now have physically networked systems, although they indicated a lag in the actual use of the network for sharing data, software, and peripheral resources. The schools also indicated there is significant opportunity for growth in integration and benefits to the curriculum.

However, the decade of the 1990s is fiscally more challenging than that of the 1980s. Computer budgets appear stable, but with the continuing difficulties of the American economy and many State governments indicating fiscal challenges ahead, maintaining the levels of services and quality of equipment will be more difficult. The leading operational issues dealt with equipment obsolescence and maintenance and, at the same time, the impacts of new, more powerful versions of software entering the market. Most schools responded as being in the early stages of a Windows or graphical user environment; however, to move along the growth curve in these areas will require more powerful systems. Thus, schools may be stalled in their ability to offer the most advanced versions of software due to the limitations of the older hardware.

In the 1991 survey, the data were described in terms of quartiles and questions were raised regarding the discrepancies between the quartiles' capacity to educate their students in the use of information technology. This year, the schools were clustered based on their perceptions of *where* their school was for the 30 computerization attributes. Once again, important differences were seen between schools' capacity to educate their students. The cluster defined by those schools which appear furthest along the life cycle curve, labeled as the "stable cluster", is spending on average, twice the resources of the next closest cluster and ten times the "start-up cluster". The long term impact of these expenditure differences which continue to separate the business schools must be considered.

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1. Introduction

Where are business schools with respect to their use of computers and information technology? Driven by the introduction and eventual pervasiveness of the microcomputer, business schools and their users have been presented with an extensive variety of hardware and software options. Faculty, student, and administrative requirements and expectations have changed as they gain sophistication and experience with this emergent technology. These dynamic changes exacerbate planning and resource allocations. Now, faced with severe budget constraints, business school policy and decision makers continue to need information which enables them to achieve a perspective beyond the boundary of their own school.

The goal of this, the Ninth Annual 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 nine years has remained the same: to provide information that can assist with computer allocation decisions and program plans. It is stressed that the focus of these surveys is to reflect what the schools report they are doing rather than to be an endorsement of what they should be doing.

The First, Second, Fourth, Sixth, and Eighth Surveys gathered information on the hardware, software, and other computer resources of the schools. Every other year the focus of the surveys changes, providing information on a more distinct issue. Thus, the Third Survey polled the deans to pull together their concerns related to business school computer issues. The Fifth 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. The Seventh Survey detailed computer operating budgets and services to provide an overview of budget distributions and estimated service costs.[1]

This year's survey, the Ninth, like the Fifth, considers business school computerization in terms of process. The nine page questionnaire requested four types of data: demographics, short description, ranking, and phase. Schools which had participated in the Eighth Survey were provided two individualized data sheets to indicate demographic and hardware updates to the current survey database. Blank data sheets were sent to the schools on which there was no current data. Short descriptions of plans, strategies, and innovations were requested. Four categories of issues (strategic, operational, communications and network, and instructional) were presented for ranking.

The fourth type of data involved the process of business school computerization. A phase diagram question format was developed by the authors based on reviews of other life cycle process graphs and personal experience. Appendix 1 details the phase diagram, together with a description of each phase. Eleven possible phase responses are delineated by points along a diagrammed process continuum. In these phase questions, the respondents identified their perception of where their particular school was, the "phase", for thirty different areas of business school computerization. The phases are all related to the individual school respondent's perception of some concept of a stable or mature environment. Thus, each particular response is relative to the perception of the specific individual who completed the questionnaire. Furthermore, the responses do not represent a common starting point (e.g. no computers) or a specific point in time (e.g 1980). Rather, the purpose is to capture a subjective reflection of where the particular respondent views his/her business school along a computerization process continuum. It indicates, to some extent, past accomplishments, present conditions, and future expectations.

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1 The Second, Fourth, Fifth, Sixth, and Seventh Surveys have been published in the Communications of the ACM, Vol. 29, No 1 (1986), Vol. 31, No 7 (1988), Vol. 32, No 1 (1989), Vol. 33, No 5 (1990), and Vol. 35, No 1 (1992).

The complete SAS files of the Second, Fourth, Fifth, Sixth, Seventh, Eighth and Ninth raw data are available to interested researchers. Please contact the Information Systems Research Program, The Anderson Graduate School of Management, University of California, Los Angeles, CA 90024-1481. (310) 825-1879

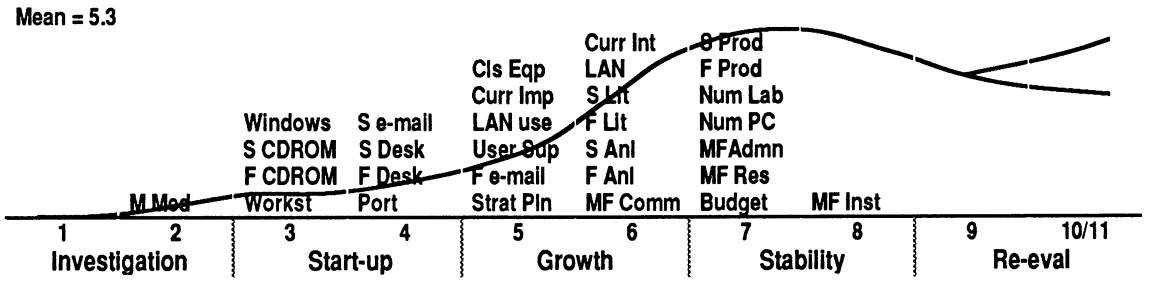
This year's questionnaire remained as similar as possible to the Fifth to allow longitudinal comparisons. However, slight changes were necessary. These changes include updating hardware models and new questions concerning business school building moves, computer facility renovations, and local and wide area network access. The rank listings for the strategic, operational, communications and network, and instructional issues were modified slightly to reflect the inclusion of new concerns. Nineteen of the phase questions remained the same. New phase questions were added regarding the strategic planning process, use of mini/mainframes as communication servers, multimedia systems implementation, e-mail usage, CD-ROM database usage, Windows implementation, the provision of support services to users, actual use of LANs, and the impact of computerization on the curriculum.

Where are business schools with respect to computerization?

One answer to this question is the average of all of the business schools' responses to all of the 30 phase questions. This single point, 5.3, suggests that, overall, the 178 AACSB-accredited business schools in this sample are in a moderate growth phase, just beyond slow growth and not quite yet at fast growth. Figure 1 presents a phase diagram showing this aggregate mean, as well as the separate means for each of the 30 phase questions, identified in an abbreviated form and placed on the phase diagram. Appendix 2 defines the abbreviated descriptions as used in this figure and throughout the report.

Figure 1 shows that, collectively, business schools are at the initial action phase for multimedia systems implementation and the start-up phase in use of high performance 32-bit graphic workstations, faculty and student use of CD-ROM databases and Windows implementation for IBM/IBM-compatible systems. In contrast, the business schools collectively reflect a mature phase with respect to the computer operating budget, mini/mainframe use in research and for administrative support, the number of microcomputers and microcomputer labs, and faculty and student usage of microcomputers as a productivity tool. The schools' collective responses suggest that use of mini/mainframes for instruction has become institutionalized, with little expansion and routine replacement of the obsolete technology.

Figure 1
Phases of Business School Computerization
(N = 178)



When this year's aggregate mean of 5.3 is compared to the mean of 5.2 as reported in the 1988 Fifth Survey, very little growth is intuited. However, this simple comparison and the immediate intuitive conclusion is not accurate. The two surveys comprise differing phase questions and differing business schools. Additionally, many of the phase questions that were added to this year's questionnaire concerned issues, such as multimedia systems or Windows implementation, where the technological innovation is too new for many schools to respond very far along the life cycle curve.

Longitudinal phase data is available for 124 schools which participated in both the Fifth and the Ninth Surveys, 70% of this year's total sample. Demographically, these schools are similar to the total sample. For the 19 phase questions which are the same in the Fifth and the Ninth

Surveys (indicated by an asterisk in Appendix 2), this single where point is 5.9 (almost fast growth) for this year's survey (academic year 1991-92), changing from a 5.2 (early slow growth) in the Fifth survey (academic year 1987-88).

However, considerable variance in growth is seen among these 19 phases, as shown in Figure 2. Two of the 19 areas of computerization moved two phases along the diagram, nine into the next phase, and the other eight areas of computerization remained in the same phase. In general, the areas of computerization lower on the diagram showed greater movement than those at or near the mature phase.

Figure 2
Phases of Business School Computerization (Longitudinal: 1988-1992)
(N = 124)

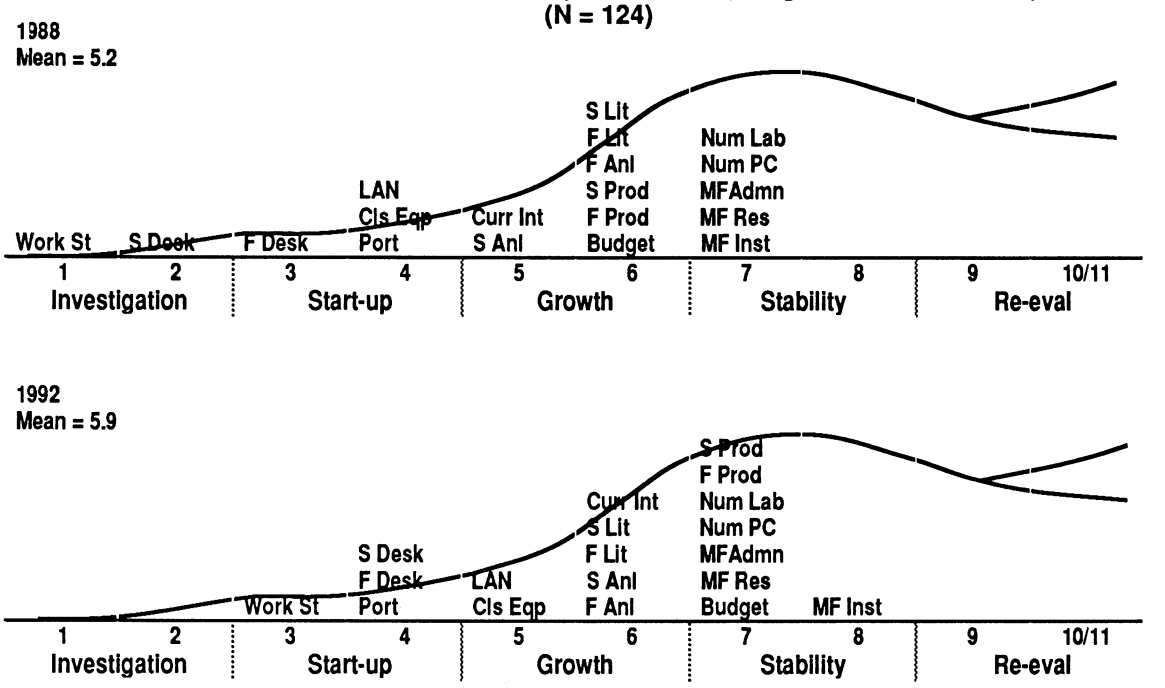


Table 1 ranks these nineteen phases by growth difference. T-tests show the changes significant at the .001 level for nine areas and significant at the .01 level or greater for four more. Growth greater than one phase (1.5 or more) is reported for development of local area networks, student use of microcomputer desktop publishing and presentation graphics, and use of the high performance 32-bit graphic workstations. In contrast, very little growth (<0.5 phase) is shown for faculty and student computer literacy, mini/mainframe use in instruction, and electronic/computer-linked equipment in the classroom. Not surprisingly, as suggested last year in the Eighth Survey, the number of portable microcomputer systems shows a very slight negative phase movement.

With regard to Table 1, the amount of change to be expected can be considered relative to the phase context in which it occurs. By definition, less change can be expected at maturity, phase 7, or institutionalized, phase 8, than at slow growth, phase 5, or fast growth, phase 6.

After a brief presentation of the sample demographics, the schools (large and small, public and private, early and late adopters) are combined to look at the data for each of the computerization process areas. Comparative longitudinal phase diagrams for the 124 schools participating in both the Fifth and the Ninth Surveys will be presented for the nine areas for which the 1988-1992 change was significant at the .001 level. Additionally, throughout this report, where appropriate and available, comparable data from the Second (1985), Fourth (1987), Fifth (1988), Sixth

Table 1
Mean Changes for 19 Phases (Longitudinal: 1988-1992)
(N = 124)

	N	1988	1992	Mean Change	t	
LAN	105	3.7	5.4	1.7	5.04	**
S Desk	110	2.4	4.0	1.6	6.40	**
Work St	84	1.1	2.6	1.5	5.95	**
F Desk	121	2.8	4.2	1.4	6.85	**
Budget	101	5.8	6.9	1.1	3.74	**
Num PC	123	6.5	7.4	0.9	4.73	**
Cur Int	121	4.8	5.6	0.8	3.81	**
S Anl	122	4.9	5.7	0.8	3.59	*
F Prod	123	6.0	6.8	0.8	4.36	**
F Anl	123	5.5	6.2	0.7	3.15	*
S Prod	121	6.0	6.6	0.6	3.46	**
Num Lab	121	6.7	7.3	0.5	2.69	*
MF Admin	107	6.8	7.3	0.5	1.53	
MF Res	118	6.9	7.4	0.5	2.24	
F Lit	121	5.8	6.3	0.4	2.35	*
S Lit	121	5.8	6.0	0.3	1.63	
MF Inst	111	7.4	7.7	0.3	0.93	
Cls Eqp	120	4.3	4.5	0.2	0.85	
Port	110	4.0	4.0	-0.01	-0.03	
Mean		**5.2**	**5.9**	**0.7**		

** significant at 0.001
* significant at 0.01

(1989), Seventh (1990) and Eighth (1991) Surveys are also included. In contrast to the direct comparisons for the 124 Fifth and Ninth schools, the data from the multiple surveys do not reflect an exact longitudinal study, as the same schools are not followed over a period of time. The accuracy of comparisons over the years are a function of the composition of the changing sample. However, given the overall consistency of the sample and its demographic structure as described in the next section, the identification of some general trends is appropriate.

The final section of this report identifies five clusters of the schools based on their similarity of responses to the 30 phase questions. Issues differences among the business schools as groups are discussed.

This report is divided into eight sections: introduction, profile of the participating schools, the strategic level, instruction and curriculum, hardware, the operational level, communications and network issues, and cluster analysis. Three appendices detail the business school computerization life cycle phase definitions, the abbreviations, and innovations.

2. 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 business which had previously been invited to participate in these surveys. Of the 288 schools sent questionnaires, 178 choose to participate, a 62% response rate. The questionnaires were completed primarily by computer center directors (34%), assistant deans (20%), and faculty members (19%). Seventy-eight percent of these 178 AACSB-accredited business schools also participated in the last survey, the Eighth. Seventy percent (124) schools participated in both this survey and the Fifth, which was also *"where"* oriented. One hundred seventy-two AACSB-accredited business schools have participated in four or more of the nine surveys.

