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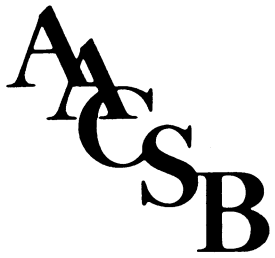
Eleventh Annual UCLA Business School Survey: Use of Learning Technologies in Business Education

Conducted in Cooperation with the American Assembly of Collegiate Schools of Business

June 1994



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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 extended to Julia A. Britt, who for the past seven years, has been an important part of these survey projects. Her spirit, if not her work, permeates this report. We wish her our very best on her new academic career.

American Assembly of Collegiate Schools of Business, Apple Computer, and the Business Education Program of Data Processing Management Association underwrote this year's survey project. Their continuing commitments have made this research and its dissemination possible.

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Executive Summary

This *Eleventh Annual UCLA Survey Of Business School Computer Usage* focuses on current and anticipated implementation of "learning technologies" to support business and management education. The learning technologies investigated here include electronic mail (e-mail), virtual library, multimedia usage, distance learning, classroom teleconferencing, laptop computer ownership, virtual classroom, and infrastructure wiring to enable electronic networks. The goal of this report is to provide deans and other policy makers with information that will assist them with allocation decisions and program plans.

An international sample of business schools, including 324 AACSB member schools in US/Canada and 28 schools across Europe, Asia/Australia, Latin/South America and Africa/Middle-East, participated in this year's survey, about half of which having responded in several previous annual surveys. Both large and small schools, public and private institutions, and undergraduate and graduate programs were included in the sample.

Based on total sample analysis, business schools are, in general, in the *initial action* phase of technology adoption with respect to the twelve learning technologies under investigation. The overall phase mean is 2.26 (based on a seven-point scale where "0" represented that a technology was *not applicable* to a school and "6" represented that a technology was *established* and used by at least 75% of the users). This score suggested that the "typical" school is engaged in general preparation for implementation of various learning technologies, that is, selecting alternatives, identifying funding, writing proposals, obtaining bids, and/or pilot testing with one or two experimenters.

Although the overall phase mean for the total sample provided a convenient way to describe where business schools are, as a collective whole, it does not reflect variations across different technologies. For example, collectively, responding schools indicated that network wiring infrastructure to faculty and administrative offices was at the *critical mass* phase (available to at least 50% of the user population), three stages beyond the *initial action* phase. In contrast, virtual classroom, class teleconference, distance learning, student laptop ownership, and networking to individual classroom and library seats were at the *investigation* phase (studying suitability of the technology for the school), one stage below the *initial action* phase. Falling in between these two extremes are multimedia usage and virtual library at the *initial action* phase, providing a network connection to each classroom one phase up, at the start-*up* phase (available to less than 25% user population), and e-mail usage at the *growth* phase (available to at least 25% user population).

This overview shows that schools are moving ahead with the "older," more familiar communication oriented application -- e-mail -- and are testing the waters on newer technologies, such as multimedia usage and virtual libraries. Further away on the horizon are virtual classrooms and classroom teleconferencing that are still being examined for their suitability within the teaching environment.

Apart from examining the rate of technology adoption, The *Eleventh Survey* also investigated impediments to, and motivators for adoption of each technology. Not surprisingly, funding was the major impediment to the adoption of every technology. Other frequently mentioned hurdles included need for greater commitment of campus and school administrations to support implementation of technologies, lack of perceived educational benefits, and faculty indifference to the use of learning technologies. On the motivator side, the two most frequently mentioned reasons for introducing and using various learning technologies were first, to demonstrate a commitment to staying on the leading-edge of instructional use of technology and second, need to maintain a competitive position with peer institutions.

Each technology was cross-analyzed by phase of adoption and the technology's reported effectiveness in fulfilling a function. Only schools which have some experience in using the technology in question (*initial action* phase and above) were included in this analysis. The results showed that with more familiar technologies, such as e-mail and multimedia usage, a progressive

pattern towards greater effectiveness was reported by schools further along the adoption curve. In contrast, there was no clear pattern for newer technologies, such as class teleconference and virtual classroom. This raises the possibility that reported effectiveness may be a function of adoption and reflects the learning curve phenomenon in which users are still trying to master a technology to do what it was supposed to.

The data also shows that schools differ from each other in terms of adoption patterns. Based on a cluster analysis of schools' responses to the 12 learning technology adoption questions, three discernible clusters emerged. Cluster 1 consisted of 94 schools with a cluster phase mean of 1.09. This indicates that they were, on average, in the *investigation* phase (i.e., studying the suitability of different technologies for its students) of the 12 technologies. The next cluster, Cluster 2, consisted of 194 schools with a cluster phase mean of 2.25, indicating that they were in the *initial action* phase (i.e., taking action to determine costs and implementation plans). The last cluster, Cluster 3, consisted of 64 schools with a cluster phase mean of 3.06, the *start-up* phase (i.e., implementation and testing the technologies).

In general, as schools moved from Cluster 1 to Cluster 3, impediments to further growth shifted from problems of funding and physical infrastructure to handling learning and socialization problems. Thus, after the equipment and network wiring are in place, the human aspects that will ensure wide-spread use of a technology, such motivating individuals to use the technology, training, and ongoing support, become more important. This approach of first focusing on hardware and then human requirements (including goals to be achieved) is representative of technology-driven change and reflective of what is occurring in many schools.

Observations and Questions

Given this broad sweep of the stages business schools are in the adoption of learning technologies, what have we learned? First, and perhaps foremost, the learning technologies that were investigated this year are not science fiction. Schools from around the world are making investments in these areas, many with an eye to differentiating themselves in a time of shrinking population pools of student applicants. Throughout the report are examples of best practices at schools: Wake Forest University is building their virtual library, Texas A&M is investing in multimedia, Ohio University is reaching students at many campus with distance learning, University of North Colorado is using teleconferencing to bring guest speakers into their classrooms, Columbia University is requiring every MBA student to own a laptop computer, and the Norwegian School of Management is using their virtual classroom to deliver a program to students who do not have traditional access formats.

These stories raise the question of whether learning technologies will play increasingly more important roles as business schools compete for students and resources, and reach across local and national boundaries into new markets.

In reading the *Eleventh Survey*, time and again, and irrespective of technology, schools indicated that their reasons for investing in learning technologies were to maintain currency, stay on the leading edge, be competitive with peer institutions, and be able to appeal to new students. Educational reasons such as to enable students to learn more or present ideas more clearly, or enable teachers to teach ideas not previously taught, were rated significantly less often, and rarely by more than 20% of the schools.

The consistency of this reported market driven force for technological advancement suggests that schools are looking at technology adoption increasingly from a strategic perspective -- one that may open up new avenues of institutional growth. Most of the learning technologies explored in this year's survey are in the early stages of adoption. This implies that the playing field is still largely to be explored and tested, and it provides both exciting opportunities as well as significant risks. Schools venturing into this area could open new education markets, become leaders in a chosen field, establish well-known names and a stable student base, and participate in the founding stage of a global learning community that transcends current geographical and

time constraints. The risks, of course are financial and educational, not technological, since all of the technologies reported here are already commercially available to some extent. Given the motivation, appropriate focus on goals, and commitment to a funding base, any school can launch a program using any one of the learning technologies discussed in this report.

This then leads to the question of return on investment (ROI). If technology investments are to be evaluated, what yardstick should we use and what time-frame should we adopt? How do we know whether the use of a particular technology, or the collective use of technologies lead to better educational experiences? In this report many different uses of learning technologies have been described, from enhancing the communication and instructional capabilities within a business school to opening up educational opportunities to some motivated individuals heretofore excluded by reason of physical distance and time barriers. While these may be progressive developments, and even possibly new growth frontiers, their long term costs and benefits have yet to be determined. These, and many other related questions have to be examined, especially considering that traditional parameters and assumptions about educational market boundaries and modes of delivery to these markets are being challenged by shifting population demographics and the explosive growth in computer and telecommunication technologies.

Table of Contents

Appendices

List of Figures

List of Tables

1. Introduction

The goal of this, the *Eleventh Annual UCLA Survey of Business School Computer Usage*, is to provide deans and other policy makers with information that will assist them with allocation decisions and program plans in the area of "learning technologies" for support of business and management education. "Learning technologies" are those applications of computer, communication, and information technologies such as laptops, e-mail, teleconferencing, multimedia, distance learning, and virtual library, which are used in support of the educational process.

Data for this survey were collected on the current use of learning technologies by business schools, their plans for these technologies over the next two years, and both motivators and impediments for their use[1]. Data was also collected on infrastructural elements essential for the wide spread use of learning technologies: computers for faculty, students, and staff, as well as wiring components to link them all together. The reader is cautioned that this survey reflects what the schools report they are doing and is not an endorsement of what they should be doing.

This *Eleventh Survey* represents a major growth in the *Annual UCLA Surveys* as it has expanded to a world-wide sample of 773 business schools. It is a twenty-fold increase over the first survey population (1984) of 37 business schools (including seven Canadian schools) and a three-fold increase over the second survey population (1985) of 241 business schools accredited by the American Assembly of Collegiate Schools of Business (AACSB) and the Canadian schools. For each of the following six years (1986 - 1991), the *Annual UCLA Surveys* has presented a report on the AACSB accredited business schools in the United States and the Canadian schools. In 1992, (the *Ninth Survey*), 95 schools located in 36 countries were invited to participate in the survey[2]. The 1993 *Survey* continued with an international sample of schools. This year, 1994, the international sample was further expanded to include the entire AACSB membership, 678 schools in all, as well as the set of international business schools previously identified.

While six surveys — the *First, Second, Fourth, Sixth, Eighth,* and *Tenth Surveys* — focused on gathering information on hardware, software, and other computer resources of the schools, others collected data on policy issues, budgets, and computerization processes. These other surveys included Third Survey which addressed issues of concern to the deans, the *Fifth* and *Ninth Surveys* which focused on business school computerization in terms of processes, recognizing that the introduction and use of technology is ongoing and that schools may not only be approaching computerization differently, but also at different rates, and the *Seventh Survey* which highlighted operating budgets and computer-related services so as to reveal the costs of computer services.

The current survey, the *Eleventh*, focuses on learning technologies which have potential significant impact on business schools when viewed within the context of the emerging Information Super Highway, extensive national and international networks, and the explosive growth in computer, communication, and information technologies. In order to gather information for analysis, a questionnaire exploring where schools were with respect to their adoption of learning technologies and associated issues was developed and tested. This included a *Business School Technology Adoption Phase* diagram for collecting information on the stage of technology development. Appendix 1 provides details of this phase diagram, together with a description of the seven adoption phases. The phases are delineated along a usage continuum, ranging from "no interest or involvement in the use of a technology at the school" to "use has expanded to at least 75% of the user population." Respondents were asked to indicate on the usage continuum their most realistic, not idealistic, estimates of where their schools were in January, 1994.

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[1] Interested researchers can access the SAS formatted dataset set via anonymous FTP from agsm.ucla.edu in the directory /pub/surveys/survey1994.

[2] Copies of the *Annual UCLA Surveys of Business School Computer Usage* can be obtained for US $30 each from Computing Services, Anderson School at UCLA, Los Angeles, CA 90024-1481.

Where are business schools with respect to the adoption of learning technologies?

One answer to this question is to average (mean) all the business schools' responses to all the technology phase questions. This single point, 2.26, suggests that, overall, the 352 responding schools were in the *initial action* phase and piloting these technologies. The top graph in Figure 1 presents the location of each of the 12 technologies along the adoption curve based on the value of each phase mean for the entire sample.

As can be observed in the top graph of Figure 1, there is a great deal of variation in the adoption phase of different learning technologies. While wiring to faculty and administrative offices had achieved a *critical mass* (50 - 75 percent completed) at the "typical" school, and e-mail was at the *growth* phase with an overall 25 - 50 percent utilization, only at most 25% of classrooms in business schools were wired with a single network connection . Also, the "typical" school is just taking *initial actions* to introduce multimedia and to create a virtual library. At the early stages of development were the rest of the six learning technologies, with schools just *investigating* (thinking and talking about) their usefulness. The low phase values reflect the newness of these technologies and the fact that only now are price performance ratios falling into a range which make the technologies affordable by a broader constituency.

Recognizing that there is a wide variation in interests, objectives, and resources across business schools, one can assume that different schools would begin to investigate and adopt different technologies according to each school's needs and required timing. Therefore, it seems reasonable, first, to group schools according to their phases of adoption of various technologies, and, only then, to review characteristics, and similarities and differences of experiences across groups. In order to do so, the total responding sample of 352 schools were cluster-analyzed on their responses to the 12 phase questions so as to identify groups by their underlying technology adoption patterns. This process resulted in three cluster groups. The location of the 12 technologies along the adoption curve for each cluster is also shown in Figure 1.

Cluster 1 had an overall mean phase score of 1.09 and consisted of 64 business schools. As can be seen in the diagram, these schools reported that about one-third of the learning technologies was *not applicable* to their environment at this time, were *investigating* about another third of them, and taking *initial actions* to introduce the rest. Technologies in this last third were multimedia, faculty office network connection, administration network connection, and e-mail.

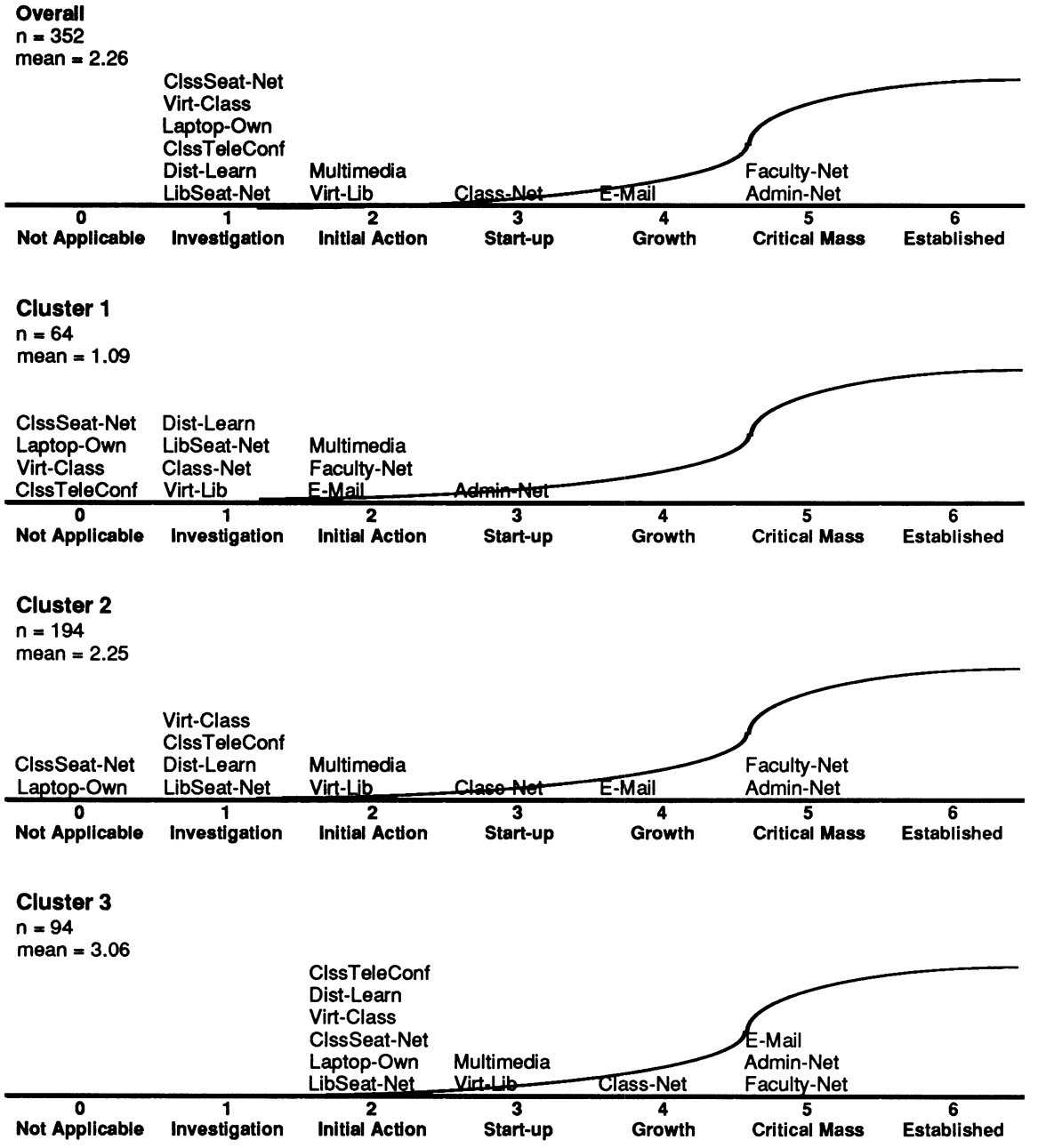
Cluster 2 had a mean phase score of 2.25, and was the largest cluster with 194 schools. For this cluster, there was considerable variation in the phase of adoption of different learning technologies. While providing network connections to faculty and administrative offices had reached *critical mass*, two technologies were viewed as *not applicable* at this time. Most of the remaining eight technologies were just being *investigated* or in the early stages of introduction.

