Title

First Global UCLA Survey of Business School Computer Usage: Where Are Business Schools In The Process of Computerization?

Authors
Frand, Jason L.
Britt, Julia A.
Ng, H. Alvin

Publication Date
1992-10-01

THE JOHN E. ANDERSON GRADUATE
SCHOOL OF MANAGEMENT AT UCLA

WHERE ARE BUSINESS SCHOOLS IN THE PROCESS OF COMPUTERIZATION?

First UCLA Global Survey of Business School Computer Usage

October 1992

Jason L. Frand
Julia A. Britt
H. Alvin Ng

WHERE ARE BUSINESS SCHOOLS IN THE PROCESS OF COMPUTERIZATION?

First UCLA Global Survey of Business School Computer Usage

October 1992

Jason L. Frand
Julia A. Britt
H. Alvin Ng

The authors wish to thank those individuals who took time to gather the extensive data necessary to complete the questionnaire. Without their effort this survey would have been impossible. Appreciation is also extended to the business school faculty members and computing directors from around the world who reviewed the lists of schools for participation and the draft report. A very special thank you is given to Melinda Daczynski for her ongoing assistance and to Research Assistant Roshan Etim for the data entry.

Apple Computer Incorporated, Digital Equipment Company, and the Center for International Business Education and Research (CIBER) at UCLA sponsored this global survey project. Their support has made this research and its dissemination possible.

Information Systems Research Program
The John E. Anderson Graduate School of Management
University of California
Los Angeles, CA 90024-1481
(310) 825-1879
Fax (310) 206-2002

Executive Summary

The goal of the UCLA Global Survey of Business School Computer Usage is to provide information which may assist educational policy and decision makers to prepare computerization plans and allocate computer resources. For this first survey, 53 schools representing 22 countries were included. Specifically, data on 14 European, 19 North American, 11 Pacific Rim, and nine schools on three other continents are presented in summary form.

Findings

The focus of this first international survey is on where the schools perceive themselves to be on 30 different aspects of the computerization process. The overall picture from their responses on a life cycle process-oriented question format indicates that they see themselves to be in moderate growth. However, for each of the 30 specific processes, the schools are at different places along the life cycle. For instance, the schools as a whole perceive themselves to be earlier in processes which involve the use of newer technology such as multimedia, Windows, CD-ROM databases, and high performance 32-bit workstations. The schools anticipate considerable growth in the integration and impact of computers on the curriculum, the introduction and use of local areas networks, increases in student and faculty computer literacy and use of microcomputers for analytical analysis and desktop publishing. On the other hand, the schools have achieved a steady state in areas such as the number of microcomputers and labs, the use of microcomputers as a basic productivity tool, and the use of mini/mainframe computers to support research, instruction, and administrative functions.

At the strategic level, the schools indicated spending a great deal of effort in strategic planning. This is exemplified by 71% of the schools being at the start-up or growth phase. In the area of the computer operating budget, about 43% of the schools anticipate growth opportunities, 35% perceived stable budgets, and 22% see declines. The median budget for the schools reporting data was US$ 283,000 with a mean of US$ 453,000. The most critical strategic issues facing the schools were appropriate curriculum development and finding adequate funding for computer operations. Many schools (56%) were also involved in extensive renovation or new construction for computer facilities.

With respect to integration of computers into the business school curriculum, 75% of the schools were at the start-up or growth phase. The major curriculum integration issues were teaching style/motivation to use technology in the classroom, incentives for developing courseware, and appropriate level of curriculum integration. Examples of innovative uses of information technology were given by 13 schools. These included computer-aided instruction and training for professionals, group decision support systems, specialized software, and network developments.

Computer hardware is the basis of information technology development at schools. Less than half of the surveyed schools reported that they have their own mini/mainframe computers. While most of these schools are at the start-up or growth phases in using mini/mainframes as communication servers, they are at the stable or re-evaluation phases in using mini/mainframes for instruction, research, and administration purposes. Some schools are even phasing out use of these larger systems. In the microcomputer area, there is an average of 250 microcomputers per school. Fifty-three percent of the schools reported a stable phase with regard to their number of microcomputers. The schools also reported that a faculty per microcomputer density of 1.1, just under one system per faculty member, is sufficient to provide for "never any waiting" in 68% of the schools. In contrast, for student usage, in 16% of the schools "never any waiting" status was achieved at a density of 18 undergraduate students per system and 14 MBA students per system.

Phase of faculty and student microcomputer usage closely follows the introduction of both software applications and hardware technological advances. Productivity utilizing word processing and simple spreadsheets was farthest along the growth curve with an average near the mature phase. More advanced spreadsheet usage showed an average at the end of the slow growth phase for students and just entering fast growth for faculty. Desktop publishing and presentation graphics followed behind by several phases with an average at the introduction to users phase for both faculty and students. E-mail is entering the slow growth phase for faculty and introduction phase for students, while CD-ROM, a later technological application, is at the start-up phase involving initial installation and testing. Phase responses to computer literacy, a general measure of knowledge about microcomputer applications, show that the schools anticipate continuing growth as only 32% of the schools perceive their faculty and students to be in the stable phase.

At the operational level, equipment obsolescence and maintenance ranked as the most critical issues. This is not unexpected, given the majority of the schools at the stable phase in the number of microcomputers. The central problem involves balancing a stable (i.e. non-growth) computer operating budget and upgrades necessitated by the latest software developments such as Windows, both of which are constrained by the current world-wide economic slowdown. The most common upgrade strategy is a trickle down approach, with newer equipment usually going to faculty and heavy users and the older equipment to student and administrative staff.

Implementation of local area networks is the area of greatest potential growth, as less than half of the schools reported that all their computers were linked together. In fact, 66% of the schools indicated they are investigating, getting started, or developing their LANs. The most critical network and communication issue listed is management of the networks (including network reliability and response time, as well as software licenses and availability). Another critical operational area is acquiring software site licenses.

Business schools start their computerization processes at different times and with different resources, goals and objectives. An aggregate view of where the schools are in the process of computerization does not take any of these factors into account. Therefore, the schools were grouped into clusters based on the similarity of their responses to the 30 phase questions. Using a cluster analysis procedure, five clusters emerged from the data. The overall means and profiles of each of these five clusters suggested they be labeled as a Start-Up cluster, an Early Growth cluster, a Mixed Phase cluster, a Late Growth cluster, and a Stable cluster. In addition to mean phase profile differences across the five clusters, the pattern of strategic, instructional, operational, and communications and network issues also differed by cluster. Analysis of these differences showed two types of issues: first, those common across all the clusters and thus independent of the stage in the computerization process (e.g., finding adequate funding), and second, those unique to the separate clusters and thus more dependent on where they are in the computerization process (e.g., computer staff management in the Start-Up cluster and supporting Windows environment in the Stable cluster).

Open Issues

This First UCLA Globabl Survey of Business School Computer Usage is being conducted approximately ten years after the introduction of the IBM PC, which signaled the beginning of acceptance of microcomputers as a viable business computer alternative. During the last decade, many business schools have moved towards putting a microcomputer on every instructor's desk and making them readily available for student in computer labs. The schools indicated that a primary goal with the introduction of these systems was computer integration into the curriculum. However, as this survey shows, user expectations exceed reality. Schools reported comprehensive growth and use of microcomputers for personal productivity improvements and access to basic analytic tools such as spreadsheets, while the goal of curriculum integration appears very difficult to achieve.

The introduction of microcomputers has enabled many schools to acquire their first computers, thus allowing access to technology previously not available because of the significant costs and operational barriers associated with mini/mainframe systems. For these schools, microcomputers were the beginning of their use of information technology. Schools with previous experience with mini/mainframe systems have probably benefited and utilized this experience in introducing computers into the curriculum and creating networks of microcomputer systems. On the other hand, schools which did not have previous mini/mainframe experience are freer from the constraints of operating centralized time-share systems, an advantage which may allow them to move faster in adopting microcomputers, and consequently assume leadership in the many new and emergent applications targeted specifically for this technology.

The funding issue is high on the critical issue list for almost every school which participated in this year's survey. Unfortunately, it appears that the decade of the 1990s is going to be fiscally more challenging than that of the 1980s, and it seems that just maintaining the level of services and quality of equipment at business schools will be difficult. The leading operational issues revolve around equipment maintenance and upgrades driven by the demands of the new powerful versions of software that are entering the market. Most schools responded as being in the early stages of a Windows or graphical user environment. However, movement along the growth curve in these areas will require more powerful microcomputers. Thus, schools may be constrained in their ability to offer the most advanced versions of software until they upgrade their existing hardware.

A major concern with any international survey relates to language. Such questions include: Are computer applications available in the natural language of the country? Many letters of characters cannot be displayed. Is this a limitation? Are schools able to offer a full range of software tools because of language or translation issues? All of these issues have varying impacts on the computerization process. Another question concerns country or regional comparisons. In this survey, that question was reserved for only a cursory look via the cluster analysis. The analysis suggested that there may in fact be country or regional factors that influence where a school is in the computerization process. The difficulties encountered in defining a region (e.g., what are the countries in the Pacific Rim) as well as identifying specific country influences (e.g., government policy toward education) precluded any comparative statement or presentation in this report. Further, such an analysis and theoretical development is beyond the goal of these UCLA Surveys, to provide descriptive information regarding business school computer usage.

Table of Contents

Executive Summary i

1. Introduction 1
2. Description of the Survey 2
   2.1 The Non-North American Sample 2
   2.2 The North American Sample 2
   2.3 The Questionnaire 2
3. Profile of Participating Schools 4
4. The Strategic Level 5
   4.1 Strategic Plans 5
   4.2 Computer Operating Budgets 6
   4.3 Strategic Computing Issues 7
   4.4 New Buildings and/or Renovations 8
5. Instruction and Curriculum 8
   5.1 Curriculum Integration 8
   5.2 Instruction and Curriculum Issues 9
   5.3 Innovations 9
6. Hardware 10
   6.1 Mini/Mainframe Computer Systems 10
   6.2 Microcomputers, Workstations and Notebooks 12
   6.3 Microcomputer Usage 15
7. The Operational Level 17
   7.1 Computer Center Operational Issues 17
   7.2 Upgrade/Phase-Out Plans and Strategies 18
   7.3 User Support 18
   7.4 New Technology 19
8. Communications and Networks 19
   8.1 Extent of Networks 19
   8.2 Communications and Network Issues 20
9. Cluster Analysis 21
   9.1 Cluster Phase Means 21
   9.2 Issues by Clusters 24
   9.2 Cluster Demographics 24
10. Country and Regional Influences 25

Appendices

1 Business School Computerization Life Cycle Phase Definitions 27
2 Abbreviations 28
3 Innovations 30
4 Research Note on Cultural Influences 32
5 General School Data 35
6 Hardware Resources 37

List of Tables

1 List of Schools Participating in the First Global Survey 3
2 Demographics of Participating Schools 4
3 Business School Computing Strategic Plans 6
4 Business School Computer Operating Budget 7
5 Business School Strategic Computing Issues 7
6 Instructional and Curriculum Issues 9
7 Innovative Uses of Information Technology 10
8 Business School Mini/Mainframe Systems Installed by Model 11
9 Business School Microcomputer Systems by Model 12
10 Microcomputer Sufficiency by User Group 13
11 Laptop and Portable Systems by Vendor 14
12 Business School Computer Center Operational Issues 17
13 Equipment Upgrade/Phase-Out Plans and Strategies 18
14 User Access to LANs 19
15 Communications and Network Issues 20
16 Issues by Cluster 23
17 Demographics by Cluster 25
18 Distribution of Schools by Region and Cluster 26

List of Figures

1 Phases of Business School Computerization 5
2 Phases of Strategic Planning for Computers, Communications and Information 6
3 Phases of Computer Operating Budget 7
4 Phases of Computer Integration into the Business School Curriculum 8
5 Phases of Computer Integration Impact on the Curriculum 8
6 Phases of Electronic/Computer-linked Equipment in the Classroom 9
7 Phases of Business School Mini/Mainframe Use 11
8 Phases of Mini/Mainframe Use as a Communications Server 11
9 Phases of Number of Microcomputers and Labs 13
10 Phases of High Performance 32-bit Graphic Workstations 13
11 Phases of Number of Notebook/Laptop Computers 14
12 Phases of Microcomputer Usage as a Productivity Tool 15
13 Phases of Microcomputer Usage as an Analytic Tool 15
14 Phases of Microcomputer Usage for Desktop Publishing and Presentation Graphics 16
15 Phases of Microcomputer Usage for E-mail 16
16 Phases of Microcomputer Usage for CD-ROM Database Access 16
17 Phases of Computer Literacy 17
18 Phases of Computer Support to Users 18
19 Phases of Multimedia Systems Implementation 19
20 Phases of Windows Implementation 19
21 Phases of Local Area Network Development and Actual Use 20
22 Mean Phases by Cluster 22

1. Introduction

For each of the past nine years, an Annual UCLA Survey of Business School Computer Usage (North American) has been conducted[1]. This report is the first of a series of comparable surveys on a global scale and was motivated by growing international interest in the North American data and request for data on an international sample.

The goal of the UCLA Surveys of Business School Computer Usage is to monitor the changing nature of business school computing environments. The purpose is to provide deans, directors, and other policy makers with information that may assist them with computer and communication technology allocation decisions and program planning. The reader is cautioned that the surveys reflect what the schools report they are doing and are not an endorsement of what they should be doing.

The specific aims of this First UCLA Global Survey of Business School Computer Usage are to present a broad overview of where business schools are in the computerization process, to examine major issues related to the use of information technology, and to identify the emerging trends in technological development and applications within the business school environment.

However, conducting an international survey presents many obstacles: Which schools should be included? How are cultural factors, educational structures and traditions, language barriers, funding sources, government policies, and numerous other influences to be handled? How do we take into account the fact that business schools, as well as the university structures in general, are very different? In light of these concerns, one major issue in preparing an international report is data presentation. Specifically, should the data be presented from a country, regional, or global perspective? For this first report, the decision was to present the data from a global perspective. That is, data from all the responding schools is treated as if it is drawn from a homogenous sample and country or regional factors are ignored. This approach was taken because not all countries or major business schools within a country are represented and regional boundaries are not well defined. Also, doing a country or regional oriented analysis presupposes that certain ethnocentric factors influence *where* schools are in the computerization process. As yet, we do not have data indicative of such a phenomenon. Consequently, presenting the data from a global perspective minimizes country, regional, or ethnocentric biases.

But the question of regional influence cannot be assumed to be totally irrelevant. Accordingly, a post-hoc analysis was conducted to determine whether there were cultural factors that might explain the results. This analysis is presented in the last section of the report.

This report is divided into ten sections: introduction, description of the survey, profile of the participating schools, the strategic level, instruction and curriculum, hardware, the operational level, communications and networks, cluster analysis, and country and regional influences. Three appendices detail the business school computerization life cycle phase definitions, the abbreviations, and innovations. A fourth appendix presents a discussion of possible cultural influences on the adoption of information technology. The fifth appendix presents general demographic data by school and the sixth, hardware resources by school.

---

[1] The Second, Fourth, Fifth, Sixth, and Seventh Surveys have been published in the *Communications of the ACM*, Vol. 29, No 1 (1986), Vol. 31, No 7 (1988), Vol. 32, No 1 (1989), Vol. 33, No 5 (1990), and Vol. 35, No 1 (1992). Copies of the Seventh, Eighth and Ninth (September, 1992) reports are available at a nominal charge. Please contact the Information Systems Research Program, The Anderson Graduate School of Management, University of California, Los Angeles, CA 90024-1481. Telephone 310-825-1879. Fax 310-206-2002.

2. Description of the Survey

A critical issue for survey research is sample selection. For the annual surveys of US and Canadian schools, all US schools accredited by the American Assembly of Collegiate Schools of Business (AACSB) are invited to participate. The selection of Canadian schools was based on their reputation as being comparable to those of the American sample. Since the first survey, three of the Canadian schools have been accredited by the AACSB. As there is no accrediting body similar to the AACSB for schools outside the US and Canada, an initial task was to identify the schools to participate in this international survey.