Table 2 displays general demographic information about the 178 schools in this year's sample, together with demographics from the previous surveys. Not considering the data for the First Survey which was not open to all of the AACSB-accredited schools, the categories, in general, reflect consistent demographics.

Table 2
Demographics of Participating Schools
(percent of schools)

	First 1984 N=35	Second 1985 N=125	Fourth 1987 N=128	Fifth 1988 N=175	Sixth 1989 N=163	Seventh 1990 N=145	Eighth 1991 N=166	Ninth 1992 N=178
Type of school: Public	49%	69%	67%	68%	68%	70%	68%	71%
Private	51	31	33	32	32	30	32	29
Degrees offered:								
Undergraduate only		2	2	2	3	3	5	6
Undergraduate & graduate	66	86	85	88	89	86	86	86
Graduate only	34	12	13	10	7	9	7	6
No data					1	2	2	2
Student enrollment (FTE):								
Less than 1000 students	37	22	25	24	22	23	22	18
Between 1000 and 2000	23	22	27	21	26	28	29	33
Between 2000 and 3000	20	26	24	23	20	20	20	20
More than 3000 students	20	30	24	32	31	27	27	27
No data					1	2	2	2
Mini/mainframe facilities:								
Both school & university	54	27	29	34	31	27	27	23
School only	6	4	7	6	6	10	8	6
University only	40	64	60	56	59	58	60	65
No data		5	4	4	4	5	5	6

However, slight differences, should be considered. The percent of undergraduate only programs continue a very gradual increase, with an offsetting very gradual decline in the percentage of graduate only programs. Larger changes are seen in the student enrollment (FTE) data, with a decrease of four percentage points in respondent schools of less than 1000 students and a corresponding increase in the schools with between 1000 and 2000 students. These two changes, however, are not inconsistent, as undergraduate only programs are usually quite large in contrast to graduate only programs. The decrease in school-owned mini/mainframe facilities is consistent with the general results of these surveys over the past several years which suggest that many mini/mainframe functions are being replaced by powerful end-user microcomputer systems.

Table 3 compares the basic demographics for this year's total sample of 178 business schools with the longitudinal sample, the 124 business schools which participated in both this survey and the Fifth. The table shows a consistent demographic profile between these two sample, with the exception that the longitudinal sample has a larger percentage of graduate only schools and a smaller percentage of undergraduate only schools. Validity of the similarity between the longitudinal sample schools and the total sample is confirmed by comparison of the 1992 longitudinal and total sample phase diagrams (e.g. see Figures 4 and 5, Figures 6 and 7, and Figures 23 and 24).

Table 3
Demographics of Participating Schools (Longitudinal: 1988-1992)
(percent of schools)
(N = 124)

	Fifth 1988 N=175	Ninth 1992 N=178	Fifth & Ninth 1988-1992 N=124
Type of school: Public	68%	71%	70%
Private	32	29	30
Degrees offered:			
Undergraduate only	2	6	2
Undergraduate & graduate	88	86	89
Graduate only	10	6	9
No data	-	2	-
Student enrollment (FTE):			
Less than 1000 students	24	18	16
Between 1000 and 2000	21	33	32
Between 2000 and 3000	23	20	23
More than 3000 students	32	27	29
No data		2	

3. The Strategic Level

The strategic level concerns planning, the operating budget, strategic issues, and school building or extensive computer facility renovations.

3.1 Plans

Forty-one percent (73) of the schools indicated having formal computer systems goals, plans, or objectives. Seventeen schools attached a copy of these plans, ranging from 1 to 62 pages in length, and 45 schools provided a brief statement of their plans. Many of these included multiple objectives. An underlying theme was to create and maintain a climate that encourages information technology, to change to an environment in which computers and information technology play a more central role. However, the difficulty of strategic planning was reflected by the very different models and/or approaches shown in the documents submitted by the 16 schools. Eight were one or two pages extracted from larger planning documents and described the computer and information technology goals or plans; two (Bentley College and Oklahoma State) presented a description of what they would like their future environments to be like; three (Ball State, U of Georgia, and Miami U) presented detailed one year plans; Oakland U presented a detailed network plan; UCLA presented a discussion of the strategic role of information technology for

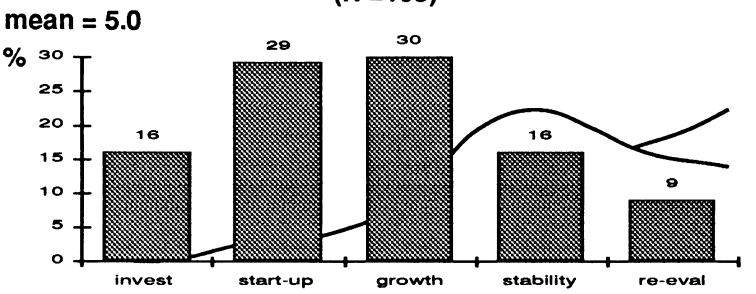
the school; and Cornell a very comprehensive, 58 page self-assessment and future directions document. It appeared from these documents that some were individual perspectives while others reflected committee efforts.

One plan submitted deserves special notice. The 64 page *Information Technology and Computing of the Syracuse University School of Management* describes the completion of a comprehensive computer and information technology planning process involving the faculty, students, and administrative staff. The topics included in this report are mission and goals, the study process, current environment, strengths, problem statements, recommendations, benefits, implementation, conclusion, and glossary. (Contact Associate Dean S. P. Ry, (315) 443-3751 for more information.)

Table 4 summarizes these strategic plans and is divided into six categories based on orientation: strategic, instructional, hardware, software/database, network, and support.

Figure 3 diagrams the phases of strategic planning for computers, communication, and information for the 163 schools providing data. The aggregate mean is 5.0, the beginning of the slow growth phase. The phase diagram suggests that the business schools are spending a lot of time on planning, either as a rather new effort for 45% of the schools who reported being in either the investigation or start-up phase, or as a decision point and possibly rejuvenating effort for 9%. Thirty percent of the schools reported being in a growth phase with regard to strategic planning. Only 16% of the schools reported stability with regard to their strategic planning.

Figure 3
Phases of Strategic Planning
for Computers, Communications, and Information
(N =163)



Ten schools indicated differing plans for their undergraduate and graduate business programs. Again, as in the Fifth Survey, little commonalty was seen in these differences. Three schools indicated their undergraduate programs received greater support than their graduate, while another school indicated more support for the graduate program. One school indicated that their undergraduates were required to have personal access to microcomputers, but this was not yet required of their graduate students. In contrast, another school required their graduate students to own microcomputers. Finally, several of the schools pointed out that a higher conceptual proficiency was expected of their graduate students, while another school stated that their graduate students were mainly users, while their undergraduates were user and developers.

3.2 Computer Operating Budgets

The respondents were asked to provide an estimate of their business school's total computer operating budget, the real dollars from any source designated to support academic and administrative computing within the school. This budget estimate includes staff salaries, benefits and support, software and data acquisition and licenses, supplies, operating overhead, and computer recharge funds. It excludes faculty salaries, capital expenditures where the list value was greater than $2000 and depreciated 3 years or more (e.g., microcomputer purchases), and lease payments. For the 138 (78%) schools providing data, the total annual computer operating budget ranged from $4,000 to $1,764,000, with a median of $127,600 and a mean of $237,360.

Table 4
Business School Computing Strategic Plans
(N = 61)

Strategic	2	climate which encourages information technology
	2	community/regional/state involvement
	2	leadership in I/S technology integration
	1	annual grants/proposals for hardware/software acquisition
	1	continual improvement of facilities
	1	long term goal of network connection in each dorm room
	1	mandated student access to own microcomputers
	1	slow down and consolidate introduction of technology
Instructional	8	adequate labs/access/scheduling for all classes
	7	more integration into classes
	5	student literacy parallel to industry applications
	3	more computer/overhead display capability in classrooms
	2	availability/use of multimedia
	2	establish/maintain modern instructional resources
	2	lead/support faculty in computer/curriculum integration
	2	basic computer literacy for MBA's
	1	update lab computers to 386/486
	1	faculty competency to provide high quality instruction
Hardware	6	provision/maintenance of "state-of-art" technology
	5	upgrade to 386 + systems
	3	all faculty with 286+ microcomputers
	3	3-5 year cycle upgrades
	2	printer upgrades to laser
	1	adequate number of workstations
	1	annual upgrade
	1	reduce dependence on campus mainframes
	1	minicomputer acquisition
	1	minimize productivity loss from failed systems
Software and Database	3	provide/maintain "state-of-art" software
	2	adequate software and documentation
	2	school-wide information system for administrative databases
	1	annual update
	1	increased availability of information resources via network
	1	LAN access
	1	software standards
Network	8	develop/improve network infrastructure
	7	integrated college-wide network
	3	support for students, faculty, administration
	3	network all microcomputers
	2	faculty access to WAN
	1	integrate faculty via telecommunications
	1	all faculty networked
	1	integrated network for faculty and staff
	1	continual expansion as funds available
Support	2	coordinate research, administrative computing support for all faculty/staff
	2	provision of teaching/advising/research support
	2	faculty requests for computer-dependent instruction materials
	2	professional development of computer personnel
	1	investigate workstation applications (RISC)
	1	educate community in appropriate use of information services

As shown in the phase diagram in Figure 4, the overall budget phase average for the 160 schools providing phase data is 6.7, at the end of fast growth and almost entering maturity. These budgets are now in a stable phase for 47% of the business schools reporting data, and were growing for 30%. Thirteen percent of the schools indicated that they were re-evaluating their budgets.

Figure 4
Phases of Computer Operating Budget
(N = 160)

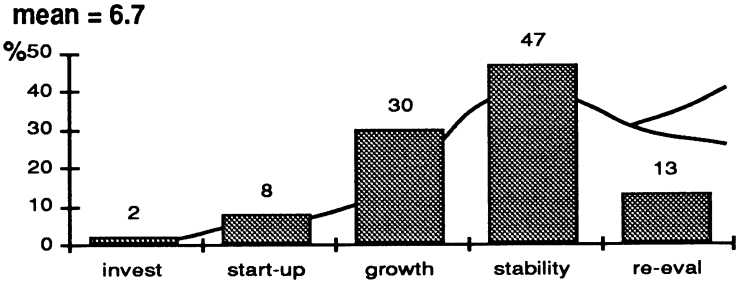


Table 5
Computer Operating Budget
(Longitudinal: 1988-1992)
(N = 97)

$	Fifth1988 %	Ninth1992 %
Less than 5 thousand	8	1
5-50 thousand	37	24
50-150 thousand	26	25
150-300 thousand	14	20
300-500 thousand	5	15
500-750 thousand	3	7
Over 750 thousand	7	8
Mean (estimated)	**$162,730**	**$244,175**

Table 5 provides a longitudinal comparison for the 97 business schools which reported budget data for both the Fifth and the Ninth Surveys. Based on the midpoints of the computer operating budget categories as used in the Fifth Survey, this budget figure increased 50%, just over $80,000, not adjusting for inflation.

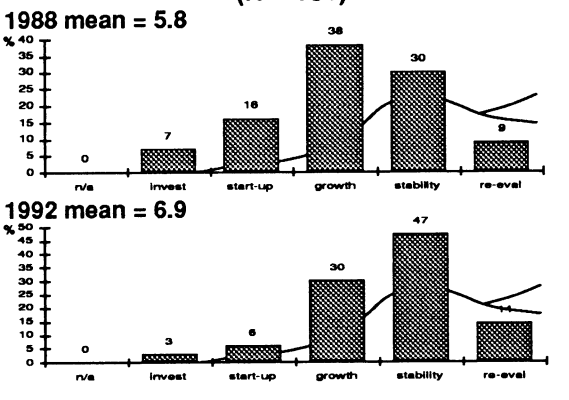
Reference to Table 1 shows that the average phase change in the computer operating budget for the 101 schools providing phase data for both the Fifth and the Ninth Surveys was 1.1, a change from 5.8, late slow growth, in 1988 to 6.9, almost maturity, for 1992. Table 5, which shows an estimated average of 50% budget growth substantiates this fast growth.

Figure 5 provides a comparison of the phase data for the longitudinal sample and shows this change from growth (38% of these schools in 1988) to stability (47% of these schools in 1992), In general, the schools in the longitudinal sample are now expecting little change from their current budget situation.

3.3 Strategic Computing Issues

The survey questionnaire presented a list of 16 strategic computing issues from which the respondents were asked to rank the 6 most important. Table 6 lists the issues identified by at least one-third of the schools. The first four issues remained the same as the first four issues identified in the Fifth Survey, with "finding funds" and "appropriate curriculum development" being ranked first and second in both surveys. Curriculum objectives have consistently been used as the justification for the high computerization costs, but yet these curriculum objectives are

Figure 5
Phases of Computer Operating Budget
(Longitudinal: 1988-1992)
(N = 101)



very subjective, and thus very difficult to quantify. "Technological currency", although still an important issue, dropped from a third rank in the Fifth Survey to share fourth place this year with "faculty incentives for courseware development". "Goals and strategic planning" remained in last position.

Table 6
Business School Strategic Computing Issues
(N = 165)

%	Issue
84	Adequate funding for operational support
72	Appropriate curriculum development utilizing computing
54	Faculty incentives for courseware development/integration
54	Keeping current on what technology is appropriate
53	Obtaining hardware/software donations
47	Managing user expectations
41	Lack of goals and/or strategic planning

Consistent with the slowing growth in the computer operating budget, as discussed above, and the first-ranked issue of "adequate funding", "obtaining hardware/software donations" entered the list of important issues this year. Of the four new issues added to the list this year (planning move/renovation, organizational structure, user expectations, and computer/library convergence), only "managing user expectations" was indicated by one third or more of the schools. The only issue dropped from the critical issues list this year was the "concern with schoolwide standards for hardware and/or software". This probably is a reflection of the microcomputer market with a large selection of price competitive clones, all of which can run the same software, as well as the implementation of LANs which enable most of the disparate systems to work together.

Several schools indicated "other" issues, not given on the list. Among these, two schools indicated lack of coordination and cooperation/support from the central university computing center for the business school and one school indicated lack of support from their dean.

3.4 New Buildings and/or Renovation

One hundred sixty-nine (95%) schools provided information regarding their status on a new business school building or extensive computer facility renovations. Forty-one percent of these schools indicated that they were not involved with either. Of the remaining, 20% of the schools indicated they were in the initial planning stage and 10% were in the process of an immediate move or renovation, either moving now or next year. Thirteen percent have a move or extensive renovation planned with two to five years. Sixteen percent moved within the past year (18 schools) or moved two to five years ago (9 schools).

Overall, the responses of the majority (59%) of business schools who answered this question point toward a major change and all of the potential disturbances to life as usual brought about by either moving to a new building or making extensive renovations.

4. Instruction and Curriculum

Instruction and curriculum concerns the use of information technology in the actual pedagogical process.