Cluster 3 had a mean phase score of 3.06 and was made up of 94 schools. Although half of the learning technologies in this cluster had individual means suggesting they were being tried out in a pilot mode, three technologies had achieved at least *critical mass*. These were e-mail, and network connections to faculty and administrative offices. What is significant about this group is that all the technologies were considered applicable to the schools.

Subsequent sections of this report will explore these learning technologies in greater detail. Apart from the question of where on the adoption continuum schools were in January, 1994, they were also asked where they expected their schools to be in, in two years' time, January 1996. Also, respondents were asked to identify factors influencing adoption, such as impediments which must be overcome and motivating forces supporting the move forward. For each of the 12 learning technologies, graphs indicating the 1994 and 1996 usage phases, and their related growth factors are presented.

Since cluster analysis revealed 3 groups that differed along the adoption curve, there is a possibility that impediments to, and motivators for growth of different technologies may differ across groups. To better understand these possible differences, growth factors for cluster 1 and cluster 3 were compared. The decision to use these two extreme clusters followed from the authors' review of various combinations of data and finding that the greatest value for those planning to use these technologies, would be gained by a comparison of the extrema.

Figure 1
Phase of Business School Adoption of Learning Technologies
N = 352



Admin-Net	Network connection to admin offices	**Faculty-Net**	Network connection to fac offices
Class-Net	One connection per classroom	**Laptop-Own**	Required student laptop ownership
ClssSeat-Net	Network connection to each classroom seat	**LibSeat-Net**	Network connection to library seats
ClssTeleConf	Bringing guest speakers into the classroom via interactive video	**Multimedia**	Integrated audio/video/text/graphics via computer
Dist-Learn	Sending instruction from classrooms to remote locations via interactive video	**Virt-Class**	Electronically interactive classroom
E-Mail	Electronic mail usage	**Virt-Lib**	On-line information resources

The following steps were used to highlight differences in growth factors across clusters 1 and 3. First, for each cluster, the percentage of schools which marked each impediment and motivator item was calculated. Next, all items marked by at least 20% of the schools in either cluster 1 or cluster 3 were tagged, and a difference score between each corresponding cluster 1 and cluster 3 item calculated. If this difference was 10% or more, the item was inserted in a table for discussion. Items with a difference of less than 10% were discussed in terms of the overall sample.

Schools were next asked to indicate their perceptions of each technology's effectiveness in achieving a specific goal. For example, respondents were asked to indicate how effective current e-mail use was at facilitating business school communication. Results from analysis of these questions were incorporated in the discussion of each technology. In presenting the results for this discussion, only schools which had actually begun using the learning technology in question were included, that is, schools which were in the *initial action* phase or above. This approach excluded all schools in the *not applicable* and the *investigation* phases. It assumes that only those who have tried the technology in question could give a realistic response on the technology's effectiveness for a certain function. Notwithstanding the intentional omission from discussion in the report, data from schools in these two categories were nevertheless examined before a decision was made to leave them out of the report. As a result of this examination, an interesting trend was noticed. For all the learning technologies investigated in this study, most schools in the *not applicable* and *investigation* phases indicated that the technology was not effective. This response raises the question of: "Do people see the technology as *not effective* because they have no experience with it, or is it because they consider the technology as *not effective*, and therefore are not investing resources (time and money) into it." This question is left for others as the focus of the current survey is on where schools are in the adoption of learning technologies.

In order to help us understand how these learning technologies were being used in schools, the authors used e-mail to contact the top schools in each technology area and requested a short descriptive paragraph of their use of that particular technology. A few schools responded and their comments are incorporated in the report.

Finally, in presenting this report, a decision was made to adopt a global perspective. That is, all the responding schools were treated as if they were drawn from a homogenous sample, and demographic factors such as size, whether public or private institution, teaching or research oriented, and regional factors and country of origin, were ignored. However, these demographic data and other detailed information on enrollment and microcomputer availability for each school are presented in the appendices. Individuals interested in a specific country, or in regional patterns, can compare the schools in question against the overall trends presented in this report.

This report is divided into four sections: Introduction, Profile Of Participating Schools, Adoption of Learning Technologies, and the Technological Infrastructure. Two appendices are included. These covered definitions of the *Business School Information Technology Adoption Phase* diagram and detailed information of each participating school.

2. Profile of Participating Schools

The target population for this year's survey was the 678 business schools which are members of the American Assembly of Collegiate Schools of Business (AACSB) and 95 schools from 38 countries originally identified for inclusion in the 1992 *First UCLA Global Survey of Business School Computer Usage*. Of the 773 schools sent the 12 page questionnaire, 352 (45%) responded. In Section 2.1 demographics for the entire sample are presented and in Section 2.2, demographics for underlying clusters within the sample arranged are discussed.

2.1 General Demographics

Table 1 displays general demographic information of the 352 schools in this year's sample, together with data from three previous surveys: the *First*, *Second*, and *Tenth*. Data was included from these surveys because they showed the growth of the surveys. The First Survey solicited information from a small sample of schools (35) in 1984. This population was expanded to all 241

Table 1
Demographics of Participating Schools
(percent of schools)

	First 1984 N = 35	Second 1985 N = 125	Tenth 1993 N = 180	Eleventh 1994 N=353
Type of school: Public	49%	69%	71%	66%
Private	51	31	29	31
No data				3
Degrees Offered:				
Undergraduate only	0	2	6	11
Undergraduate & Graduate	66	86	81	74
Graduate only	34	12	10	9
No data			3	6
Student Enrollment:				
Less than 1000	37	22	18	34
Between 1000 & 2000	23	22	34	26
Between 2000 & 3000	20	26	19	16
More than 3000	20	30	26	17
No data			3	6
Geographic Region:				
US/Canada	100	100	83	92
Europe			7	4
Asia/Australia			6	2
Latin/South America			3	1
Africa/Mid-East			1	1

AACSB accredited schools the next year, of which 125 participated. For the following 7 years, the sample population remained the same through the *Ninth Survey*. In the *Tenth Survey* an international sample of schools was added which resulted in a sample of 150 US/Canadian schools and 30 schools from 24 other countries. For the *Eleventh Survey*, 325 US/Canadian schools (92% of the total sample) and 27 schools (8%) were from 17 other countries participated in the survey.

With the increase in sample size in 1994, the most significant demographic shift was the distribution of student enrollments. The responding sample now consisted of a larger proportion of smaller schools, somewhat closer to the *First Survey's* sample than those of the past several years. However, despite this shift in enrollment distribution, the proportion of public and private schools had remained relatively stable over the years (approximately two-thirds public and one-third private). The proportion of schools with undergraduate programs also doubled over the 1993 sample (from 6% to 11% of the sample), while the proportion of schools with graduate programs remained about the same (10%).

Another aspect of this sample of schools is the very significant number (more than half of the schools) which have recently, or will soon, occupy a new building. Of the 340 schools responding to the question of a new business school building, only 47% said it did not apply to them. The remaining had/or will be experiencing some building development. Nineteen percent said a building was in the planning stage, 15% said they moved within the last 2 to 5 years, 5% moved last year, 6% were moving this year, and the remaining 8% of the schools had construction underway and will be moving within the next couple of years.

2.2 Cluster Demographics

In order to better understand the make-up of the three clusters described in Figure 1, their demographic data are displayed in Table 2. As can be seen, a larger proportion of cluster 3 schools are private schools as compared to those in cluster 1 and cluster 2. The missing data for degrees offered made it impossible to know whether these schools offered single degrees, or both undergraduate and graduate degrees. In spite of this missing data, the enrollment pattern and degrees offered for clusters 2 and 3 were very similar. Geographically, the US/Canadian and the

Table 2
Demographics by Cluster

	Cluster 1 N = 64	Cluster 2 N = 194	Cluster 3 N=94
Type of school: Public	62.5%	71.6%	63.4%
Private	34.4	26.8	42.5
No data	3.1	1.6	4.2
Degrees Offered:			
Undergraduate only	17.2%	10.8%	5.3%
Undergraduate & Graduate	65.6	75.8	76.6
Graduate only	10.9	6.7	3.8
No data	6.3	6.7	14.3
Student Enrollment:			
Less than 1000	46.9%	38.7%	38.3%
Between 1000 & 2000	31.3	25.8	23.4
Between 2000 & 3000	12.5	18.0	16.0
More than 3000	9.3	17.5	22.3
No data	0.0	0.0	14.0
Geographic Region:			
US/Canada (n = 328)	87.5%	95.4%	86.1%
Europe (n = 13)	1.6	1.3	9.6
Asia/Australia (n = 8)	4.7	1.0	3.2
Latin/South America (n = 5)	4.7	1.0	1.1
Africa/Mid-East (n = 4)	1.5	1.3	0.0
Phase Mean (std dev)			
Overall Cluster (scale 0 - 6)	1.09 (0.40)	2.25 (0.49)	3.13 (0.62)
Application Phase Means:			
E-mail	2.16 (1.20)	4.11 (1.28)	4.78 (1.25)
Virtual Library	1.23 (1.15)	2.19 (0.49)	3.17 (1.22)
Multimedia	1.55 (0.96)	1.81 (0.99)	2.92 (0.97)
Distance Learning	0.62 (0.85)	1.26 (1.49)	1.73 (1.57)
Classroom Teleconference	0.47 (0.79)	0.78 (0.95)	1.68 (1.37)
Laptop Ownership	0.23 (0.46)	0.48 (0.74)	2.23 (1.75)
Virtual Classroom	0.35 (0.68)	0.59 (0.83)	1.79 (1.22)
Infrastructure Phase Means:			
Admin offices networked	2.67 (1.50)	5.44 (0.99)	5.34 (1.27)
Faculty offices networked	2.14 (1.19)	5.28 (1.12)	5.37 (1.18)
Classroom networked	0.92 (0.94)	2.97 (2.05)	4.27 (1.88)
Library seats networked	0.65 (1.05)	1.28 (1.63)	2.31 (1.76)
Classroom seats networked	0.16 (0.37)	0.42 (0.69)	1.79 (1.51)

Asia/Australia schools were fairly evenly distributed across the three clusters. The European schools tend to fall within cluster 3, Africa/Middle East within cluster 2, and Latin/South America within cluster 1. The reader should not generalize from this geographical data because of the very small sample of schools outside of the US/Canada group.

The remainder of Table 2 displays the mean and standard deviation for the overall clusters, the individual applications of learning technologies, and the wiring infrastructure phase means. Note that for the overall clusters, the value of the standard deviations are relatively small compared to the mean indicating that schools within the clusters are very similar. However, for some of the learning technologies, the variation within a cluster is large. For example, for laptop ownership, it is difficult to distinguish between schools in cluster 1 and cluster 2 because of the large standard deviations when compared to their respective means, thus indicating wide variability among schools within each cluster.

When we examine the overall phase data, cluster 1 schools showed a phase mean of 1.09, suggesting that they were, overall, at the *investigation* phase. Schools in this cluster indicated that three of seven application areas and one of five infrastructure items were *not applicable* to their environment. In general, cluster 1 schools were just beginning to focus on putting the infrastructure into faculty and administrative offices, and at the same time, developing their e-mail capabilities.

Cluster 2 schools, with a overall phase mean of 2,25 were overall, at the *initial action* phase. However, individual technology means were distributed across all phases. In contrast to cluster 1, this cluster had well developed e-mail capabilities as well as network infrastructure to offices, while making initial efforts at networking classrooms. This cluster had just started to explore virtual library and multimedia technologies.

Cluster 3 schools, with a overall phase mean of 3.13 were overall, just beyond the *start-up* phase, with activities occurring in all 12 application and infrastructure areas. Like cluster 2, this cluster was well advanced in e-mail and office network infrastructure. However, cluster 3 schools were further along with introducing a virtual library, multimedia applications, and student laptop ownership.

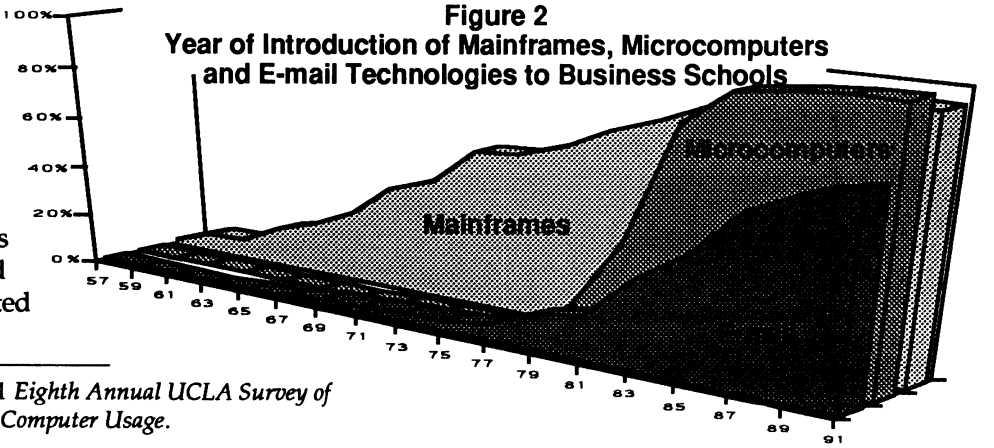
3.0 Learning Technology Applications

In this section, for each learning technology application, the adoption phase is presented along with an analysis of the impediments to and motivators for growth. Also, the reported effectiveness of the technology in achieving a particular goal is discussed. Finally, examples of best practices from schools intensively engaged in using each technology are presented.

3.1 Electronic Mail

The use of electronic mail (e-mail) for business school communication is an "old," well established technology which was first introduced in the late 1960s on mainframe systems and which slowly migrated to minicomputers during the 1970s and early 1980s, as shown in Figure 2[3]. This migration was the result of the explosive growth of microcomputers. E-mail growth has continued as microcomputers proliferated and become connected via networks.

Figure 2
Year of Introduction of Mainframes, Microcomputers and E-mail Technologies to Business Schools



[3] Data from 1991 *Eighth Annual UCLA Survey of Business School Computer Usage.*

Figure 3
Phase of Current 1994 and Anticipated 1996 E-mail Adoption
N =352
(percent of schools)

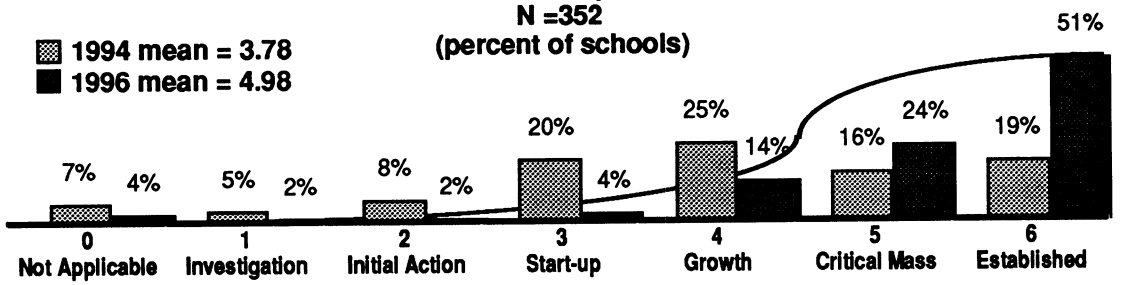
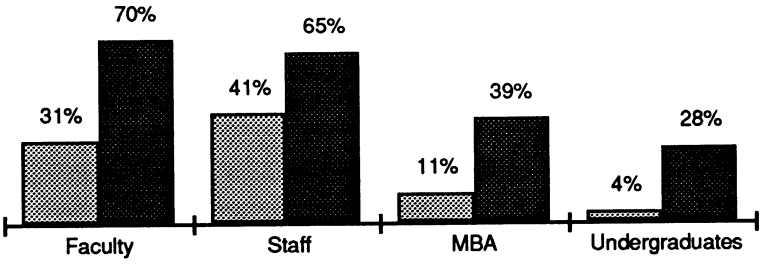


Figure 3 displays the phases of e-mail usage as reported by the 352 schools in this year's sample. As shown in the figure, e-mail is currently in active use (at least the *start-up* phase) at 80% (20%+25%+16%+19%) of the responding schools. This figure is expected to grow to 92% by 1996. Continued e-mail growth is also reflected in the overall phase mean as can be seen in the expected increase from 3.78 to 4.98 over the next two years.

To better understand the pattern of e-mail use in schools, respondents were asked to indicate their best estimates on the percent of faculty members, students, and administrative staff who utilized e-mail at least three times each week. Figure 4 shows the percentage of schools at the *established* phase (used by at least 75%) for each user group. For 1994, 31% of the schools reported that e-mail was at the *established* phase for faculty members, and over the next two years, this percentage is likely to increase to 70%. The most dramatic increase is expected at the undergraduate level where currently only 4% of the schools reported being at the *established* phase with an anticipated seven fold increase to 29% in two years.