For this first global survey, two major sampling decisions were made. First, due to limited resources, time, and knowledge of countries and business schools in the world, not all countries would be represented nor all the schools in a given country invited to participate. Second, a subset of the schools which participated in the Ninth Annual Survey would be used for the North American sample.

2.1 The Non-North American Sample

For this first global survey, a comprehensive list of over 150 universities with business schools or programs in Europe, Asia, South and Central America, the Middle East, Africa, and India were compiled. This list was circulated via electronic-mail to twelve scholars in seven countries. They were asked to indicate those schools they considered as comparable to a sample of "leading" US business schools. Nine lists were returned. Schools which received two or more recommendations were considered for inclusion in the sample. Based on this feedback, a sample of 95 schools in 36 countries were invited to participate: 45 European schools, 30 schools along the Pacific Rim region, nine South American schools, and 11 schools from the Middle East, South Africa, and India.

The survey questionnaire together with letters inviting participation were sent to the directors, deans, or a specific professor, depending on the information available for a given school. Out of the 95 business schools which were recommended and sent the questionnaire, 34 (36%) schools located in 20 countries responded. These schools are listed in Table 1.

2.2 The North American Sample

One hundred seventy-eight North American business schools participated in the Ninth Annual UCLA Survey of Business School Computer Usage. If all were included, by sheer number, the analysis would be skewed towards the North American profile. Therefore, a sub-sample of schools was extracted. Specifically, it was decided to select those schools that were rated to be in the top 20 US business school category in at least one of two guide books to business schools, *Business Week's Guide to the Best Business Schools*[2] and *The Gourman Report on Graduate and Professional programs*[3]. The union of the top 20 schools from both of these sources resulted in 26 schools, 12 of which had participated in the Ninth Annual UCLA Survey of Business School Computer Usage. To complete the global sample, all seven Canadian business schools that participated in the Ninth Annual UCLA Survey of Business School Computer Usage were included. These schools are listed in Table 1. Appendix 5 presents general demographic data by school.

2.3 The Questionnaire

The primary focus of this First Global Survey was on *where* the schools perceived themselves in terms of the computerization process. Data was gathered through a nine page questionnaire distributed between April and July 1992. The questionnaire requested four types of data: demographic profiles and computer equipment; short descriptions of plans, strategies,

---

[2] Byrne, John A., 1991. *Business Week's Guide to The Best Business Schools.* New York: McGraw Hill.

[3] Gourman, Jack, 1987. *The Gourman Report: A Rating of Graduate and Professional Programs in American and International Universities.* (4th ed.). Los Angeles: National Education Standards.

Table 1
List of Schools Participating in the First Global Survey
(N = 53)

European Schools (14)	
Cranfield School of Management (U.K.)	Manchester Business School (U.K.)
ESADE (Spain)	Norwegian School of Management (Norway)
ESSEC (France)	Stockholm School of Economics (Sweden)
Group Esc Lyon (France)	Templeton College (U.K.)
Groupe Esc Toulouse (France)	University Kiel (Germany)
IMD (Switzerland)	University of Leeds (U.K.)
London Business School (U.K.)	University of St. Gallen (Switzerland)
North American Schools (19)	
Carnegie Mellon University	University of Alberta
Cornell University (Johnson)	University of British Columbia
Dartmouth College (Tuck)	University of Calgary
Duke University (Fuqua)	University of California, Berkeley (Haas)
Indiana University	University of California, Los Angeles (Anderson)
McGill University	University of Chicago
McMaster University	University of Michigan, Ann Arbor
MIT (Sloan Business Sch)	University of Texas, Austin
Stanford University	University of Toronto
	University of Western Ontario
Pacific Rim Schools (11)	
Hong Kong University of Science & Technology	National University of Singapore
Korea University	Osaka University (Japan)
Macquarie University (Australia)	Seoul National University (Korea)
National Institute of Development Administration (Thailand)	South-East Asia University (Thailand)
National Taiwan University	The Chinese University of Hong Kong
	University of New South Wales (Australia)
Other Schools (9)	
Fundacao Getulio Vargas (Brazil)	Narsee Monjee Institute of Management Studies (India)
IESA (Venezuela)	Tel Aviv University (Israel)
Indian Institute of Management (India)	University of Pretoria (South Africa)
King Fahd University of Petroleum & Minerals (Saudi Arabia)	University of Sao Paulo (Brazil)
	University of Stellen Bosch (South Africa)

and innovations; rankings of strategic, operational, communication, and instructional issues; and perceptions of where the school is on a computer phase life cycle diagram for 30 different attributes.

The last type of data, computer phase diagrams, is a subjective means of capturing the business school computerization process. The phase diagram question format was developed by the two authors, Frand and Britt, through reviews of different types of life cycle processes and the authors' personal experience. Appendix 1 provides details of the phase diagram, together with a description of the 11 phases. These 11 phase responses are delineated along a process continuum. For each phase question (30 in all), the respondents identify their perceptions of where their schools are (the "phase") on the process continuum. The phases are all related to the individual respondent's perception of a stable or mature environment. Thus, each particular response is the subjective perception of the specific individual who completed the questionnaire. Furthermore, the responses do not represent a common starting point (e.g. no computers) or a specific point in time (e.g. 1980). Rather, the purpose is to capture a subjective reflection of where each respondent views his/her business school along a computerization process continuum. It indicates, to some extent, past accomplishments, present conditions, and future expectations.

Table 2
Demographics of Participating Schools
(N = 53)

Type of School	
Public	62%
Private	38
Language of Instruction	
English only	57
English and other	19
Other only	24
Degrees Offered	
Undergraduate only	0
Undergraduate & Graduate	62
Graduate only	34
Incomplete information	4
Student Enrollment (FTE)	
Less than 1000 students	43
Between 1000 and 2000	38
Between 2000 and 3000	10
More than 3000 students	9
Networked Computers	
More than 2/3 computers networked	49
Between 1/3 and 2/3 networked	29
Less than 1/3 networked	22

3. Profile of Participating Schools

The questionnaires for this First International Survey of Business School Computer Usage were completed primarily by computer center directors (36%), faculty members (20%), assistant deans (12%), and computer center staff (12%). Table 2 presents demographic information for the 53 participating schools.

About three fifths of the schools exist within "public school" education systems (those that are primarily state or government funded) while the rest are "private" schools (responsible for generating most of their own funds). English is the only instructional language in 57% of the schools, while another quarter only uses a non-English national or local language. About one third of the schools offer only graduate degrees. In terms of student enrollment, two-fifths of the schools have enrollments of below 1000 students and another two-fifths have enrollments of between 1000 and 2000 students. The extent to which schools have networked their various computers is an indication of information technology advancement. About half of the schools have networked most of their computers, while an additional 29% have about half of their computers connected.

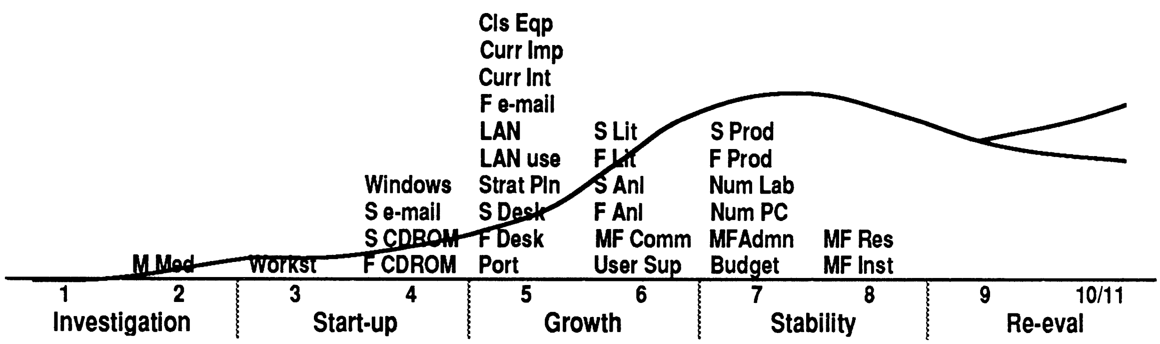
Where are business schools with respect to computerization?

One answer to this question is the average of all of the business schools' responses on all the 30 phase questions[4]. This single point, 5.3, suggests that overall, the 53 business schools in are in a moderate growth phase, just beyond slow growth and not quite yet at fast growth. Figure 1 presents a phase diagram showing this aggregate mean, as well as the separate means for each of the 30 phase questions. Each phase question is identified in an abbreviated form and placed on the phase diagram according to the location of its mean. Appendix 2 defines the abbreviated

[4] Although the phase responses were captured on an 11 point ordinal scale, they were treated as interval scale data for the purpose of analysis.

Figure 1
Phases of Business School Computerization
(N = 53)

Mean = 5.3



descriptions as used in this figure and throughout the report.

Figure 1 shows that, collectively, this sample of international business schools are at the initial action phase for multimedia systems implementation and the start-up phase in the use of high performance 32-bit graphic workstations. Faculty and student use of CD-ROM databases, Windows implementation for IBM/IBM compatible systems, and student use of e-mail systems are just being introduced to users. In contrast, the schools' collective responses suggest that the use of microcomputers as productivity tools (e.g., word-processing and basic spreadsheets) by students and faculty, the number of microcomputers and microcomputer labs, the use of mini/mainframe systems for administrative support, and computer operating budgets have reached steady state, the maturity phase in the life cycle diagram. Furthermore, the use of mini/mainframes for research and instruction has become institutionalized, with little expansion and provision for only routine replacement of obsolete technology. The remaining 16 attributes of computerization are all in slow or fast growth phases.

The following sections of this report examine each of the 30 computerization attributes. The report then presents the data from another perspective, that of clusters of business schools formed from responses on the thirty different computer phase (life-cycles) questions. Readers are likely to find a closer match between their own schools and a specific cluster than to the overall sample. The match will assist readers to understand current issues and also identify future issues they might face, just from observing other clusters that are in later growth phases. These clusters will also be used in considering the impact of cultural factors on the computerization process.

4. The Strategic Level

At the strategic level are issues of planning, the operating budget, strategic matters, and school building or extensive computer facility renovation.

4.1 Strategic Plans

Twenty-three schools (43%) indicated that they have formally stated computer/information systems goals, plans, or objectives for their business school. Of these, 12 gave brief descriptions or attached plans with their survey returns. Table 3 presents an overview of these plans from strategic, instructional, hardware, and support orientations.

The plans presented by the schools covered a wide range of topics. Many topics include long term strategies for incorporating information technology throughout the school with an emphasis on integration into the curriculum. The plans also focus on communications and networks, precursors of electronic mail and sharing of data and peripheral equipment.

Table 3
Business School Computing Strategic Plans
(N = 12)

Strategic	3	Long term planning
	2	Planned growth
	1	Integration of teaching and technology
Instructional	8	Adequate labs/access/scheduling for all classes
	7	More integration into classes
	5	Student literacy parallel to industry applications
	3	More computer/overhead display capability in classrooms
	2	Availability/use of multimedia
	2	Establish/maintain modern instructional resources
	2	Lead/support faculty in computer/curriculum integration
	2	Basic computer literacy for MBA's
	1	Faculty competency to provide high quality instruction
Hardware	4	Improve network infrastructure and distributed computing
	2	Provide latest facility, information, audio-video oriented tools
	1	Update lab computers to 386/486
	1	Price/performance
	1	Vendor reliability
	1	Acquire and use workstations for research computing
	1	Increase microcomputers and acquire minicomputer for teaching
Support	2	E-mail communications
	1	Quick user response
	1	Serve all business students in school
	1	School-wide administrative databases on information system
	1	Research and administrative support

Figure 2
Phases of Strategic Planning
for Computers, Communications, and Information
(N =24)

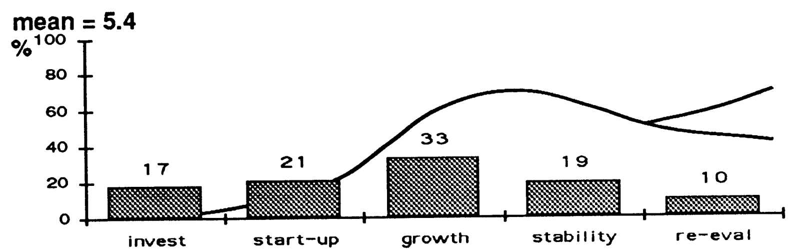


Figure 2 shows the phases of strategic planning for computers, communication, and information for the 24 schools (45%) providing data. The phase mean is 5.4, the beginning of the slow growth phase. The phase diagram suggests that the schools are spending a lot of effort on planning. It is a rather new effort for 38% who reported being in either the investigation or start-up stages, while another one-third is in the growth stage. Only 19% of the schools reported stability with regard to their strategic planning efforts.

Twenty-five schools (47%) indicated that they have similar goals for both graduate and undergraduate programs. Five schools indicated differing goals, with the major difference being a focus on statistical and database handling skills for graduate students and on traditional productivity skills for undergraduate students.

4.2 Computer Operating Budgets

Forty-three schools (81%) provided estimates of their school's computer operating budget, the actual dollars designated to support academic and administrative computing within the business school. The budget did not include faculty salaries or computer hardware acquisitions, nor university funds allocated for recharge on university systems. The average budget per school was US$ 453,000, with a range from US$ 6 thousand to US$ 1.7 million. The median budget was considerably less, at US$ 283,000. Table 4 presents the budget distribution for the 43 schools which provided data.

Fifty-one schools (96%) provided budget phase data displayed in Figure 3. For these schools, the overall budget phase average is 6.7, at the end of fast growth and almost entering maturity. Thirty-five percent of the schools are in stable stage, while 22% of the schools are re-evaluating their budgets. The relatively high percentage of schools in the re-evaluation phase is perhaps a reflection of the difficult financial times being experienced around the world. On the other hand, a sizable proportion of schools (43%) are still at or below the growth stage (phases 1 to 7). This implies likely continual computer budget growth in these schools.

Table 4
Business School Computer Operating Budget
(N = 43)

	US dollars (000s)	%
Distribution		
	Less than 50	16
	50 - 100	14
	100 - 400	26
	400 - 700	16
	700 - 1000	12
	1000 - 1300	9
	1300 - 1700	7
		100
Average/school	453	
Range	6 to 1,700	
1st quartile	70	
Median	283	
3rd quartile	700	

4.3 Strategic Computing Issues

Apart from planning and budget concerns, the responding schools were also asked to indicate and rank the six most critical strategic issues out of a list of 16. Table 5 lists the six issues that were identified by at least one third of the schools.

The first ("appropriate curriculum development utilizing computing"), third ("managing user expectations") and fifth ("faculty incentives for courseware development/integration") issues have an external "customer" orientation, reflecting the importance of making computing services relevant to users and in turn obtaining their support. The remaining three issues have an internal "maintenance" orientation, focusing on ensuring sufficient resources to keep the computer operations effective and up-to-date.

Figure 3
Phases of Computer Operating Budget
(N = 51)

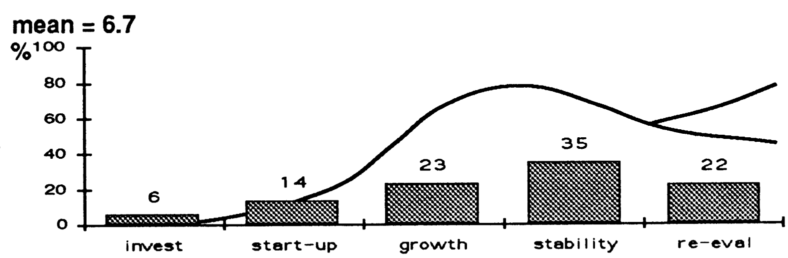


Table 5
Business School Strategic Computing Issues
(N = 53)

%	Issue
62	Appropriate curriculum development utilizing computing
55	Adequate funding for operational support
53	Managing user expectations
53	Keeping current on what technology is appropriate
45	Faculty incentives for courseware development/integration
40	Obtaining hardware/software donations

4.4 New Buildings and/or Renovations

Fifty-one schools (96%) provided information regarding their status on facilities improvement. Sixty-eight percent of these schools indicated that they were involved in either new building development or extensive renovation activities. Out of this group, 48% were evenly distributed in four stages: six schools (12%) each at initial planning, moved two to five years ago, moved within the past year, or moving now or next year. The remaining 20% of the schools indicated they are moving within the next two to five years.