4.1 Curriculum Integration

Where are business schools in their use of computers in instruction? With an average phase mean of 5.5 for the 173 schools providing data, Figure 6 shows that 45% of the respondents perceive their schools in a growth phase regarding computer integration into the business school curriculum, 26% perceive their schools in the start-up phase, balanced by 23% perceiving their schools in a stability phase. Reference to Table 1 shows that the mean phase change for the longitudinal sample changed from a phase mean of 4.8 (late introduction to users) in 1988 to 5.6

(mid slow growth) in 1992, an increase of just under one phase. This change, significant at the .001 level, is shown in the phase diagrams in Figure 7, with movement along the phase diagram to the right and towards a more normal-shaped distribution. The implications from the high percentage of schools (68%) still in the start-up and growth phases is that the schools are expecting even more progress in their integration of computers into the curriculum.

Figure 6
Phases of Computer Integration into the Business School Curriculum
(N = 173)

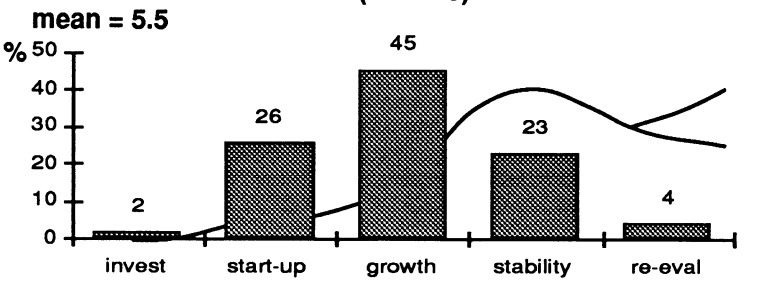
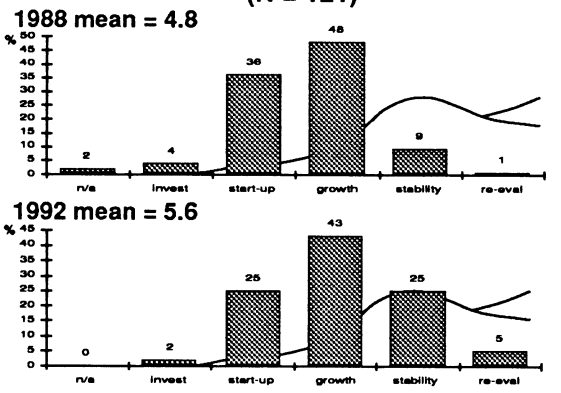
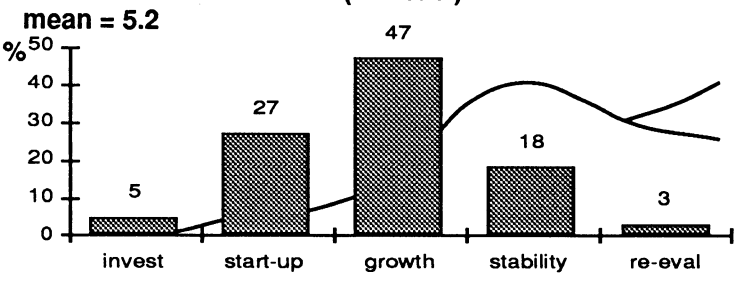


Figure 7
Phases of Computer Integration into the Business School Curriculum
(Longitudinal: 1988-1992)
(N = 121)



With these expectations, it is reasonable to assume that the schools consider this integration to be having a positive impact. Figure 8 confirms this assumption and shows the schools' perceptions of this impact. The average phase mean is 5.2 (slow growth) for the 171 schools providing data. Three percent of the schools indicated re-evaluation of the impact of their computerization efforts. The 18% in the stable phase can be assumed to be reasonably satisfied with their impacts and the remaining 79% are showing expectations of increasing impacts on the curriculum from their implementations of information technology.

Figure 8
Phases of Computer Integration Impact on the Curriculum
(N = 171)



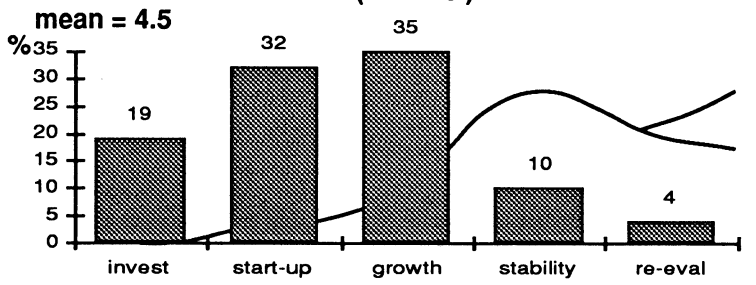
4.2 Curriculum and Integration Issues

In spite of these expectations, however, there are many challenges for business schools as information technology is introduced into the curriculum and the classroom. Table 7 lists the issues which at least one-third of the responding schools identified as among the six most important from a list of eleven. Again, as with the strategic issues, there was little change in this list from the Fifth Survey. And, again, this list just further delineates the second and third ranked strategic issues given in Table 6, "appropriate curriculum development utilizing computing" and "faculty incentives for courseware development and integration". The first two issues in Table 7, "faculty incentives" and "teaching style/motivation", will probably remain until the traditional criteria for promotion and tenure are revised to acknowledge the time spent on courseware development and computer integration.

Table 7
Instructional and Curriculum Issues
(N = 165)

%	Issue
84	Faculty incentives for developing courseware
80	Teaching style/motivation to use technology
73	Defining an appropriate level of curriculum integration
59	Courseware development support
55	Selection of courses to be integrated
53	Inability to use computers in classroom
45	Lack of courseware

Figure 9
Phases of Electronic/Computer-linked Equipment In the Classroom
(N = 173)



However, the increasing addition of computer courseware into standard business textbooks by the major publishers may diminish some of the pressure for issues such as "courseware development support", "selection of courses to be integrated", and "lack of courseware". Another major obstacle, "inability to use computers in the classroom", the basic equipment problem, still exists, together with pragmatics such as equipment delivery, security, configuration changes to meet individual faculty needs, and guarantees against frustrating malfunctions which often supersede the value of the lesson. Figure 9 shows that 32% of the responding schools perceive their schools in the start-up phase and 35% in the growth phase. These phase designations suggest that even with the existing problems, the business schools show a clear commitment to the continuing use of information technology, together with expectations of more progress in actual implementation.

In contrast to the significant change in computer integration into the business school curriculum, the longitudinal sample showed a non-significant change regarding electronic/computer-linked equipment in the classroom (see Table 1), suggesting that the intent for curriculum integration may actually be being dragged down by the pragmatics of physical problems related to the introduction of information technology into the classroom.

Computer labs also have problems such as scheduling and the availability of equipment upgraded sufficiently to handle the more powerful software. Yet, hardwired classrooms may be inherent in the move to a new building and/or extensive facility renovations, which together with new advancements in portable technology and decreasing prices, may signal the end of some of these equipment obstacles. Thus, it is possible that within five years, both the courseware and the equipment issues may begin to dissipate.

"Other" curriculum and integration issues given by some of the schools included raising faculty awareness of these instructional issues, finding appropriate courseware, and acquiring release time for faculty development of integration materials.

4.3 Innovations

This survey again presented an opportunity for the business schools to describe innovative and exciting uses of information technology which they may have developed. Forty-three (24%) schools provided a short description or attached materials (articles, proposals, or brochures) for a total of 60 projects summarized in Table 8. As compared to the innovations given

Table 8
Innovative Uses of Information Technology
(N = 43)

Area	#	Innovative use
Curriculum/software	4	Research/modeling projects
	3	Courseware
	2	Access front-ends
	1	Innovative software
Applications	5	Multimedia in courses
	3	CD-ROM/databases
	2	Groupware/GDSS into curriculum
	2	E-mail
	1	Use of presentation software
	1	Windows-based curriculum
Facilities/classrooms	8	Instructional labs/computerized lecture classrooms
	5	Multimedia classrooms
	3	Electronic conferencing/GDSS
	1	POM classroom
Network	7	Extent of networking
	4	LAN
	2	Networked CD-ROM/databases
	1	Variety of hardware
Organization/support	2	E-mail for grading/feedback
	1	Network extended to dormitory rooms
	1	Assignments/reports database
Hardware	1	Apple Powerbooks in Executive MBA programs

in the Fifth Survey which stressed basic computer availability in classrooms and networked labs, the innovations in this year's survey deal with the extent of the networking installed and more advanced classrooms which provide multimedia and group decision support systems (GDSS). With a basic infrastructure in place, there is now more emphasis on innovative curriculum applications using multimedia, GDSS systems, CD-ROM, presentation software, and Windows-based courseware.

Appendix 3 provides a short description of each project, together with a contact name and telephone number.

5. Hardware

With the increase in power and capability of desktop computers, there is considerable difficulty in establishing hardware category demarcations. For purposes of this report, mini/mainframes are considered to be centrally-controlled time-sharing systems which accommodate multiple concurrent users. In contrast, microcomputers and high performance 32-bit graphic workstations are considered single user systems. However, as network technology matures and all systems become nodes on a network, this distinction will also become less obvious.

5.1 Mini/Mainframe Computer Systems

One hundred sixty-seven (94%) of the business schools indicated that their users had access to mini/mainframe systems. Of these schools, 11 used only their own mini/mainframes, 42 provided access to both their own and central university mini/mainframes, and the remaining 114 relied exclusively on access to the central university systems.

The 51 business schools (29%) which maintained their own mini/mainframes listed 87 separate computers. Although 13 different vendors were represented, only four had systems supported by at least three or more of the schools. Table 9 displays the make, model, and number of these mini/mainframes. Digital Equipment Corporation had the largest number of systems installed in the schools in this sample, 29 (33%) of the total 87 (five in "other" category), and IBM had 24 (28%) (one in "other" category). There were two models installed in 11 business schools, the AT&T 3Bxs and the HP9000s. The average number of systems per school appears to be remaining just under 2 systems for those business schools who own and maintain their own mini/mainframe. Sixteen (9%) of the 178 schools in this survey indicated plans for acquiring a new mini/mainframe or a significant upgrade to their existing system.

Table 9
Business School Mini/Mainframe Systems Installed by Model
(number of systems)

Make (at least three systems)	First 1984 N=33	Second 1985 N=39	Fourth 1987 N=46	Fifth 1988 N=70	Sixth 1989 N=61	Seventh 1990 N=54	Eighth 1991 N=58	Ninth 1992 N=51
AT&T 3Bx			3	14	15	10	9	11
Digital VAX 11/7xx	7	10	17	23	18	15	5	3
VAX 3xxx							6	3
VAX 4xxx							4	4
VAX 6xxx						5	6	5
VAX 8xxx			4	7	8	7	9	3
MicroVAX			5	11	16	7	6	5
Hewlett-Packard								
HP3000s	6	8	11	12	12	5	5	3
HP9000s							4	11
IBM 43xx	2	9	13	16	17	12	9	7
S36,38		1	3	6	7	6	5	5
9370						3	5	4
AS400							6	7
Others (1 or 2 each)	22	31	24	38	29	30	16	16
Total	**37**	**59**	**80**	**127**	**122**	**100**	**95**	**87**
Average per school	1.1	1.5	1.7	1.8	2.0	1.9	1.7	1.7

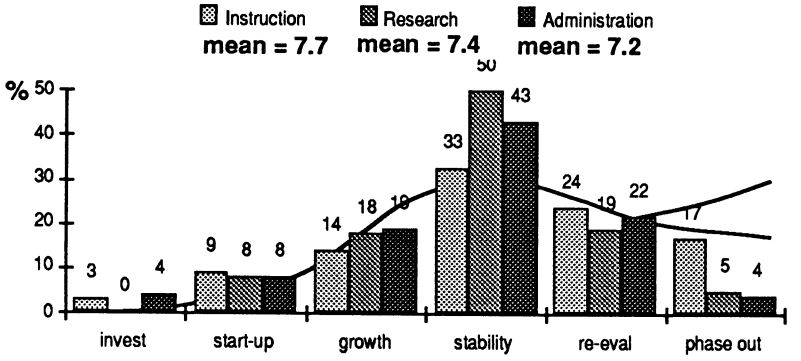
Usage patterns, summarized in Table 10, were provided by 45 of the business schools which own and maintain a total of 78 their own mini/mainframes. Twenty-six (33%) of these systems were used for a single purpose only, either for coursework (13 schools), for research (6 schools), or for administration (7 schools). Usage was shared among coursework, research, and administration for 23 (30%) of these mini/mainframe systems, and the remaining 29 (37%) were used for dual purposes, the most common being sharing the larger system between coursework and research.

Corresponding to the usage patterns are the schools' perceptions of where they are in use of the mini/mainframes for instruction, research, and administration, shown in Figure 10. Consistent with the lack of change in average number of mini/mainframes per schools given in Table 8, the means

Table 10
Business School Mini/Mainframe Systems Usage Patterns
(N = 45 business schools using 78 mini/mainframes)

Usage	Course		Research		Admin
13 used only for	x				
6 used only for			x		
7 used only for					x
23 used for all	x	and	x	and	x
22 used for	x	and	x		
3 used for	x			and	x
4 used for			x	and	x

Figure 10
Phases of Business School Mini/Mainframe Use
(Instruction N =164; Research N =169; Admin N = 165)

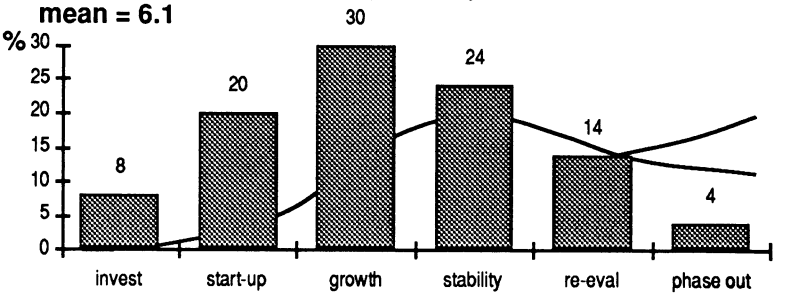


fall within the stability phase for all three of these applications. No schools reported being in the investigation phase for research.

Additionally, this mini/mainframe phase data is unique in that this is the only area in which a phase-out response (indicating discontinued use and/or replacement by new technology) has been given by more than one school. Thus, this is the only diagram which presents phase-out data, information critical for understanding the future role and use of mini/mainframes in business schools. As shown in Figure 10, 17% of the 164 business schools providing a response indicated that they were phasing out mini/mainframe use in instruction. Further, 5% of the 169 business schools providing a response indicated they were phasing out mini/mainframe use in research, and 4% of the 165 business schools providing a response indicated they were phasing out mini/mainframe use in administrative support. Additionally, an average 22% of the business schools providing data, indicated they were re-evaluating mini/mainframe use for instruction, research, and administration. It may be concluded that the use of business school-owned and maintained mini/mainframes has peaked and may even be on a decline.