Figure 4
E-mail Usage by User Group at the Established (>75%) Phase
N = 352
(percent of schools)



Growth Factors

When we review differences in e-mail adoption between Cluster 1 and Cluster 3 schools, it was clear that there was a sizable gap between them: Cluster 1 schools were just piloting e-mail (phase mean = 2.16) with a few users while cluster 3 schools (phase mean = 4.78) were close to having a *critical mass* using this communication media. In order to better understand the relationship between where schools were and the issues they faced as e-mail usage increased, impediment items marked by at least 20% of the schools in cluster 1 or cluster 3 were compared. This produced ten items. Four of these had very similar percent response scores (i.e., less than 10% difference) between the two clusters and were considered to be general impediments to continued growth of e-mail across all the schools. These items included faculty indifference on e-mail usage (identified by 50% of the schools), need for faculty training (43%), faculty reluctance to use e-mail (29%), and lack of a commitment from campus administration to support e-mail (23%). Based on these items, it seems that faculty members hold the key to growth of e-mail across all schools, regardless of where these schools were in the technology adoption cycle.

While the four items discussed above highlighted across-cluster generic impediments, the remaining six items revealed changes in impediments (10% or more) across clusters 1 and 3.

These are listed in Table 3. Inadequate funding, which was a universal and dominant problem, was less of an issue for schools in cluster 3 than in cluster 1. This is probably because cluster 3 schools, being further along the cycle, had already made substantial investments in infrastructure charges such as computers or wiring, while those in cluster 1 were just facing these hurdles. Similarly, the lack of classroom wiring and uncertainty over educational benefits become lesser issues as e-mail usage expands in schools. On the other hand, with continued expansion, schools are faced with new problems. These included complications in technology, such as incompatible systems, student training, and lack of easy access from outside the business school environment.

Ten items that motivate expanded e-mail usage were marked by at least 20% of the schools in

Table 3
Impediments to E-Mail Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 2.16 N = 64 %	Cluster 3 mean = 4.78 N = 94 %	% difference
Funding money	67	44	-23
Wiring or infrastructure to use in classroom	38	19	-19
Perceived long term benefits, educational value	43	33	-10
Technology too complicated to use	19	29	10
Student training	9	27	18
Easier access from remote locations	13	31	18

cluster 1 or cluster 3, with six items having very similar percent response scores (i.e., less than 10% difference) between the two clusters. These six generic motivating factors included commitment to staying on the leading edge (listed by 55% of all schools), need to communicate with people off-campus (52%), faculty demand for e-mail capability (29%), as a tool to increase the number of students an instructor can reach (28%), as a means of sustaining competitive posture with peer institutions(27%), and as a means of appealing to new entrants, and indicating technological sophistication of the school (22%).

The four remaining motivators that were different between the two clusters are shown in Table 4. First, as e-mail usage becomes more wide-spread among faculty and staff (cluster 3 schools), student demand for e-mail also increases. The data shows that while only 11% of cluster 1 schools indicated student demand as a reason for e-mail expansion, 31% of cluster 3 schools did so. Also, e-mail is a more important consideration in the mission of the schools in cluster 3 than those in cluster 1. Not surprisingly, when e-mail becomes more widespread, pressure to be able to access campus resources from outside the campus became less acute—decreasing from 50% in cluster 1 schools to 35% in cluster 1 schools—since these resources become accessible through the e-mail system. Correspondingly, as campus resources are made more easily accessible, demand

Table 4
Motivators for E-mail Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 2.16 N = 64 %	Cluster 3 mean = 4.78 N = 94 %	% difference
Student demand	11	31	20
Part of school's mission	16	29	13
Ability to access campus resources from community	50	35	-15
Access to data resources not on campus	55	38	-17

for off-campus data resources become less acute, and hence as a motivator for continued growth of on-campus e-mail, less significant.

Effectiveness

When e-mail phase responses were tabulated against e-mail effectiveness ratings in facilitating business school communication, a distinct progressive pattern — from *not effective* to *effective* as the technology phase increases — was seen and this is shown in Table 5. Out of 265 schools which have implemented e-mail, 45% tend to rate it as *effective* in facilitating communication, 21% as *neutral*, and 34% as *not effective*. Further review of these figures showed that those in the *effective* category were more likely found in the *critical mass* and *established* phases of the technology curve (32%) while those in the *not effective* category were more likely to be in the *initial action* and *start-up* phases (22%). Responses in the *neutral* category were largely concentrated in the *growth* phase.

Table 5
Phase of E-mail Usage by Effectiveness for Business School Communication
N = 265

	Not Effective	Neutral	Effective
Initial action	5%	0%	2%
Start-up	17	3	3
Growth	9	11	8
Critical mass	2	4	13
Established	1	3	19
Total	**34**	**21**	**45**

This progressive pattern is not unexpected, since for e-mail to be effective in facilitating communication, a sizable proportion of the school population must be using it in order to ensure that those sending out messages do actually reach their intended receivers who would logon, access and respond to these messages. Based on the results in Table 5, it seems that at least the *critical mass* stage (50% of school population using e-mail) is needed before it becomes *effective* in facilitating business school communication.

Internet Access

E-mail connects the environment within schools as well as links schools to the outside world. In this year's sample 70% of the schools reported having an Internet connection and thus providing access to the current "information highway." Via Internet, individuals can transfer e-mail and files between organizations outside their own school, and furthermore, access a growing number of information services at remote locations. To aid those who are not network sophisticated and fluent in the UNIX operating system which is essential for ease in navigating the Internet, many schools had installed gopher servers. These sets of software programs, now installed by 36% of the current sample, assist network explorers identify and access remote information services.

Examples Of Best Practices

As an example of the power of e-mail the authors want to share their experience regarding its role in the development of this report.

> A major portion of the analysis was performed through remote access to the school's computer system and as draft material was prepared, it was exchanged electronically for revision. Consequently, we minimized travel and settling-in time. Even more important, we could work on drafts at a time that was individually most productive and convenient, knowing we had the latest revision available from each other. Also, through e-mail we were able to invite 20 other schools to contribute examples of their best practices for inclusion within a two-week time frame. A challenge was in finding "Internetable" file formats. For example, with some schools we were only able to exchange plain text files without any formats (bold fonts, italicized letters, indention, etc.), while with others the technology has matured to a point where actual documents, with their formats preserved, could be exchanged.

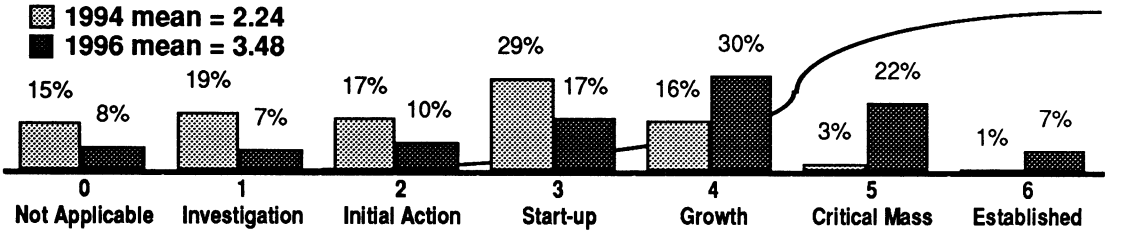
Many anecdotes have been reported on the value of e-mail:

> Electronic mail is a powerful augmentation to the "traditional" means of communicatioin within the business school environment. Instructors have reported their ability to "personally" reach more students without the constraints of time, place, and perhaps more importantly, personal inhibitors; students who are too shy to ask questions in person, for personal or cultural reasons, share freely over the electronic media; e-mail can be used to distribute course material and to respond to individual inquiries, thus expanding and continuing the classroom experience over time; faculty are "getting to know their students better" through the exchange of e-mail; electronic polling can be used to identify students views on issues and enhance discussions; faculty discussion of issues and committee meetings are being held on-line, as are extensive world wide discussion through list servers and the Internet; and many more other stories that are related at conferences and the authors' personal interactions with faculty and students. Schools reported different strategies for increase e-mail participation among faculty and staff. For example, at one school, secretaries were instructed to relay phones messages via e-mail and not on paper slips. At another, the chairman told faculty members that they would receive 24 hour turn around to requests submitted via e-mail.

3.2 Virtual Library

In the *Eleventh Survey* questionnaire, a "virtual library" was defined to mean on-line availability of journals, magazines, books, library catalogues, and information databases (including text, graphics, sounds, pictures, and video) to be accessed electronically from any location at any time. The overall adoption phase mean for the total sample of 352 schools was 2.24 in 1994, with schools distributed across all seven phases of the curve as shown in Figure 5. This wide distribution is expected to continue to over the next two years, with the mean increasing to 3.48 in 1996.

Figure 5
Phase of Current 1994 and Anticipated 1996 Virtual Library Adoption
N =352
(percent of schools)



Only 4% of the schools reported they were at the *critical mass* or the *established* phase of the curve. In contrast to this small group of schools at the *critical mass* stage or higher, the majority of the schools are not considering or just *investigating* on-line access within their environments. Given the growing interest in the information superhighway and its potential access to massive amounts of information, one might wonder why more schools are not investing in this learning technology.

Growth Factors

When we examine impediments to the growth of on-line access to information resources, the overwhelming impediment was lack of funds. This was listed by 82% of the schools. The other problems commonly faced by schools in the introduction of a virtual library are dramatically less

significant than the funding issue, with faculty training listed by 31% of the schools, lack of perceived long term benefits or educational value by 30%, faculty indifference by 28%, and inadequate wiring or infrastructure to use in classroom by 20% of the schools.

When contrasting differences between cluster 1 and cluster 3 schools on this technology, five impediment factors were different across clusters (Table 6). As schools moved along the adoption phase curve, obtaining a commitment from either the central campus or school administration for changes arising from on-line information services became less of an issue—decreasing 15% for campus and 10% for school administrations. On the other hand, as on-line resources do become more available, demands for easier access from remote locations increased by 10%, providing easy to use interfaces or methods of getting information increased by 13%, and need for student training increased by 15%. Overall, as access becomes more generally available, impediments to growth shift from demands for implementation resources to needs for making systems more accessible and user friendly.

Table 6
Impediments to Virtual Library Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 1.23 N = 64 %	Cluster 3 mean = 3.17 N = 94 %	% difference
Commitment from campus library administration	45	30	-15
Commitment from school administration	31	21	-10
Easier access from remote locations	13	23	10
Technology less complicated to use	8	21	13
Student training	13	28	15

The primary motivators for schools to invest in on-line data access environments were commitment to stay on the leading-edge of instructional use of technology (63%), need for access to data resources not on campus (52%), access to data resources on campus (47%), and need to remain competitive with what peer institutions were doing in this area (46%). Four other reasons were identified by at least 20% of the schools, but at a lower proportion: appeal to new students/audiences (28%), faculty demands (26%), ability to gain insights not possible otherwise (21%), and student demands (22%). Two reasons appeared more frequently in cluster 3 schools than in cluster 1 schools. First, cluster 3 schools identified virtual library being part of their mission 35% of the time as compared to only 20% by cluster 1 schools. Also, 24% of Cluster 3 schools listed virtual library being part of their international focus as compared to only 13% of cluster 1 schools.

Examples of Best Practices

In preparing for life with a virtual library. Eloisa Gomez Borah, Head of Public Services at the Management Library (ECZ5YEA@MVS.OAC.UCLA.EDU) at the Anderson School at UCLA, has prepared the following list of "Top Ten Reasons NOT To Come To The Library" as an indication of the direction, and new and more complex roles of libraries and users. (Note: ORION is the on-line UCLA library catalog and campus information system.)

10. Full-text business journal articles available on Melvyl with a free ORION account.
9. Renew books yourself using ORION terminal or home/office ORION connection.
8. Check loan periods, fines and other library policies on the Anderson School gopher.
7. Reserve readings on course lists on the AndersoNet e-mail system.
6. Check list of books you've got checked out from any ORION connection.
5. Full-image articles from UCLA Libraries' subscriptions delivered at a small fee.

4. Copies of course-specific research strategies on the Anderson School gopher.
3. Put a HOLD against a charged-out book you need from any ORION connection.
2. Get personalized research strategies from reference librarians via AndersoNet e-mail.

and the number one reason NOT to come to the library ...if you haven't figured it out yet ...

1. Because the Library comes to YOU!

Another example of what a school is doing in the virtual library area is provided Dean William L. Duff, Jr of the College of Business Administration at the University of Northern Colorado, (WDUFF@SLINKY.UNIVNORTHCO.EDU):

> The college provides students access to a number of electronic resources previously available in print form at the library. Examples are Lexis/Nexis, the CRSP and Compustat financial databases, CompuServe, Prodigy, etc. A high-speed link through Bridge Communications will soon link finance students to information from financial markets around the world. One finance class is successfully using this information to manage their investment portfolio of $300,000 from the University's Foundation. Other students are using the Internet to access databases of information for class research projects. The college also provides desktop access to the Colorado Alliance of Research Libraries. CARL provides abstract and full-text access to a number of literary sources both in and out of Colorado.

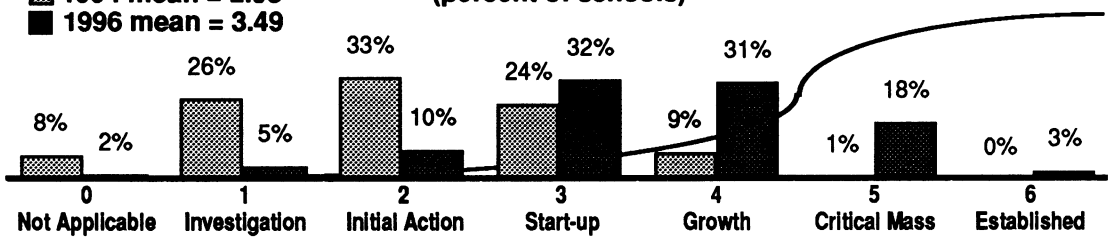
Barry Dombo (barry_dombro@mail.mba.wfu.edu) of the Graduate School of Management in Wake Forest University reported what they were doing in implementing a virtual library:

> The Worrell Professional Center building, the new home of the Graduate School of Management at Wake Forest University, provides an ideal environment for the close integration of computer and library resources. The school's network is accessible from all faculty and staff offices, classrooms, study rooms, the computer lab and selected areas in the library, and via a telephone modem pool. There are 110 Macintosh computers on the network, each running a suite of network application software.
>
> Students and faculty use the network to access a number of electronic information resources. A network CD-ROM server provides access to Compact Disclosure, a database of financial information from 10,000 public companies; Corporate America, a listing of 1 million private companies; and Standard & Poor's Corporations, with information on both public and private companies. Users of the network may also access the Wake Forest University library catalog or connect to the LEXIS/NEXIS online information system, which provides the full-text of articles from hundreds of news and business sources.
>
> All of the above resources work together seamlessly. For example, the user can do a search on LEXIS/NEXIS and save the results as a Word Document; then search a CD-ROM database and save the results as an Excel spreadsheet. Then the user can send both documents as enclosures to someone else on the network.

3.3 Multimedia

Multimedia refers to computer based integrated text, graphics, video, and audio materials. Data from last year's *Tenth Survey* showed that one-third of the responding business schools had multimedia labs with CD-ROM systems, scanners, and color printers. Data from this year's *Eleventh Survey*, displayed in Figure 6, suggested that these labs were still being used by a relatively small number of people in a pilot testing mode or in preparation for more general implementation. Eighty-three percent of the schools were in the *investigation, initial action,* and *start-up* phases. Note that only 1% of the schools today see themselves as having a *critical mass* of users. However, this is expected to expand very significantly to 21% over the next two years. The overall mean phase score is expected to increase from 2.03 in 1994 to 3.49 in 1996. This is the

Figure 6
Phase of Current 1994 and Anticipated 1996 Multimedia Adoption
N =352
(percent of schools)



largest anticipated growth area for the seven application of learning technologies in this year's survey.

When the total sample was cluster analyzed, the multimedia mean phase score for schools in cluster 1 was 1.55. That is, schools in this cluster were midway between investigating and taking preliminary acquisition steps, with a few schools beginning to experiment the technology. In contrast, the mean phase score for cluster 3 schools was 2.92, or just beginning to involve a broader segment of the faculty and student population.

Growth Factors

Why are schools investing in multimedia? This can be answered from their responses to motivators and impediments of adopting this technology. Analysis showed that the most important reason for introducing multimedia was a commitment to staying on the leading-edge of instructional use of this technology. This was identified by 66% of all responding schools. As shown in Table 7, this was one of four motivating factors which emerged with significant differences between cluster 1 and cluster 3 schools. The role of multimedia to keep schools on the cutting edge of technological innovation and have multimedia as part of the school's mission increased in importance as schools moved further along the adoption path. On the other hand, multimedia as an alternative means of providing remedial education and enhancing class-time productivity decreased in importance when multimedia technology expands in schools.

Table 7
Motivators for Multimedia Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 1.55 N = 64 %	Cluster 3 mean = 2.92 N = 94 %	% difference
Commitment to staying on the leading-edge of instructional use of technology	64	79	15
Part of school's mission	16	28	12
Alternative learning approach for remediation	21	11	-10
Increase classtime productivity (cover more material)	32	22	-10

There were six other items commonly identified by schools regardless of cluster groups. These were: to be able to present concepts not possible otherwise (53%), to gain competitive advantage over peer institutions (41%), appeal to new students/audiences (39%), enable students to gain insights not possible otherwise (32%), increase faculty teaching productivity (number of students reached) (32%), and respond to faculty demands (27%).