5. Instruction and Curriculum

This section covers instruction and curriculum concerns in the area of information technology.

5.1 Curriculum Integration

The average phase mean for computer integration into the business school curriculum was 4.9, or just entering slow growth. Figure 4 shows the distribution. Forty-two percent of the respondents perceive their schools to be in the investigation or start-up stages, 33% in the growth stage, 21% in the stability stage, and 4% in the re-evaluation stage.

The distribution in Figure 4 implies that the schools perceive much is still to be done in integrating computer usage into their business school curriculum. This concern for computer curriculum integration was also reflected in Table 5, where determining appropriate curriculum development that utilizes computing was raised by 62% of the schools as a critical issue.

Figure 4
Phases of Computer Integration Into the Business School Curriculum
(N = 52)

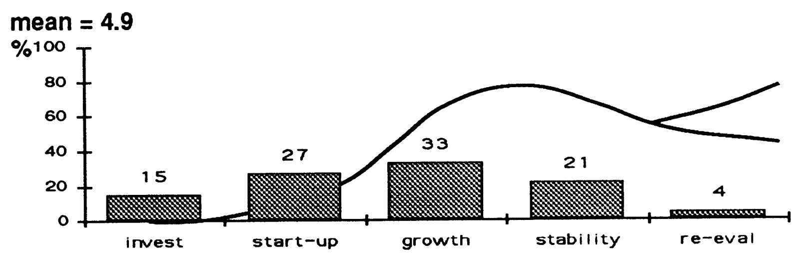
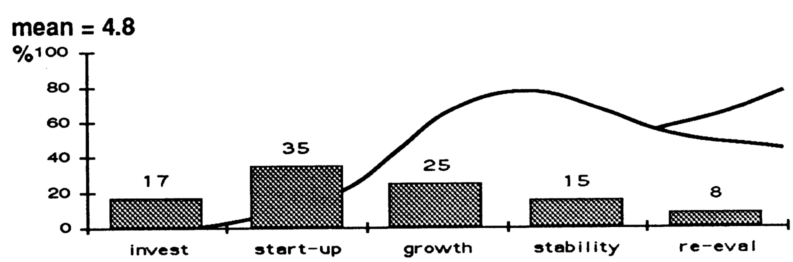


Figure 5
Phases of Computer Integration Impact on the Curriculum
(N = 52)



With such high potential for more computer integration, it is reasonable to assume that the schools consider the existing integration to have a positive impact. However, as could be expected, the perceptions of actual impact are lagging behind actual integration as the effect of integration can only be felt some time later after students have gone through the integrated curriculum and schools have time to review the situation.

The phase diagram for the schools' perceptions of the actual impact is given in Figure 5. Fifty-two percent of the schools felt that the impact is at the investigation or the start-up stages as compared with 42% for the curriculum integration implementation. In general, the phase distribution in Figure 5 lags behind that of Figure 4.

5.2 Instruction and Curriculum Issues

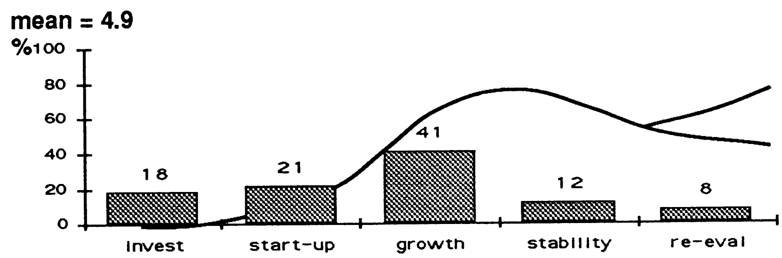
There are many challenges for business schools when integrating information technology into the curriculum and the classroom. Table 6 lists the eight issues identified by at least one-third of the schools as most important for curriculum integration. The first two of these issues ("teaching style/motivation to use the technology" and "faculty incentives for developing courseware") are concerned with motivation to use available technology. These will probably remain a primary concern until the traditional criteria for promotion are revised to acknowledge time spent on courseware development and computer integration. Almost all of the remaining issues revolve around the appropriate level of curriculum integration, identifying the courses to be integrated, and courseware matters. The increasing addition of computer courseware into standard business textbooks by major publishers may diminish some of the pressure on these issues.

Table 6
Instructional and Curriculum Issues
(N = 53)

%	Issue
81	Teaching style/motivation to use technology
74	Faculty incentives for developing courseware
74	Defining an appropriate level of curriculum integration
60	Courseware development support
53	Lack of courseware
49	Selection of courses to be integrated
47	Courseware design
39	Inability to use computers in classroom

The last issue in Table 6 is "inability to use computers in the classroom." This is a broad issue that encompasses pragmatic matters such as equipment delivery, security, configuration changes to meet individual faculty needs, and guarantees against frustrating malfunctions which can supersede the value of a class lesson plan. Figure 6, with an average phase mean of 4.9, shows that 39% of the respondent schools perceive themselves to be in the investigation or start-up stage on the issue of electronic/computer-linked equipment in the classroom. Another, 41% are in the growth stage. This implies that even with the existing problems, a large percentage of the business schools are committed to the continuing use of information technology, and have expectations of more progress in actual implementation.

Figure 6
Phases of Electronic/Computer-linked Equipment in the Classroom
(N = 51)



This high growth might also be based on expectations of what information technology can do: the productivity gains seen in computer-prepared classroom materials, integration of class notes and presentation outlines on microcomputers and the possibility of students being able to download selected files, and finally, the sheer pleasure in presenting visual materials through computer-integrated overheads as opposed to the struggle with a dusty chalkboard.

5.3 Innovations

Respondents were given the opportunity to describe any project, computer laboratories, or other applications at their schools that they consider to be innovative or exciting uses of computer information technology. Thirteen schools responded with various projects that they are working on. Some of these include integration of MS-DOS, Mac, and UNIX operating systems on Ethernet (University of New South Wales, Australia), computer-aided instruction and computer-

Table 7
Innovative Uses of Information Technology
(N = 13)

Area	#	Innovative use
Curriculum/ software	2	Computer-aided instruction; training programs for professionals
	1	Format language for information system specs.
	1	Computer support of collaborative work systems
	1	Apple PowerBook used in Executive MBA curriculum
Applications	1	Commercial databases through SAS
	1	Specialized software for commercial applications
	1	Manufacturing scheduling and marketing information systems
	1	Financial stochastic model
Network	1	100 Mbits/sec campus-wide network
	1	All labs linked to FDDI network
	1	All faculty, staff, students on network and uses e-mail
	1	Integration of DOS, MAC, and UNIX on Ethernet
Organization/ support	1	Group support systems lab
	1	Public labs offer full range of academic, research, & admin support
	1	On-line CD-ROM information access

based training projects (FGV-Fundagao Getulio Vargas, Brazil), and a "point and click" front end to large financial databases on mainframes (Tuck Business School, Dartmouth College). Table 7 summarizes these projects. Appendix 3 provides a short description of each project, together with a contact name and telephone number (where available) for those who would like to contact the schools for additional information.

6. Hardware

With the increase in power and capability of desktop computers, there is considerable difficulty in establishing hardware category demarcations. For purposes of this report, mini/ mainframes are considered to be centrally-controlled time-sharing systems which accommodate multiple concurrent users. In contrast, microcomputers and high performance 32-bit graphic workstations are considered single user systems. However, as network technology matures and all systems become nodes on a network this distinction will become less obvious. Furthermore, in some cases, a specific model (e.g., a Digital Vaxstation) may be reported by some schools as their mini/mainframe and by other schools as a microcomputer/workstation. In such cases, the models are listed in the category as reported by the particular school because of the different role at each school. Appendix 6 presents the hardware resources by school.

6.1 Mini/Mainframe Computer Systems

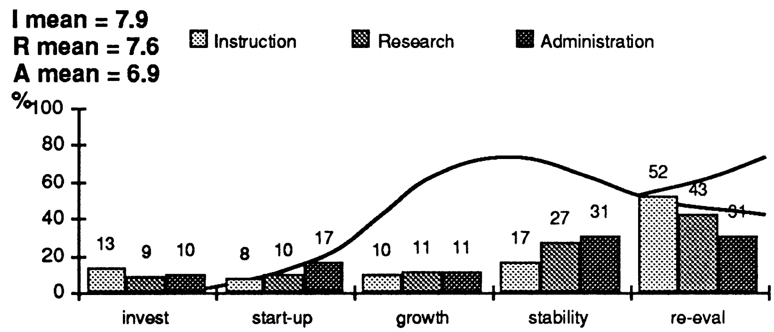
Forty-one (77%) of the business schools indicated that their users had access to mini/ mainframe systems. Of these schools, 13 used only their own mini/mainframes, 10 provided access to both their own and central university mini/mainframes, and the remaining 18 relied exclusively on access to the central university systems.

Table 8 shows the distribution of 50 different systems supplied by 11 vendors for the 23 schools which operated their own mini/mainframe computers. Only models with more than one installation in the sample are listed separately. Digital Equipment Corporation had the largest number of systems, 19, installed in the schools in this sample. This is followed by Hewlett

Table 8
Business School
Mini/Mainframe Systems
Installed by Model
(N = 23)

Model	n
Data General	
MV x000	2
HV x500	2
Others	1
Digital	
DEC 5xxx	2
MICROVAX	3
VAX 3xxx	4
VAX 6xxx	2
VAX STATION	2
Others	6
Hewlett Packard	
HP 3000	6
HP 9000	5
IBM	
4xxx	2
RS 6000	2
Others	1
SUN	
330	4
Other (one each)	
Apollo, AT&T	
Landmark, MIPS	
NeXT, Pyramid	6
Total	50
Average/school	2.2

Figure 7
Phases of Business School Mini/Mainframe Use
(Instruction N =48
Research N =47
Administrative N = 48)



Packard with 11 installations. The average number of mini/mainframe systems in a school is 2.2.

Figure 7 shows the phase diagram for mini/mainframe computer usage in instruction, research and administrative support. Fifty-two percent of the schools are re-evaluating the use of mini/mainframe systems for instruction, 43% for research, and 31% for administrative support. Only about 10% of the schools are at the growth stage for all these three functions. The overall picture suggests that mini/mainframe computers are better able to support administrative users, while instructional or research users are reconsidering their usefulness.

Figure 8 shows a different perspective of how school-owned and maintained mini/mainframes are used. As a communications server, 33% of the business schools who responded to this phase question perceive the mini/mainframe to be either in a start-up or growth phase, while a further 19% are investigating this potential. In contrast, 25% of the schools are re-evaluating this role of mini/mainframes.

Figure 8
Phases of Mini/Mainframe Use
as a Communications Server
(N = 48)

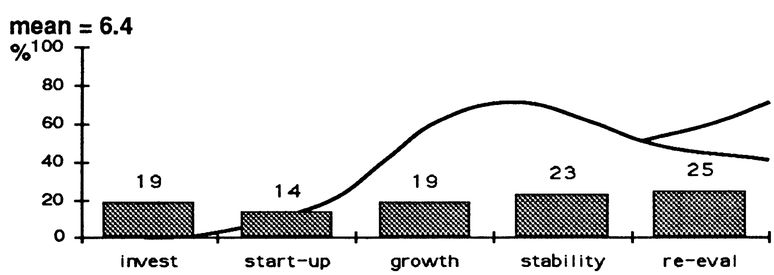


Table 9
Business School Microcomputers by Model
(N=53)

	Total Systems n	%	Percent Schools
Apple			
Mac,Plus,SE	1,015	7.7	50
SE30,ClasII	284	2.1	25
II,II LC	366	2.8	35
IIC,CX,SI	542	4.1	35
IIFX	24	0.2	8
Quadras	11	0.1	2
AT&T			
6300	94	0.7	4
286	158	1.2	6
386	45	0.3	4
NCR	108	0.8	4
Digital			
Decstation	11	0.1	12
Vaxstation	39	0.3	2
Hewlett Packard			
286	781	5.9	25
386	318	2.4	23
486	64	0.5	2
HP/Apollo	21	0.2	4
IBM			
XT	1,048	7.9	52
AT,PS2 30,60	2,010	15.2	60
PS2/70,80	806	6.1	44
PS2/90	78	0.6	6
RISC 6000	15	0.1	2
RT	6	0.0	2
NeXT	28	0.2	6
Sun	81	0.6	15
Unisys	557	4.2	6
Xerox	11	0.1	2
Zenith			
150	40	0.3	10
286	20	0.2	4
386	7	0.1	2
Clones			
8086/8088	840	6.3	48
80286	1,413	10.7	63
80386	1,514	11.4	65
80486	408	3.1	33
Other	491	3.7	
TOTAL	**13,254**	**100.0**	
Average /school	**250**		

6.2 Microcomputers, Workstations, and Notebooks

As stated in the introduction to this section, microcomputers are considered to encompass the full range of computers designed for an individual user, from the early IBM PCs based on old 8-bit technology to full 32-bit, high performance graphics workstations. Table 9 lists the microcomputer models for which at least six systems were reported. For each model, the number of systems, market share in this sample, and availability across schools (percent of schools which reported using that model) are presented. Overall, a total of 13,254 microcomputers were reported, for an average of 250 systems per school. Ten specific manufacturers were mentioned, but almost one-third of all of the reported systems were listed as "no-name clones."

From a market share perspective, the top three systems are the IBM AT,PS2/30-60, 80386 clones, and 80286 clones. These systems are also very widely available, with respectively 60, 65, and 63 percent of the schools reporting their use. Two other early models were reported as being used by at least half the schools, the Apple Macintosh Plus and SE models and the original IBM PC/XT models.

Figure 9 shows that in about half the schools (53%) the number of microcomputers is at the stability stage. This suggests that there will be little further growth in the number of microcomputers at these schools. The potential for growth in the number of computer labs also seems to be limited with 56% of the schools indicating that they are at the stability stage.

The large number of schools in the stability stage in Figure 9 suggests that, on average, there are now enough microcomputer systems at these schools to meet their needs. Table 10 further supports this observation, showing the schools' perceptions of sufficiency of microcomputer access by user group (faculty, undergraduate and MBA), together with the average microcomputer density (the number of users who have to share one computer). For faculty members, 68% of the schools reported "never any waiting" at a density of 1.1 (slightly more than one faculty member sharing a single microcomputer), while 22% reported "occasional waiting" at a density of 1.3. For undergraduate students, a microcomputer density of 17.9 students sharing a single system achieved "never any waiting" for 16% of the schools while a density of 22.8 students sharing a single system points to "occasional waiting" for 50% of the schools. MBA students have to compete less for computer resources. A density of 14.4 students sharing a single system achieved "never any waiting" in 16% of the schools while a density of 18.9 students sharing a single system achieved "occasional waiting" in 68 % of the schools. These data, together with the data in Figure 9, suggest that the schools perceive there are sufficient microcomputer systems to meet user's needs and a general willingness to tolerate some waiting for student access.