Figure 11 shows a contrasting view of another use of the school-owned and maintained mini/mainframes. As a communications server, 50% of the 159 business schools who responded to this phase question, perceive the mini/mainframe to be either in a start-up or growth phase, and a further 8% are investigating this potential. However, 14% of the schools indicated are re-evaluating their use of the mini-mainframe as a communications server, and 4% are phasing out this usage.

Figure 11
Phases of Mini/Mainframe Use
as a Communications Server
(N = 159)



5.2 Microcomputers

Table 11, detailing the microcomputer models for which at least 300 systems were reported, shows that although the overall number of microcomputers has increased, the average number per school declined 3%. However, further analysis showed that this decrease was due to sample variation. When comparing the 134 schools which participated in both the Eighth and Ninth Surveys, the average number of microcomputers per school increased 4% to 223. In spite of these fluctuations, the high growth rates seen in the 1980s has been slowing and now seem to be approaching a steady state of approximately 215 systems per school.

Table 11
Business School Microcomputers by Model
(number of systems)

Model (>300 systems)	Second 1985 N=119		Fourth 1987 N=128		Fifth 1988 N=175		Sixth 1989 N=161		Seventh 1990 N=143		Eighth 1991 N=164		Ninth 1992 N=171	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
IBM AT, PS2 30,50,60	259	3	1194	7	2110	8	1827	6	1506	5	4916	14	5872	17
IBM PC/XT, PS2/25	5120	54	7509	45	10149	37	9286	30	7204	25	6543	19	4965	14
Clones 386									615	2	2650	8	4261	12
Clones 286							1055	3	1597	6	2303	6	3250	9
Mac Plus, SE, Classic	457	5	925	5	1893	7	2165	7	2456	9	2747	8	2483	7
IBM PS2/70,80					1305	5	2393	8	3678	13	2545	7	2041	6
Clones 8086							2714	9	2666	9	2070	6	2019	6
Macintosh IICI											977	3	1165	3
Zenith 386											760	2	1095	3
HP Vectra 286	40	0	349	2	538	2	1194	4	715	3	1328	4	1068	3
Zenith 150	411	4	1791	11	3274	12	3923	13	1276	4	1484	4	884	2
HP Vectra 386							632	2	315	1	886	3	833	2
Clones 486													702	2
Macintosh II							444	2	1011	4	868	2	679	2
Macintosh SE/30											665	2	652	2
Zenith 286									2037	7	722	2	632	2
AT&T 6300											678	2	578	2
AT&T 286					1172	4	1043	3	489	2	550	1	511	1
AT&T 386													364	1
Unisys	544	6	593	4	765	3	881	3	848	3	731	2	336	1
Others	2725	28	4364	26	6004	22	3183	10	2345	7	1805	5	1140	3
Total	**9556**	**100**	**16725**	**100**	**27210**	**100**	**30740**	**100**	**28758**	**100**	**35228**	**100**	**35530**	**100**
Average systems per school	**80**		**131**		**155**		**191**		**201**		**215**		**208**	
Average percent growth			**64%**		**18%**		**23%**		**5%**		**7%**		**-3%**	

Figure 12 also shows that little further growth in the number of microcomputers can be expected, with 65% of the 176 schools providing data indicating that the number of their microcomputers is in the stability phase. Additionally, the potential for growth in the number of computer labs is also weak with 62% of the schools providing data indicating the stability phase.

The longitudinal data for the number of microcomputers, presented in the diagram in Figure 13, shows the significant shift from high growth seen in the Fifth Survey (1988) to stability this year.

Figure 12
Phases of Number of Microcomputers and Labs
(Microcomputers N = 176; Labs N = 173)

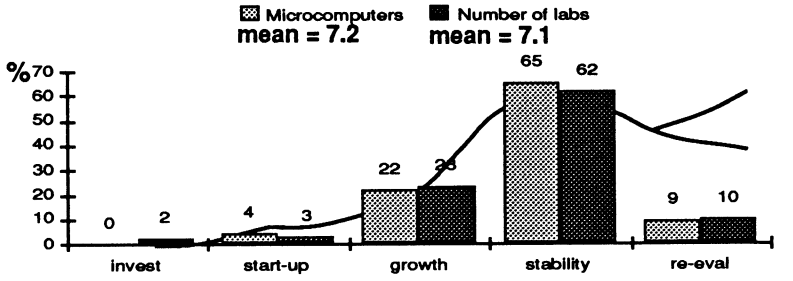
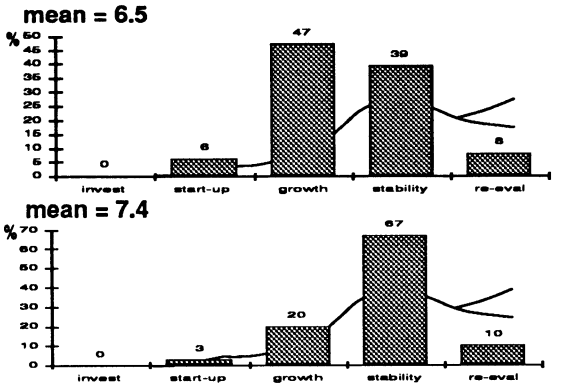


Figure 13
Phases of Number of Microcomputers
(Longitudinal: 1988-1992)
(N = 122)



The stability in the number of microcomputers per school and the expectations of little growth may reflect that the schools, on average, perceive that there are now enough microcomputer systems to meet their needs. Table 12 shows the schools' perceptions of the sufficiency of microcomputer access by user group (faculty, undergraduate and MBA), together with the average microcomputer density for each response cell. With a density of 1.3 (one and a third faculty members sharing a single microcomputer), 78% of the schools reported "never any waiting" and 19% "occasional waiting". A microcomputer density of 27 students sharing a single system achieved "never any waiting" for 12% of the schools and a density of 40 students sharing a single system "occasional waiting" for 71%. This data is congruent with similar data from the Eighth Survey, with the majority of schools showing differing standards for the faculty ("never any waiting") than for the students ("occasional waiting"). This data indicates that the schools' perceive there are sufficient microcomputer systems to meet their needs and a willingness to tolerate some waiting for student access.

Table 12
Microcomputer Sufficiency by User Group
(percent of schools)

	Faculty N=161		Undergraduate N=146		MBA N=150	
Microcomputer access	**%**	**density**	**%**	**density**	**%**	**density**
Never any waiting	78	1.3	12	27	14	22
Occasional waiting	19	1.3	67	40	71	42
Usually a wait	3	2.2	21	66	15	61

Returning to Table 11, the data also shows that the IBM PC/ATs, PS2/30s, 50s, and 60s, together with the IBM PC/XTs, PS2/25s remain dominant, as in the Eighth Survey, representing 31% of the total microcomputer systems. This year the ATs finally replaced the XTs which have been in the leading position since the First Survey in 1984. It should also be pointed out that the total percentage of clones increased nine percent this year, with the clones now accounting for

29% of the total microcomputer systems. The Macintosh Pluses, SEs, Classics account for 7% of the total systems and the IBM PS2/70s and 80s for 6%. All of the other models represent 3% or less of the total microcomputer systems.

Table 13 presents the same microcomputer data in terms of availability across business schools where a school has 4 or more of any one model. IBM's traditional dominance dropped this year to 64% for the AT/PS2s and has been overtaken by the 386 clones which are shown as being in 68% of the schools. Other than all of the clone categories, the only other models which increased in business school representation more than one percentage were the Macintosh IICIs, increasing 7%, the IBM PC/ATs, PS2/30s, 50s and 60s, increasing 4%, the Macintosh IIFXs increasing 3%, and the IBM PS2/90s, 95s increasing 2%. The Quads entered at 2%. The other models, increased only 1%, stayed the same, or decreased in school representation percentage.

Table 13
Business School Microcomputers
(percent of schools with model)

Model (at least 4 systems)	Second 1985 N=119	Fourth 1987 N=128	Fifth 1988 N=175	Sixth 1989 N=161	Seventh 1990 N=143	Eighth 1991 N=164	Ninth 1992 N=171
Clones 386				8%	23%	47%	68%
IBM PC/AT, PS2/30,50,60	5%	35%	35%	34	33	60	64
IBM PC/XT, PS2/25	82	86	86	86	85	74	61
Clones 286				17	32	43	50
Macintosh Plus, SE, Classic	13	26	29	35	48	51	45
IBM PS2/70, 80			31	49	58	45	43
Clones 8086				35	39	32	37
Macintosh IICI						27	34
Macintosh II				17	30	25	26
Macintosh SE/30						24	24
Zenith 386						20	21
Zenith 150					27	24	19
Clone 486						4	19
Zenith 286	10	30	42	29	32	21	18
HP Vectra 286	3	9	11	13	13	16	13
HP Vectra 386				7	8	14	13
AT&T 6300					6	13	12
AT&T 286		6	14	12	8	7	6
Unisys	4	8	7	6	7	7	5
AT&T 386				3	6	6	5
Macintosh IIFX						1	4
IBM PS2/90, 95						1	3
Macintosh Quadras							2
DEC Rainbow	13	6	6	6	4		
Apple II series	16	10	7	5	4		
Leading Edge				4	4		
NCR				2	3		
HP 150s	4	10	7	6			
Tandy	10	2	4	2			
Other	19	31	35	33	21	24	16

5.3 Microcomputer Usage

An important element in understanding the business school microcomputer environment is consideration of how these systems are being used by faculty and students. This year's survey asked a series of phase diagram questions related to microcomputer usage as a productivity tool (e.g., word processing, basic spreadsheets), as an analytic tool (e.g., modeling, advanced spread-

sheets, statistics), for desktop publishing and presentation graphics, for e-mail, and for CD-ROM database access. A summary phase question asked for a perception of general computer literacy. Figures 14 through 21 present this data.

As could be expected, these phase diagrams show the specific uses following the introduction of both software applications and the hardware technological advances. Productivity utilizing word processing and simple spreadsheets applications are farthest along the growth curve with an average near the mature phase. These early applications are followed by more advanced spreadsheet usage which shows an average at the end of the slow growth phase for students and just entering fast growth for faculty. Desktop publishing and presentation graphics follow behind by several phases with an average in the introduction to users phase for both faculty and students. E-mail is entering slow growth for the faculty and introduction to the students, and CD-ROM, a later technological application, is at the start-up phase with initial installation and testing.

Overall, for all of the usage categories, both the faculty and students are furthest along in their usage of the microcomputer as a productivity tool, with mean phase averages of 6.7 and 6.5 respectively, as shown in Figure 14.

Figure 14
Phases of Microcomputers Usage as a Productivity Tool
(Faculty N = 175; Student N = 174)

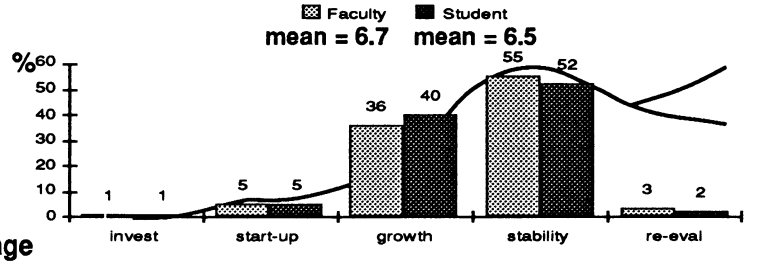
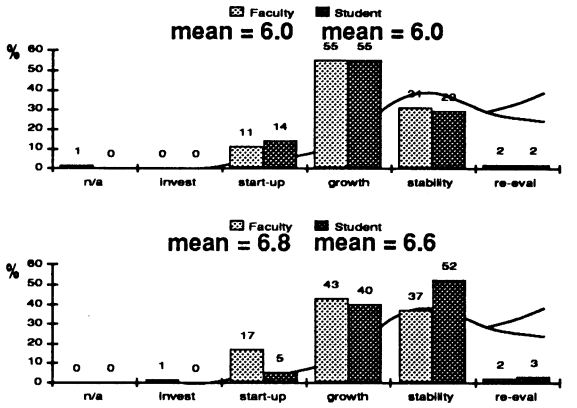


Figure 15
Phases of Microcomputers Usage as a Productivity Tool
(Longitudinal: 1998-1992)
(Faculty N = 123; Student N = 121)



The longitudinal data in Table 1 showed that both the faculty and student productivity usage mean changes were significant at the .001 level. Figure 15 presents the comparative phase diagrams. In 1988, the longitudinal schools were almost identical in the faculty and student distributions. However, the 1992 data for the same schools show that the students moved farther along the phase diagram than the faculty, with 52% of the schools' perceiving their students to be in the stable phase in contrast to only 37% of their faculty. The difference is seen mainly in the start-up phase for the faculty.

Figure 16 presents usage of microcomputers as an analytic tool, with a faculty phase average of 6.1 and a student phase average of 5.6. In this usage, the mean change was significant only at the .01 level and the data in Table 1 suggests that the students are lagging behind the faculty, even though the students showed a slightly greater phase change, .8 compared to .7 for the faculty. Figure 2 showed the faculty (F Anl) remaining in fast growth (6) for 1988 and 1992, but the students (S Anl) moving from slow growth (5) in 1988 to fast growth (6) in 1992.

Figure 16
Phases of Microcomputers Usage as an Analytic Tool
(Faculty N = 175; Student N = 174)

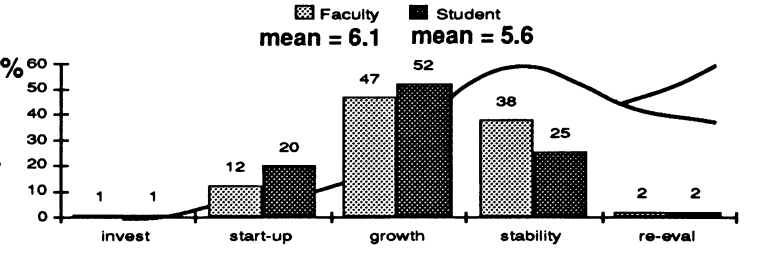
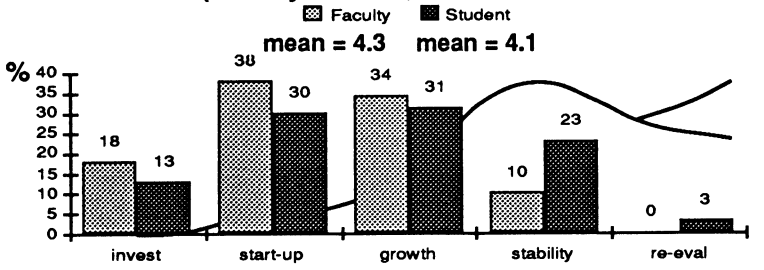


Figure 17
Phases of Microcomputers Usage
for Desktop Publishing and Presentation Graphics
(Faculty N = 172; Student N = 167)



in the introduction to users, phase 4. The longitudinal data in Table 1 shows a mean change average significant at the .001 level and that the faculty and the students are tracking together in their phase movements. Together the faculty and students show an average of 1.5 phase movement, the largest shift except for LANs and equal to the work-station shift. Figure 18 shows this significant usage shift over a four year period.