When we reviewed factors that impede the growth of multimedia for instructional purposes, lack of adequate funds was identified by 81% of the schools. This was followed by faculty indifference (50%), need for faculty training (50%), lack of computers, projectors, and other technology needed to use multimedia in the classroom (32%), and lack of faculty incentives for them to invest time and energy in this technology (26%). Again, faculty motivation and training—similar to the review of impediments to e-mail—are important considerations for growth of multimedia technology in schools.

When more people begin using multimedia and we moved towards cluster 3, the issue of users wanting less complicated technology became more important (Table 8). On the other hand, issues that became less important in cluster 3 schools were: need for a commitment from the school's administration, need to make multimedia part of the schools' mission statement, need to justify long term educational benefits, and a commitment from central campus administration.

Table 8
Impediments to Multimedia Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 1.55 N = 64 %	Cluster 3 mean = 2.92 N = 94 %	% difference
Technology less complicated to use	14	28	14
Commitment from school administration	28	18	-10
Become part of school's mission	23	11	-12
Perceived long term benefits, educational value	66	50	-16
Commitment from campus administration	39	15	-24

Effectiveness for Instructional Support

Respondents to the Eleventh Survey were asked to indicate their perceptions of the effectiveness of current multimedia use in enhancing classroom instruction. This rating was matched against the phase of multimedia adoption in the school, and is shown in Table 9.

Table 9
Phase of Multimedia Usage by
Effectiveness for Enhancing Classroom Instruction
N = 209
(percent of schools)

	Not Effective	Neutral	Effective
Initial action	24%	11%	11%
Start-up	15	11	11
Growth	2	5	7
Critical mass	0	0	1
Established	0	0	0
Total	**42**	**27**	**31**

As can be seen from the table, 42% of the schools perceive multimedia as *not effective* at enhancing classroom instruction, while 27% felt that it was *neutral*, and 31% reported it to be *effective*. Further review showed that 15% of the schools were in the *growth* or *critical mass* phases, out of which only half viewed multimedia to be *effective* for enhancing classroom instruction. Considering the large proportion of schools that are just starting to implement multimedia, with all the difficulties of classroom displays and preparation of materials, it is not surprising that only a small group find the technology to be *effective* in enhancing classroom instruction.

Effectiveness at Developing Student Skill

It is one thing for faculty members to prepare multimedia material to support their teaching, and yet another to give assignments which require students to actually sit down and work with the software to create their own presentations. The *Eleventh Survey* sought information on the effectiveness of multimedia to develop these student skills and the results are shown in Table 10.

Once again, the effectiveness ratings were tabulated for the 209 schools which are currently using multimedia. Forty-eight percent of the schools indicated that multimedia was *not effective* in developing student skills, while only 22% indicated it was *effective.*

Table 10
Phase of Multimedia Usage by Effectiveness for Developing Student Skills
N = 209
(percent of schools)

	Not Effective	Neutral	Effective
Initial action	27%	13%	6%
Start-up	16	12	9
Growth	5	5	5
Critical mass	0	0	1
Established	0	0	0
Total	**48**	**31**	**22**

Note that for both applications of multimedia— enhancing classroom instruction and developing student skills—schools with the least experience rated the technology least effective. This opens the question of whether the technology is *not effective,* because of a lack of real experience to make it an effective tool or it is, in fact, *not effective* and therefore schools were slow to invest in it. However, despite differences in perceptions of effectiveness, these same schools were overwhelmingly continuing to invest in this technology.

Why are schools investing in multimedia? This can be seen from their reasons for adopting this technology. Analysis of data indicated that the role of multimedia to keep schools on the cutting edge of technological innovation received the highest responses (66%). This was followed by ability to present concepts not possible otherwise (55%), and multimedia as a means to gain competitive advantage over peer institutions (41%).

Example of Best Practice

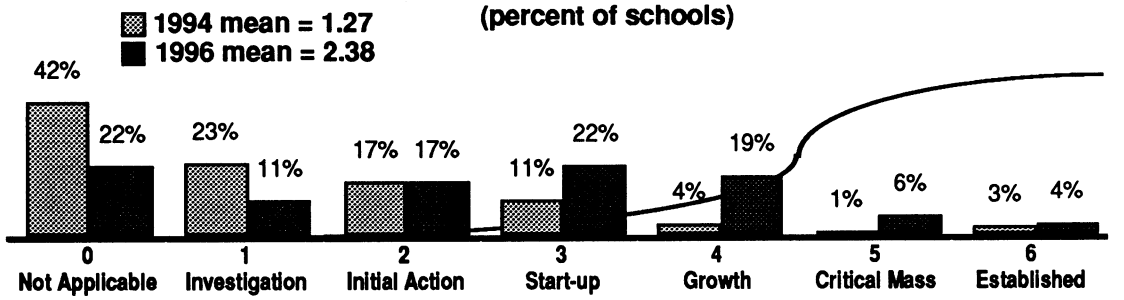
To help us understand the implementation of multimedia applications, Dean Wichem (H010DW@TAMVM1.TAMU.EDU) from the Graduate School of Business, Texas A&M University provided the following anecdote on how multimedia is being used in the school:

> The College of Business Administration/Graduate School of Business has an InfoTech Lab. This lab is dedicated to the analysis and use of emerging information technologies. Currently, the lab is concentrating on three technologies: Multimedia, Computer Assisted Software Engineering (CASE) in conjunction with EDS and Sun, and Group decision making support systems in conjunction with Group Technologies Corporation. The Lab is available to graduate students and faculty for assistance in multimedia lecture presentations. They are free to use the machines and software. Training is provided by graduate assistants. The Lab is also use by certain MIS classes. To date, a limited number of faculty (primarily in MIS) have used the Lab to prepare multimedia material. This material is then used in the classroom. Three of our classrooms are equipped with ceiling mounted three-gun projectors. We also use LCD panels and overhead projectors for displaying materials. Our new building will be available in the Fall and all classrooms will have ceiling mounted projection and touch screen lecterns to control audio-video equipment.

3.4 Distance Learning

The concept of "distance learning" is very old, arising from education through correspondence schools in England in the 1850s and, later, in the United States in the 1890s. Ever since the wide-spread introduction of television in the 1950s, college credit courses have been broadcast over airwaves to students who could not get to campus. In recent years, computers and commu-

Figure 7
Phase of Current 1994 and Anticipated 1996 Distance Learning Adoption
N =352
(percent of schools)



nication technologies have added a new dimension to distance learning—interactivity between the instructor located in one place and students distributed across many locations.

In this year's survey questionnaire, distance learning was defined as "for credit courses offered by the business school, broadcast live to more than one classroom with interactive question and answer capability." As can be seen in Figure 7, the distribution of schools across the adoption curve is skewed towards the *not applicable* phases, with some developmental growth anticipated over the next two years. The overall 1994 phase mean of 1.27 is expected to increase to 2.38 in 1996. Viewed yet another way, while only 19% of the schools are actively providing distance learning opportunities in 1994, this figure is expected to increase to about half of the schools (51% = 22%+19%+6%+4%) in 1996.

From the perspective of the different clusters shown in Figure 1 (in the Introduction Section), the distance learning mean phase scores for cluster 1 and cluster 3 schools were one phase apart with mean phase scores of 0.62 and 1.73, respectively. This means that cluster 1 schools were midway between not seeing the technology as having any applicability at all and initiating questions on the relevance of distance learning to their environments. Cluster 3 schools were closer to beginning a pilot program to test the value of this technology to their institutions.

Growth Factors

In evaluating barriers to the use of distance learning at schools, funding was listed as the dominant factor (67% for all schools). This was followed by a lack of perceived long term benefits (51%). Five other impediments which were listed by at least 20% of the schools were faculty dis-interest (35%), lack of appropriate strategic planning (34%), lack of commitment from school administration (31%), lack of faculty training (23%), lack of cameras, wires, transmitters, etc., to do distance learning (21%), and faculty reluctance to use the technology (20%). Only two impediments were different across clusters: distance learning as part of the school's mission decreased from 44% to 30% and lack of commitment from campus administration decreased from 42% to 21%, as we move from cluster 1 to cluster 3, respectively.

On the motivator side, five items were identified by at least 40% of the schools as reasons for investing in distance learning, and three were identified by at least 20% of the schools. For all the technologies evaluated in this survey, distance learning was the only technology that was listed as a motivator to increase faculty teaching productivity through increasing the number of students reached (48% of the schools). A closely following factor was to appeal to new student audiences (46% of the schools). Two items, maintaining competitiveness with peer institutions and remaining on the leading-edge of instructional use of technology were each listed by 44% of the schools. Reducing the overall cost of instruction over time was specified by 31% of the schools, and using distance learning to achieve some part of school's mission was indicated by 27%. Only one item was different across clusters—communication with people off-campus—increased from 20% of the schools in cluster 1 to 33% in cluster 3.

Effectiveness

When distance learning phase responses were tabulated against rated effectiveness of distance learning in developing student learning, 44% of the schools (N=105) fell within the *not effective* category, 32% in the *neutral* category, and 24% in the *effective* category, as shown in Table 11. Further examination of schools in the *effective* category showed that they ranged from one extreme, the *initial action* phase, to the other, the *established* phase, with the median at the *growth* phase. Within this category, there seems to be a rather wide range of schools reporting the technology as useful in facilitating student learning. Interestingly, 5% of the schools that were in the *established* phase were *neutral* on the effectiveness of the technology. Due to the rather small sample that have actually implemented this technology and the somewhat unclear effectiveness pattern, the current effectiveness of this technology in facilitating student learning is inconclusive.

Table 11
Phase of Distance Learning Usage by Effectiveness for Facilitng Student Learning
N = 105
(percent of schools)

	Not Effective	Neutral	Effective
Initial action	32%	10%	4%
Start-up	10	12	9
Growth	0	6	6
Critical mass	1	0	2
Established	0	5	4
Total	**44**	**32**	**24**

Example of Best Practice

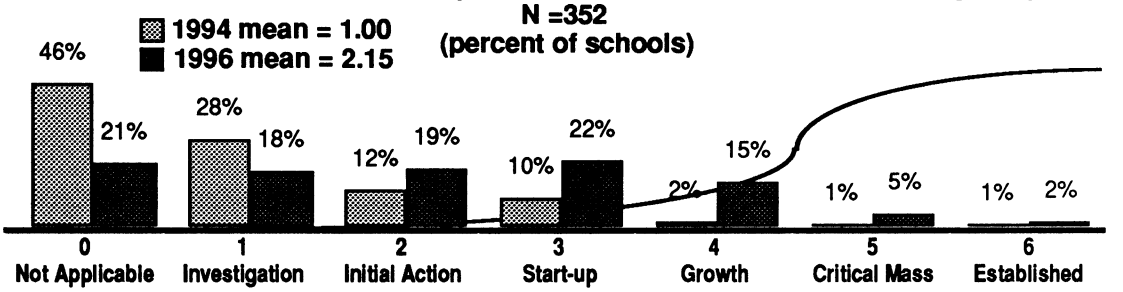
Responding to our queries on how distance learning is being implemented to enhance distance learning, John Day (DAYJ@OUVAXA.CATS.OHIOU.EDU) MIS Chair , and Bob Hails (HAILS@OUVAXA.CATS.OHIOU.EDU, phone 614-593-0241), Director of Higher Education Media Service at the College of Business, Ohio University, provided the following information regarding their Higher Education Microwave Services (HEMS):

> Ohio University in rural southeastern Ohio has been involved in offering televised courses for over ten years. OU's five regional campuses are linked with the main campus in Athens by a two-way audio/video microwave television network. The Higher Education Microwave Services (HEMS) system carries 40-60 hours of live, interactive undergraduate and graduate courses each quarter. The HEMS courses in communication, law enforcement, nursing, home economics, education, and business. The HEMS system also carries voice and data between campuses.
>
> Each HEMS classroom consists of three cameras (instructor, students, overhead), a 60" big-screen television, voice-activated microphones, and playback capabilities. A student operator controls the technology for the instructor, which allows the instructor to focus on teaching. HEMS courses originate from any campus and can involve from two to six of the campuses for each course. Three courses can be transmitted simultaneously on the HEMS system to different campuses. Faculty participate in a course development process during the quarter prior to teaching their HEMS course. Assistance is provided to them for adapting their courses for presentation on television. In addition, HEMS Course Development Grants are available to faculty interested in further developing their courses to take advantage of the television medium.
>
> In addition to courses, the HEMS system carries a variety of workshops and meetings. Topics of interest not only to University faculty and staff but community members as well are presented. Utilization of the HEMS system for meetings has resulted in substantial savings in time and travel costs for faculty and staff.

3.5 Classroom Teleconferencing

The concept of distance learning as used in this survey encompasses an instructor broadcasting classroom program and interacting with students at remote locations.. In contrast, classroom teleconferencing was defined as a means of bringing external speakers into the classroom environment via real-time, interactive video communications. For example, in conducting an interview from a classroom with a guest in another city. Although the technology to enable this is commercially available, few schools have incorporated it into their programs. As can be seen in Figure 8, the majority of schools either do not see teleconferencing as appropriate or are just investigating it. Over the next two years, respondents indicated that some change, albeit minimal, will occur in this area. The overall phase mean is currently at 1.00, and only 14% of responding schools are in the *start-up* through *established* phases. Based on the projections of respondents, classroom teleconference usage is expected to reach 44% of the schools, with an overall phase mean of 2.15 by 1996.

Figure 8
Phase of Current 1994 and Anticipated 1996 Classroom Teleconferencing Adoption



Growth Factors

The biggest impediment to use of teleconferencing is lack of funds. This was listed by 75% of the schools. Other impediments included ambiguity about its educational value (50%), faculty indifference (47%), lack of commitment from school administration (32%), and need for faculty training (21%).

Three impediments showed rather large decreases in importance when cluster 1 and cluster 3 schools were compared. As shown in Table 12, schools in cluster 3 were less likely than those in cluster 1 to find lack of commitment from the central campus administration, lack of classroom infrastructure, and teleconference being part of the school's mission, as impediments to expanded use of classroom teleconferencing.

Also, schools in these 2 clusters showed some differences in motivators as listed in Table 13. Motivators that become more important to schools in cluster 3 than those in cluster 1 were: an international focus to reach students in distance locations, as a means of increasing faculty teaching productivity, and as a sign of commitment to staying on the leading edge of instruc-

Table 12
Impediments to Classroom Teleconferencing Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 0.47 N = 64 %	Cluster 3 mean = 1.68 N = 94 %	% difference
Commitment from campus administration	36	16	-20
Infrastructure to use in classroom	45	28	-18
Become part of school's mission	36	22	-14

Table 13
Motivators for Classroom Teleconferencing Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 0.47 N = 64 %	Cluster 3 mean = 1.68 N = 94 %	% difference
International focus	16	37	22
Increased faculty teaching productivity (number of students reached)	13	34	22
Commitment to staying on the leading-edge of instructional use of technology	52	66	14
Ability to gain insights not possible otherwise	44	27	-17
Ability to access campus resources from community	30	13	-17

tional use of technology. Motivators that were listed less frequently by schools further along the adoption curve were use of classroom teleconferencing to enable students to gain greater insights into concepts and as a means of bringing off-campus data resources (as compared with human resources) into the classroom. The ability to communicate with people off-campus was a common motivator listed by 42% of all schools. Other common motivators were to maintain a competitive posture with peer institutions (43%), as part of the school's appeal to new students (31%), and the ability to present concepts not possible otherwise (26%).

When phase responses for 73 schools which were piloting or using class teleconference were tabulated against rated effectiveness in enhancing classroom instruction, 56% of the schools fell within the *not effective* category, 23% in the *neutral* category, and 21% in the *effective* category, as shown in Table 14. Since ninety percent of these schools were at the *initial action* or *start-up* phases, this technology is still in the early stages of development. Similar to the distance learning technology, the rather small sample that have implemented class teleconferencing and the unclear pattern in effectiveness responses made it difficult to draw any preliminary conclusions on the technology.

Table 14
Phase of Classroom Teleconferencing Usage by Effectiveness for Enhancing Classroom Instruction
N = 73
(percent of schools)

	Not Effective	Neutral	Effective
Initial action	32%	10%	7%
Start-up	22	8	10
Growth	3	3	3
Critical mass	0	1	1
Established	0	1	0
Total	**56**	**23**	**21**

Example of Best Practicess

Dean William L. Duff, Jr. (WDUFF@SLINKY.UNIVNORTHCO.EDU, phone (303) 351-2764), of the College of Business Administration , University of North Colorado, Greeley, describes their use of classroom teleconferencing:

> The college uses classroom teleconferencing to enhance classroom instruction in three ways. First, the college downloads satellite teleconferences into the classroom. These teleconferences expose the students to expertise outside the college; usually, students will also have the opportunity for phone access to conference participants. Second, students use the college's Decision Support Center (a twenty station electronic meeting room) to exchange ideas, evaluate alternatives, vote on proposals, etc. Remote access to this technology provides meeting participants with "different time, different place" virtual meeting possibilities. These business classes are also communicating through Internet e-mail with students and

faculty at universities around the world. Usually they discuss topics related to classroom assignments. Finally, the college has a 3-year, Department of Energy grant to deliver non-credit business seminars to managers in a six-state region. The college has partnered with Mind Expansion University and uses the internet to deliver these classes and provide support communications.