Figure 9
Phases of Number of Microcomputers and Labs
(Microcomputers N = 53
Labs N = 53)

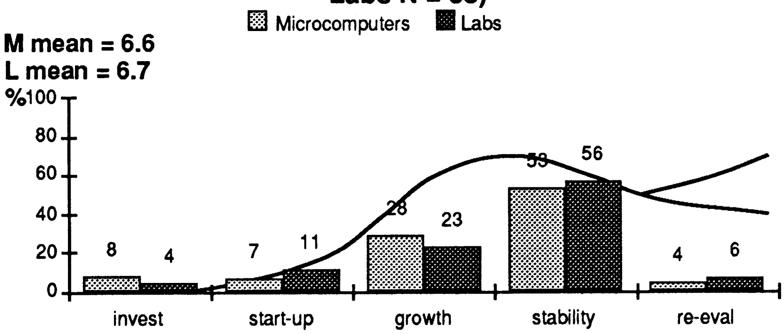
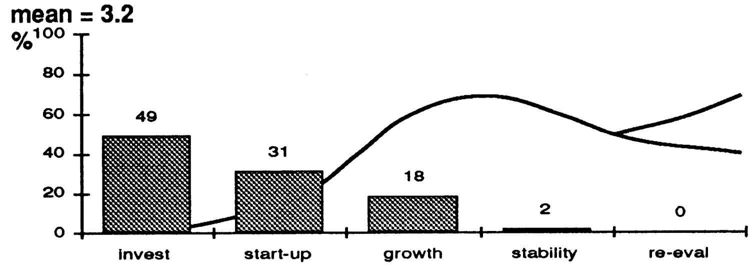


Table 10
Microcomputer Sufficiency by User Group
(percent of schools)

	Faculty N=50		Undergraduate N=36		MBA N=49	
Microcomputer access	**%**	**density**	**%**	**density**	**%**	**density**
Never any waiting	68	1.1	16	17.9	16	14.4
Occasional waiting	22	1.3	50	22.8	68	18.9
Usually a wait	8	8.9	28	21.5	8	22.0
Always a wait	2		6	33.1	8	22.9

Even though high performance graphic workstations such as the Sun, NeXT, and HP/ Apollo models were listed with the microcomputers, they seem to have a niche within the business school community, especially for applications that require extensive numeric calculations, high resolution graphics, modeling, artificial intelligence and expert systems. Such systems, as shown in Figure 10, are still at a very early stage of usage in business schools. Nearly half of the 49 schools reporting data are at the investigation stage of using such systems, while an additional

Figure 10
Phases of High Performance 32-bit Graphic Workstations
(N = 49)



one-third are at the start-up stage. There is no school at the re-evaluation stage. The large number of schools in the very early stages implies that there is still some uncertainty of the appropriateness of workstations in business schools, as normal business needs do not require extremely high graphic definitions or intensive numeric applications.

In contrast to the pervasive presence of desktop microcomputers, notebook and laptop computers are still relatively new in business schools. Table 11 shows the number of portable systems (by vendor) reported by 40 schools. For each model, the number of systems, market share based on total systems across all the schools, and availability (percent school which reported using that model), are presented. Overall, the 40 schools reported a total of 1,307 laptop/notebook microcomputers, an average of 33 systems per school. Twenty-three specific manufacturers were mentioned, but only those vendors with six or more systems were listed separately in the table. Based on this data, the top three notebook vendors were Toshiba (31%), Olivetti (24%), and Hewlett Packard (17%). Hewlett Packard's presence in Table 11 is somewhat confusing given that production of the HP110 and HP110 Plus systems were discontinued a few years ago. But their presence is similar to that of the IBM PC/XT in Table 9, which was also discontinued some years ago. These systems are examples of the staying power of old technology which has yet to be replaced.

Table 11
Laptop and Portable Systems by Vendor
(number of systems)
(N = 40)

Vendor (at least 6 systems reported)	Total Systems n	%	Percent Schools
Toshiba	406	31	28
Olivetti	310	24	3
Hewlett Packard	219	17	15
Apple	119	9	13
Zenith	60	5	15
IBM	55	4	10
Compaq	50	4	13
NEC	12	1	3
Epson	11	1	3
Dell	6	.	3
Other*	59	4	
TOTAL	**1307**	**100**	
Average/school	**33**		

* Other brands reported with one to three systems: AST, Daewoo, Data General, Digital, Elonex, Ergo, Panasonic, Samsung, Sharp, SRM, Tandy, TI, Zeos

Figure 11
Phases of Number of Notebook/Laptop Computers
(N = 49)

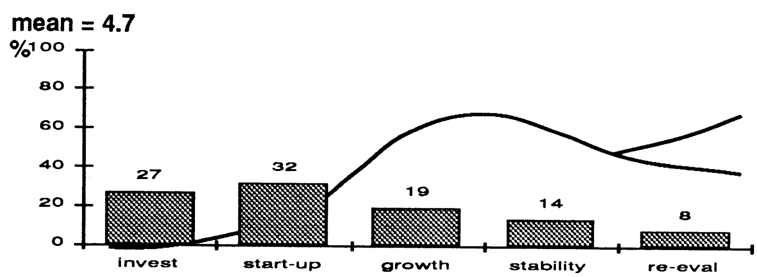


Figure 11 shows the phase diagram for the number of portable microcomputers . Fifty percent of the schools are at the investigation or start-up stage of the life-cycle. In contrast, 8% responded that they are re-evaluating this technology. Whether there is potential for further growth will depend to some extent on how curriculum is designed. At the moment, it seems that desktop systems adequately meet the needs of business school computer users. However, if future curriculum changes require "mobile" computing by students and faculty, the usage of such portable systems may grow quickly. With the continuing decreases in cost and weight, combined with increases in power, notebook systems seem especially appropriate for the educational environment.

6.3 Microcomputer Usage

An important element in understanding the business school microcomputer environment is consideration of how these systems are being used by faculty and students. This year's survey asked a series of phase diagram questions related to microcomputer usage as a productivity tool (e.g., word processing, basic spreadsheets), as an analytic tool (e.g., modeling, advanced spreadsheets, statistics), for desktop publishing and presentation graphics, for e-mail, and for CD-ROM database access. A summary phase question asked for a perception of general computer literacy. Figures 12 through 17 present this data.

An overall view of usage patterns can be deduced from Figure 1. Productivity utilizing word processing and simple spreadsheets applications is farthest along the growth curve with an average near the mature phase. These early applications are followed by more advanced spreadsheet usage which shows an average at the start of the fast growth phase. Desktop publishing and presentation graphics follow behind by two phases with an average in the introduction to users phase for both faculty and students. E-mail is entering slow growth for the faculty and introduction to the students, and CD-ROM, a later technological application, is at the start-up phase with initial installation and testing. For these five areas of microcomputer usage, faculty and student phase averages are almost identical.

For usage of the microcomputer as a productivity tool, both the faculty and student phase averages were 6.6. As shown in Figure 12, over 50% of the schools indicated that both students and faculty are at stability. A quarter of the schools indicated that faculty and students are still at the growth stage and about one-sixth of both groups are at the start-up stage.

Figure 12
Phases of Microcomputer Usage as a Productivity Tool (Faculty N = 53; Student N = 52)

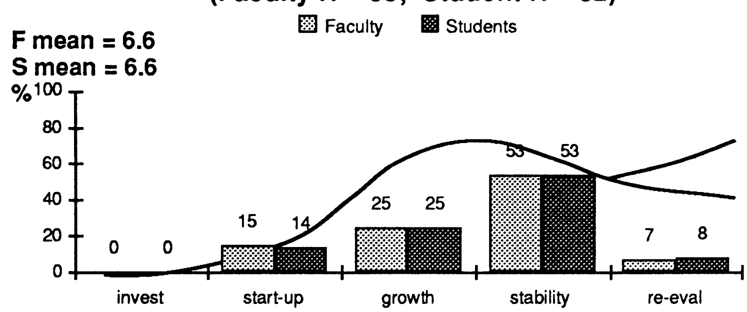


Figure 13 presents usage of microcomputers as an analytic tool. Even though the profiles are quite different, the faculty and student phase averages are the same, 6.1. Note that a greater proportion of faculty (39%), as compared to students (28%), is at the growth stage in using microcomputers as analytical tools, while a smaller proportion of faculty (31%), as compared to students (40%), is at the stability stage. One might expect the reverse pattern to be true with the faculty further along than the students. One possible explanation is that students have become more proficient because they are given course assignments which require them to use analytic software tools.

Figure 13
Phases of Microcomputer Usage as an Analytic Tool (Faculty N = 53; Student N = 53)

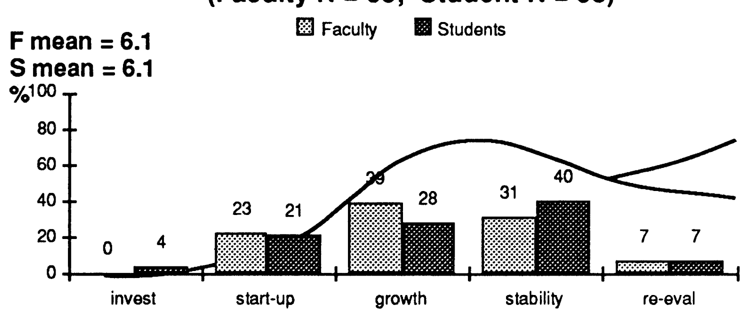
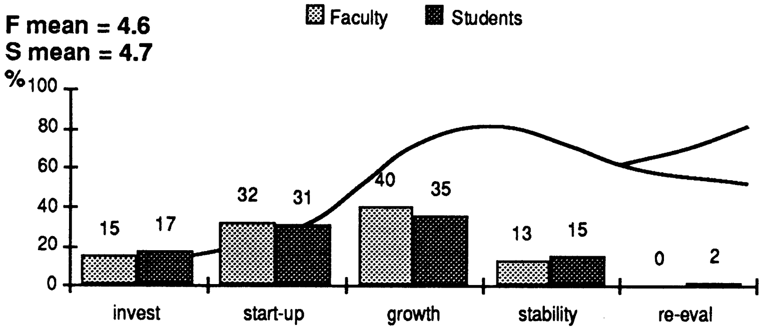


Figure 14 shows the phase diagram of microcomputer usage for desktop publishing and presentation graphics. Both students and faculty have about similar patterns across the different

Figure 14
Phases of Microcomputer Usage
for Desktop Publishing and Presentation Graphics
(Faculty N = 53; Student N = 52)



stages with phase means of 4.6 and 4.7, respectivitely. This area is two phases behind basic productivity tool use and is likely to grow as users look for methods to best present their ideas. With 72% of the faculty and 66% of the students in the start-up and growth stages, this area is one which is poised for significant growth.

Figure 15 shows the average faculty usage of e-mail to be at 5.3 , just getting into slow growth with initial acceptance by users. The average student usage is almost a full phase behind, at 4.4, the introduction to user phase, with its corresponding identification of day-to-day requirements to support the application. Faculty access to e-mail is fairly evenly distributed across the investigation to stable stages, but lagging considerably behind for students. E-mail use is one area which requires significant resources beyond an individual user with a stand-alone microcomputer. There needs to be a centralized e-mail server (either mini/mainframe or microcomputer), access methods to this e-mail server (either via telephone and modem or over a network), and e-mail software. There also needs to be a critical mass of other e-mail users. Given these requirements and the mixed pattern in Figure 15, it is not clear how e-mail usage patterns will evolve over time.

Figure 15
Phases of Microcomputer Usage for E-mail
(Faculty N = 53; Student N = 53)

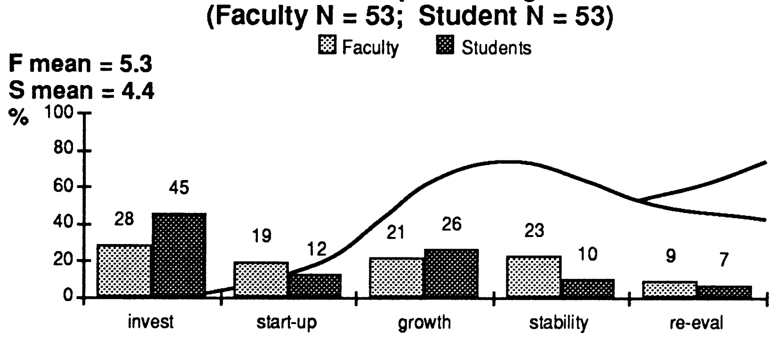


Figure 16 displays CD-ROM usage patterns for faculty and students. The phase averages are 3.8 for faculty and 3.6 for students, moving from the "getting things ready" phase to the "putting it in the hands of initial users." CD-ROM systems appear to have real potential in the area of library databases, but issues of access, networking, cost, and site license may be a factor limiting the wide-spread use of this new technology. The phase diagram shows that use of CD-ROM database is at a very early stage of development, and when compared to other usage applications, is at the earliest stage.

Figure 16
Phases of Microcomputer Usage
for CD-ROM Database Access
(Facultv N = 53; Student N = 53)

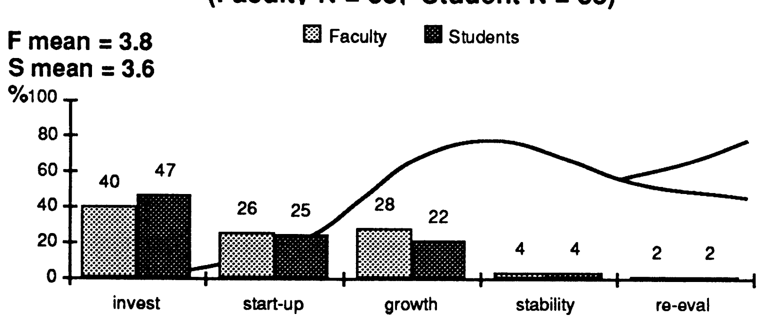
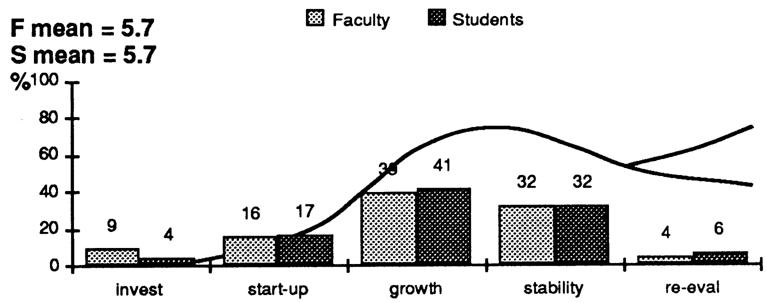


Figure 17 shows the phase diagram for computer literacy among faculty and students. Once again both faculty and students have similar patterns and identical phase means, 5.7. The data suggests that about one-third of the schools, overall, perceive their faculty and students to be computer literate, leaving sizable proportions of both faculty and students who are still learning about computer applications.

Figure 17
Phases of Computer Literacy
(Faculty N = 53; Student N = 53)



7. The Operational Level

Traditional ongoing daily operational concerns and responsibilities (e.g., equipment maintenance, user support) are the central focus of business school computer center directors, their staff, the schools' strategic planners, and the deans. New opportunities and attendant issues emerge with every software introduction, as well as upgrade modifications and technological advancements, each demanding considerable time and attention. Furthermore, all of these concerns, responsibilities, opportunities, and issues are constrained by the current economic realities and consequent budget limitations.

7.1 Computer Center Operational Issues

The survey questionnaire presented a list of 26 issues concerning the daily operation of business school computer centers. Respondent schools were requested to select and rank the 10 issues most critical to their schools. The 14 issues identified by at least a third or more of the responding schools are listed in Table 12. Five issues deal with management, five with equipment and facilities, and four with meeting user expectations.

The management issues show that running a computer center is not just attending to hardware problems. General managerial activities are important in ensuring smooth daily operations. Budget and staff problems are generic to any managerial situation, while software issues are more specific to the management of computer centers. Software site license negotiations and attempts to insure the integrity of these licenses from copyright infringements often take an inordinate amount of time and energy. Additionally, nothing ever seems to be resolved, for ongoing software enhancements and new developments, such as Windows, demand continuing managerial attention.

Table 12
Business School Computer Center Operational Issues
(N = 53)

%	Issue
60	Equipment obsolescence
55	Acquiring software site licenses
55	Equipment maintenance
53	Providing adequate student training
53	Creating realistic budget, identifying the real costs
45	Sufficient space for computing facilities
45	Providing adequate faculty training
42	Matching technology to user needs
40	School standards vs. individual preferences
38	Computer staff management
36	Finding and/or retaining technical staff
36	Not enough hardware to meet demand
36	Output peripherals for presentation graphics
36	Supporting Windows environment

7.2 Upgrade/Phase-Out Plans and Strategies

Equipment obsolescence and maintenance issues are the major operational concerns. One explanation for their dominance may be the fact that 48% of the microcomputers listed in Table 9 are of the earliest 8086/8088/80286 (IBM PC/XT and PC/AT) technology. These systems do not support the latest software, and due to their older age, are likely to exhibit constant disk and monitor problems.

In conjunction with these equipment-related issues, respondents were also asked whether their schools have plans for upgrading or phasing-out older equipment. Twenty-two schools (47%) stated they have plans for equipment upgrading and 20 schools (48%) have plans for phasing out such equipment. Thirteen schools listed their plans. These are summarized in Table 13. The "trickle down" distribution strategy is most common, with newer equipment going to one group of users who already have systems, while in turn their systems are redistributed to others who previously had even less or nothing.