E-mail and CD-ROM database usage are both new to this year's survey. Figure 19 shows the average faculty usage of e-mail to be at 4.9, just at the end of introduction to

As shown in Figure 1, for both faculty and students microcomputer usage for desktop publishing and presentation graphics is two phases behind analytic usage and three phases behind productivity usage. Figure 17 shows both the faculty and student phase averages to be

Figure 18
Phases of Microcomputers Usage for
Desktop Publishing and Presentation Graphics
(Longitudinal: 1988-1992)
(Faculty N = 121; Student N = 110)

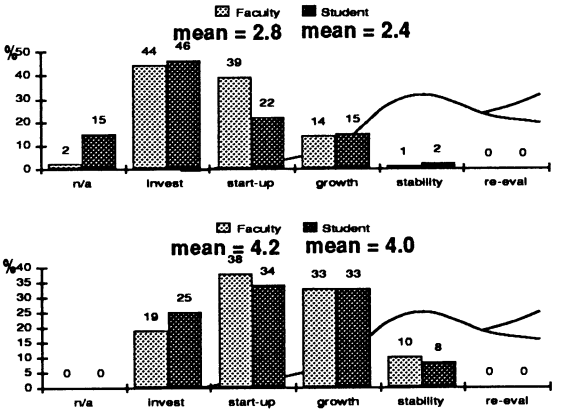


Figure 19
Phases of Microcomputers Usage for E-mail
(Faculty N = 170; Student N = 153)

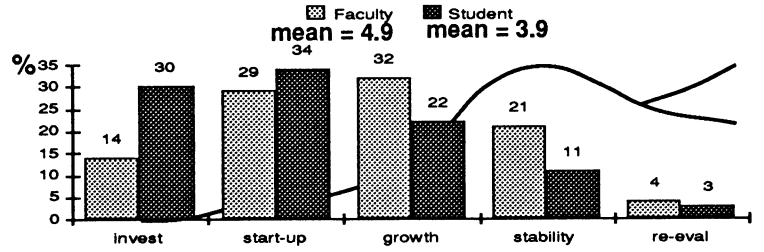
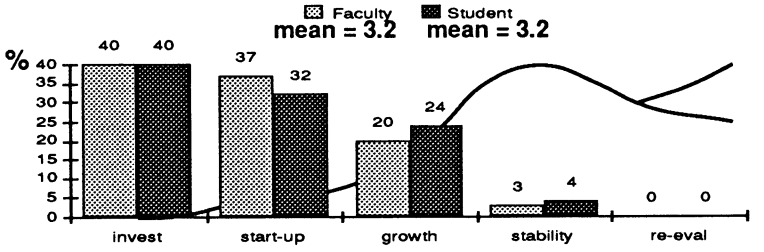


Figure 20
Phases of Microcomputers Usage
for CD-ROM Database Access
(Faculty N = 158; Student N = 144)

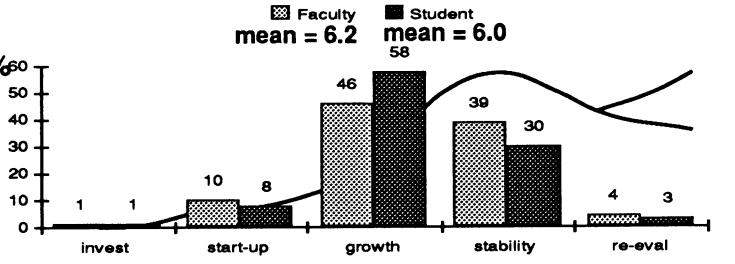


users, and the average student usage to be at 3.9, just at the end of start-up. Thus, the phase diagram is showing a lot of potential growth for this area, although student usage of e-mail seems to be lagging about a phase behind faculty usage. Figure 20, CD-ROM usage, is much farther behind e-mail usage, with both the faculty and student phase average to be 3.2, at the beginning of start-up.

From the longitudinal data in Table 1, a first consideration of computer literacy, a general summary of microcomputer usage, seems disappointing, showing only a slightly significant average change of .4 for the faculty and an insignificant change of .3 for the

students. However, within the context of the phase diagram, both moved from late slow growth (5.8) to fast growth (6.3 and 6.0 respectively). The schools' respondents are reflecting expectations of a great deal more change with regard to computer literacy, which thus becomes encouraging. As may seen in Figure 21, only 39% of the schools indicated that their faculty were in a stability phase with regard to computer literacy, with 46% expecting continuing growth and 10% just starting. Similarly, only 30% of the schools indicated stability for their students with regard to computer literacy, with 58% expecting continuing growth and another 8% just starting. Again, the schools' respondents are reflecting expectations of a great deal more change with regard to computer literacy.

Figure 21
Phases of Computer Literacy
(Faculty N = 175; Student N = 175)



5.4 Portable Computer Systems

Last year's survey pointed out that laptops and portable microcomputer systems have been considered the new area of potential growth and expansion, with the popular press indicating that laptops and the new lightweight notebook systems are the fastest growing segment in the computer market. However, the business school data is not substantiating this view. In Table 1, the portables and laptop systems mean phase change was the only one of the 19 phases which showed no change between the 110 business schools providing data in 1988 and 1992.

Table 14 shows a decrease in the total number of portable systems owned by the business schools, as well as the corresponding decline in the average number of portables per school. Except for Apple's increase from 29 to 116 portable systems, all of the other vendors data stayed just about the same or decreased slightly from last year's data. AST made an impressive entry

Table 14
Laptop and Portable Systems by Vendor
(number of systems)

Vendor	Fourth 1987 N=82		Fifth 1988 N = 135		Sixth 1989 N = 135		Seventh 1990 N = 122		Eighth 1991 N = 143		Ninth 1992 N = 150	
	n	%	n	%	n	%	n	%	n	%	n	%
Hewlett-Packard	1,076	66	990	43	3,226	69	436	21	1602	49	1360	45
Zenith	77	5	291	13	502	11	567	28	637	19	539	18
Compaq	151	9	338	15	315	7	297	14	292	9	258	9
IBM	226	14	447	19	236	5	159	8	218	6	170	6
Toshiba	13	1	149	6	153	3	279	14	227	7	148	5
Tandy	7	>1	11	>1	113	2	113	5	126	4	127	4
Apple							14	1	29	1	116	4
AST											85	3
Data General							28	1	29	1	8	>1
NEC	28	2	25	1	29	>1	20	1	20	1	23	>1
Other	49	3	77	3	126	3	136	7	104	3	178	6
Total	**1,627**	**100%**	**2,328**	**100%**	**4,700**	**100%**	**2,049**	**100%**	**3284**	**100%**	**3012**	**100%**
Average systems per school	19.8		17.2		34.8		16.8		23.0		20.0	
% schools with laptops	64		77		83		85		86		84	

with 85 systems reported by the business schools. HP has usually had the largest number of systems, the HP110 and 110 Pluses. These systems were discontinued a few years ago as were the IBM PCs andare examples of the staying power of old technology which has yet to be replaced.

Table 15 shows slight changes in the percentage of schools owning portables by vendor. Apple showed the largest gain in ownership by school, with an increase in availability to 19%, up from only 8% last year. Both Toshiba and IBM, showing increases of 5% and 6% from last year's data, are available in 33% of the schools providing portable data.

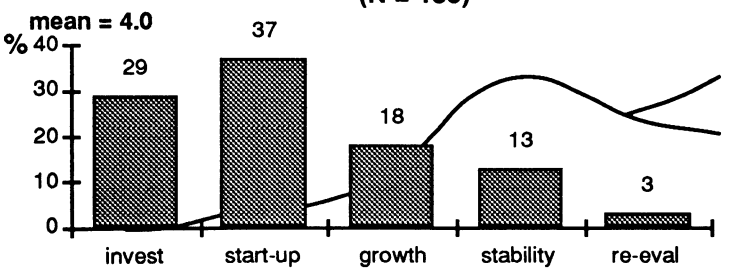
Table 15
Laptop and Portable Systems
(percent of schools)

Vendor	Fourth 1987 N=82	Fifth 1988 N=135	Sixth 1989 N=135	Eighth 1991 N=143	Ninth 1992 N=150
Zenith	23%	43%	47%	59%	59%
Compaq	23	39	28	37	37
Toshiba		16	17	28	33
IBM	27	33	26	27	33
Apple				8	19
Hewlett-Packard	11	15	14	8	9
Tandy		4	3	6	7
NEC	2	5	6	5	7
AST					3
Data General				2	3
Other	16	14	-	16	30

The Eighth Survey (last year) suggested that the portable and laptop data may be reflecting computer lab environments where desktop systems are more appropriate, and further, that laptop systems may be perceived by the business schools as more appropriate for individual rather than school ownership. The phase diagram, Figure 22, suggests a contrary view, with 66% of the 158 schools providing data perceiving their school to be in the investigation and/or start-up phase in the number of portable systems at their school and 18% indicating entry into the growth phase. From this phase data, the schools seem to be indicating a great deal of interest in portable systems with anticipations of implementation and growth activity to come. However, the 1988 data showed just about the same phase distribution, and the same interpretation could have been made from that data.

The positioning of the portables within the business schools is unclear. Some schools envision classrooms of the future with students able to plug their own portables into the desks to port data and files from the lecturer's central classroom computer and from the electronic blackboard. Recent size/weight and technological improvements together with cost reductions could make these expectations more of a reality. However, required ownership of portable systems remains problematic with the public schools having difficulty in mandating student purchase. With many issues unclear and the technology changing so dynamically, portables and laptop systems remain an interesting area of the business school computer environment to watch.

Figure 22
Phases of Number of Portable Microcomputers
(N = 158)



5.5 High Performance 32-bit Graphic Workstations

Differentiation between fully loaded microcomputers, the high performance workstations, and minicomputers is increasingly difficult as the hardware and functional specifications merge. As presented in the hardware introduction, one distinguishing characteristic between the mini/mainframes and the workstations is central control of concurrent (time-sharing) users, a feature still unique to the mini/mainframes. The distinction between the microcomputers and the workstations is not as clear. This report, probably for the last time, will present the workstations as separate from the microcomputers, based solely on the 32-bit distinction.

Table 16, shows an average of just over seven workstations per respondent school and that 35% of all the business schools in this year's sample had one or more workstations. The table, which presents the workstations by vendor, also shows Sun remaining the leader with 36% of the systems, although, as last year, followed closely by Digital with 34%. The other major vendor is NeXT which shows a percentage increase from 10% to 17%. Table 17 presents the same information, but with the workstations dispersed throughout the respondent schools.

Table 16
High Performance 32-bit Graphic Workstations by Vendor
(number of systems)

	Fifth 1988 N = 31		Sixth 1989 N = 33		Seventh 1990 N = 49		Eighth 1991 N = 48		Ninth 1992 N = 62	
Vendor	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Sun	50	34%	73	23%	105	46%	124	35%	157	36%
Digital	16	11	153	49	43	19	115	32	148	34
NeXT			3	1	3	1	37	10	73	17
IBM	59	41	33	10	33	15	38	11	20	5
HP/Apollo	13	9	21	7	2	1	24	7	19	4
Xerox	4	3	30	9	33	15	9	3	9	2
TI	3	2	3	1	6	3	6	2	4	1
Other					2	1	2	1	10	1
Total	**145**	**100%**	**316**	**100%**	**227**	**100%**	**355**	**100%**	**440**	**100**
Average systems per school	4.7		9.6		4.6		7.4		7.1	
% schools with workstations	18		20		34		29		35	

Table 17
High Performance 32-bit Graphic Workstations
(percent of schools)

Vendor	Fifth 1988 N=31	Sixth 1989 N=33	Seventh 1990 N=49	Eighth 1991 N=48	Ninth 1992 N=62
Sun	42%	39%	39%	58%	48%
Digital	19	36	31	48	42
NeXT		9	6	17	26
IBM	26	30	27	33	21
HP/Apollo	10	9	4	13	13
TI	10	9	10	10	7
Xerox	3	9	6	2	3
Other			2	4	3

Figure 23 shows the phase responses for the 121 business schools providing data. Fifty-five percent of the respondent schools indicated the investigation phase, gathering information about workstations and beginning the initial actions of selecting between alternatives and seeking support. Twenty-eight percent of the schools indicated they had actually begun initial installation and introducing the workstations to their users, while sixteen percent indicated growth. Like other phase diagrams which are heavily skewed to the right, this diagram is suggesting that the business schools which responded are anticipating considerable interest in this area.

Figure 23
Phases of High Performance 32-bit Graphic Workstations
(N = 121)

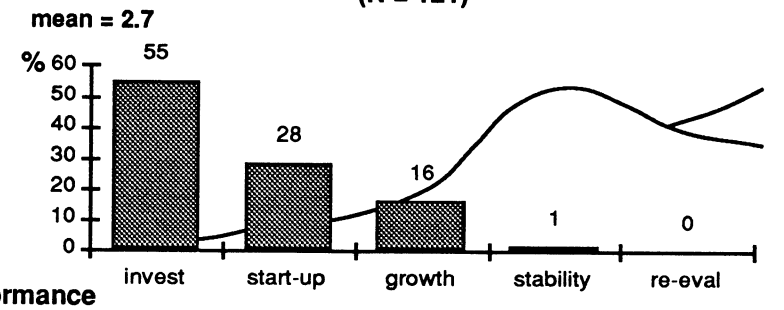
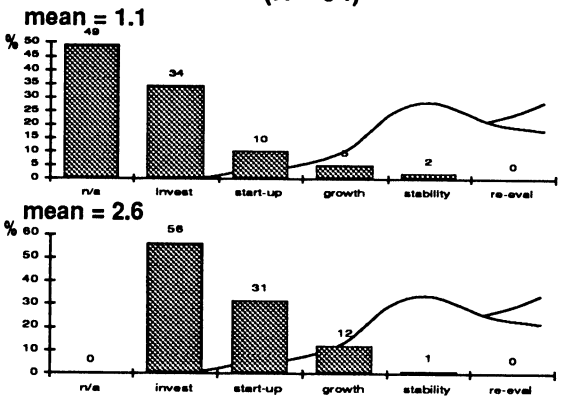


Figure 24
Phases of High Performance
32-bit Graphic Workstations
(Longitudinal: 1988-1992)
(N = 84)



In spite of such an early positioning on the phase diagram in Figure 23, the longitudinal data in Table 1 showed that the mean change was significant at the .001 level, and one of the highest changes. Figure 24 shows the four year phase diagram comparisons for the workstations. The phase diagrams in Figure 24 are unique in that they clearly show the progression of the business schools' changing expectations, especially for the 49% of the schools for whom workstations were not applicable in 1988, but who have now apparently moved through into the investigation phase. This longitudinal comparison confirms a progression along the phase diagram at a momentum which has been shown to be highly significant.