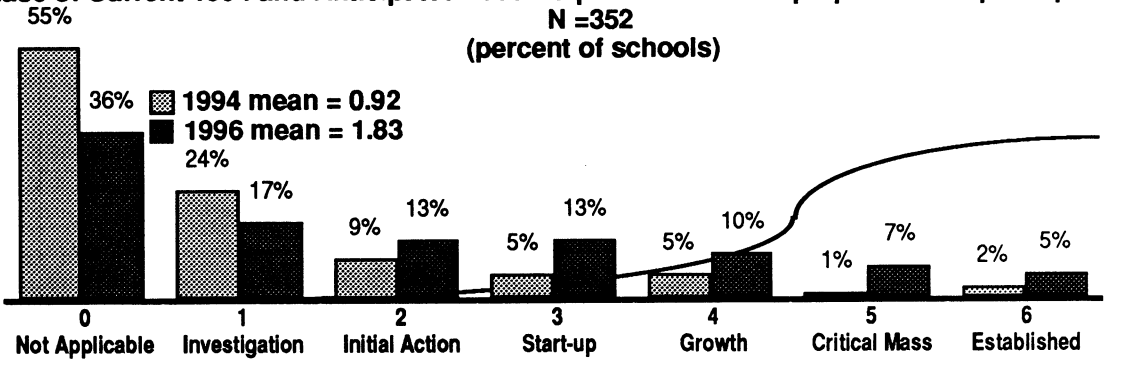
Cindy Frank (FRANKC1@CTRVAX.VANDERBILT.EDU), Director of Computing at the Owen Graduate School of Management, Vanderbilt University provided a second example of the use of classroom teleconferencing:

> The main piece of electronic equipment in each classroom is a Sony video projection unit that is mounted on the ceiling. This projection unit accepts video-tapes, slides, and computer (Mac and PC) input. The system is also connected to Vanderbilt's cable-TV system, thus enabling us to receive video downlinks into the rooms. When combined with telephone lines available in all the rooms, we are able to provide live teleconferencing services whenever needed. We have also improved sound quality of the rooms by providing audio equipment in each room. Both the students and professors use all these equipment in their classes and find that they provide very professional and exciting presentations.

3.6 Student Laptop Computer Ownership

Survey respondents were asked to specify where along the adoption curve their schools were with respect to requiring students to own laptop or portable computer systems for use in the classroom, library, lounge, or anywhere on campus. Figure 9 presents the responses. As can be seen, 13% of the schools currently require laptop ownership by their students, and over the next two years, this is expected to increase to 35%. The overall phase mean for laptop ownership will also grow from the 1994 level of 0.92 to 1.83 in 1996. Of the seven applications of learning technologies studied in the Eleventh Annual Survey, this category has the smallest anticipated phase increase and the greatest level *of not applicable* in both the 1994 and 1996 time frames. The diagram clearly suggests that business schools were proceeding very slowly with student laptop ownership. Similarly, the cluster means of 0.23 for the cluster 1 and 2.23 for the cluster 3 reflected the slow adoption of this technology.

Figure 9
Phase of Current 1994 and Anticipated 1996 Required Student Laptop Ownership Adoption
N =352
(percent of schools)



Growth Factors

Why are business schools slow to require students to purchase laptop systems, especially since price-performance measures of these systems have been steadily improving over the past several years with many quality systems available from under $1000. Analysis of reported impediments to growth of laptop ownership provided a partial answer. Cost was an important

reason since it was listed by 53% of the schools while commitment from school administration was identified by 41%, and having laptop ownership related to achieving the school's mission by 32%. Another 28% of the schools indicated that requiring student laptop ownership raised concerns about access and equity of the programs. This was the only learning technology for which the access and equity issue was raised. Interestingly, it is an issue which decreases in frequency of mention when we move from cluster 1 to cluster 3 (Table 15). Two other impediments which decreased in occurrence were the need for a commitment from the campus administration and concerns over perceived educational value. On the other hand, impediments that became more important as we moved from cluster 1 to cluster 3 included easier access from remote locations, classroom wiring, and student training.

Table 15
Impediments to Laptop Ownership Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 0.23 N = 64 %	Cluster 3 mean = 2.23 N = 94 %	% difference
Commitment from campus administration	48	26	-23
Access equity	31	18	-13
Perceived long term benefits, educational value	59	49	-10
Easier access from remote locations	8	21	13
Wiring or infrastructure to use in classroom	16	30	14
Student training	13	28	15

On the motivator side, schools see requiring laptop ownership as an indication of their commitment to be at the leading edge of the use of instructional use of technology. Table 16 shows this motivator to be more frequently listed by cluster 3 schools than cluster 1 schools. Similarly, access to data resources on campus was a more frequent reason for expanding laptop ownership requirements in cluster 3 schools. On the other hand, appealing to new students seems to be higher for schools in cluster 1 than those in cluster 3. For the entire sample of 352 schools regardless of cluster membership, laptop ownership as a means of maintaining competitive position with peer institutions was listed by 36% of the schools, while using the technology to enable instructors to use class time more productively to cover more material was listed by 28%. Student demand for this technology was listed by 20% of all the schools.

Table 16
Motivators for Laptop Ownership Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 0.23 N = 64 %	Cluster 3 mean = 2.23 N = 94 %	% difference
Commitment to staying on the leading-edge of instructional use of technology	47	65	18
Access to data resources on campus	20	34	14
Appeal to new students/audiences	39	22	-17

When student laptop ownership phase responses were tabulated against rated effectiveness of laptops in enhancing student learning, 36% of the 61 schools fell within the *not effective* category, 21% in the *neutral* category, and 43% in the *effective* category, as shown in Table 17. It is interesting to note that despite the very small sample of schools which have implemented student laptop ownership requirement, more than 40% of the schools have reported it to be *effective* in

enhancing student learning. The median for the *effective* category is clearly at the *growth* phase with schools ranging from the *initial action* to *established* phases. As in the e-mail effectiveness analysis data (table 5 in section 3.1), data from student laptop ownership presented here shows a progressive pattern— although less clear — from *not effective* to *effective* as schools moved towards the *established* phase of the technology curve.

Table 17
Phase of Laptop Ownership Usage by Effectiveness for Enhancing Student Learning
N = 61
(percent of schools)

	Not Effective	Neutral	Effective
Initial action	23%	5%	10%
Start-up	11	5	8
Growth	2	11	15
Critical mass	0	0	2
Established	0	0	8
Total	**36**	**21**	**43**

Overall, the data suggests that student laptop ownership requirement could be effective in enhancing student learning, especially when schools progress further along the technology curve.

Example of Best Practices

In order to help us understand how laptop ownership is affecting the business school environment, James Haggard (JHAGGARD@admin.gsb.columbia.edu) from the Graduate School of Business at Columbia University reported the increasing computer technology competence of students as a result of student laptop ownership:

> The Student Notebook Computer Initiative at Columbia Business School is a strategic component of our academic program. It is based on the use of student owned notebook computers with an emphasis on network connectivity and infrastructure wiring to leverage the substantial investment we have made over the past several years in network applications and services. The resulting synergy supports our new, far more robust, academic curriculum and allows us to more efficiently use our information technology resources, budget and physical space resources. Student response is favorable and the average level of technology awareness and competence among our graduates is rising substantially.

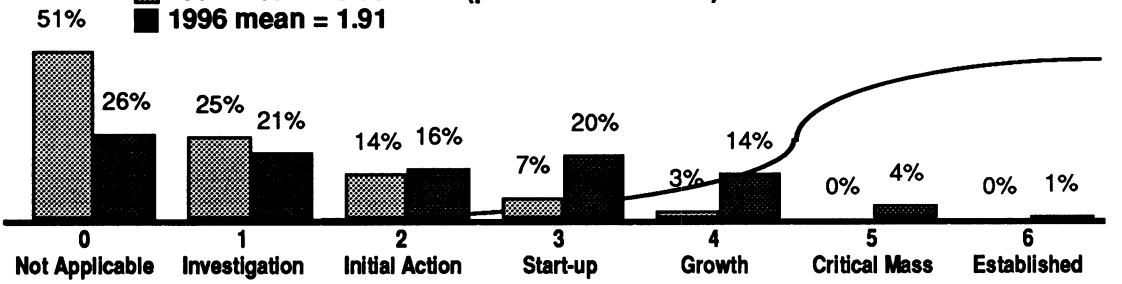
Also, John Clarke, Computing Services Director at the Graduate School of Management, University of California, Irvine, provided the following description of the use of laptop computers in their Executive MBA program:

> The Graduate School of Management at UCI installed network connections at every seat in all three of the School's largest case study rooms (70 seats). This year, Notebook-equipped Exec. MBA students plug into the network every time they come to class; news, electronic mail, new software are transferred automatically on logging in. Although still in the experimental stage, we believe this "electronic classroom" will convey tremendous teaching advantages.

3.7 Virtual Classroom

The availability of computer and communication technologies has removed the constraints of space and time in instructor and student interactions. Through learning technologies such as multimedia, classroom teleconference, and laptop computers, interactive learning interactions can take place within a virtual environment in which physical presence is not a requirement. As a result, students and instructors are able to interact at any time, from any location, by utilizing a variety of intervening media. For example, students can access instructional materials (e.g., pre-recorded lectures) at any time and from any location while faculty can use electronic mail, computer conferencing, or networked multimedia to support the instructional process. Also,

Figure 10
Phase of Current 1994 and Anticipated 1996 Virtual Classroom Adoption
N =352
(percent of schools)



faculty presentation may be pre-recorded, transmitted over satellites and made available over any one of the hundreds of TV channels which extent into our homes. In response, students using their interactive home communication devices (combinations of telephone, computer, stereo, CD player, etc.) may access libraries and lecture tapes, take exams, and correspond via e-mail (which will probably be "video-email") with classmates and instructors.

Schools in this year's survey were asked to assess the stage of their current adoption of virtual classroom technologies and their expectations over the next two years. Figure 10 displays the school's responses. Since this technology is still new, it was not surprising that the overall mean was only 0.85 this year, and expected to grow to 1.91 in 1996. A small group, about ten percent of the responding schools, indicated some implementation of the virtual classroom. They were located in the *start-up* or *growth* phase. Over the next two years, adoption is expected to grow to 39%, with 5% anticipated to be in the *critical mass* or *established* phases.

Growth Factors

Schools reported some impediments to the growth of virtual classrooms. Among them were lack of funding (79%), ambiguous long term benefits (41%), lack of commitment from school administration (37%), and need to be seen as part of school's mission (25%). Three impediments were varied across cluster 1 and cluster 3 schools, as seen in Table 18. While the need for commitment from campus administration decreased as schools moved further along the adoption curve towards cluster 3, the need for faculty training and overcoming faculty indifference increased.

Table 18
Impediments to Virtual Classroom Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 0.35 N = 64 %	Cluster 3 mean = 1.79 N = 94 %	% difference
Commitment from campus administration	50	29	-21
Faculty training	20	31	11
Faculty indifferent	30	43	13

On the motivator side, many different reasons were given for why schools were interested in creating a virtual classroom. The most common reason given was staying on the leading-edge of instructional use of technology. This was listed by 54% of all the schools. Other reasons included maintaining a competitive advantage with peer institutions (41%), increased faculty teaching productivity via the number of students each faculty member could reach (34%), ability to present concepts not possible otherwise (22%), reduced overall cost of instruction over time (22%), and providing an alternative learning approach for remediation (20%).

Table 19 shows three motivators that were listed more often by cluster 3 schools than those in cluster 1: ability to increase class time productivity, meet the needs of the school's mission, and a commitment to an international focus. On the other hand, the virtual classroom as a means of appealing to new students decreased as we moved from cluster 1 from cluster 3.

Table 19
Motivators for Virtual Classroom Growth
Comparison of Cluster 1 and Cluster 3 Schools

	Cluster 1 mean = 0.35 N = 64 %	Cluster 3 mean = 1.79 N = 94 %	% difference
Increase classtime productivity (cover more material)	13	30	17
Part of school's mission	16	28	12
International focus	9	21	12
Appeal to new students/audiences	42	26	-17

Effectiveness

When virtual classroom phase responses were tabulated against effectiveness ratings of virtual classroom in enhancing student learning, 48% of the 71 schools fell within the *not effective* category, 27% in the *neutral* category, and 25% in the *effective* category, as displayed in Table 20. More than four fifths of these schools were at the initial or start-up phases of the curve. The combination of a small sample and the high proportion of schools that were at the beginning phases of implementation indicates that this is a very new technology as was class teleconference usage analyzed earlier. Consequently, it is not surprising that only about a quarter of the schools reported that this technology was *effective* while nearly half reported that it was not. Similar to analyses of class teleconference and distance learning, the rather small sample that has implemented virtual classroom technology and the unclear effectiveness response pattern made it difficult to draw any preliminary conclusions on the data.

Table 20
Phase of Virtual Classroom Usage by Effectiveness for Enhancing Student Learning
N = 71
(percent of schools)

	Not Effective	Neutral	Effective
Initial action	32%	10%	15%
Start-up	14	10	4
Growth	1	7	6
Critical mass	0	0	0
Established	0	0	0
Total	**48**	**27**	**25**

Example of Best Practice

Mr. Anders Gaaserud (contact in care of Espen Lyngaas EDB88002@NOBIVM.BITNET) of the Norwegian School of Management (NSM) described their distance education program, which is a version of what can be done in a virtual classroom environment.

> Since 1990, the Business Candidate Programme provides students with a package of study materials containing: standard textbooks, extensive study guides, video-taped lectures, counseling material, communication software and a computer conferencing system handbook. The students are free to choose from the following services: weekend face to face tuition sessions twice every semester; ordinary lectures at any of NSM's 13 regional colleges; computer conferences on each subject; assignments for submission; telephone counseling and counseling via telefax. The students are allowed to take the nine exams in the programme any semester. They have to complete the programme within 4 years. The curriculum is fixed, but the students have all the other essential freedoms of distance education: time, place, pace, medium and access.

The computer conference system is run on a computer at NSM headquarters in Sandvika near Oslo. It has currently some 700 users - out of which approximately 500 are active students. The conference system offers the following facilities: notices, conferences, mail, file transmission and chat function.

In an ongoing study preliminary results suggest that more than 80% of the Business Candidate students have chosen to use the conference system. Frequency of use varies. Some 20% of the users seem to drop in approximately once a month to search for relevant information. 20% join the system 1 - 2 times per two weeks. 20% log on 2 - 4 times per week and 40% are addicts who log on 5 times or more per week. Approximately 15% of the logon events result in a written message in a conference.

Subject specialists use the following pedagogical techniques in their conferences: Present "topic of the week" according to recommended progression; present topics for debate; answer any student questions; give summaries and supplementary material. The main task is to motivate students, help them organize their work and to solve their immediate subject related problems within no more than 36 hours. The study suggests that 73% of the users find the system useful or very useful, 17% say the system is of some use while 10% do not find it useful.

The students are also offered a "cafeteria" type of conference for social interaction. Many students state that the system helps them to overcome the feeling of isolation. Several of them use the system to work together solving project tasks. Student activity varies from conference to conference. The factors influencing student activity are currently studied at NSM. The highest level of student activity is reached in conferences where a case assignment used to prepare for the examination is introduced. These cases stimulate vigorous discussion among students resulting in up to 800 messages in a one semester conference.

Distance students generally achieve better examination results than day-time and evening class students. Whether this is caused by the characteristics of the student population, the conference system or other parts of the distance education system is still to be determined.

4 The Technological Infrastructure

This year, questions covering the availability of microcomputers for faculty, students, and staff, as well as information on the "amount of wire" installed in schools was included in the survey. The availability of microcomputers and amount of wiring are the critical underlying infrastructure elements necessary for the use and potential growth of various learning technologies. The following section, Section 4.1, explores microcomputer distribution and availability while Section 4.2 summaries the school's current and anticipated investment in network infrastructure.

4.1 Microcomputers

In this year's survey, 342 schools reported 75,749 school owned microcomputer system, or, on the average, 221 microcomputers per school, with a range from 2 to 1903 microcomputers and a median of 162. (Note that this data excludes personally owned systems.) When compared against data from the 1993 Survey, this year's data has a wider variation since the range for 1993 was between 31 and 1015 with a mean of 239 and median of 200. The growth of microcomputers is quite dramatic when we review the Second Survey (1985) data in which 119 schools reported only an average of 80 microcomputers per school.

Microcomputer Distributions

In this year's questionnaire, respondents were asked to report the number of school owned microcomputer systems by user category (students, faculty, staff, and network servers), type system (desktop or laptop/portable), and operating system (Apple, DOS, Windows, or UNIX). Table 21 displays the distribution for 75,749 systems that were reported by 342 schools. Ap-

proximately 40% of the systems are available for student use (both undergraduate and MBAs), 36.5% for faculty members, 20.8% for administrative staff, and the remaining 2.8% as network servers. This distribution is very similar to the 1993 data of 42% for students, 38% for faculty, 19% for staff, and 1% for network servers. The almost tripling of systems allocated to support network servers reflects the growth in e-mail and virtual libraries which are dependent on microcomputers set aside to support these applications.