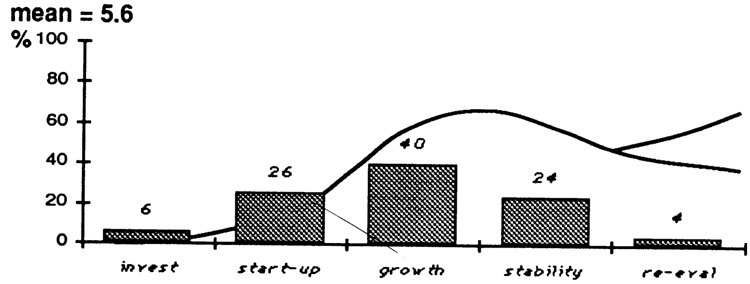
Table 13
Equipment Upgrade/Phase-Out Plans and Strategies
(N = 13)

%	Plans and strategies
5	Trickle down approach, usually new to faculty and heavy users, passing down to PhDs, other graduates, student labs, and staff
3	Regular time replacement cycle; phase out 5 year old equipment; replace every 4 years assuming demonstrated need
2	Cannibalize
2	Discard, do not repair if broken
2	Upgrade to meet user needs, to minimize user learning curve
2	Upgrades only if good cost/benefit, else buy new
1	Donate to other schools, service agencies, K-12 schools
1	Migrate applications to new platforms; run in parallel to validate
1	Old used as print servers, E-mail units, or for network
1	Plan in development
1	Public auction to staff and students
1	Replacement rather than repair
1	Sell if possible, otherwise donate
1	Upgrade to 386 microcomputers
1	Upgrade to mini, 486, Mac II platforms

7.3 User Support

The last group of operational issues revolve around meeting user expectations of providing adequate training, matching technology to user needs, and resolving the conflict of implementation of school standards versus individual preferences. Related directly to these user need issues are the schools' perceptions of where they are in providing computer services support, Figure 18. Over 60% of the schools are at the start-up or growth stage, indicating that a great deal of computer center operational attention is being directed towards user support.

Figure 18
Phases of Computer Support to Users
(N = 53)



7.4 New Technology

In addition to user support and training issues, the introduction of new technology also bring challenges to computer center management. Figures 19 and 20 show the phase diagrams for Multimedia and Windows implementation, respectively. While 82% (49 respondent schools) are in the investigation phase for Multimedia implementation, 21% of the 53 respondent schools indicated that they are in the investigation phase for Windows implementation . These phase diagrams stress the considerable effort involved in information gathering, selection between alternatives, seeking support, obtaining bids, and other general preparatory activities which take place even before the start-up phase can begin. To further complicate this situation, earlier systems that are not powerful enough to support Windows software will also have to be upgraded or replaced.

Figure 19
Phases of Multimedia Systems Implementation
(N = 49)

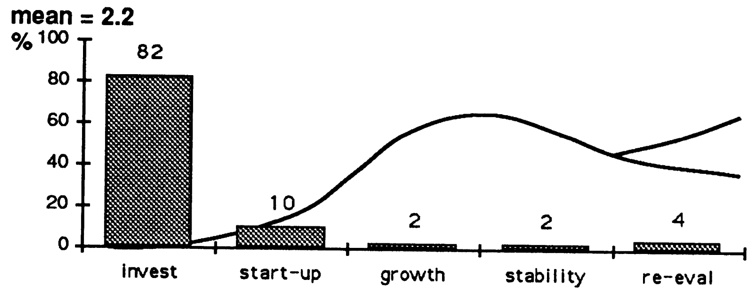
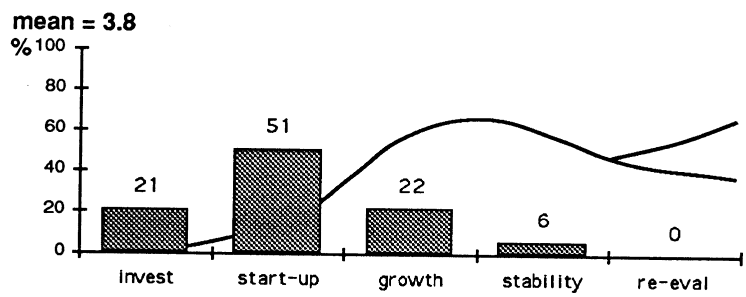


Figure 20
Phases of Windows Implementation
(N = 53)



8. Communications and Networks

8.1 Extent of Networks

The growth of networks in business schools can be seen in the extent microcomputers and workstations are linked to each other and to host computers. Out of 13,254 microcomputers and workstations (Table 9) that are used in the 53 schools in this sample, 76% are linked to each other in some way. Forty-nine percent of these microcomputers and workstations are linked both to each other and to host computers. Another 16% are linked only to host computers, while 10% are linked only to each other without host computers.

The pervasiveness of local area networks (LANs) is seen in the extent that microcomputers in student computer labs are linked together. Table 14 presents LAN access by user group. Of the 50 international schools providing student data, 58% reported that all of their student labs are

Table 14
User Access to LANs
(percent of users)

	N	None	Some	All
Student labs	50	16%	26%	58%
Faculty offices	50	18	34	48
Administrative offices	50	20	36	44
Are these LANs bridged together?	49	22	29	49

networked. In addition, 48% of the schools reported that their faculty microcomputers are fully networked 44% of the schools reported that their administration microcomputers were fully networked. This is a sizable proportion when compared against that for faculty and is contrary to expectations that faculty are usually given priority before administrative staff. The sizeable proportion of administrative offices that are linked together may reflect the necessity of file and software sharing, more common among administrative staff who are working with the same student, budget and other data sets than faculty whose research requires a more individualistic approach.

Table 14 also shows that 49% of the schools have all their LANs bridged together, thus implying a fully networked facility. The extent of networking at the national and international levels is seen in the provision of access to a wide area network (e.g., BITNET or Internet). Eighty-seven percent of the schools have such networks.

Figure 21
Phases of Local Area Network Development and Actual Use
(Development N = 53; Use N = 53)

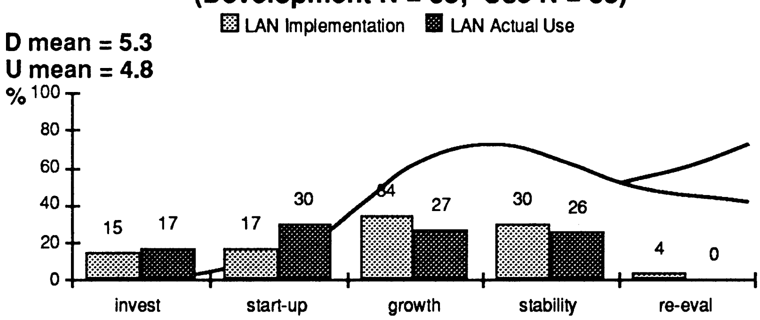


Figure 21 presents the phase diagram for LAN implementation and LAN usage. As is expected, actual use lags behind implementation. Less than one-third of the schools are at the stability stage in both the development and usage areas. Another one-third are at the growth stage, with development being 7% ahead of usage.

8.2 Communications and Network Issues

The survey questionnaire presented a list of 19 communications and network issues from which each respondent school was asked to select and rank the six most critical issues. Table 15 presents the six issues chosen by at least a third of the responding schools.

The first three issues are directly related to network performance while the third to sixth issues are related to application software on the network. This combination of network performance and application software issues shows that networks are not ends in themselves. Network issues and their related problems exist only in conjunction with those of other software applications, as a total package. Therefore, when developing networks to bring microcomputers together, network performance has to be considered together with the other equally important concern of whether existing and future user application software will perform well on the network.

Table 15
Communications and Network Issues
(N = 53)

%	Issue
32	Reliability of network
31	Network management
25	Response time on network
24	Software license for use on a network
20	Software not designed for use on networks
18	Software availability on use on a network

9. Cluster Analysis

This year's questionnaire was designed to capture information regarding *where* business schools from around the world are in the computerization process. The analysis to this point has focused on the total sample. However, recognizing that schools started at different times, with different human and financial resources, and different objectives, they could be assumed to be in different places in this process. Furthermore, the issues and concerns facing the schools may be different at different points in the process. More information might be provided to business school deans and strategic planners if the schools could be grouped according to similarity of their phase responses. By doing so, specific issues and resource allocation decisions that are related to each group might emerge. One method for grouping schools according to their similarity is cluster analysis. Accordingly, the 53 schools in this year's sample were clustered on their responses to the 30 phase questions. One school was omitted because of too many missing phase values.

9.1 Cluster Phase Means

Five distinct clusters emerged from the data. However, given the overall sample size, three of the clusters are quite small (two with 6 schools and one with only 4). Although the clusters were generated through a procedure which could have yielded any number of clusters, the five that did finally emerge is considered meaningful because similar patterns of five clusters also emerged when 172 North American schools in 1988 and 170 North American schools in 1992 were subjected to a similar analysis[5]. Given the similarity of the pattern structures in the resulting clusters of all three of these samples, there is evidence of a consistent underlying structural dimension. Accordingly, the clusters generated from the current sample are presented and discussed.

As part of the clustering process, a mean for each of the 30 phase questions in each cluster (roughly giving the unique character of each cluster), along with an overall cluster mean, was generated. Figure 22 presents the complete profile for each cluster, with each phase mean represented by an abbreviated description (defined in Appendix 2).

The clusters can be differentiated from each other by the overall cluster mean on all the 30 phases. For example, the six schools which grouped with an overall mean of 3.1 are identified as the Start-Up cluster. These schools, in general, are just getting started with many of the various computerization processes. The six schools which grouped with an overall mean of 5.0 are labeled the Early Growth cluster. The other three clusters were similarly labeled as the Mixed Phase Cluster (overall phase mean = 5.5), Late Growth (overall phase mean = 5.3), and Stable Cluster (overall phase mean = 6.7).

The Mixed Phase cluster is special because its distribution of phase issues on the phase diagram does not have a single peak as is the case for each of the other four clusters. The Mixed Phase Cluster has two peaks, one at phase 3 (Start-up phase) and the other at phase 8 (Institutionalized phase) in the phase diagram. The Mixed Phase Cluster shows a very broad distribution with some means located at the institutionalized phase, as well as some at the start-up phase. This phenomenon might seem paradoxical. An examination of the distribution, however, shows that issues at the institutionalized phase (8) are related to faculty applications (microcomputer usage as productivity tools, analytical tools and E-mail), microcomputer usage as productivity tools by students, and the number of microcomputers and computer laboratories. The schools can therefore be interpreted to be more advanced in microcomputer usage than some of the other schools. On the other hand, these schools are still at an early stage on issues such as curriculum integration and impact and those applications oriented towards information exchange and presentation (e.g., CD-ROM and Desktop publishing).

In general, Figure 22 shows the phase means gradually progressing along the phase diagram towards the right as clusters become more mature. Student usage of CD-ROM databases (S CDROM) is an example of this general progression. The Start-Up and Early Growth

---

[5] See the Fifth (1988) and Ninth (1992) Annual UCLA Survey of Business School Computer Usage,

Figure 22
Mean Phases by Cluster
(N = 52)

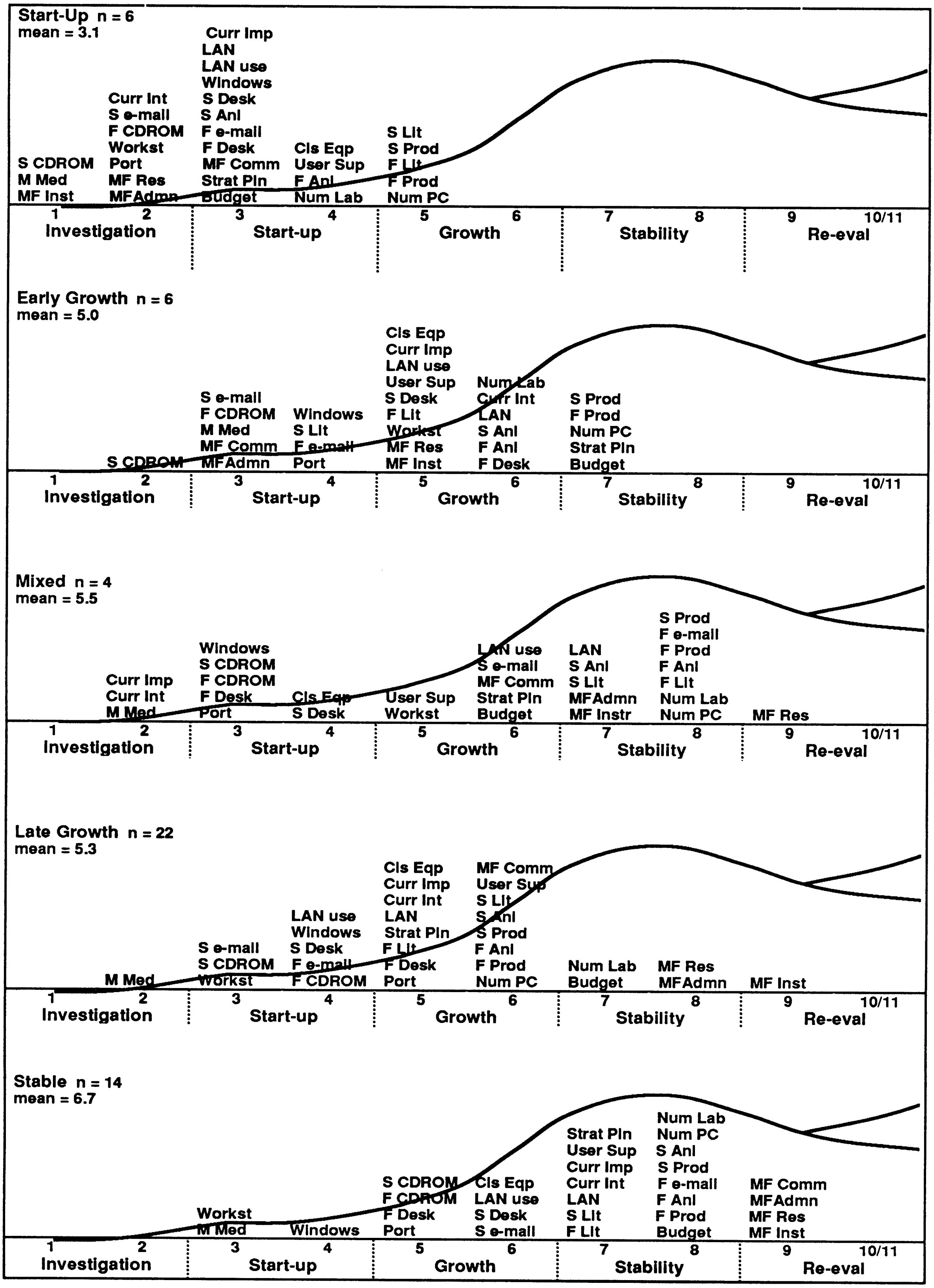


Table 16
Issues by Cluster
(N = 52)

Start-up n = 6	Early growth n = 6	Mixed n = 4	Late growth n = 22	Stable n = 14
		Strategic		
Curr devel	Funding	Funding*	Curr devel	Curr devel
HW/SW donation	Curr devel	User expect*	User expect	User expect
Technology	User expect	Org structure	Fincentives	Funding
Org structure	Lack goals	Technology	Funding	HW/SW donation
Funding	Vendor rel	Curr devel	Technology	Technology
Move/renov	Move/renov	Fincentives	Org structure	Comp/library
		Instructional		
Amt integr	Fincentives	Amt integr	Style	Style
CW dev suppt	Style	CW dev suppt	Fincentives	Fincentives
What integr	What integr	Fincentives	Amt integr	Amt integr
Style	PC in class	What integr	CW dev suppt	CW dev suppt
CW design	Amt integr	Lack of CW	Lack of CW	Lack of CW
PC in class	CW design	Style	CW design	What integr
		Operational		
Real budget	SW licenses	Real budget	Obsolescence	Windows
Staff manage	Real budget	HW maint	SW licenses	S training
Obsolescence*	F training	Implement std	Real budget	Obsolescence
Insuff HW*	Insuff space	S training	Illegal SW	HW maintence
Insuff SW*	HW maintence	Insuff space	HW maintence	S ownership
SW licenses	Staff retention	Staff retention	F training	Graph output
		Network		
Net mgmt	Net mgmt	Net mgmt	SW licenses	Reliability
Reliability*	Expansion	Reliability*	Micro to MF	Respons time
Net SW*	Reliability	Net SW*	Non net SW	Net mgmt
WAN access*	SW licenses	SW licenses	Net mgmt	Non net SW
Micro to micro	WAN access	Net output	Reliability	SW licenses
Respons time	Respons time	Respons time	Net SW	Data security

* Phase issues ranked next to each other within the same cluster and that are marked with * indicate the same rank.

clusters show the CD-ROM phase mean to be in the investigation stage, while the Mixed Phase and Late Growth clusters show the CD-ROM phase mean to have moved to the start-up stage. Finally, the Stable cluster has a CD-ROM phase mean in the growth stage.