6. The Operational Level

Ongoing daily operational concerns and responsibilities continue for the business school computer center directors, their staff, the schools' strategic planners, and the deans. Additionally, new opportunities and their attendant issues are emerging with every software introduction or upgrade modification and hardware technological advancements. Further, all of these concerns and responsibilities, opportunities and issues are constrained by the current economic realities and budget cuts.

6.1 Computer Center Operational Issues

The survey questionnaire presented a list of twenty-six issues concerning operation of the business school computer center from which the respondent schools selected and ranked the ten most critical to their school. This list included all of the operational issues presented in the Fifth Survey, except for three which received very little responses in the Fifth: "disillusionment with what computing can do", "uncontrolled use of laser printers", and "checking out of portable systems". Five issues identified by the Fifth Survey schools as "other" were added to the list.

Table 18 presents the issues chosen by at least a third or more of the responding schools, ordered by the percent of schools identifying an issue. As with the strategic and instructional/

curriculum issues presented earlier, most of the operational issues identified as critical in the Fifth Survey remained. However, more variation in the ordering of the issues was seen with the operational issues, than with these other two issue areas. For instance, the issue identified by the most schools in the Fifth Survey, "providing adequate faculty training" dropped to fourth in the list this year, and "sufficient space for computing facilities", third in the Fifth Survey, dropped to eighth on this year's ranking. "Equipment maintenance" remained in second place, "providing adequate student training" moved to third this year from sixth in the Fifth, and "creating a realistic budget, identifying the real costs" moved from eleventh in the Fifth to sixth.

Table 18
Business School Computer Center Operational Issues
(N = 163)

%	Issue
73	Equipment obsolescence
63	Equipment maintenance
61	Providing adequate student training
57	Providing adequate faculty training
53	Creating a realistic budget, identifying the real costs
53	Acquiring software site licenses
50	Supporting Windows environment
48	Sufficient space for computing facilities
47	Matching technology to user needs
47	When to upgrade equipment
42	Not enough hardware to meet demand
40	Implementation of school standards vs individual preferences
36	Finding and retaining technical staff
36	Not enough software to meet demand

Two issues were identified as critical this year which were not on the Fifth's top issues list. "Equipment obsolescence" entered the list in first place and, together with "equipment maintenance" in second place, underlines the problems of replacing and/or maintaining older technology. In contrast to dealing with old technology is "supporting Windows environment", the only one of the five new issues added for selection this year that was identified as critical by more than one-third of the schools. Two issues, "role of the mini/mainframe" and "illegal copying of software", identified as critical by the Fifth Survey schools, failed to be identified this year, indicating that these problems have been at least partially resolved.

"Other" issues which were not offered for selection, but identified as critical by some of the respondent schools, included viruses and sabotage, non-integrated software, acquisition of the latest technology, system reliability and performance, and lack of support from higher management.

6.2 Upgrade/Phase-Out Plans and Strategies

Forty-nine percent of 155 schools indicated they had a plan or strategy for upgrading older equipment and 50% of 150 schools indicated they had a plan or strategy for phasing-out the older equipment. Because of many similarities, Table 19 summarizes both the upgrade and phase-out plans and strategies together for the 62 schools that provided details. A wide variety of options are presented by the schools. The trickle down approach was the most common, with the new equipment given to the faculty and/or heaviest users and the replaced equipment being passed down throughout the system, usually to the PhDs and other graduate students, to the student labs, and then to the staff. Another version of the trickle down approach was given by ten schools which migrated the equipment to novice users, other university departments, and off-site facilities. Some schools donated the older equipment to other schools and service agencies. In contrast to the trickle down approach which designated new equipment allocation by hierarchical position and use, other schools used committees.

Twelve schools responded that the lowest technology was systematically cannibalized for parts and maintenance use, but others based the repair/maintenance decision solely on a cost/benefit analysis. Another popular strategy was a time-dependent upgrade cycle, usually based on availability of funding. Upgrade of both memory and hard disk were specifically indicated as necessitated by the requirements of the newer software.

Table 19
Equipment Upgrade/Phase-Out Plans and Strategies
(N = 62)

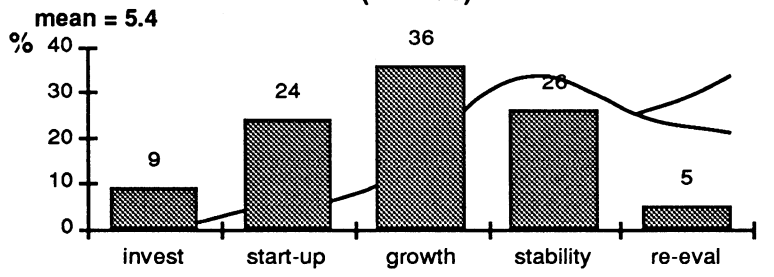
%	Plans and strategies
25	Trickle down approach, usually new to faculty and heavy users, passing down to PhDs, other graduates, student labs, and staff
12	Cannibalize
11	Time dependent upgrades (every 3 to 7 years, 5 year cycle)
10	Migrate older equipment to novice users and/or other university departments, or off-campus sites
7	Upgrade when money is available
7	Minimum 386 standards for new equipment
7	All 8088 and 80286 machines will be phased out by 1994
7	Upgrade regularly to latest technology
6	Memory and hard disk upgrades to support new software
5	Use until worn out, then discard or to surplus property
5	Trade in or sell on open market or to other University units
4	Donate to other schools, service agencies, K-12 schools
4	Old used as print servers, E-mail units, or for network
3	Upgrades only if good cost/benefit, else buy new
3	Replacement rather than repair
3	Plan in development
2	Allocation by committee using blind review
2	Available for faculty purchase or home use
1	As a class project, have information systems students upgrade for course credit
1	Check out to financially restricted students

Another popular upgrade/replacement strategy set a minimum standard of 386s for any new equipment, as well as a deliberate goal of getting rid of the 8088 and 80286s. In contrast, some schools used the older technology for print servers, e-mail units, or for additional network workstations. Perhaps, the most unique option was the use of microcomputer upgrades and maintenance as a computer and information systems student class project. Several strategies that appeared in the Fifth Survey that did not appear this year included networking all of the old systems, requesting university funding, asking vendors for donations, and waiting until prices come down.

6.3 User Support

The ranking of both faculty and student training among the most critical of the operational issues (Table 18), stresses the importance of user support. Figure 25 shows the schools' indications as to where they are with regard to this issue. Sixty percent of the 172 business schools providing data reported being in either the start-up or growth phase, thus indicating that user support is an area which the schools have not only recognized as important, but also is an area in which they are expending much effort. Concern for user support was also seen in the 5% of the respondent schools which indicated re-evaluation. Only 26% of the respondent schools indicated being in the stable phase, with routine patterns and little expansion.

Figure 25
Phases of Computer Support to Users
(N = 172)



6.4 New Technology

In addition to user support and training issues, the introduction of new technology also

causes computer center operational problems (Table 18). Figure 26 and 27 show the phase diagrams for Windows and multimedia implementation, respectively. Thirty-seven percent of the 167 respondent schools indicated being in the investigation phase for Windows implementation and 75% of the 147 respondent schools indicated being in the investigation phase for Multimedia implementation. These phase diagrams emphasize the time and effort required for information gathering, selection between alternatives, seeking support, obtaining bids, creating the hardware platform needed to run the software, and other general preparatory activities which must take place even before the start-up phase can begin.

Figure 26
Phases of Windows Implementation
(N = 167)

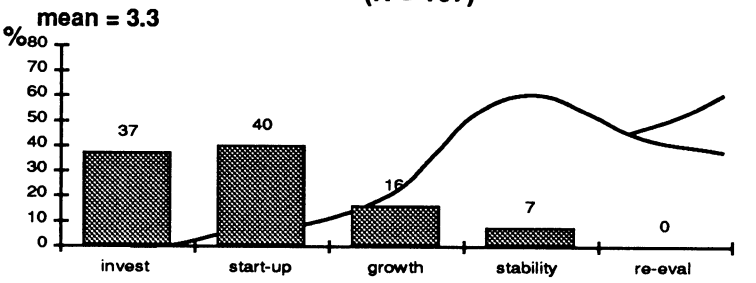
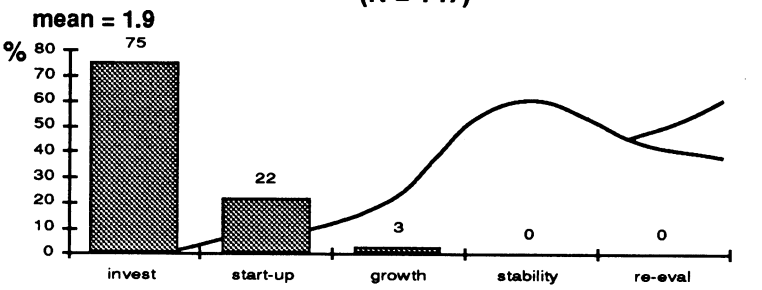


Figure 27
Phases of Multimedia Systems Implementation
(N = 147)



7. Communications and Network Issues

7.1 Extent of Networks

For the 149 business schools providing data regarding the extent of local area networking (LAN) of their microcomputers, 61% had more than two-thirds of the microcomputers linked, compare to less than 25% in 1988. The magnitude of this shift, significant at the .001 level in Table 1, is presented in the longitudinal comparison phase diagrams in Figure 28. For the 105 schools for which both 1988 and 1992 data is available, the mean LAN development phase was 3.7 in 1988 and 5.4 in 1992. In 1988, 60% of the schools indicated being in the investigation or start-up phase, in contrast to 64% reporting being in the growth or stability phase is 1992.

Figure 28
Phases of Local Area Network Development
(Longitudinal: 1988-1992)
(N = 105)

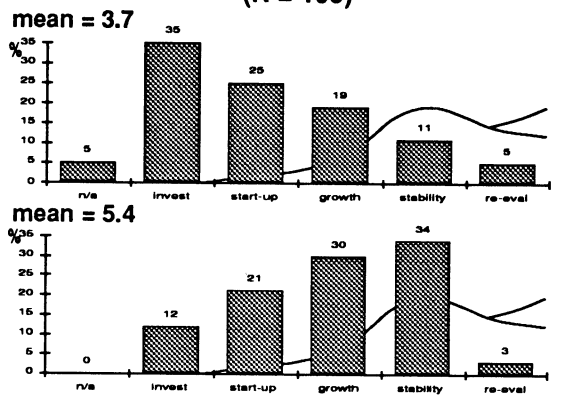
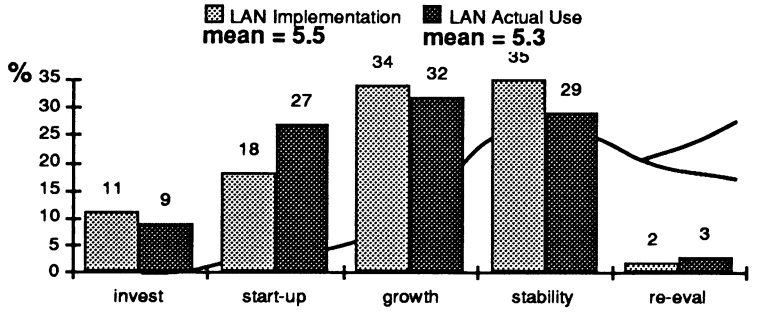


Figure 29 presents the phase diagram data for the 174 business schools which provided LAN implementation data for 1992 and shows that 69% of the 1992 schools are in the growth or stability phase. This figure further compares LAN implementation with an estimate of actual use. Although the means are quite close, the distributions show that, as could be expected, actual use is lagging slightly behind the implementation.

The pervasiveness of LANs is also seen in Table 20 which presents LAN access by user group. Of the 171 schools providing student data, 64% reported that all of the student labs are networked. In contrast, only 38% of the

Figure 29
Phases of Local Area Network Development and Actual Use
(Development N = 174; Use N = 168)



same number of schools reported that their faculty microcomputers are fully networked. For about the same number of schools, 47% reported that their administration microcomputers were fully networked, contrary to expectation, as faculty are usually given priority over administrative staff. However, this may reflect that data and software sharing is a major reason for installing LANs and that these needs are more prevalent among the administrative staff working with the same student and budget data than faculty who work with very different discipline-oriented data.

Table 20 also shows that 42% of the schools providing data reported all of their LANs were bridged together, implying a fully networked facility. Another indicator of the extent of networking in the business schools computer environment is the provision of access to a wide area network (WAN) reported by 96% of 174 schools.

Table 20
User Access to LANs
(percent of users)

	N	None	Some	All
Student labs	171	8%	28%	64%
Faculty offices	171	15	47	38
Administrative offices	169	14	39	47
Are these LANs bridged together?	166	21	37	42

7.2 Communications and Network Issues

The survey questionnaire presented a list of nineteen communications and network issues from which the respondent schools were asked to select and rank the six most critical. This list included all but two of the issues presented in the Fifth Survey and six new issues.

Table 21 presents the issues chosen by at least a third or more of the responding schools, ordered by the percent of schools choosing any particular issue. As in the issues areas presented in previous sections, most of the communication and network issues identified as critical in the Fifth Survey remained on the list. However, in this area three of the five new issues entered as critical: "network management" (ranked as first), "reliability of the network" (third), and "network expansion" (last). "Software licenses for use on a network", first in 1988, remained of high concern this year.

Two issues, "microcomputer to microcomputer connections" and "which network technology to adopt", identified

Table 21
Communications and Network Issues
(N = 164)

%	Issue
74	Network management
56	Software licenses for use on a network
48	Reliability of network
45	Software not designed for use on networks
38	Software availability for use on a network
37	Operating network in lab setting
37	Response time on network
37	Microcomputer to mini/mainframe connection
33	Expansion (adding nodes to networks)

as critical by the Fifth Survey schools, failed to be identified this year, indicating that these problems have been at least partially resolved. "Other" issues identified by the respondent schools included concern about viruses on the network, problems in university-wide planning and operation of the campus backbone, together with central university ownership and management of the business school LAN, getting the faculty to use the LAN, basic funding, and upgrades.

8. Cluster Analysis

Recognizing that business schools have started their computerization process at different times, with differing resource bases, and with differing objectives, it is reasonable to assume that the schools could be grouped according to where they were in the computerization process. In the Fifth Survey, the schools were grouped into five clusters based on 21 phase questions. The results of the Fifth Survey showed that these business school clusters had differing issues and concerns.

Again, this year using a cluster analysis procedure, the schools were grouped according to their similarity of responses to the 30 phase questions. And again, five distinct clusters emerged from the data provided by the 178 schools. Three schools failed to achieve cluster membership because of insufficient data. Even though clustered on a differing number of phase questions (30 as opposed to 21) with only 19 of the phase questions being the same, cluster profiles similar to those found in the Fifth Survey were identified. The overall cluster means were within 0.1 to 0.3 of the overall means for each similar cluster from the Fifth Survey. As with the Fifth Survey, school cluster membership is confidential, being sent privately to each school in the cover letter that accompanies the distribution of this survey report.