Table 21
Distribution of Micocomputers by User Group
N = 75,749 systems (342 schools)

	Student	Faculty	Staff	Net Server	Total
Apple Desktop	4.6%	3.8%	3.0%	0.2%	11.7%
Apple Powerbook	0.2	0.8	0.3	0.0	1.2
DOS Desktop	17.7	16.7	9.3	1.4	45.1
DOS Laptop	0.5	1.4	0.3	0.0	2.2
Window Desktop	15.2	12.1	7.3	0.7	35.4
Window Laptop	1.4	1.2	0.4	0.0	3.0
UNIX	0.6	0.4	0.2	0.2	1.4
Total	**40.2**	**36.5**	**20.8**	**2.6**	**100.0**

Data in Table 21 presents the share of different types of microcomputer systems. It shows that Apple systems accounted for 12.9% of microcomputer systems reported in the surveyed business schools[4]. Systems running DOS without Window's capabilities (e.g., Intel 286 class system like IBM ATs or PS/2 30s, etc.) accounted for 47.3%, Window's capability systems (e.g., Intel 386 or higher) for 38.4%, and UNIX systems for 1.4%. When compared against the 1993 Survey data, corresponding figures were 15.4% for Apple, 42.1% for DOS without Window's capabilities, 41.1% for Window's capability systems, and 1.4% for UNIX systems. The different categories of systems were spread across students, faculty and staff user groups without any particular user group preferring a particular system.

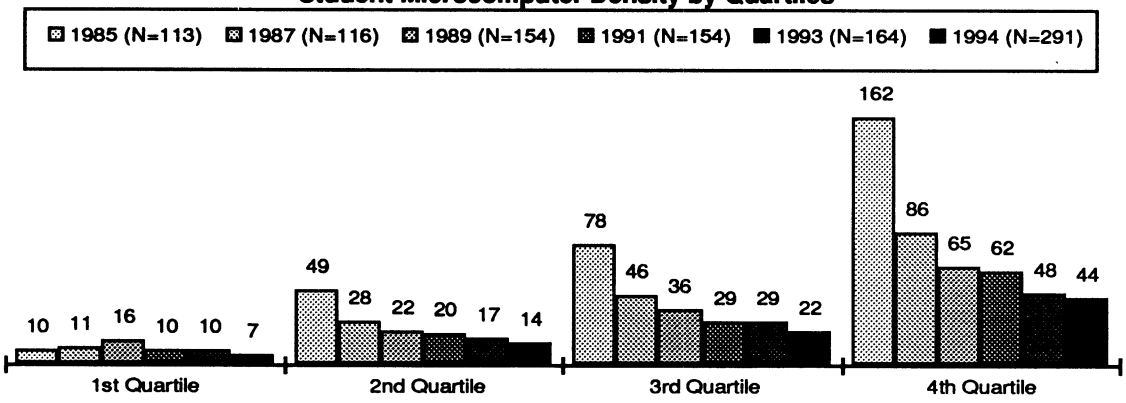
Microcomputer Densities

Two ratios were calculated to provide further understanding of the penetration of microcomputers into the business school computer environment. The first ratio, student-per-microcomputer, was calculated by dividing the total student FTE by the number of the school's microcomputers available for student use. This density measure reflects the number of students who share access to a single microcomputer. For example, a student microcomputer density of 18 is interpreted as 18 students sharing access to a single microcomputer system. The second ratio, faculty-per-microcomputer, was calculated by dividing the faculty FTE by the number of school's microcomputers available exclusively for faculty use. Since these ratios do not take into consideration any microcomputer systems that might be owned privately by students or faculty, the actual number of students or faculty who share access to microcomputer systems is probably lower (i.e., better) than reported.

In analyzing student and faculty microcomputer densities, density data were divided into quartiles in order to give a more detailed picture of the distribution across schools. For each quartile, the median value is reported rather than the mean. This avoids skewing problems that occur when extremely high or low values are present in the sample. Additionally, comparable data from previous surveys were also included so as to obtain a sense of the improvement in density ratios. It must be remembered that these surveys do not comprise an exact longitudinal study, as there are some variations in the sample from year to year. However, given the overall consistency of general sample demographics across years as shown in Table 1, the identification

[4] Note: these numbers do not reflect required student ownership. For example, at the Anderson School at UCLA the 420 executive MBA students are issued Apple PowerBooks as part of their tuition and this is not reflected in any of the reported statistics in this report.

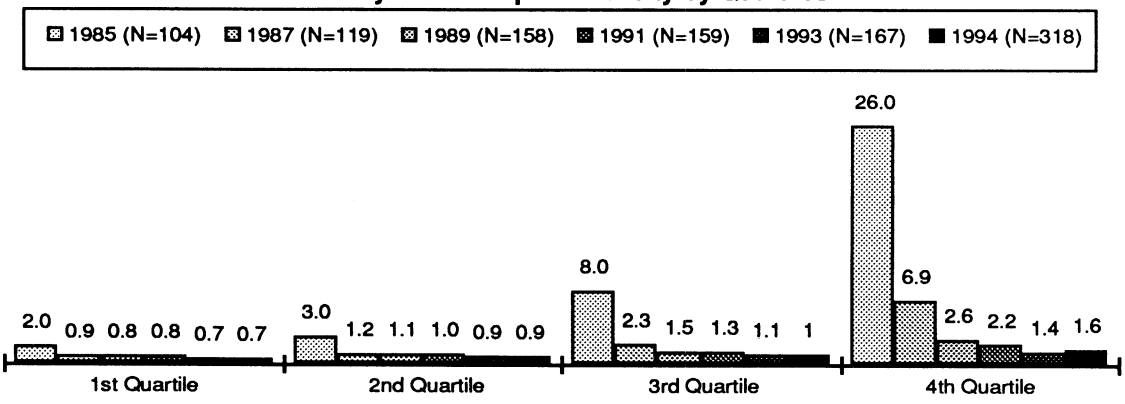
Figure 11
Student Microcomputer Density by Quartiles



of some general trends seems appropriate.

Of the 291 schools which provided data this year, the median student-per-micro density, by quartiles 1 to 4, were 7, 14, 22, and 44, respectively, as shown in Figure 11. Similar quartile data provided by 318 business schools for faculty were 0.7, 0.9, 1.0, and 1.6, as shown in Figure 12. In spite of the very large increase in number of participating schools, these figures reflect a continuing, albeit slowing, growth of microcomputers in the business school computer environment. Also, the data shows a continuing decline in disparity of density ratios between the quartiles. For example, the ratios between student microcomputer density in the first and fourth quartiles in 1985 were 1:16, while in 1994 it was 1:6. This represents a significant improvement in densities for schools in the fourth quartile over the 9 years. The improvement for faculty density was even more dramatic, from 1:13 in 1985 to 1:2 in 1994.

Figure 12
Faculty Microcomputer Density by Quartiles



4.2 Electronically Wired School

A critical behind the scene enabler for successful use of learning technologies are the installed cabling components to link all users for communication and provide access to networked software, data, and information resources. In this survey, respondents were asked to indicate their current network capability in five areas: faculty offices, administrative staff offices, instructor area of classrooms, student seats in classrooms, and student study seats in the library. No distinction was made between the ways in which an office may be connected (such as token ring, ethernet, serial interface, coax cable, twisted pair wires, etc.), but just the availability of wiring to link one location with another.

Figure 13 presents the phase of current 1994 and anticipated 1996 network wiring infrastructure for the five areas. The graphs are arranged from the area of greatest current network wiring

to the least. As can be seen, 70% of the schools reported that, currently, at least half of their administrative staff office areas have network access (*critical mass* or *established* phases), and this is expected to increase to 87% over the next two years. The faculty office connectivity profile is almost identical to that of administrative offices, with 66% currently connected and increasing to 85% within two years. The high degree of connectivity among these offices reflects the priority given to those performing operational support and instructional roles, and who are more likely to regularly share information, data, and software.

The next area of network implementation is to bring one network connection into each classroom so as to enable faculty members to transfer materials electronically from their offices to the class. This is especially desirable and useful if large, multimedia data files are to be included in classroom presentations. Figure 13 shows that only 29% of the schools reported that at least half their classrooms currently have a network connection. However, this number is expected to increase to 54% of the schools over the next two years.

If connections in the schools were further expanded, many other possibilities emerged. For example, a virtual library requires access to numerous on-line resources. When card catalogs migrated to on-line library systems, dedicated computer terminals were installed. This was the first major step towards convenient and easy access to data resources. With the growth of networks, host systems for electronic library catalogs become nodes on a network making access from numerous locations possible. Also, these networks could be used to access CD-ROM systems which are becoming increasingly networkable when compared against earlier versions that required dedicated computers. One approach to providing access to this wide array of services is to add network connections to seats throughout the library. This approach, as can be seen in Figure 13, has been taken by 6% of the schools which currently have at least half of their library seats wired. The number is expected to increase to 19% of the schools over the next two years.

The last area of networking that was examined in this year's Survey, was networking seats in each classroom. Schools planning on students bringing their laptop computers to class may make this investment since it would enhance the electronic distribution of materials in class as well as access to on-line resources outside of class. Only 2% of the schools currently have at least half of their library seats wired. This number is expected to increase to 8% of the schools over the next two years.

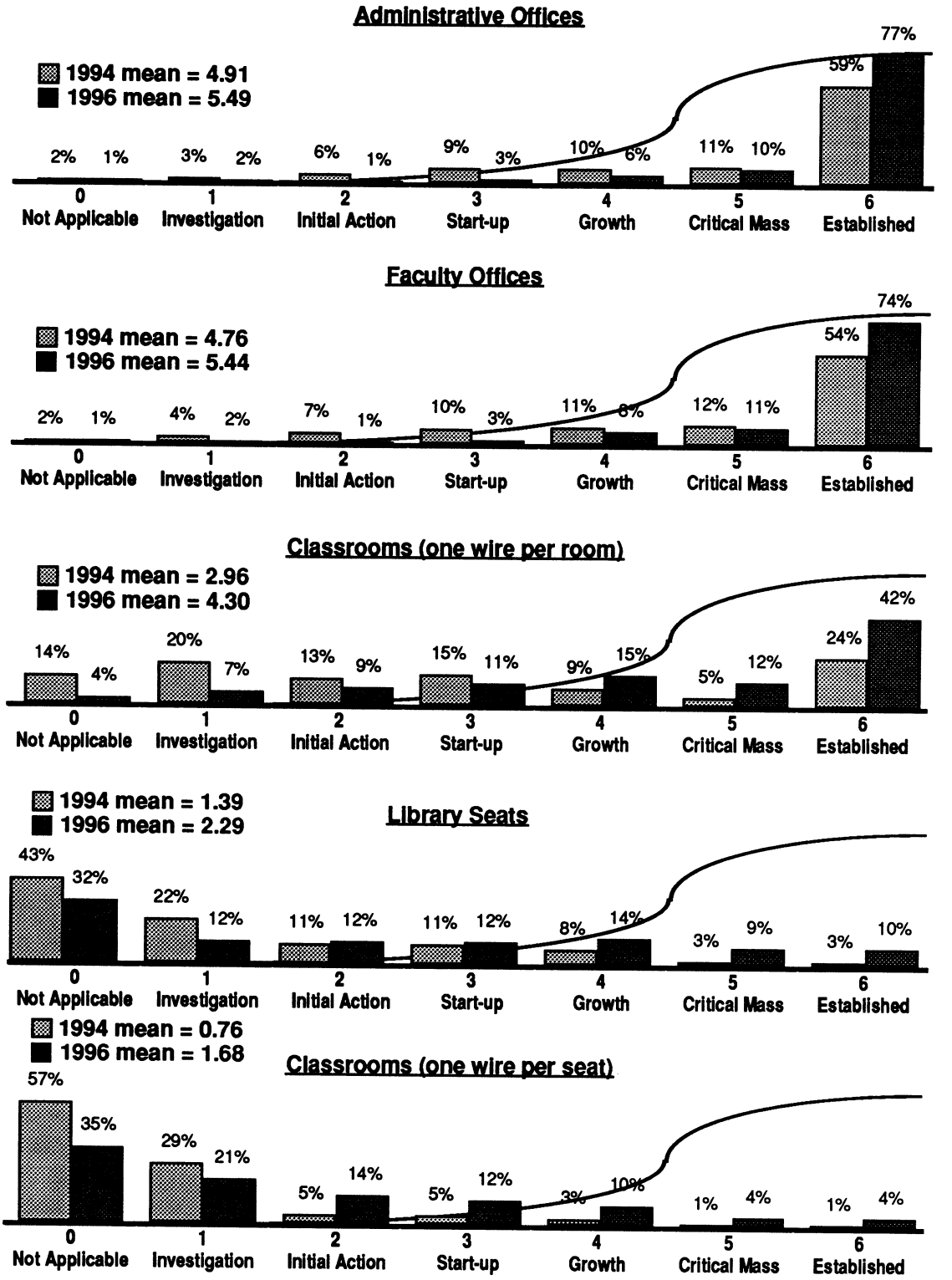
Overall, business schools have made significant network wiring infrastructure investments for faculty and administrative staff offices, and to a lesser degree, the classroom and libraries. Schools are just beginning to network libraries and classes, although very slowly at this time.

Example of Best Practice

In exploring difficulties of intensive networking, an anecdote was received from David Van Middlesworth (david.van.middleworth@anderson.ucla.edu), Network Manager, Anderson Graduate School of Management at UCLA:

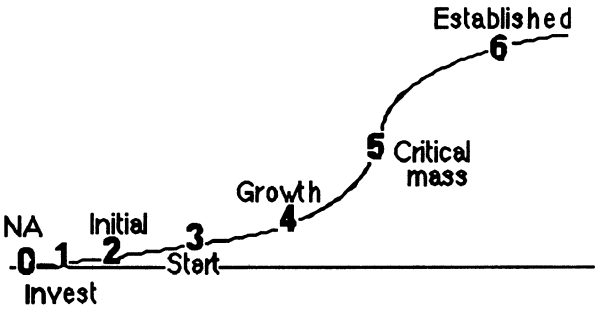
> The Anderson School at UCLA will be moving into its new 276,000 square foot complex in the first quarter, 1995. An underlying assumption is that over the next couple of years, every one will have a laptop computer or personal digital assistant which they will want to use anywhere. Accordingly, there are 2467 ethernet nodes, located at every location an individual would sit: offices, classrooms, library, and docking stations in the "computerless" computer labs. Knowing change is inevitable, a major design objective was wire management flexibility. Individual conduit to locations rather than wiring trays were selected so that individual needs can be accommodated. For example, on day one of move in, every location will have 10 megabit network capability running over twisted pair wiring. For individuals involved in scanner database research and others in multimedia development who require 100 megabit rates, upgrades of interface cards on their systems are made available. However, as these individual offices or others need higher band width, the option of pulling fiber optic cables into their offices is available.

Figure 13
Phase of Current 1994 and Anticipated 1996 Network Wiring Infrastructure Adoption
N= 352
(percent of schools)



Appendix 1

Business School Technology Adoption Phase Definitions



0	**Not applicable:** Not appropriate for our business school at this time; no interest, support or motivation to use this technology
1	**Investigation:** Gathering information, generating discussion, promoting idea to faculty and administration
2	**Initial actions:** General preparation for implementation including selecting alternatives, identifying funding, writing proposals, obtaining bids, testing with one or two experimenters, pilot testing phase.
3	**Start-up:** Implementation of the technology with at most 25% of the users involved.
4	**Growth:** Use of the technology has expanded to 26 - 50% of user population.
5	**Critical mass:** Use of the technology has expanded to 51 - 75% of user population.
6	**Established:** Use of the technology has expanded to at least 76% of user population.