The movement of the 30 phase issues across the 11- point phase diagram is general (Figure 22). As schools mature in their use of computers, the earliest computerization efforts seen in mini/mainframe computers are likely to be re-evaluated, microcomputers applications institutionalized, and the latest technologies such as use of CD-ROM, workstations and multimedia integration being implemented.

9.2 Issues by Clusters

Table 16 shows various computer issues as ranked by the schools in each of the five clusters. These issues are grouped under the four broad categories used throughout this report: strategic, instructional, operational, and network. The abbreviations used in this table are given in Appendix 2.

At the Strategic issues level, determining appropriate curriculum development that utilizes computing and finding funds for support are common across all five clusters (Start-Up, Early-Growth, Late-Growth, Mixed-Phase and Stable Clusters). The curriculum issue tends to be in the top two positions while the funding issue fluctuates between the fifth and top position depending on the cluster. Funding is the top issue in the Early-Growth and the Mixed-Phase Clusters. Meeting user expectations, common in the later four clusters, is either in the second or third position.

At the Instructional issues level, teacher style/motivation to use technology and defining an appropriate level of curriculum integration are two issues that are common across the five clusters. The teacher style issue tends to move towards the top position (fourth position to first position) as clusters move toward the stability stage. The curriculum issue falls within the first three positions except for the Early-Growth Cluster in which it is at the fifth position. Again, each of the clusters has its own slightly different emphasis. The Start-Up Cluster emphasizes issues on curriculum integration and support and courseware design. The Early-Growth, Late-Growth and Stable Clusters have nearly similar issues with strong emphases on teacher styles/motivation and incentives for developing courseware. However, the Early-Growth Cluster has a concern for faculty inability to use computers in the classroom. The Mixed-Phase Cluster has a mix of curriculum, teacher style and incentive issues, with greater priority given to curriculum issues, issues similar to those of the Late-growth Cluster, but in a different order except for lack of curriculum design (fourth position).

At the Operational issues level, there is a wider variation across the clusters. Creating realistic budgets are within the top three positions in the first four clusters while it is not even listed as an issue in the Stable Cluster. Equipment maintenance is an issue in the later four clusters but is not an issue in the first cluster. Whereas the Start-Up Cluster is more concerned with equipment and software availability, the Early-Growth Cluster has focused on daily operational issues (e.g., creating realistic budget, acquiring software site licenses, recruiting and retaining user-support staff, and equipment maintenance). The Late-Growth Cluster has somewhat similar issues as the Early-Growth Cluster but has hardware obsolescence as its top issue and other issues, such as of illegal copying of software and software licenses on networks. The Mixed-Phase Cluster has a mix of issues such as management (budgets and staffing), hardware maintenance and facilities, and student training and implementing software standards. The Stable Cluster has the greatest external orientation, focusing on user issues such as Windows implementation, graphics output peripherals and training of students in addition to hardware maintenance and obsolescence problems.

At the Network level, two issues are common across all the five clusters, network management and network reliability. These two issues are in the top three positions in all the clusters except the Late-Growth Cluster. Response time on network is the last issue in the early clusters but moves to the top position in the Stable Cluster, perhaps reflecting the increasing load carried on the network as schools move towards stability. In addition to the above network management, reliability and response time concerns, each cluster shows a slightly different emphasis: connecting peripherals to local and wide area networks for the Start-Up Cluster; network expansion and software licenses for the Early-Growth Cluster; software licenses and availability, and non-network software issues for the Late-Growth Cluster; and somewhat similar issues (network software and response emphases) for both Mixed-Phase Cluster and the Stable Cluster, but with response time being in the second position for the Stable Cluster but in the last position for the Mixed-Phase Cluster.

9.3 Cluster Demographics

Table 17 shows demographic data for the five clusters of schools. This table presents several anomalies, likely a result of the small sample. Most of the cells of Table 17 represent "reasonable" properties of the various clusters of schools. However, the Start-Up cluster, with the lowest overall mean, has the "best" (i.e., lowest) student per microcomputer ratio, the second "best" faculty per micro ratio, and the largest number of innovations, seemingly inconsistent with the overall indication of where the cluster is in terms of the various attributes of the computerization process. When the phase diagram (Figure 22) and cluster demographics (Table 17) for the Start-Up Cluster is re-examined, it becomes clear that schools in this group may be intentionally slowing the adoption of mini/mainframe computers, while simultaneously, quickly adopting microcomputers to attain the required computing power. By so doing, they might avoid the costly mini/mainframe investment that many schools in the Stable Cluster are currently reevaluating.

Table 17
Demographics by Cluster
(N = 52)

	Start-Up	Early Growth	Mixed Phase	Late Growth	Stable
Cluster size	6	6	4	22	14
Phases mean (range)	3.1 (2.3-3.8)	5.0 (4.3-5.7)	5.5 (5.1-6.0)	5.3 (4.1-6.2)	6.7 (6.1-8.2)
Type					
Public	40%	67%	50%	74%	50%
Private	60%	33%	50%	26%	50%
Student FTE (range)	723 (90-1334)	2416 (379-8700	1757 (1080-2315)	1895 (98-9847)	1146 (265-2837)
Student/micro (range)	8 (3-13)	22 (7-65)	18 (6-27)	22 (5-70)	13 (5-34)
Faculty/micro (range)	1.1 (1-1.3)	1.3 (0.4-2.5)	1.3 (1.1-1.5)	2.4 (0.4-20)	0.8 (0.2-1.6)
MF ownership	17%	67%	50%	50%	36%
Listed innovations	50%	33%	0%	27%	43%

10. Country and Regional Influences

Thus far, in this First International Survey of Business School Computer Usage report, the 53 business schools have been treated as a single homogeneous sample. This approach was taken because a country or regional-oriented analysis requires the assumption that some ethnocentric factors (at the country or regional level) may separate these schools and may influence the use of information technology. This assumption was felt to be unwarranted at this stage. However, despite our reservation in imposing such an assumption, country or regional influences may exist and therefore should not be totally ignored. Accordingly, a post-hoc analysis was conducted to determine whether country values might provide some explanations of how the 53 schools fall within the five clusters. Appendix 4 presents this analysis from a theoretical perspective. This section presents a brief summary of the conclusion of that discussion.

The cluster analysis presented in Section 9 reflects an underlying computer usage developmental continuum that ranges from introductory to stability stages for the 53 business schools. These schools were empirically distributed into five groups using cluster analysis to analyze the "subjective" responses of each school on the 30 phase questions. No country or regional data were included in the analysis. Therefore, ethnocentric biases were totally avoided. However, after intentionally avoiding the imposition of country or regional frameworks in the analysis, it is now possible to examine if, in fact, there is any indication of country or regional differences which might be related to information technology usage in these schools.

The first question to be answered when examining regional influence is "how is a region to be defined?" There is no conclusive answer. For this first survey, due to the small number of participating schools and the limited number of countries, the schools were separated into four broad geographic regions - North America, Europe, Pacific Rim, and Others (Table 1, page 3). Using this categorization, the schools in the five clusters were organized by the regions as shown in Table 18. Note that the "region" labeled as "Others" is not a region at all, but rather the countries which could not be readily classified and for which there were only one or two schools represented.

In general, the North American schools tend to fall within the Stable stage, the European schools within the Late Growth stage, the Pacific Rim schools within either the Start-up or Late-Growth stage, and the other schools in the Late-Growth stage. The patterns from this regional distribution seem to suggest a possibility of regional influences for differences in where the business schools are in the computerization process.

In addition to possible regional differences, there might also be country differences. As this current study was not originally designed to examine country or regional differences, no country level data was collected. However, the classic study by Geert Hofstede[6] in 1980 across 40 countries identified four dimensions which may be used here to describe the value orientation of

Table 18
Distribution of Schools by Region and Cluster
(percent of schools)

	n	Start-Up	Early Growth	Mixed	Late Growth	Stable	Countries
Europe	14	0%	15%	0%	63%	22%	7
North America	19	0	5	16	32	47	2
Pacific Rim	10	40	20	10	30	0	7
Other	9	22	12	0	44	22	6

each country. These dimensions are power-distance (psychological distance between subordinates and their superiors), uncertainty-avoidance (preference for predictability and stability), individualism (preference for self-control versus dependence on the organization or group), and masculinity (attitude of dominance and achievement versus nurturance and cooperation). These four dimensions were represented by four value indices.

For each school, the four value indices of its country (as established by Hofstede, 1980) were placed in the cluster in which the school was located. Only one school did not have a set of country value indices. A discriminant analysis was performed to determine whether a country's value indices could explain the way the 52 schools were distributed in the five clusters. The preliminary results suggest that 49% of the variance in the value indices is related to cluster structure.

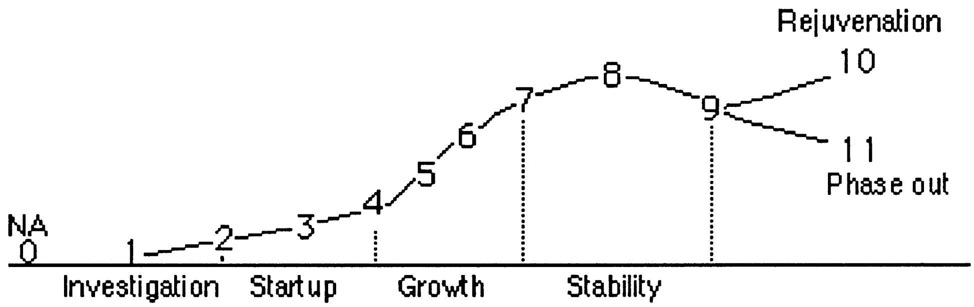
Based on these two preliminary analyses, it appears that both regional and country influences could be considered when reviewing the use of computers in business schools. Further research is needed to determine whether and how these value dimensions, as well as other country or regional characteristics, computer technology variables, and other contextual variables might affect and explain how business schools adopt computer technology. However, as this theoretical orientation is beyond the goals of these UCLA Surveys of Business School Computer Usage, these relationships will be left for others to examine.

---

6 Hofstede, G. 1980. *Culture's consequence: International differences in work-related values.* Beverly Hills, California: Sage Publications.

Appendix 1

Business School Computerization Life Cycle



Phase Definitions

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

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

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

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

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

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

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

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

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

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

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

11 **Phase out:** discontinued use replaced by new technology

Appendix 2

Abbreviations

Phase Definitions

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

Strategic Issues

Comp/library	Computer/library cooperative projects or convergence planning
Curr devel	Appropriate curriculum development utilizing computing
HW/SW donation	Obtaining hardware/software donations
F incentives	Faculty incentives for courseware development/integration
Funding	Adequate funding for operational support
Lack goals	Lack of goals and/or strategic planning
Move/renov	Planning move to new building or renovating computer facility
Org structure	Business school's computing services organizational structure
Technology	Keeping current on what technology is appropriate
User expect	Managing user expectations
Vendor rel	Vendor relationships (cooperatiion, support, responsiveness)

Instructional Issues

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

Operational Issues

F training	Providing adequate faculty training
Graph output	Output peripherals for presentation graphics
HW maintence	Equipment maintenance
Illegal SW	Illegal copying of software
Implement std	Implementation of school standards vs. individual preferences
Insuff HW	Not enough hardware to meet demand
Insuff space	Sufficient space for computing facilities
Insuff SW	Not enough software to meet demand
Obsolescence	Equipment obsolescence
Real budget	Creating a realistic budget, identifying the real costs
S ownership	Student computer ownership
S training	Providing adequate student training
Staff manage	Computer staff management
Staff retention	Finding and/or retaining technical staff
SW licenses	Acquiring software site licenses for school
User needs	Matching technology to user needs
When upgrade	When to upgrade equipment
Windows	Supporting Windows environment

Network Issues

Data security	Data security
Expansion	Expansion, adding nodes to network
Micro to MF	Microcomputer to mini/mainframe connections
Micro to micro	Microcomputer to microcomputer connections
Net mgmt	Network management
Net output	Obtaining output over network
Net SW	Software availability for use on a network
Non net SW	Software not designed for use on networks
Reliability	Reliability of network
Respons time	Response time on network
SW licenses	Software licenses for use on a network
WAN access	Access to wide area networks

Appendix 3

Innovations

University of Calgary (Canada)
Theresa Mueller, Computer Center Staff
(403)220-8592 tmueller@acs.uclagary.ca
Group Support System lab.
Also negotiations now to finish a faculty-wide network installation that will allow use of new and innovative technologies for research and teaching.

University of California, Los Angeles (Anderson Graduate School of Management; U.S.)
Jason L. Frand, Computer Center Director
(310) 825-2725 jfrand@agsm.ucla.edu
100% faculty, students, and staff use e-mail.
Apple Powerbook used in Executive MBA program.

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

ESADE (Spain)
Feliciano Sese
34-3-203-7800
Format language for information system specification.

FGV-Fundagao Getulio Vargas (Brazil)
Fernando De Souza Meirelles
5511-284-2311
Computer-aided instruction; test IT resources for courseware.

Hong Kong University of Science and Technology (Hong Kong)
Ernest Scalberg
852-358-7532
100 Mbits/sec network covering whole campus including dormitories and staff quarters.

Indian Institute of Management (India)
Subir Bhattacharya
Process planning system for refinery; geographic survey information system.

Manchester University (U.K.)
P.M. Drinkwater
44-61-275-6333
Interest in computer support of collaborative work (CSCW) technology/system.

University of Michigan (Ann Arbor; U.S.)

Elizabeth Walker

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

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

Narsee Monjee Institute of Management Studies (India)

Y.K. Bushan

614-3176

Training programs for doctors, lawyers, and other professionals.

National Taiwan University (Taiwan)

Chang-Sung Yu

2-363-9352

All labs on FDDI network.

University of New South Wales (Australia)

Chris Doney

61-2-931-9253

Integration of DOS, Mac, UNIX operating systems on Ethernet network.

University of Toronto (Canada)

Larry Harrison, Computer Center Director

(416) 978-7427 lh@fmgmt.utoronto.ca

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

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

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

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

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

Appendix 4

Research Note on Cultural Influences
prepared by H. Alvin Ng

The five clusters reflect an underlying developmental continuum (from introductory to stability stages) in business school computer usage. These clusters show the characteristics and issues that are important at each stage of development. A natural question to ask is whether there are exogenous factors (factors outside of school computer usage characteristics) that might have caused these schools to fall into any particular cluster, i.e., to be ahead or behind others along the developmental continuum. This question brings us into the area of technology diffusion and adoption.

Classical technology diffusion theory states that the spread and adoption of technology is primarily influenced via communication with external agents (Coleman et al., 1966)[1]. What this means is that adoption of technology is a result of the persuasion of early innovators and prior users on potential users to adopt that technology. Therefore, one can conclude that the more users there are of a technology and the closer these users are to non-users, the higher will be the communication and influence on non-users to adopt that technology. Consequently, technology diffusion is first, a function of the population (in this case, business school population) size of an area, and second, of the distance of that area from other centers of population (Rogers, 1983)[2]. When this theory is applied to the current analysis of business school computer usage, it is expected that regions with higher concentrations of business schools should be ahead of other regions with lower concentrations of business schools, in terms of computer innovation and usage. As the United States is the leader in business education and also has the highest number of business schools on a continent, this implies that American schools should be leaders in computer usage. A breakdown of how the current sample of business schools is distributed across broad geographical regions will give a rough indication of the applicability of this theory. Table 18 shows the number of business schools by their broad geographic regions and the developmental clusters that they fall within.