8.1 Cluster Demographics

General demographics for each cluster are given in Table 22. Forty-two schools grouped into a cluster identified as Start-Up with an overall mean of 4.3 (4.2 in the Fifth Survey), in general these schools are in the early phase of computerization, just getting started with many of the

Table 22
Demographics by Cluster
(N = 175)

	Start-Up	Early Growth	Mixed Phase	Late Growth	Stable
Cluster size	42	19	42	41	31
Phases mean (range)	4.3 (1.5 - 6.7)	4.8 (1.6 - 6.8)	5.2 (1.9 - 8.8)	5.6 (2.3 - 8.4)	6.6 (2.0 - 8.8)
Type					
Public	69%	58%	79%	76%	61%
Private	31	42	21	24	39
Student FTE (range)	2287 (414 - 6000)	2769 (268 - 9847)	2482 (85 - 6052)	2818 (546 - 6769)	1313 (330 - 3404)
$/student (range)	$39 (3 - 149)	$179 (5 - 938)	$114 (3 - 824)	$159 (3 - 1245)	$382 (8 - 2162)
Student/micro (range)	66 (10 - 439)	27 (3 - 67)	39 (2 - 300)	44 (7 - 321)	16 (4 - 62)
Faculty/micro (range)	2 (0.8 - 25)	1.3 (0.3 - 2.3)	1.6 (0.3 - 22)	1.3 (0.2 - 4.1)	0.9 (0.3 - 2.0)
MF ownership	12%	32%	26%	37%	48%
Listed innovations	4	4	7	15	11

various computerization processes. Nineteen schools grouped into a cluster identified as Early Growth with an overall mean of 4.8 (4.5 in the Fifth Survey), thus slightly farther along in the computerization process than the Start-Up cluster. Forty-two schools grouped into a cluster identified as Mixed Phase with an overall mean of 5.2 (5.3 in the Fifth Survey), and again, farther along in the computerization process than the previous two clusters. This Mixed Phase cluster showed a wider range of means for the 30 phase questions, and because of its overall mean is placed between the Early Growth and Late Growth clusters in the following figures and tables. Forty-one business schools grouped into a cluster identified as Late Growth with an overall mean of 5.7 (5.6 in the Fifth Survey) and 31 schools grouped into a cluster identified as Stable with an over mean of 6.6 (6.5 in the Fifth Survey).

The Early Growth and the Stable clusters had greater percentages of private schools than the other three clusters, as well as the lowest student microcomputer densities and the largest computer operating budget dollar per student. The Late Growth and the Stable cluster schools had the greatest percentage of school-owned mini/mainframes as well as the largest number of innovative uses of information technology.

8.2 Cluster Phase Means

The mean for each of the 30 phase questions summarizes where each cluster is in the computerization process for each phase. Figure 30 presents the complete profile of each cluster, with each phase mean represented by an abbreviated description (defined in Appendix 2) as in Figure 1.

In Figure 30, most of the phase means show a gradual pattern of progression along the phase diagram. Electronic/computer-linked equipment in the classroom (Cls eqp) is an example of this general progression, with the Start-Up cluster showing a mean falling in the start-up phase, the Early Growth cluster and the Mixed Phase cluster means falling in the introduction to user phase, the Late Growth cluster mean falling in the slow growth phase, and the Stable cluster mean falling in the fast growth phase.

Less differentiation in progression, however, is seen in other phase questions, especially those related to the newer technology such as multimedia systems implementation (M Med), and high performance 32-bit graphic workstation use (Work St), which both show only one phase change between the Start-Up cluster and the other four. The Early Growth cluster is even ahead of the Mixed Phase cluster and the Late Growth cluster in phase means for student usage of CD-ROM databases (S CDROM), faculty usage of CD-ROM databases (F CDROM), and Windows implementation (Windows).

8.3 Issues by Clusters

Table 23 separates the four issue areas (strategic, instructional, operational, and network) discussed previously by cluster, presenting the issue in the order as ranked by the cluster members. The abbreviations used in this table are given in Appendix 2.

Among the strategic issues, four issues were of primary concern in all of the clusters: adequate funding for operational support (Funding), appropriate curriculum development utilizing computing (Curr devel), obtaining hardware/software donations (Donations), and faculty incentives for courseware/integration (F incentives). These issues seem to be independent of *where* the schools are in the computerization process. Funding, curriculum development and faculty incentives were also identified by almost all of the clusters in the Fifth Survey, an indication that these issues have not yet been resolved. In contrast, short term planning and school-wide standards for hardware and software were strategic issues identified in the Fifth Survey, but not identified among those of primary concern this year, an indication that these issues have been at least partially resolved. The issue of keeping current on what technology is appropriate (Technology) was identified by all of the clusters except Late Growth.

Other issues, however, show more differentiation among the clusters, indicating, a greater relationship to *where* the schools are in the computerization process. Lack of goals are issues

identified by the Start-Up cluster and the Mixed Phase cluster, with managing user expectations (User expect) of more importance to the other three clusters. It is interesting to note that only one cluster, the Late Growth, identifies planning a move to a new building or renovating their computer facility (Move/renov) as an important issue.

As with the strategic issues, several instructional issues were identified by all of the clusters: defining an appropriate level of integration (Amt integr), faculty incentives for developing courseware (F incentives), and teaching style or motivation to use technology (Style). Again, these issues seem to be independent of *where* the schools are in the computerization process. Courseware design issues (CW design) dropped from the list, again indication of at least a partial resolution, perhaps a function of being subsumed by textbook publishers as suggested earlier.

All of the clusters except for the Stable cluster seem to be concerned with the selection of courses to be integrated (What integr). In contrast all but the Start-Up cluster indicate concern with the lack of courseware (Lack of CW). At first it is somewhat confusing to see all but the Mixed Phase cluster and the Late Growth cluster concerned with their inability to use computers in the classroom (PC in cls). However, this apparent discrepancy of equal concern for this issue by the Start-Up cluster and the Early Growth cluster as well as the Stable cluster may be explained in part by considering the degree of utilization probably considered as adequate by these clusters of schools widely separated on the phase diagram. It is likely that the schools early on the phase diagram are concerned with just getting the most basic systems into their classrooms, whereas the Stable cluster is more likely concerned with issues such as hardwiring the classrooms and setting up the different hardware configurations required to support differing advanced software applications.

Major operational issues identified by all of the clusters were equipment maintenance (HW maintence), provision of adequate student training (S training), acquisition of software site licenses (SW licenses), and equipment obsolescence (Obsolescence). Equipment obsolescence was new to the issues offered for selection this year and is seen to be very important across all of the clusters in different phases of the computerization process. In contrast, three issues of primary concern to the clusters in the Fifth Survey, but not appearing this year, may again be considered partially resolved: illegal copying of software, not enough software to meet demand, and the role of the mini/mainframe. The software issues may in part have been resolved through network availability, however, as shown just above, software site licenses still remain a major issues.

All of the clusters except the Stable cluster are concerned with providing adequate training for their faculty (F training), and all but the Late Growth cluster and the Stable cluster are also concerned with creating a realistic budget and identifying the real costs of providing computers and supporting services to their students (Real budget). In contrast, issues of concern identified only by the Stable cluster are not enough hardware to meet demand (Insuff HW) and the provision of output peripherals for presentation graphics (Graphics), issues apparently able to surface only after the basics of creating a realistic budget and adequately trained faculty have been resolved. Another issue of concern found only in the three clusters farther along the phase diagram is support of a Windows environment (Windows).

The issue of when to upgrade equipment (When upgrade) is found only in three clusters (Start-up, Mixed Phase, Late Growth). These three clusters spend the least amount of dollars per student, and may have not yet been able to make outright purchases of the latest technologies. Thus, they are concerned with upgrade strategies rather than replacement.

The communications and network issues show the greatest variation among the clusters, with only two issues, network management (NW mgmt) and software licenses for use on the network (SW licenses) of common concern to all of the clusters. Four issues identified in the Fifth Survey four years ago, but now not listed among those of major concern by the clusters are data security, the incompatibility of competing network technologies, microcomputer to microcomputer connections, and the choice of which network technology to adopt.

Other issues seem to be related to *where* the schools in the cluster are along the phase diagram. Only the Start-Up cluster and the Early Growth cluster identified microcomputer to mini/mainframe connectivity (Micro to MF) and access to wide area networks (WAN access) as issues.

Figure 30
Mean Phases by Cluster
(N = 175)

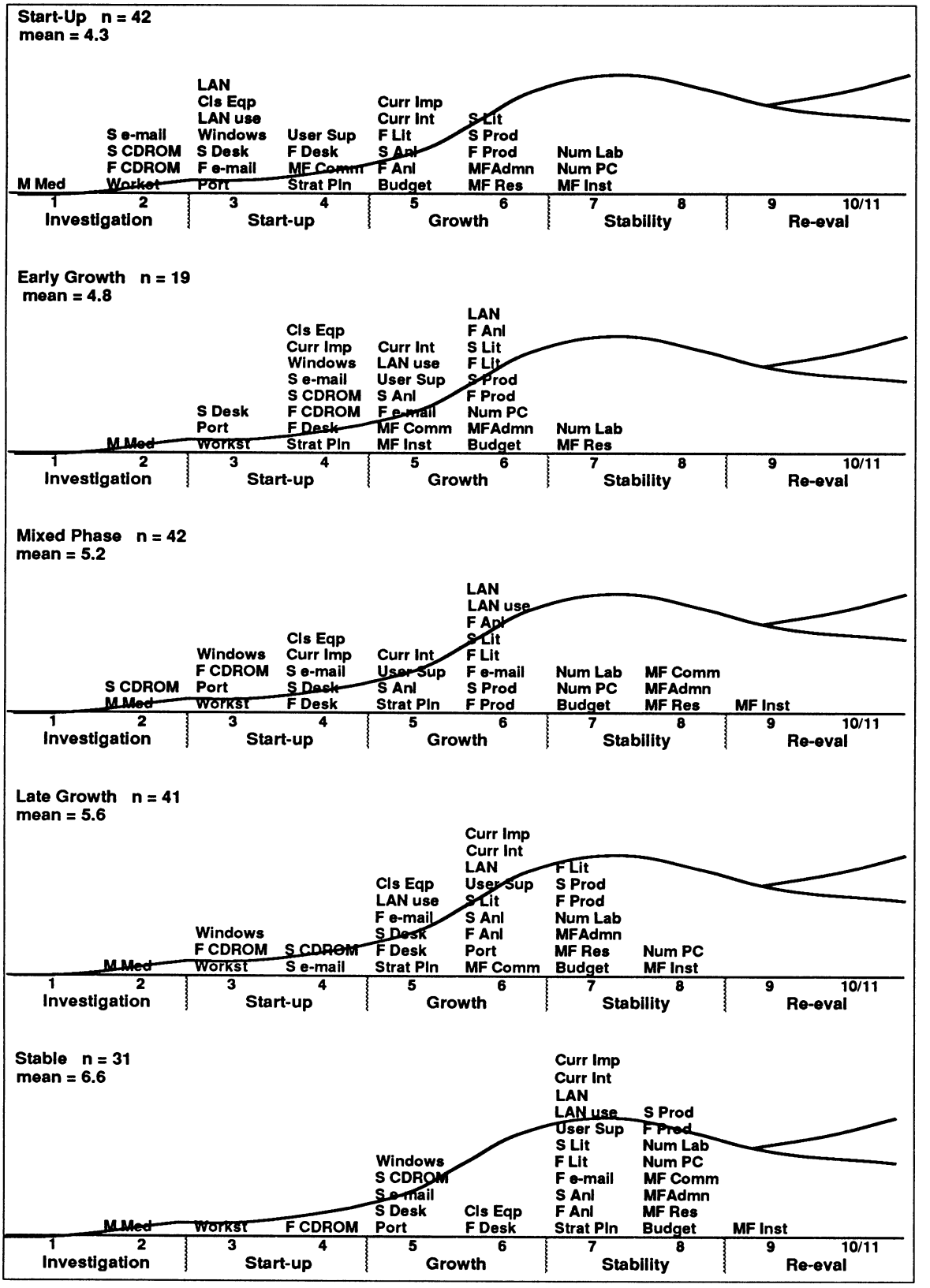


Table 23
Issues by Cluster
(N = 175)

Start-up N = 42	Early growth N = 19	Mixed N = 42	Late growth N = 41	Stable N = 39
		Strategic		
Funding	Funding	Funding	Funding	Funding
Curr devel	Curr devel	Curr devel	Curr devel	Curr devel
Donations	Technology	Technology	User expect	Donations
Fincentives	User expect	Fincentives	Fincentives	User expect
Lack goals	Fincentives	Donations	Donations	Technology
Technology	Donations	Lack goals	Move/renov	Fincentives
		Instructional		
Amt integr	Fincentives	Fincentives	Fincentives	Style
Fincentives	Style	Style	Style	Fincentives
Style	Amt integr	Amt integr	Amt integr	Amt integr
What integr	What integr	CW dev suppt	CW dev suppt	CW dev suppt
PC in cls	PC in cls	What integr	What integr	PC in cls
CW dev suppt	Lack of CW	Lack of CW	Lack of CW	Lack of CW
		Operational		
F training	F training	Obsolescence	Obsolescence	Windows
Obsolescence	Insuff space	HW maint	HW maint	Obsolescence
Real budget	S training	SW licenses	F training	HW maintence
S training	Obsolescence	F training	S training	S training
HW maintence	HW maintence	Real budget	Insuff space	User needs
SW licenses	SW licenses	S training	SW licenses	Insuff HW
User needs	Real budget	When upgrade	When upgrade	SW licenses
When upgrade	User needs	Windows	Windows	Graphics
		Network		
NW mgmt	Non net sw	NW mgmt	NW mgmt	NW mgmt
Net in lab	NW mgmt	SW licenses	SW licenses	Reliability
Micro to MF	Network SW	Non net SW	Non net SW	Respons time
SW licenses	SW licenses	Reliability	Reliability	SW licenses
Network SW	Micro to MF	Network SW	Network SW	Non net SW
WAN access	WAN access	Respons time	Net in lab	Expansion

In contrast, all of the clusters except the Start-Up cluster were concerned with the use of software not specifically designed for networks, and all but the Start-Up cluster and the Early Growth cluster indicated reliability of the network (Reliability) to be an issue. The Mixed-Phase cluster and the Stable cluster both listed response time on the network (Respons time) as an issue. The Stable cluster was the only one which indicated a concern for network expansion.