Appendix 2
Business School Demographic Data

INSTITUTION	TYPE	UGRAD FTE	MBA FTE	PHD FTE	XMBA FTE	TOTAL FTE	FAC FTE	STD/ MICRO	FAC/ MICRO	STD/CMP STAFF
ABO AKADEMI	PUB	530	25	50	.	104	30	11.2	.	202
AF INST OF TECH (AFIT/LA)	PUB	.	150	.	.	81	40	5.4	1.0	38
ALABAMA A & M U	PUB	1000	200	.	.	93	50	40.0	1.0	.
ALVERNO COLLEGE	PRIV	543	.	.	.	139	17	4.1	2.8	136
ARIZONA STATE U	PUB	2500	550	100	60	357	175	.	0.7	1070
ARKANSAS STATE U	PUB	1382	129	.	.	380	58	25.2	0.5	756
ARKANSAS TECH U	PUB	675	.	.	.	34	22	.	0.8	338
ASHLAND U	PRIV	472	280	.	.	100	42	9.9	2.2	.
AUBURN U	PUB	3200	250	30	.	175	98	174	0.8	3480
AURORA U	PRIV	500	150	.	.	9	17	.	2.1	.
BABSON COLLEGE	PRIV	1560	1100	.	.	933	150	7.6	0.9	67
BALL STATE U	PUB	2738	303	.	.	307	105	14.9	1.0	.
BELMONT U	PRIV	1040	214	.	.	163	44	10.5	1.1	157
BENTLEY COLLEGE	PRIV	3714	1193	.	.	1637	247	5.9	0.9	88
BOISE STATE U	PUB	2500	200	.	.	245	82	36.0	1.0	540
BOSTON COLLEGE	PRIV	2200	675	25	.	.	90	.	.	.
BOSTON U	PRIV	1643	746	82	.	286	116	22.5	1.4	494
BOWLING GREEN STATE U	PUB	2409	284	.	111	139	102	.	0.8	1402
BRADLEY U	PRIV	900	105	.	15	135	53	15.7	1.0	1020
BRIGHAM YOUNG U-HAWAII	PRIV	500	.	.	.	346	19	3.8	0.6	250
BUTLER U	PRIV	600	400	.	.	78	40	25.0	1.3	333
CALIF STATE U, CHICO	PUB	2300	40	.	.	195	62	20.7	1.0	1170
CALIF STATE U, FRESNO	PUB	2741	211	.	.	356	100	13.4	0.8	1476
CALIF STATE U, FULLERTON	PUB	4141	189	.	.	333	128	27.1	0.9	541
CALIF STATE U, LONG BEACH	PUB	3891	452	.	4	390	102	18.1	0.8	1449
CALIF STATE U, LOS ANGELES	PUB	4400	458	.	.	566	100	13.9	0.6	1619
CALIF STATE U, NORTHRIDGE	PUB	4949	296	.	.	308	132	52.5	0.9	1049
CALIF STATE U, SACRAMENTO	PUB	3750	264	.	.	244	102	50.2	0.8	4014
CALIF STATE U, SAN BERNARDINO	PUB	1800	200	.	.	420	90	6.6	0.9	1000
CARNEGIE MELLON U	PRIV	.	540	.	.	382	100	4.0	0.6	90
CASE WESTERN RESERVE U	PRIV	200	580	100	70	260	85	11.6	1.0	136
CENTRAL CONNECTICUT STATE U	PUB	2468	59	.	.	236	56	18.1	0.8	2527
CENTRAL MICHIGAN U	PUB	1905	147	.	.	249	93	14.7	1.1	1026
CENTRAL MISSOURI STATE U	.	2240	165	.	.	265	79	17.2	0.7	1203
CENTRAL WASHINGTON U	PUB	1500	.	.	.	125	50	21.4	1.0	1500
CHAPMAN U	PRIV	.	.	.	.	37	19	.	0.7	.
CHINESE U OF HONG KONG	PUB	1567	223	10	.	237	94	17.1	1.0	600
CHRISTIAN BROTHERS U	PRIV	600	130	.	30	91	28	14.1	0.9	.
CLARK U	PRIV	79	157	.	1	55	22	11.3	1.2	79
CLEMSON U	PUB	2192	606	46	.	167	116	71.1	1.0	1422
CLEVELAND STATE U	PUB	1181	694	46	.	360	100	8.6	1.0	961
COASTAL CAROLINA U	PUB	1100	.	.	.	262	30	5.5	1.1	275
COLLEGE OF CHARLESTON	PUB	562	.	.	5	72	34	18.9	0.9	.
COLLEGE OF INSURANCE	PRIV	.	.	.	.	23	.	.	.	.
COLLEGE OF ST. SCHOLASTICA	PRIV	150	60	.	.	319	11	2.6	0.1	30
COLLEGE OF WILLIAM & MARY	PUB	.	.	.	.	193	.	.	.	.
COLORADO STATE U	PUB	793	246	.	.	247	84	7.2	1.1	94
COLUMBIA U	PRIV	.	1590	95	.	332	123	32.4	0.9	120
COLUMBUS COLLEGE	PUB	100	100	.	.	39	22	.	0.7	50
CORNELL U - JOHNSON SCH	PRIV	.	500	40	.	.	45	14.2	.	39
CRANFIELD SCHOOL OF MGMT	PUB	.	285	84	.	274	150	3.9	1.7	92
CYPRUS COLLEGE	PRIV	1050	29	.	.	188	58	9.1	2.6	98
DALHOUSIE U	PUB	800	215	3	.	111	41	22.6	0.9	255
DARTMOUTH COLLEGE	PRIV	.	360	.	.	247	45	3.6	0.8	51
DAVID LIPSCOMB U	PRIV	2300	.	.	.	56	25	71.9	1.3	.
DEPAUL U	PRIV	2400	1300	.	.	451	110	15.4	0.7	370
DUKE U	PRIV	.	660	40	100	417	73	5.7	0.5	57
EAESP-FGV -	PRIV	1400	300	150	750	380	200	16.3	1.3	74

INSTITUTION	TYPE	UGRAD FTE	MBA FTE	PHD FTE	XMBA FTE	TOTAL FTE	FAC FTE	STD/ MICRO	FAC/ MICRO	STD/CMP STAFF
EAST CAROLINA U	PUB	700	170	.	.	180	77	10.5	0.9	290
EAST TENNESSEE STATE U	PUB	1538	213	.	.	137	57	32.4	0.9	1751
EASTERN ILLINOIS U	PUB	807	72	.	.	274	69	6.6	0.6	879
EASTERN KENTUCKY U	PRIV	700	88	.	.	92	28	19.7	0.6	.
EASTERN NEW MEXICO U	PUB	650	90	.	.	99	26	11.7	0.9	.
ECOLE D HAUTES MONTREA	PUB	1891	322	16	.	856	179	13.0	0.4	80
EMORY U	PRIV	273	353	.	100	187	56	10.7	1.2	91
EMPORIA STATE U	PUB	1169	102	.	.	122	34	21.2	0.7	1271
ERASMUS U ROTTERDAM	PRIV	2700	220	30	.	463	150	18.4	1.0	197
ESSEC	.	1084	162	51	.	388	65	10.8	0.5	216
FERRIS STATE U	PUB	3097	116	.	.	467	98	11.7	0.6	1071
FLORIDA INTERNATIONAL U	PUB	2200	456	42	.	198	117	45.0	1.1	2698
FLORIDA STATE U	PUB	2300	200	100	.	352	104	27.7	0.5	371
FORT HAYS STATE U	PUB	946	87	.	.	141	32	10.3	1.1	1033
GAKUSHUIN U	PRIV	.	.	.	.	.	.	.	.	.
GEORGE MASON U	PUB	1980	500	.	.	130	76	91.9	1.1	1240
GEORGETOWN U	PRIV	1220	358	.	.	199	60	19.7	0.9	175
GEORGIA INST OF TECH	PUB	710	215	32	.	104	50	25.9	0.9	319
GEORGIA SOUTHERN U	PUB	2187	173	.	.	187	95	32.3	1.0	2360
GEORGIA STATE U	PUB	5258	1867	168	.	362	191	149	1.2	1042
GEORGIAN COURT COLLEGE	PRIV	285	.	.	.	119	15	4.1	0.9	143
GONZAGA U	PRIV	.	.	.	.	91	.	.	.	.
GROUPE ESC NANTES ATLANTIQUE	PUB	500	300	.	50	134	42	10.2	2.0	106
GROUPE SUP DE CO MONTPELLIER	PUB	.	530	.	.	108	141	8.8	6.7	177
HANDELSHO STOCKHOLM	PRIV	1200	.	120	20	400	200	13.4	1.0	134
HANDELSHO KOBENHAVN	PUB	16000	30	.	.	852	650	71.2	65.0	844
HANDELSHOYSKOLEN BI	PRIV	11500	410	4	.	1903	550	11.9	1.2	596
HARVARD U	PRIV	.	1600	20	1800	1714	200	.	1.1	68
HOFSTRA U	PRIV	3200	800	.	.	.	130	.	.	200
HOLY FAMILY COLLEGE	PRIV	1537	83	.	.	211	138	20.3	2.3	810
HOOD COLLEGE	PRIV	.	.	.	.	.	.	.	.	.
IDAHO STATE U	PUB	800	90	.	.	185	39	7.1	0.9	.
IESA	.	.	.	.	.	349	.	.	.	.
ILLINOIS WESLEYAN U	PRIV	450	.	.	.	18	15	.	0.9	.
IMD	PRIV	.	83	.	7200	323	140	68.7	2.3	910
INDIAN INST OF MGMT	PUB	.	400	50	.	162	82	11.0	1.0	25
INDIANA U	PUB	2000	550	100	.	600	150	13.3	0.8	177
INDIANA U - NORTHWEST	PUB	351	258	.	.	30	34	.	1.5	.
INDIANA U AT SOUTH BEND	PUB	400	100	.	.	64	70	20.0	2.3	.
INDIANA U KOKOMO	PUB	450	50	.	.	110	.	5.9	.	.
INDIANA U SOUTHEAST	PUB	6000	100	.	.	70	270	610	6.8	254
INTERNATIONAL U OF JAPAN	PRIV	.	100	.	.	97	18	1.7	0.6	17
ITHACA COLLEGE	PRIV	655	.	.	.	76	36	21.1	1.0	.
JACKSON STATE U	PUB	1129	399	.	.	187	45	12.5	0.8	1528
JACKSONVILLE STATE U	PUB	817	55	.	.	93	40	18.2	1.1	.
JAMES MADISON U	PUB	2310	205	.	.	214	102	47.5	0.9	2515
JOHN CARROLL U	PRIV	411	114	.	.	89	41	14.6	1.0	.
KANSAS STATE U	PUB	2137	125	.	.	126	48	37.7	0.9	2262
KENNESAW STATE COLLEGE	PUB	2900	410	.	.	380	76	18.4	0.8	662
KING FAHD U - PETROL & MINER	PUB	878	163	.	.	97	41	28.1	0.8	521
KING SAUD U	PUB	4600	370	.	.	50	160	.	.	331
LANDER U	PUB	400	.	.	.	21	14	57.1	1.1	.
LIVINGSTON U	PUB	525	.	.	.	69	18	11.7	0.9	263
LONDON BUSINESS SCHOOL	.	.	.	.	.	.	.	.	.	.
LONGWOOD COLLEGE	PUB	450	.	.	.	77	22	8.7	1.0	450
LOUISIANA STATE U	PUB	1318	451	101	.	322	125	16.0	1.0	935
LOYOLA U	PRIV	640	130	.	.	98	36	11.7	1.4	770
LOYOLA U CHICAGO	PRIV	1100	940	.	.	161	84	35.2	1.1	.
LYNCHBURG COLLEGE	PRIV	283	123	.	.	23	14	203	0.8	.
MACQUARIE U	PUB	.	386	23	.	93	19	14.1	0.6	409
MANHATTAN COLLEGE	PRIV	635	40	.	.	153	34	6.8	0.8	338
MANKATO STATE U	PUB	2500	90	.	.	144	88	74.0	0.9	2590

INSTITUTION	TYPE	UGRAD FTE	MBA FTE	PHD FTE	XMBA FTE	TOTAL FTE	FAC FTE	STD/ MICRO	FAC/ MICRO	STD/CMP STAFF
MARIST COLLEGE	PRIV	3200	56	.	.	400	28	.	.	.
MARQUETTE U	PRIV	1450	240	.	.	172	65	16.6	1.1	1690
MARSHALL U	PUB	1124	75	.	.	109	50	20.0	1.3	.
MARYVILLE U-ST LOUIS	PRIV	600	138	.	.	19	27	.	1.8	.
MASSACHUSETTS INST OF TECH	PRIV	100	600	100	100	421	150	14.3	0.7	90
MCGILL U	PUB	1541	417	43	.	253	73	20.6	0.8	667
MCMASTER U	PUB	1600	351	17	.	200	60	18.9	0.9	656
MEMPHIS STATE U	PUB	2581	729	92	.	410	145	18.4	0.9	1134
MIAMI U	PUB	3553	99	.	.	300	157	34.1	0.9	1826
MICHIGAN STATE U	PUB	4800	400	150	.	526	150	43.9	0.5	1338
MICHIGAN TECHNOLOGICAL U	PUB	310	40	.	.	72	30	11.7	0.9	88
MILLIKIN U	PRIV	425	.	.	.	59	15	10.6	1.0	.
MISSISSIPPI STATE U	PUB	2748	133	77	.	168	63	18.5	21.0	1479
MONTANA STATE U	PUB	966	.	.	.	82	35	26.8	0.9	.
NARSEE MONJEE INST OF MGMT.	PRIV	.	1020	15	.	30	115	41.4	57.5	173
NATIONAL U	PRIV	1100	1100	.	.	188	245	.	1.4	220
NAVAL POSTGRAD SCHOOL	PUB	.	330	.	.	206	66	5.6	0.5	165
NEW YORK U	PRIV	2135	1937	138	172	1087	207	12.7	0.5	67
NICHOLLS STATE U	PUB	800	150	.	.	134	41	11.3	1.0	475
NORFOLK STATE U	PUB	1500	.	.	.	150	48	16.7	0.8	750
NORTH CAROLINA A&T STATE U	PUB	1345	.	.	.	75	60	.	1.0	336
NORTH CAROLINA CENTRAL U	PUB	520	41	.	.	92	50	17.5	1.0	561
NORTH DAKOTA STATE U	PUB	.	60	.	.	29	23	.	1.0	60
NORTHEAST MISSOURI STATE U	PUB	1096	21	.	.	92	31	26.6	0.8	.
NORTHEASTERN ILLINOIS U	PUB	1365	73	.	.	66	36	719	0.8	.
NORTHERN ARIZONA U	PUB	2000	80	.	.	418	61	10.2	0.5	693
NORTHERN ILLINOIS U	PUB	3596	863	.	.	383	99	27.4	0.6	4459
NORTHERN KENTUCKY U	PUB	1800	200	.	.	58	43	.	1.0	.
NORTHERN MICHIGAN U	PUB	1000	.	.	.	158	34	9.0	0.9	.
NW STATE U LOUISIANA	PUB	900	.	.	.	151	25	8.6	0.6	.
NORTHWESTERN U	PRIV	.	2540	100	.	297	150	23.0	1.6	.
OHIO NORTHERN U	PRIV	283	.	.	.	37	15	15.7	1.2	.
OHIO U	PUB	1800	39	.	.	189	67	20.0	0.9	920
OKLAHOMA STATE U	PUB	3400	240	70	.	210	90	46.4	1.0	1855
ORT URUGUAY SCHOOL OF MGMT	PRIV	700	80	.	100	110	60	12.6	4.0	110
PACE U	PRIV	2150	2300	69	20	720	296	11.9	1.6	908
PACIFIC LUTHERAN U	PRIV	575	160	.	.	128	23	7.4	1.0	.
PENN STATE U AT ERIE	PRIV	575	79	.	.	208	27	3.7	1.1	131
PENN STATE U AT HARRISBURG	PUB	.	137	.	.	34	30	.	1.1	.
PITTSBURG STATE U	PUB	926	123	.	.	135	40	12.5	1.2	95
PURDUE U	PUB	1800	260	110	150	470	85	10.6	0.8	258
ROBERT MORRIS COLLEGE	PRIV	3382	524	.	.	516	185	14.0	1.8	279
ROCHESTER INST OF TECH	PRIV	1300	160	.	.	113	63	36.5	1.3	730
ROLLINS COLLEGE	PRIV	.	250	.	50	42	20	30.0	1.3	150
RUTGERS U-CAMDEN	PUB	516	195	.	.	62	33	32.3	1.1	.
RUTGERS U-NEW BRUNSWICK	PUB	800	.	.	.	131	39	8.0	1.3	400
RUTGERS U-NEWARK	PUB	1300	1300	120	.	380	130	34.0	0.7	2720
RYERSON POLYTECHNICAL INST	PUB	2700	.	.	.	154	90	33.8	1.4	.
SACRED HEART U	PRIV	270	320	.	.	211	40	4.9	0.8	.
SAINT CLOUD STATE U	PUB	14000	100	.	.	197	70	160	0.7	14E3
SAINT JOSEPH'S U	PRIV	950	650	.	40	51	55	.	1.1	547
SAINT LEO COLLEGE	PRIV	.	.	.	.	52	.	.	.	.
SAMFORD U	PRIV	487	219	.	.	61	21	28.2	0.9	353
SAN DIEGO STATE U	PUB	1819	389	.	54	282	102	17.4	0.9	754
SAN JOSE STATE U	PUB	2200	200	.	.	297	93	15.3	1.0	800
SANTA CLARA U	PRIV	950	750	.	.	186	95	16.0	1.5	850
SEATTLE PACIFIC U	PRIV	390	200	.	.	37	35	.	1.2	.
SEATTLE U	PRIV	650	400	.	.	75	50	.	0.9	1050
SETON HALL U	PRIV	1100	830	.	.	88	65	40.2	2.2	1930
SHIPPENSBURG U	PUB	.	8	.	.	71	52	0.6	1.0	.
SIMON FRASER U	PUB	1200	250	.	.	121	55	26.4	1.0	725
SOUTHEAST MISSOURI STATE U	PUB	.	.	.	.	135	.	.	.	.