In general, North American schools (American and Canadian schools) tend to fall within the Stable stage of the developmental continuum, European schools within the Late Growth stage, Pacific Rim schools within either the Start-up or Late-Growth stage, and the remaining schools (South American, South African, Indian, Israeli, and Saudi Arabian schools) within the Late-Growth stage. Based on our sample of 52 schools, it does seem that North American schools are generally ahead of the other schools in business school computer usage. However, they are only one stage ahead of European schools (Late Growth stage). Further examination shows that out of the 14 schools at the Stable stage, North American schools make up 63% (or 9 out of 14) of that sub-sample. Another 37 % comes from European and other regions that have much lower densities of business schools. The pattern from this regional distribution seems to signal a possibility of regional causes for technological differences. Therefore, the classical theory that uses a density of population explanation for technology diffusion does not clearly and unequivocally explain this distribution. In fact, classical diffusion theory has been shown to be better at explain-

---

[1] Coleman, J.S., E. Katz and H. Menzel. 1966. Medical Innovation: A Diffusion Study. New York: Bobbs Merrill.

[2] Rogers, E. 1983. The Diffusion of Innovation (3rd Ed). New York: Free Press.

[3] Pred, A.R. 1977. City systems in advanced economics: Past growth, present processes, and future development options. New York: Halsted Press.

Mansfield, E. 1968. Industrial research and technological innovation: An economic analysis. New York: Norton

[4] Eveland, J.D. and L. Tornatzky 1990. "The deployment of technology," Chapt 6 in L. Tornatzky and M. Fleischer, The processes of technological innovation, Lexington, MA: Lexington Books.

ing social innovations such as TV stations and heroin addictions than such industrial innovations (Pred, 1977; Mansfield, 1968)[3].

An alternative diffusion theory that takes into account contexts that constrain and mold choices in technology diffusion is posited by Eveland and Tornatzky (1990)[4]. The context includes the nature of technology, characteristics of users, characteristics of deployers of technology, boundaries within and between deployers and users, and characteristics of communication and transaction mechanisms. Compared to classical diffusion theory that is based on broad indicators like population density and influence through communication, this alternative theory emphasizes the importance of individual characteristics of technology and the technological context in explaining diffusion. This approach is more appealing because such a reductionistic approach tries to pinpoint, identify and separate out different causes of diffusion. It is therefore more likely to produce clearer causal relationships among complex technology variables.

With this alternative theory in mind, regional or even country characteristics that might underlie these school characteristics could become possible explanations for technological differences. This is in line with Cole's argument that cultural background and practices do matter in exploiting modern technology (Cole, 1973)[5]. However, as this current study is not originally designed to examine country or regional differences, no country level data was collected. Despite this, a pseudo country differential analysis can still be performed if there are secondary data sources that can explain deep enduring country differences, and not just superficial data that fluctuate according to economic cycles or political upheavals. Such data would likely be related to the deep cultural uniqueness of each country.

One such study that examines enduring values in nearly all the countries where our sample of schools is located, seems particularly suited for our purpose here. This is the study done by Geert Hofstede in 1980 across 40 countries (Hofstede, 1980)[6]. This study on country differences was based on four national value dimensions. These dimensions are Power-distance, Uncertainty-avoidance, Individualism and Masculinity. Power-distance refers to the psychological distance between subordinates and their superiors. Uncertainty-avoidance refers to the preference for predictability and stability. Individualism refers to the preference for self-control versus dependence on the organization or group. Masculinity refers to the preference for dominance and achievement versus nurturance and cooperation. Many different analysis have been made of the data by the original researcher. One particular analysis provides key information that we could use here (Hofstede, 1983)[7]. For each country in our sample, corresponding value indices, where available from the Hofstede study, were integrated with our business school database so that each school has a set of 4 value indices that reflect the country's value orientation. Only one country in our sample does not have a set of indices.

Subsequent to this integration of the four value indicies, a canonical discriminant analysis was performed using the previously generated computer usage cluster group as the categorizing variable and the set of four indices for the discriminant function. The results are encouraging. The first canonical variate (underlying dimension formed from the value indices) shows that the cluster structure is related to the value indices. This variate, which is a "dependency" or a "sense of helplessness" dimension, explains 49% of the variance in the value indicies that are categorized according to the cluster structure. In other words, this variate has potential power in explaining how the countries were clustered together in the existing structure.

The first canonical variate (total canonical structure) has high negative correlation (-0.989) with the Individualism index and positive correlation with the Power-Distance index (0.809). It

[5] Cole, R.E. 1973. "Functional alternatives and economic development: An empirical example of permanent employment in Japan'. American Sociological Review, 1973, vol 38, pp. 323-345.

[6] Hofstede, G. 1980. Culture's consequence: International differences in work-related values. Beverly Hills, California: Sage Publications.

[7] Hofstede, G. 1983. "National Cultures in four dimensions: A research-based theory of cultural differences among nations". International Studies of Management and Organization, Vol 13, no. 1-2, pp. 46-74.

has moderate positive correlation with Uncertainty-avoidance (0.36) and low negative correlation with Masculinity (0.26). Therefore, this canonical variate shows that the 5 developmental clusters are highly related to the Individualism and Power-Distance indices. The raw canonical coefficients that are used to predict which cluster a country is likely to fall within, also show that the Individualism and Power-Distance indices have the greatest impact.

The second and third canonical variates respectively accounted for only 9% and 8% of the variance in the 4 value indices. The second canonical variate is an indicator of "powerlessness". It has a moderate positive correlation with Power-distance (0.43) and negative correlation with Masculinity (0.45). The third canonical variate clearly only reflects the Uncertainty-Avoidance index through a high positive correlation of 0.91 with that index. The last canonical variate accounts for less than 1% of the variance and reflects the Masculinity index. The rather low variance accounted for by the last three variates highlights the importance of the first canonical variate in discriminating schools in each of the 5 developmental clusters. The Maximum likelihood ratio shows that only the first canonical variate is a significant variate (Likelihood ratio=0.422; approx. F=2.69; DF=16; prob F=0.001).

This empirical analysis indicates that deep enduring country values might be related to business school computer innovation and usage. If this is proven true in later studies, the emphasis will shift to explaining how such country values might affect the diffusion and adoption of information technology. Two hypothetical explanations are given here. The first is that a country with high Individualistic but low Power-Distance and Uncertainty Avoidance orientations will exhibit these characteristics: High individualism leads to an environment that allows freer expression of creativity and peripheral ideas, which when combined with low Power-Distance allows freer flow of information and suggestions. In addition, low Uncertainty-Avoidance lowers barriers to testing of new ideas and adoption of new and risky technologies. The combination of these three value orientations enables a country to experiment and stretch the limits of technology without fear of strong negative social sanctions. Consequently, such countries are more likely to become innovation leaders in the long run. In contrast, a country with low Individualistic but high Power-Distance and Uncertainty-Avoidance orientations, is likely to have an environment where subordinates become highly dependent on their superiors to give direction. When directions are given, such subordinates only concentrate on not making mistakes and following the dictates of social norms, instead of going beyond requirements. They do not take risks in excelling in their task performance. This is likely to result in minimum innovation. Countries with such an orientation will probably be late adopters of technology as risks are generally to be avoided. These are two possible explanations of how the value orientations of a country might affect technology diffusion and adoption in business schools. However, these explanations are only preliminary guesses based on an empirical analysis that uses secondary country value data and the original business school computer usage data that were collected here. Further research is needed to determine whether and how these value dimensions might affect business school computer usage, as well as other characteristics, such as country or regional differences, computer technology variables, and other contextual variables that might affect and explain how business schools adopt computer technology.

Appendix 5
General School Data

NINTH ANNUAL UCLA SURVEY: 1992
GENERAL SCHOOL DATA

INSTITUTION		TYPE	UGRAD (FTE)	MBA (FTE)	PHD (FTE)	XMBA (FTE)	NON-D (FTE)	FAC (FTE)	COMP OP BUDGET	COMP BDGT/ STUDENT($)	STUD/COMP STAFF
NORTH AMERICAN SCHOOLS											
UNIV CALIF, BERKELEY, HAAS SCH		PUB	530	457	93	.	.	76	140000	130	114
UNIV CALIF, L. A., ANDERSON SCH		PUB	.	800	125	240	38	101	847000	880	56
CARNEGIE MELLON UNIVERSITY		PRIV	602	545	88	.	13	83	.	.	125
UNIVERSITY OF CHICAGO		PRIV	.	1300	80	160	.	125	.	.	58
CORNELL UNIVERSITY, JOHNSON SCH		PRIV	.	506	40	.	19	53	680000	1204	33
DARTMOUTH COLLEGE, TUCK SCH		PRIV	.	330	.	.	32	35	172189	476	52
DUKE UNIVERSITY, FUQUA SCH		PRIV	.	775	44	.	119	70	.	.	67
INDIANA UNIVERSITY		PUB	2400	600	100	50	108	140	.	.	229
MASS. INST OF TECH, SLOAN SCH		PRIV	300	650	100	100	105	120	700000	606	128
UNIV MICHIGAN, ANN ARBOR		PUB	552	1858	96	.	229	158	1341659	491	100
STANFORD UNIVERSITY		PRIV	.	661	84	41	122	95	1700000	1960	47
UNIV TEXAS, AUSTIN		PUB	8265	1387	195	.	.	213	.	.	340
UNIV OF ALBERTA	(CANADA)	PUB	1660	189	38	.	.	95	435000	231	629
UNIV OF BRITISH COLUMBIA	(CANADA)	PUB	1500	400	70	.	7	110	500000	253	329
UNIV OF CALGARY	(CANADA)	PUB	1000	350	13	.	5	107	1080000	789	228
MCGILL UNIVERSITY	(CANADA)	PRIV	1600	450	45	.	.	111	280000	134	322
MC MASTER UNIVERSITY	(CANADA)	PUB	1458	324	14	.	2	60	.	.	599
UNIV OF TORONTO	(CANADA)	PUB	850	403	53	125	6	72	286037	218	375
UNIV OF WESTERN ONTARIO	(CANADA)	PRIV	300	500	30	35	63	66	400000	448	116
EUROPE											
ESSEC	(FRANCE)	PRIV	600	1000	40	80	18	111	1000000	603	332
GROUP ESC LYON	(FRANCE)		200	619	34	3300	158	105	570000	564	144
GROUP ESC TOULOUSE	(FRANCE)	PRIV	300	750	.	.	51	105	600000	545	157
UNIVERSITY KIEL	(GERMANY)	PUB	1200	700	52	.	.	60	120000	61	651
NORWEGIAN SCHOOL OF MGT	(NORWAY)	PRIV	8300	400	.	.	125	120	1498500	170	679
ESADE	(SPAIN)	PRIV	726	832	.	188	.	198	998500	641	111
STOCKHOLM SCH OF ECONS	(SWEDEN)	PUB	.	1500	100	.	7	210	1300000	809	153
UNIV OF ST. GALLEN	(SWITZERLAND)	PUB	3500	500	.	.	25	300	.	.	168
IMD	(SWITZERLAND)		.	65	.	200	250	40	1000000	3175	39
CRANFIELD SCHOOL OF MGT	(U.K.)	PUB	.	297	64	.	.	119	800000	2216	52
LONDON BUSINESS SCHOOL	(U.K.)	PUB	.	501	65	62	111	106	850000	1256	50
UNIV OF MANCHESTER	(U.K.)		.	.	.	.	.	.	325000	.	.
TEMPLETON COLLEGE	(U.K.)	PUB	34	43	21	.	74	23	283000	1650	43
UNIVERSITY OF LEEDS	(U.K.)		1200	50	25	.	.	59	60000	47	850
PACIFIC RIM SCHOOLS											
UNIV OF NEW SOUTH WALES	(AUST)	PUB	.	240	30	650	49	36	441750	1387	53
MACQUARIE UNIVERSITY	(AUST)	PUB	.	170	21	.	6	19	120000	608	66
THE CHINESE UNIV OF HONG KONG		PUB	1533	191	10	.	67	86	22400	12	900
HONG KONG UNIV OF SCIENCE & TECH		PUB	163	68	.	.	.	15	.	.	.
OSAKA UNIV, SCH OF ECONS	(JAPAN)	PUB	500	30	25	.	.	32	200000	360	555
KOREA UNIV, SCH OF BUSINES	(KOREA)	PRIV	.	.	.	.	87	29	20000	231	.
SEOUL NAT'L UNIV, MGT SCH	(KOREA)	PUB	940	334	60	.	175	40	19000	13	252
NAT'L UNIV OF SINGAPORE	(SINGAPORE)	PUB	1800	513	2	.	25	180	.	.	.
NAT'L TAIWAN UNIV	(TAIWAN)	PUB	1356	269	52	.	.	108	61500	37	224
NAT'L INST OF DEV	(THAILAND)	PUB	.	559	17	.	.	29	6000	10	.
SOUTH-EAST ASIA UNIV	(THAILAND)		1150	60	.	.	.	31	75824	63	1210

OTHER SCHOOLS

FGV-FUNDAGAO GETULIO VARG	(BRAZIL)	PRIV	1647	287	81	550	125	201	200000	93	79
INDIAN INSTITUTE OF MGT	(INDIA)	PUB	.	364	15	.	1204	69	102389	65	99
NARSEE MONJEE INST OF MGT	(INDIA)		.	737	.	15	2	460	11660	16	148
TEL AVIV UNIVERSITY	(ISRAEL)	PUB	1111	1638	67	21	50	100	70000	24	409
KING FAHD UNIV	(SAUDI ARABIA)	PUB	450	100	.	.	.	45	.	.	.
UNIV OF STELLEN BOSCH	(S. AFRICA)		.	169	7	.	339	21	37000	72	258
UNIV OF PRETORIA	(S. AFRICA)	PRIV	.	350	40	.	33	15	12000	28	423
IESA	(VENEZUELA)	PRIV	.	90	.	.	.	.	60000	667	5

NINTH ANNUAL UCLA SURVEY: 1992
HARDWARE RESOURCES

INSTITUTION	MAINFRAME MODEL(S), YR(S)	#	MICROCOMPUTERS (N>3)	TOTAL MICROS	STUDS/ MICRO	FAC/ MICRO
	* B-SCHOOL ACCESS ONLY					
UNIV CALIF, BERKELEY (HAAS)	IBM 3090	23	APPLE MAC, PLUS, SE, CLASSIC	275	6	1.4
	DEC VAX 6420	25	APPLE MAC SE/30, CLASSIC II			
	DEC VAX 8650	22	APPLE MAC II, II LC			
	CRAY XM/14	24	HP VECTRA 286			
		33	IBM PC/XT,PS2/25			
		75	IBM PC/AT,PS2/30,50,55,60			
		22	IBM PS2/70,80			
		16	80386 CLONES			
		30	PS2/35SX			
UNIV CALIF, L.A., (ANDERSON SCH)	IBM 9000 (92)	9	APPLE MAC, PLUS, SE, CLASSIC	392	8	.0.7
	* HP 9000/850 (88)	44	APPLE MAC IICI, CX, SI			
		96	HP VECTRA 286			
		56	HP VECTRA 386			
		29	IBM PC/XT,PS2/25			
		146	IBM PC/AT,PS2/30,50,55,60			
		9	IBM PS2/70,80			
CARNEGIE MELLON UNIVERSITY	IBM 3083	11	APPLE MAC, PLUS, SE, CLASSIC	346	11	0.7
	VAX 6420	40	APPLE MAC II, II LC			
	* SUN 330 SPARCSTATION	43	APPLE MAC IICI, CX, SI			
	* SUN SPARCSTATION1, 2	48	IBM PC/XT,PS2/25			
	* DEC VAXSTATION	62	IBM PC/AT,PS2/30,50,55,60			
	* DEC DECSTATION	90	IBM PS2/70,80			
	* HP 9000 MODEL 720	4	80286 CLONES			
		10	80386 CLONES			
		7	80486 CLONES			
		4	HP/APPOLO			
		9	SUN			
		5	DIGITAL VAXSTATION			
UNIVERSITY OF CHICAGO	* VAX CLUSTER	28	APPLE MAC, PLUS, SE, CLASSIC	379	19	1.1
	* DEC-20	7	APPLE MAC SE/30, CLASSIC II			
	* SUN 4/330	12	APPLE MAC II, II LC			
		29	APPLE MAC IICI, CX, SI			
		62	AT & T 6300			
		30	HP VECTRA 286			
		6	IBM PC/AT,PS2/30,50,55,60			
		4	IBM PS2/70,80			
		4	ZENITH Z150			
		5	ZENITH Z386			
		35	80286 CLONES			
		101	80386 CLONES			
		9	80486 CLONES			
		8	NEXT			
		24	SUN			
		7	DIGITAL VAXSTATION			