Thus, in summary, across all of the areas, whether strategic, instructional, operational, or network, some issues are seen to be more independent of *where* the business schools are in the computerization process. These issues include the strategic issues of funding, curriculum devel-

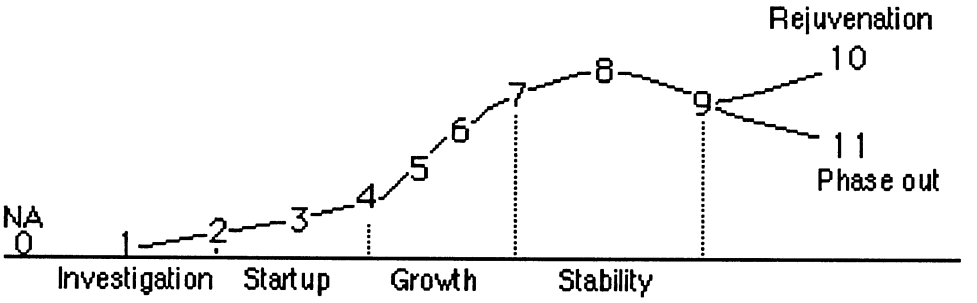
opment, finding donations, and faculty incentives, the instructional issues of identifying the appropriate amount of computer integration, faculty incentives, and teaching style, the operational issues of equipment obsolescence, hardware maintenance, providing adequate student training, and obtaining software site licenses, and the network issues of network management and obtaining licenses for software to be used on the networks.

Other issues show clearer relationships to *where* the schools in the clusters are in the process of their computerization. These issues include the strategic issues of lack of goals identified by the earlier clusters and managing user expectations identified by the later clusters, the instructional issues of selection of the computer-facilitated courses to introduce into the curriculum identified by all but the latest cluster, and lack of courseware identified by all but the earliest, the operational issues of a realistic budget and faculty training identified by the earlier clusters and insufficient hardware, graphics output peripherals, and implementation of Windows identified by the later clusters, and the network issues of connectivity and wide area access identified by the earlier clusters in contrast to network reliability and the use of a wider variety of software identified by the later clusters.

Finally, some issues seem to have been partially resolved during the past four years. These include the strategic issues of lack of short term plans and school-wide hardware and software standards, the instructional issues of courseware design, the operational issues of illegal copying of software, insufficient software, and the role of the mini/mainframes, and the network issues of data security, incompatibility of competing network technologies, and basic microcomputer connectivity.

Appendix 1

Business School Computerization Life Cycle



Phase Definitions

0 **Not applicable:** not appropriate for our business 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/two experimenters

3 **Start-up:** initial installation, testing, 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 obsolescence technology, expectation is "this is the way it ought to be"

9 **Choice point or decline:** 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

Appendix 2

Abbreviations

Phase Definitions

Budget	*	Computer support operating budget
Cls Eqp	*	Electronic/computer-linked equipment in classroom
Curr Imp		Computer integration impact on the curriculum
Curr Int	*	Computer integration into curriculum
F Anl	*	Faculty use of microcomputer analytic tools
F CDROM		Faculty usage of CD-ROM databases
F Desk	*	Faculty usage of microcomputer desktop publishing and presentation graphics
F e-mail		Faculty usage of e-mail
F Lit	*	Faculty computer literacy
F Prod	*	Faculty use of microcomputer productivity tools
LAN	*	Development of local area networks
LAN use		Actual use of local area networks
MFAdmn	*	Mini/mainframe use for administrative support
MF Comm		Mini/mainframe use as communication server
MF Inst	*	Mini/mainframe use in instruction
MF Res	*	Mini/mainframe use in research
M Med		Multimedia systems implementation
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 CDROM		Student usage of CD-ROM databases
S Desk	*	Student usage of microcomputer desktop publishing and presentation graphics
S e-mail		Student usage of e-mail
S Lit	*	Student computer literacy
S Prod	*	Student use of microcomputer productivity tools
Strat Pln		Strategic planning process
User Sup		Computer support services to users
Windows		Windows implementation
Workst	*	High performance 32-bit graphic workstation use

---

* Phase question in both Fifth and Ninth Surveys

Strategic Issues

Curr Devel	Appropriate curriculum development utilizing computing
Donations	Finding grants for support
F incentives	Faculty incentives for courseware development/integration
Funding	Finding funds for support
Lack goals	Lack of goals and/or strategic planning
Move/renov	Planning move to new building or renovating computer facility
Technology	Keeping current on what technology is appropriate
User expect	Managing user expectations

Instructional Issues

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

Operational Issues

F training	Providing adequate faculty training
Graphics	Output peripherals for presentation graphics
HW maintence	Equipment maintenance
Insuff HW	Not enough hardware to meet demand
Insuff space	Sufficient space for computing facilities
Obsolescence	Equipment obsolescence
Real budget	Creating a realistic budget, identifying the real costs
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
Windows	Supporting Windows environment

Network Issues

Expansion	Expansion, adding nodes to network
Micro to MF	Microcomputer to mini/mainframe connections
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
NW mgmt	Network management
Reliability	Reliability of network
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

Auburn Univ
Charles Snyder, Department Head
(205) 844-6515 csynder@auducvax.auburn.edu
Showcase instructional lab, Fall 92 (- not yet completely funded).

Bentley Col
Dave Callaghan, Computer Center Director
(617) 891-3422 dcallagh@bentley.bitnet
Bentley Information Resource Dormnet Ethernet to portable computers in dorm rooms using xircom adapters and DEC pathworks, offering E-mail, EBBS, CD-ROM library, fileseeking, remote DB access (Lexb/Nexb, NAARS, Dow Jones) and remote PC/MAC access.

Anderson School, UCLA
Jason L. Frand, Computer Center Director
(310) 825-2725 jfrand@agsm.ucla.edu
100% faculty, students, and staff use e-mail.
Apple Powerbook used in Executive MBA program.

Cal State, Sacramento
Dr. Tom Hebert
(916) 278-7133
By Fall 92, 4 computerized lecture classrooms, each with a 486 machine permanently installed, color LCD and another overhead for lecture notes.

Cal State, Long Beach
Jerry Shoudt (network) (310) 985-4988
Mike Nosow (DSF) (310) 985-1755
Bob Smith, (310) 985-4718
Group Decision Support Facility: 16 mbit fiber optic token ring LAN (UTP to desk)

Weatherhead School of Mgmt, Case Western Reserve Univ
Linda Karaffa
(216) 368-5106 ek2@po.cwru.edu
In addition to being one of the first b-schools to implement a LAN, WSOM now has a "hands-on" training facility, and is planning a computer-supported multimedia classroom.

Clemson Univ
Dr. Larry LaForge
(803) 656-3758 rllafg@clemson
Production Operations Management Lab/classroom. Course teaches principles through running a "factory" and assigning students "jobs". Major portion of grade is based on how well the factory does. Hardware: AS/400 Software:Mopics, Factor

Dartmouth
John Roback
(603) 646-2518 john.roback@dartmouth.edu
"Point-and-click" front end to large financial databases on mainframes, using SAS. For example: CRSP and Compustat data sets can be easily accessed from a PC, and data downloaded.

Univ of Dayton

Elizabeth Fay-Werner
(513) 229-2117 fay@udavxb.oca.udayton.edu

3 business labs - all networked together utilizing netware 3.11. All 386/486 units run Windows Workstation which allows a personalized menu to run under Windows and prevents the user from exiting Windows unnecessarily.

Col of Bus & Econ, Univ of Delaware

Clinton White,Jr.
(302) 831-6902 bb16615@udelvm

Use of multimedia in selected courses.
Use of e-mail in selected courses.
Use of electronic conferencing.
Use of CD-ROM.

East Carolina Univ

Richard Kerns, Assistant Dean
(919) 757-6350 sbkerns@ecuvm1

Many outsiders who have come here say our lab is unique.

Emory Business School

Eric Fliegel, Computer Center Director
(404) 727-6498 efliegel@emubus.bus.emory.edu

All PCs and all MACs are connected to the same network using Digital's Pathworks software so they can share the same printer and file servers.

Florida Atlantic Univ

Alan H. Friedberg
(407) 367-3447 friedberg@fauvax

Extent of networking across multiple campuses.

Georgetown Univ

William C. Moncrief, Computer Center Director
(202) 687-4233 moncrief@guvm

Extensive use of groupware as part of curriculum - primarily GDSS for management and marketing classes (attempting to integrate collaborative s/w into curriculum).

Terry Col of Business, Univ of Georgia, Athens

Barbre S. McLeroy, Computer Center Director
(404) 542-3830 bmcleroy@uga.cc.uga.edu

Maintain individual accounts for all students, faculty, and some administrative personnel which totals about 6,000 accounts; SMTP E-MAIL for all users; Telnet and FTP for all users; fileserver disk storage for all users. USENET news access soon. Student accounts are generated with access based on courses taken.

Georgia Tech

Dr. G. F. Mackey
(404) 894-2611 gm19@prism.gatech.edu

Database to manage assignments, reports, etc. for large, case-study classes.
Authoring system for multimedia applications for teaching our business students a foreign language.
Technical communications for engineering managers using multimedia concepts.

Gonzaga Univ

Don Barker, Computer Center Director
(509) 328-4220x3424 barker@gonzaga

Development of an entire Windows-based curriculum including our own textbooks. Teach Windows 3.1, Lotus 1-2-3 for Windows, WordPerfect for Windows, and (soon) Paradox for Windows. Plus other Windows packages such as Levels object.

Howard Univ

Walter Oliver (202) 806-1647
Lonnie Cooper (202) 806-1649

COBISS lab (room 549) AT&T 3B2/500, 16 AT&T 6312 workstations, 2 laser printers all connected via starlan LAN. Uses of computers in systems analysis/design courses.

Classroom demonstrations using micro and Kodak Data Show include manipulation of popular software packages and applications to solve common business problems.

Univ of Maine

Virginia Gibson
(297) 581-1981 gibson@maine.maine.edu

"Speculative Markets Laboratory: an Interdisciplinary Project in Finance and MIS": finalist in 1991 DSI Instructional Innovation Competition.

Univ of Michigan

Elizabeth Walker
(313) 763-0462 user_lgrj@um.cc.umich.edu

Michigan Business School operates five public labs including one remote facility, a full range of services are offered to clientele including academic, administrative, and research support.

Univ of Mississippi

Dr. John Johnson (601) 232-5492
Dr. Bob Dorsey (601) 232-7575

Neural Network Software for Social Sciences Grant funded by FIPSE.

GDSS Projects:
Dr. Milam Aiken (601) 232-5464

Univ of Nebraska

John Fiene, Computer Center Director
(402) 554-2649 fiene@zeus.unomaha.edu

Implementation of multimedia classroom and authoring stations.

Univ of Nevada

William A. Newman
(702) 739-3287 newman@nevada.edu

Starting multimedia and object-oriented design and programming lab and two new courses. Also research multimedia lab in place with 5 Apple machines supported by grant.

Univ of North Carolina

John Neufeld, Dept of Economics
neufeld@uncg.bitnet

Computer lab to complement statistics course. Uses IBM OS/2 system on network. SAS used to teach statistical concepts. Course manual developed and written by faculty member.

Northeast Louisiana Univ

John Rettenmayer, Computer Center Director
(318) 342-1125 rettenmayer@merlin.nlu.edu

Lab of 22 NeXt systems for students and 8 for faculty.

Experimenting with multimedia (image and voice and text).

E-mail for grading/feedback.

Developing software for GDSS research.

The Ohio State Univ

Marjorie Brundage, Computer Center Director
(614) 292-1741 brundage.1@osu.edu

Stock market use of labs for connecting to stock exchanges (investment classes).

Simon School, Univ of Rochester
Dick West, Assistant Dean
(716) 275-4409 kevin@uorgsm.bitnet
Photo database of students integrated with student information system.
"State-of-the-art" case-style classroom design with rear screen video.

Rutgers Univ
Martin Markowitz, Assistant Dean
(908) 932-3600 markowit@rocky.rutgers.edu
SB-NB setting up classroom with 40 multimedia computers. Applications will include digitized animation, hypertext, full motion video and sound that will be created and will incorporate introductory type seminars, tutorial, help and information based systems. Will also develop instructional applications in problem solving demonstration, case study, visual image representations focussing on human responses such as advertising, consumer behavior, and also production analysis and operations management.

San Diego State Univ
geaston@sciences.sdsu.edu
Electronic boardroom featuring group systems software.

San Francisco State Univ
John Palme
(415) 338-1817 jpalme@sfsuvaxl.sfsu.edu
Network lab.

Southern Illinois Univ
Dr. Arkalgud Ramaprasad, Director
(618) 453-7892 ga0780@siucvmb
Pontikes Center for Management of Information.

Southern Methodist Univ
Sharon L. Criswell, Computer Center Director
(214) 692-2590 vb7r0001@smuvm1
New 386 Windows lab and regular PC lab of 30+ with additional CD-ROM-on-line workstations all in same PC environment. Fully networked and access to ethernet and TCP/IP Internet access from all machines.

SUNY, Buffalo
Julia Cohan
(716) 636-3286 mgtcohan@ubvm.cc.buffalo.edu
LAN using IBM PS/S 70 as file server with 40 IBM PS/2 30/286s connected.

Texas Tech Univ
Dr. Dave Bertram, Computer Center Director
(806) 742-1532 OOadm@ttacs
Development of a comprehensive open-access network. Emphasis is on all workstations and users having access to all resources.

Utah State Univ
Lloyd W. Bartholome
(801) 750-2341 lbart@usu
May not be unique, but have 150 student micros and about 50 faculty micros all networked (LAN and WAN). Also teaching use of presentation software to enhance teaching and business use.

Darden, Univ of Virginia
George Williams, Computer Center Director
(804) 924-3215 gfwgs@virginia.edu
Networked CD-ROM databases.
Access to info services via internet.

Babcock Graduate School, Wake Forest Univ

Barry Dombro, Computer Center Director
(919) 759-4703

Network configuration for new building, moving December 1992.

Haworth Col of Business, Western Michigan Univ

Ralph N. Yingling, Computer Center Director
(616) 387-5356 yingling@hcob.wmich.edu

In process of equipping multimedia/presentation graphics labs.

Univ of Calgary

Theresa Mueller, Computer Center Staff
(403)220-8592 tmueller@acs.uclagary.ca

Group Support System lab.

Also negotiations now to finish a faculty-wide network installation that will allow use of new and innovative technologies for research and teaching.

Univ of Toronto

Larry Harrison, Computer Center Director
(416) 978-7427 lh@fmgmt.utoronto.ca

Business Information Centre uses PC-based technology to access research material from internal and external computerized information sources.

Canadian Centre for Marketing Information Technologies in cooperation with IBM Canada and eight other corporate sponsors has set up a powerful PS/2 LAN using Data Interpretation Software (DIS) and a high speed network to the U of Toronto Computing Services host IBM 4381 for data base manipulation. Object to develop methods to analyze data for Canadian retail industry and trains students in use of information technologies to address marketing and operational problems.

Digital VAX cluster of Manufacturing Research Corporation of Ontario used for research into simulation, modeling and algorithm development in areas of manufacturing scheduling system with random interference, hierarchical production control and system failure detection and identification.

International Business Research Program focusing on international competition and trade and investment issues using Macintosh technology for research data collection and manipulation, presentations, case development and teaching material for strategic management courses.

Finance faculty using several high-powered workstations to investigate new stochastic programming based models.