INSTITUTION	TYPE	UGRAD FTE	MBA FTE	PHD FTE	XMBA FTE	TOTAL FTE	FAC FTE	STD/ MICRO	FAC/ MICRO	STD/CMP STAFF
SOUTHERN ARKANSAS U	.	.	.	.	.	.	.	.	.	.
SOUTHERN CONNECTICUT STATE U	PUB	1413	25	.	.	72	47	39.9	1.6	1438
SOUTHERN ILL U - CARBONDALE	PUB	1414	167	74	.	167	50	.	0.4	552
SOUTHERN ILL U - EDWARDSVILLE	PUB	1100	600	.	.	284	.	15.5	.	.
SOUTHERN METHODIST U	PRIV	500	220	.	.	298	175	10.0	2.5	144
SOUTHERN U AT NEW ORLEANS	PUB	500	.	.	.	109	25	5.9	1.4	500
SOUTHWEST MISSOURI STATE U	PUB	2877	190	.	.	355	107	13.9	1.0	.
ST BONAVENTURE U	PRIV	450	180	.	.	52	29	35.0	1.0	630
ST JOHN FISHER COLLEGE	PRIV	.	210	.	.	87	25	4.2	0.8	.
ST JOHNS U	PRIV	2600	500	.	.	164	140	20.7	14.0	207
ST MARY'S COLLEGE , CALIF	PRIV	546	314	.	.	18	42	.	3.0	.
ST MARY'S U	PRIV	800	150	.	.	48	36	.	0.9	.
STANFORD U	PRIV	.	700	85	45	504	95	7.2	0.5	46
STATE U OF NY AT ALBANY	PUB	735	358	29	.	135	75	21.2	1.2	1122
STATE U OF NY AT BUFFALO	PUB	800	500	65	.	194	75	30.3	0.8	455
STATE U OF NY AT STONY BROOK	PUB	200	150	.	.	63	24	19.4	0.7	350
STATE U OF NY COL AT FREDONIA	PUB	600	.	.	.	56	18	15.0	1.4	.
STATE U OF NY COL-PLATTSBURGH	PUB	725	.	.	.	53	29	36.3	1.0	.
STATE U OF NY COL-OSWEGO	PUB	1500	55	.	.	105	35	20.7	1.4	1555
STATE U OF NY INST OF TECH	PUB	.	40	.	.	65	27	1.3	0.9	.
SUFFOLK U	PRIV	939	569	.	1	184	85	19.3	1.3	302
SYRACUSE U	PRIV	1080	240	40	.	171	71	26.7	0.8	453
TEL-AVIV U	PUB	300	1500	200	150	223	70	24.4	0.7	358
TEMPLE U	PUB	3759	1216	221	39	338	167	43.3	0.8	1745
TENNESSEE TECHNOLOGICAL U	PUB	1136	96	.	.	142	47	.	.	616
TEXAS A & I U	PUB	850	39	.	.	.	22	.	.	.
TEXAS A & M U	PUB	5500	400	110	.	437	140	31.6	0.9	301
TEXAS CHRISTIAN U	.	900	250	.	.	312	50	7.2	0.6	1150
TEXAS TECH U	PUB	2898	374	91	.	199	98	48.7	1.3	306
TEXAS WESLEYAN U	PRIV	.	.	.	.	55	.	.	.	.
THE AMERICAN U	PRIV	700	700	.	.	100	61	46.7	1.0	350
THE OHIO STATE U	PUB	1931	279	140	.	558	121	29.4	0.3	181
THE PENNSYLVANIA STATE U	.	4015	289	95	.	13	139	.	.	400
THE U OF MICHIGAN	PUB	552	1913	94	.	593	158	11.3	0.8	88
THE U OF MICHIGAN-DEARBORN	PUB	.	.	.	.	75	31	.	1.1	.
THE U OF RHODE ISLAND	PUB	1208	241	24	42	141	63	32.9	0.9	758
TULANE U	PRIV	328	260	17	66	207	51	6.6	1.2	336
U OF ILLINOIS URBANA-CHAMPAIGN	PUB	3000	500	200	20	759	200	24.8	0.4	372
U OF MARY HARDIN-BAYLOR	PRIV	300	15	.	.	73	16	5.3	1.6	315
U OF MASS-DARTMOUTH	PUB	1900	110	.	.	58	52	.	1.1	503
U OF N CAROLINA AT ASHEVILLE	PUB	455	.	.	.	28	23	37.9	1.8	.
U OF N CAROLINA AT CHARLOTTE	PUB	2051	259	.	.	175	116	40.5	1.1	1155
U OF N CAROLINA AT GREENSBORO	PUB	1525	221	.	.	125	73	109	0.8	.
U OF N CAROLINA AT WILMINGTON	PUB	548	80	.	.	119	55	14.0	0.9	628
U OF TENNESSEE AT KNOXVILLE	PUB	3700	270	150	16	405	122	51.7	0.5	689
U OF WISCONSIN-EAU CLAIRE	PUB	2200	.	.	.	288	63	11.0	1.0	.
UNIVERSIDAD DEL VALLE	PUB	1400	400	15	.	56	103	78.9	6.9	1815
UNIVERSITE LAVAL	PUB	3344	571	45	.	708	115	32.5	0.2	495
U OF AKRON	PUB	2100	640	.	.	287	110	13.7	1.6	2740
U OF ALABAMA	PUB	3279	264	96	.	389	98	17.1	1.0	1213
U OF ALABAMA IN HUNTSVILLE	PUB	711	110	.	.	126	38	13.7	1.0	274
U OF ALASKA FAIRBANKS	PUB	327	31	.	.	105	34	6.2	0.9	33
U OF ALBERTA	PUB	1804	210	46	10	240	87	22.5	0.8	414
U OF ARIZONA	PUB	4513	351	140	.	661	155	14.6	0.8	417
U OF ARKANSAS	PUB	2250	131	35	.	311	104	12.2	1.2	1208
U OF BALTIMORE	PUB	1000	500	.	.	142	80	37.5	1.1	375
U OF BRADFORD	PUB	600	180	50	20	173	52	10.5	0.9	283
U OF BRITISH COLUMBIA	PUB	1300	400	70	.	446	130	17.7	0.5	354
U OF CALGARY	PUB	1000	353	27	.	342	110	9.6	0.8	230
U OF CALIF AT BERKELEY	PUB	450	550	75	.	320	100	11.9	0.9	108
U OF CALIF, IRVINE	PUB	.	222	61	200	404	48	2.0	0.5	54
U OF CALIF-LOS ANGELES	PUB	.	700	103	360	344	94	13.2	0.8	61

INSTITUTION	TYPE	UGRAD FTE	MBA FTE	PHD FTE	XMBA FTE	TOTAL FTE	FAC FTE	STD/ MICRO	FAC/ MICRO	STD/CMP STAFF
U OF CALIF-RIVERSIDE	PUB	600	140	.	50	135	40	12.7	0.8	263
U OF CENTRAL ARKANSAS	PUB	1700	100	.	.	146	42	20.0	0.9	1800
U OF CENTRAL FLORIDA	PUB	4226	576	24	23	160	89	.	0.8	970
U OF CENTRAL OKLAHOMA	.	2043	417	.	.	172	90	23.9	2.0	984
U OF CINCINNATI	PUB	2100	175	45	.	180	90	23.2	1.1	387
U OF COLORADO AT BOULDER	PUB	2500	150	50	.	179	100	30.0	1.4	1350
U OF CONNECTICUT	PUB	1073	1270	48	67	256	79	32.8	0.7	307
U OF DELAWARE	PRIV	.	.	.	.	280	.	.	.	.
U OF DETROIT MERCY	PRIV	571	570	.	.	121	45	11.9	2.8	163
U OF FLORIDA	PUB	1642	506	96	33	395	113	69.0	0.6	285
U OF GEORGIA	PUB	3500	150	120	.	216	120	18.9	9.2	198
U OF HAWAII	PUB	1200	400	.	.	276	80	17.8	0.8	400
U OF HOUSTON	PUB	3667	1420	121	.	289	100	521	25.0	473
U OF HOUSTON-DOWNTOWN	PUB	3500	.	.	.	173	50	33.3	0.9	.
U OF ILLINOIS AT CHICAGO	PUB	2380	.	3600	.	436	70	49.8	0.3	2990
U OF IOWA	PUB	1220	590	133	58	356	112	12.8	0.9	334
U OF KANSAS	PUB	750	300	35	.	120	56	22.1	1.0	362
U OF LA VERNE	PRIV	1243	640	.	.	133	60	16.1	4.3	.
U OF LETHBRIDGE	PUB	900	3	.	.	77	50	.	.	903
U OF LOUISVILLE	PUB	1105	444	.	.	259	101	16.0	1.1	516
U OF MAINE	PUB	645	76	.	2	4	19	.	4.8	723
U OF MARYLAND	PUB	3700	800	130	.	473	125	48.7	0.5	926
U OF MARYLAND EASTERN SHORE	PUB	337	.	.	.	37	11	14.0	1.1	337
U OF MASSACHUSETTS-AMHERST	PUB	1550	150	40	.	200	60	29.0	0.5	1740
U OF MASSACHUSETTS-BOSTON	PUB	850	330	.	.	2	50	.	.	1180
U OF MIAMI	PRIV	.	.	12	.	61	.	0.2	.	2
U OF MINNESOTA-DULUTH	PUB	1220	25	.	.	53	50	.	1.3	.
U OF MISSISSIPPI	PUB	1632	138	70	.	205	57	16.7	0.7	.
U OF MISSOURI - COLUMBIA	PUB	.	.	.	.	101	.	.	.	.
U OF MISSOURI - ST LOUIS	PUB	1700	250	.	.	85	50	163	0.9	1950
U OF MISSOURI -KANSAS CITY	PUB	321	215	11	.	106	61	9.8	1.5	547
U OF MONTEVALLO	PUB	346	.	.	.	44	.	12.4	.	.
U OF NEBRASKA AT KEARNEY	PUB	1625	50	.	.	59	50	.	1.0	1675
U OF NEBRASKA AT OMAHA	PUB	2786	445	.	40	188	80	43.6	0.9	409
U OF NEBRASKA-LINCOLN	PUB	2700	180	130	.	291	72	19.9	0.9	301
U OF NEVADA, LAS VEGAS	PUB	3500	300	.	.	264	112	42.7	0.8	1267
U OF NEVADA, RENO	PUB	1700	320	.	.	143	50	24.6	1.0	2020
U OF NEW BRUNSWICK	PUB	1200	80	.	.	102	44	22.9	1.2	1280
U OF NEW HAMPSHIRE	PUB	1138	65	12	50	110	62	316	1.2	.
U OF NEW MEXICO	PUB	950	210	1	50	113	64	28.8	1.4	242
U OF NEW SOUTH WALES	PUB	.	250	30	.	180	34	7.4	0.6	35
U OF NORTH FLORIDA	PUB	1500	500	.	.	84	60	.	0.9	.
U OF NORTH TEXAS	PUB	4985	710	109	.	478	143	24.8	0.8	264
U OF NORTHERN COLORADO	PUB	950	.	.	.	174	42	9.4	0.8	238
U OF NORTHERN IOWA	PUB	3500	180	.	.	238	90	51.1	0.8	1840
U OF NOTRE DAME	PRIV	1500	270	.	140	154	100	43.4	1.2	1910
U OF OKLAHOMA	PUB	2200	200	36	.	239	82	22.1	0.9	271
U OF OREGON	PUB	2136	175	41	.	161	.	29.0	.	470
U OF PENNSYLVANIA	PRIV	2885	1522	219	200	979	220	15.9	0.8	134
U OF PITTSBURGH	PUB	553	774	73	114	217	105	24.0	1.4	189
U OF PRETORIA	PUB	.	359	23	.	40	13	19.1	13.0	382
U OF PUERTO RICO-MAYAGUEZ	.	1680	67	.	.	190	55	14.0	1.3	1747
U OF RICHMOND	PRIV	360	210	.	20	69	51	98.3	1.1	.
U OF RIO GRANDE	PRIV	232	.	.	.	.	.	.	.	58
U OF S'WESTERN LOUISIANA	PUB	2100	150	.	.	206	70	20.1	1.0	150
U OF SAN FRANCISCO	PRIV	900	450	.	53	141	80	22.6	1.6	702
U OF SAO PAULO	PUB	2000	500	100	50	161	200	37.9	3.3	88
U OF SCRANTON	PRIV	832	139	.	.	72	44	31.3	1.6	.
U OF SOUTH CAROLINA	PUB	2000	1300	100	.	573	120	17.0	0.6	283
U OF SOUTH DAKOTA	PUB	680	200	.	.	115	52	25.1	0.8	440
U OF SOUTHERN CALIF	PRIV	3500	745	59	187	768	240	14.6	1.0	225
U OF SOUTHERN COLORADO	PUB	525	25	.	.	26	22	.	1.0	.

INSTITUTION	TYPE	UGRAD FTE	MBA FTE	PHD FTE	XMBA FTE	TOTAL FTE	FAC FTE	STD/ MICRO	FAC/ MICRO	STD/CMP STAFF
U OF SOUTHERN INDIANA	PUB	950	82	.	.	204	36	6.5	0.9	.
U OF SOUTHERN MISSISSIPPI	PUB	1800	115	.	.	197	70	23.4	0.8	958
U OF TEXAS AT AUSTIN	PUB	5123	1231	145	.	738	212	35.5	0.7	382
U OF TEXAS AT SAN ANTONIO	PUB	.	.	.	.	96	80	.	1.3	.
U OF TEXAS AT TYLER	PUB	450	120	.	.	23	23	570	1.3	.
U OF TOLEDO	PUB	1548	209	10	.	227	79	17.7	0.7	1767
U OF TULSA	PRIV	641	166	.	.	112	47	18.3	0.9	404
U OF ULSTER	PUB	3000	418	19	.	302	181	39.5	1.1	1719
U OF UTAH	PUB	.	.	.	.	292	.	.	.	.
U OF VERMONT	PUB	850	80	.	.	56	29	66.4	1.0	465
U OF VIRGINIA	PUB	.	480	8	.	184	60	11.6	0.9	70
U OF WASHINGTON	PUB	1500	500	100	70	104	100	.	1.6	434
U OF WEST FLORIDA	PUB	.	.	.	.	116	.	.	.	.
U OF WISCONSIN-GREEN BAY	PUB	900	.	.	.	84	18	15.0	0.8	900
U OF WISCONSIN-LA CROSSE	PUB	.	.	.	.	61	46	.	1.0	.
U OF WISCONSIN-MADISON	PUB	1100	700	100	50	288	120	13.6	1.0	260
U OF WISCONSIN-OSHKOSH	PUB	1600	500	.	.	101	45	162	0.9	2100
U OF WISCONSIN-WHITEWATER	PUB	3500	520	.	.	270	94	28.1	1.0	574
UTAH STATE U	PUB	2291	342	.	.	296	65	13.2	1.0	203
VALDOSTA STATE U	PUB	937	30	.	.	97	30	16.7	0.9	242
VANDERBILT U	PRIV	.	374	12	101	202	51	8.5	0.6	122
VIRGINIA POLYTECHNIC INST	PUB	2512	439	83	.	278	100	23.5	0.9	3034
W VIRGINIA INST OF TECH	PUB	353	.	.	.	87	28	5.9	1.3	.
WAKE FOREST U - BABCOCK	PRIV	.	500	.	.	154	40	6.6	0.9	167
WAKE FOREST U - SBA	PRIV	300	.	.	.	96	22	4.6	0.9	300
WALSH COLLEGE	PRIV	921	698	.	.	287	74	10.8	6.2	231
WASHINGTON AND LEE U	PRIV	300	.	.	.	83	30	7.9	0.8	300
WASHINGTON U	PRIV	546	647	32	115	176	65	17.9	1.0	268
WAYNE STATE U	PUB	1303	1907	.	.	302	115	24.3	1.0	459
WEBER STATE U	PUB	1800	.	.	.	158	50	20.0	0.9	1800
WEST VIRGINIA GRAD COLLEGE	PUB	.	.	.	9	19	15	.	1.0	2
WEST VIRGINIA U	PUB	1040	120	27	.	187	75	15.8	1.0	396
WESTERN CONNECTICUT STATE U	PUB	1100	130	.	.	152	43	12.3	1.0	.
WESTERN ILLINOIS U	PUB	1385	105	.	.	140	71	49.7	0.9	.
WESTERN MICHIGAN U	PUB	6258	824	.	.	387	111	33.2	0.8	590
WIDENER U	PRIV	900	560	.	.	134	40	18.3	0.9	.
WILFRID LAURIER U	PUB	2145	140	.	.	160	97	40.1	1.4	762
WOODBURY U	PRIV	.	.	.	.	59	.	.	.	.
WORCESTER POLYTECHNIC INST	PRIV	109	209	.	.	39	20	19.9	1.1	.
WRIGHT STATE U	PUB	.	.	.	.	134	.	.	.	.
XAVIER U	PRIV	28	20	.	.	558	51	0.2	0.2	7
YALE U	PRIV	.	425	25	.	221	45	4.9	0.6	56
YORK U	PUB	530	961	44	.	152	98	25.6	2.2	171
YOUNGSTOWN STATE U	PUB	1830	68	.	11	90	69	.	0.8	.
YUAN-ZE INST OF TECH	PRIV	90	15	.	40	85	12	2.2	1.1	145