INSTITUTION	MAINFRAME MODEL(S), YR(S)	#	MICROCOMPUTERS (N>3)	MICROS	MICRO	MICRO
	* B-SCHOOL ACCESS ONLY					
CORNELL UNIVERSITY (JOHNSON SCH)	* VAX 6410	57	APPLE MAC, PLUS, SE, CLASSIC	223	7	0.7
	* MICROVAX II	18	APPLE MAC II, II LC			
	IBM 4381	20	APPLE MAC IICI, CX, SI			
	IBM 3090	12	HP VECTRA 286			
	* HP 9000 835	5	HP VECTRA 386			
	* HP 9000 425	13	IBM PC/XT,PS2/25			
		27	IBM PC/AT,PS2/30,50,55,60			
		37	IBM PS2/70,80			
		24	8086 CLONES			
DARTMOUTH COLLEGE (TUCK SCH)	DIGITAL VAX CLUSTER	64	APPLE MAC, PLUS, SE, CLASSIC	190	5	0.7
	HONEYWELL DPS	10	APPLE MAC SE/30, CLASSIC II			
	IBM 4281	6	APPLE MAC II, II LC			
		36	APPLE MAC IICI, CX, SI			
		5	IBM PC/XT,PS2/25			
		6	IBM PC/AT,PS2/30,50,55,60			
		60	IBM PS2/70,80			
DUKE UNIVERSITY (FUQUA SCH)	* IBM 4381 (89) MODEL R23	76	AT & T 286	393	7	0.6
		71	IBM PC/XT,PS2/25			
		13	IBM PC/AT,PS2/30,50,55,60			
		21	IBM PS2/70,80			
		7	IBM PS2/90,95			
		108	UNISYS			
		5	80286 CLONES			
		50	80386 CLONES			
		8	80486 CLONES			
		16	NCR			
		7	IBM 70-A21			
INDIANA UNIVERSITY	IBM 3090-120	4	APPLE MAC II, II LC	645	14	0.6
	VAX 11/780	130	HP VECTRA 286			
	VAX 11/800	5	HP VECTRA 386			
	VAX 11/900	95	IBM PC/XT,PS2/25			
	VAX 9000	110	IBM PC/AT,PS2/30,50,55,60			
		190	IBM PS2/70,80			
		10	80386 CLONES			
		50	NCR PC6'S			
		42	NCR 386SX/486			
MASS. INSTITUTE OF TECH (SLOAN SCH)	* IBM 4381 (89)	87	APPLE MAC, PLUS, SE, CLASSIC	480	19	0.5
	* ATT 3B2 (88)	15	APPLE MAC SE/30, CLASSIC II			
		44	APPLE MAC II, II LC			
		80	APPLE MAC IICI, CX, SI			
		5	APPLE MAC IIFX			
		55	AT & T 286			
		36	AT & T 386			
		87	IBM PC/AT,PS2/30,50,55,60			
		47	IBM PS2/70,80			
		5	IBM RISC 6000			
		10	SUN			
		6	DIGITAL VAXSTATION			

INSTITUTION	MAINFRAME MODEL(S), YR(S)	#	MICROCOMPUTERS (N>3)	MICROS	MICRO	MICRO
	* B-SCHOOL ACCESS ONLY					
UNIV OF MICHIGAN, ANN ARBOR	IBM 3090-600E (MTS)	90	APPLE MAC, PLUS, SE, CLASSIC	924	12	0.5
	AMDAHL 5860	44	APPLE MAC SE/30, CLASSIC II			
	DEC VAX (OCC USE)	7	APPLE MAC II, II LC			
		39	APPLE MAC IICI, CX, SI			
		4	APPLE MAC IIFX			
		11	IBM PC/XT,PS2/25			
		4	IBM PC/AT,PS2/30,50,55,60			
		60	IBM PS2/70,80			
		149	UNISYS			
		5	ZENITH Z286			
		15	8086 CLONES			
		272	80286 CLONES			
		81	80386 CLONES			
		130	80486 CLONES			
		9	SUN			
STANFORD UNIVERSITY	* VAX 3800 (88)	132	APPLE MAC, PLUS, SE, CLASSIC	506	6	0.7
	* VAX 4000-300 (90)	16	APPLE MAC SE/30, CLASSIC II			
	* HP 3000 (1990)	10	APPLE MAC II, II LC			
		63	APPLE MAC IICI, CX, SI			
		26	HP VECTRA 286			
		24	HP VECTRA 386			
		57	IBM PC/XT,PS2/25			
		46	IBM PC/AT,PS2/30,50,55,60			
		19	IBM PS2/70,80			
		42	80286 CLONES			
		64	HP VECTRA 486			
UNIV OF TEXAS (AUSTIN)	VAX 11/780	111	APPLE MAC, PLUS, SE, CLASSIC	680	31	1.7
	IBM 8081	7	APPLE MAC II, II LC			
	CRAY	22	APPLE MAC IICI, CX, SI			
		40	HP VECTRA 386			
		223	IBM PC/XT,PS2/25			
		108	IBM PC/AT,PS2/30,50,55,60			
		37	IBM PS2/70,80			
		23	8086 CLONES			
		32	80286 CLONES			
		22	80386 CLONES			
		50	HP VECTRA 386			

INSTITUTION	MAINFRAME MODEL(S), YR(S) * B-SCHOOL ACCESS ONLY	#	MICROCOMPUTERS (N>3)	MICROS	MICRO	MICRO
UNIVERSITY OF ALBERTA (CANADA)	AMDAHL 5870 (78) MTS	81	APPLE MAC, PLUS, SE, CLASSIC	307	18	0.8
	IBM 4381 (80) VM	10	APPLE MAC SE/30, CLASSIC II			
	IBM 3081 (K) MVS	27	APPLE MAC II, II LC			
		74	IBM PC/XT,PS2/25			
		10	IBM PC/AT,PS2/30,50,55,60			
		8	ZENITH Z150			
		11	ZENITH Z286			
		7	8086 CLONES			
		8	80286 CLONES			
		40	80386 CLONES			
		10	80486 CLONES			
		12	AJS10,IBM,DECWRITER			
UNIV OF BRITISH COLUMBIA (CANADA)	* DATA GEN MV10000	6	APPLE MAC, PLUS, SE, CLASSIC	449	21	0.4
	UBC MAINFRAME	19	APPLE MAC IICI, CX, SI			
		6	IBM PC/XT,PS2/25			
		76	IBM PC/AT,PS2/30,50,55,60			
		8	IBM PS2/70,80			
		10	ZENITH Z150			
		10	8086 CLONES			
		107	80286 CLONES			
		179	80386 CLONES			
		8	80486 CLONES			
		13	NEXT			
		4	SUN			
UNIVERSITY OF CALGARY (CANADA)	BULL DPS/870M	35	IBM PC/XT,PS2/25	309	10	1.1
	CDC CYBER 860	177	IBM PC/AT,PS2/30,50,55,60			
	IBM 4381 (ACSS)	95	IBM PS2/70,80			
	CDC CYBER 830					
	IBM RS 6000 1991					
MCGILL UNIVERSITY (CANADA)	IBM ES9000-320	29	IBM PC/XT,PS2/25	245	22	1.2
	IBM 4381-92E	6	IBM PC/AT,PS2/30,50,55,60			
	* DEC SERVER 3100	8	IBM PS2/70,80			
		33	8086 CLONES			
		34	80286 CLONES			
		81	80386 CLONES			
		42	80486 CLONES			
		6	DIGITAL VAXSTATION			
MC MASTER UNIVERSITY (CANADA)	VAX 6420	35	IBM PC/XT,PS2/25	193	22	0.8
	VAX 11/780	21	IBM PC/AT,PS2/30,50,55,60			
	IBM 4381	4	IBM PS2/70,80			
		39	8086 CLONES			
		7	80286 CLONES			
		46	80386 CLONES			
		33	80486 CLONES			

INSTITUTION	MAINFRAME MODEL(S), YR(S)	#	MICROCOMPUTERS (N>3)	MICROS	MICRO	MICRO
	* B-SCHOOL ACCESS ONLY					
UNIVERISTY OF TORONTO (CANADA)	* DIGITAL DEC 5810/90	7	APPLE MAC, PLUS, SE, CLASSIC	140	24	1.4
	* DIGITAL VAX 3500/88.	11	IBM PC/XT,PS2/25			
	* DIGITAL MICRO VAX/88	14	IBM PC/AT,PS2/30,50,55,60			
		7	IBM PS2/70,80			
		10	ZENITH Z150			
		54	80286 CLONES			
		13	80386 CLONES			
		9	XEROX			
		7	DIGITAL DEC STATION RISC			
UNIV OF WESTERN ONTARIO (CANADA)		20	HP VECTRA 286	161	18	0.9
		7	HP VECTRA 386			
		108	IBM PC/AT,PS2/30,50,55,60			
		10	80386 CLONES			
		12	80486 CLONES			
ESSEC (FRANCE)	* VAX 8530 - 1989	40	APPLE MAC, PLUS, SE, CLASSIC	160	22	3.6
		62	APPLE MAC II, II LC			
		57	8086 CLONES			
GROUP ESC LYON (FRANCE)	* HP 3000 SERIE G32	22	APPLE MAC, PLUS, SE, CLASSIC	220	73	1
		19	APPLE MAC SE/30, CLASSIC II			
		44	APPLE MAC II, II LC			
		35	HP VECTRA 286			
		11	IBM PC/XT,PS2/25			
		9	IBM PC/AT,PS2/30,50,55,60			
		16	80286 CLONES			
		62	80386 CLONES			
GROUP ESC TOULOUSE (FRANCE)	* HP 3000	80	HP VECTRA 286	98	23	0
		10	80386 CLONES			
		5	80486 CLONES			
UNIVERSITY KIEL (GERMANY)	CRAY XMP	11	IBM PC/XT,PS2/25	63	61	1.9
	VAX	29	IBM PC/AT,PS2/30,50,55,60			
	PDP 70	5	IBM PS2/70,80			
		8	80286 CLONES			
		6	80386 CLONES			
NORWEGIAN SCH OF MGT (NORWAY)	* IBM 9121	114	APPLE MAC, PLUS, SE, CLASSIC	949	21	0.4
		22	APPLE MAC SE/30, CLASSIC II			
		19	APPLE MAC II, II LC			
		6	APPLE MAC IICI, CX, SI			
		4	APPLE MAC IIFX			
		4	APPLE MAC QUADRA 700, 900			
		10	IBM PC/XT,PS2/25			
		702	IBM PC/AT,PS2/30,50,55,60			
		16	IBM PS2/70,80			
		10	IBM PS2/90,95			
		10	80286 CLONES			
		30	80386 CLONES			

INSTITUTION	MAINFRAME MODEL(S), YR(S)	#	MICROCOMPUTERS (N>3)	MICROS	MICRO	MICRO
	* B-SCHOOL ACCESS ONLY					
ESADE (SPAIN)	* DATA GENERAL HV 1500 1989	5	APPLE MAC SE/30, CLASSIC II	226	32	2.1
	* DATA GENERAL HV 2500 1990	11	APPLE MAC II, II LC			
	* DATA GENERAL MV 2000 1986	38	HP VECTRA 386			
	* DATA GENERAL AVION 5225 1	9	IBM PC/AT,PS2/30,50,55,60			
		5	IBM PS2/70,80			
		21	8086 CLONES			
		61	80286 CLONES			
		67	80386 CLONES			
		5	80486 CLONES			
STOCKHOLM SCH OF ECONS (SWEDEN)	* VAX 6310 (1990) 2	5	APPLE MAC, PLUS, SE, CLASSIC	503	18	0.6
	* MICRO VAX (1990) 3	82	APPLE MAC SE/30, CLASSIC II			
		20	APPLE MAC II, II LC			
		5	APPLE MAC IICI, CX, SI			
		21	IBM PC/AT,PS2/30,50,55,60			
		80	80286 CLONES			
		290	80386 CLONES			
UNIV OF ST. GALLEN (SWITZERLAND)	4 VAX	50	APPLE MAC IICI, CX, SI	808	35	0.7
		300	UNISYS			
		450	AST, COMPAQ			
		5	DIGITAL VAXSTATION			
IMD (SWITZERLAND)	VAX (TOSSING IT)	6	APPLE MAC IIFX	170	0	0.2
		30	HP VECTRA 286			
		30	HP VECTRA 386			
		50	IBM PS2/70,80			
		50	IBM PS2/90,95			
CRANFIELD SCH OF MANAGEMENT (U.K.)	* DEC 5000/240 1992	70	HP VECTRA 286	191	7	4.8
	* DEC 3100 1992	44	HP VECTRA 386			
	* HP 3000 1987	70	8086 CLONES			
	* VAX 1987	4	DIGITAL VAXSTATION			
	VAX CLUSTERS (6410, 8650)					
LONDON BUSINESS SCHOOL (U.K.)	* HP 3000/950, 1988	8	APPLE MAC, PLUS, SE, CLASSIC	376	11	0.7
	* HP 9000/825, 1989	10	APPLE MAC II, II LC			
		228	HP VECTRA 286			
		19	HP VECTRA 386			
		19	8086 CLONES			
		34	80286 CLONES			
		50	80386 CLONES			
		8	80486 CLONES			
MANCHESTER BUSINESS SCHOOL (U.K.)					0	0
TEMPLETON COLLEGE (U.K.)	DEC VAX 6620/1992	22	AT & T 6300	93	8	1.1
	* DEC VAX 3800 (2)	26	AT & T 286			
		8	AT & T 386			
		12	IBM PC/XT,PS2/25			
		4	ZENITH Z150			
		9	80286 CLONES			
		4	80386 CLONES			

INSTITUTION	MAINFRAME MODEL(S), YR(S) * B-SCHOOL ACCESS ONLY	#	MICROCOMPUTERS (N>3)	MICROS	MICRO	MICRO
UNIVERSITY OF LEEDS (U.K.)	AMDAML	39 19 41	8086 CLONES 80286 CLONES 80386 CLONES	102	25	1.5
UNIV OF NEW SOUTH WALES (AUST)	* PYRAMID 9825 (1991) * APOLLO X 4 (1987) * IBM RS 6000/530 (1991) * MIPS M/120 (1990) IBM 3090 (1988)	4 63 42 11	APPLE MAC, PLUS, SE, CLASSIC APPLE MAC IICI, CX, SI IBM PC/AT,PS2/30,50,55,60 HP/APPOLO	122	36	0.6
MACQUARIE UNIVERSITY (AUST)		27 28 4	APPLE MAC, PLUS, SE, CLASSIC IBM PC/XT,PS2/25 80486 CLONES	59	10	0.7
THE CHINESE UNIVERSITY OF HONG KONG		10 20 47 79	IBM PC/XT,PS2/25 8086 CLONES 80286 CLONES 80386 CLONES	159	28	1.1
HONG KONG UNIV OF SCIENCE & TECH	VAX 4500/VMS (1992) DEC 5200 (1992) HP-UX 9000/750 (1992) HP-UX 9000/1730 (1992)	14 12	80386 CLONES 80486 CLONES	29	0	0.9
OSAKA UNIVERSITY, SCH OF ECONS (JAPAN)	ACOS (NEC) * NEXT				0	0
KOREA-UNIVERSITY, BUSINESS SCH (KOREA)		81	IBM PC/XT,PS2/25	83	1	14.5
SEOUL NAT'L UNIV, SCH OF MGT (KOREA)		20 112 6	8086 CLONES 80286 CLONES 80386 CLONES	142	15	1.2
NATIONAL UNIVERSITY OF SINGAPORE	IBM 3090 MAINFRAME NEX SX-14 SUPER COMPUTER PHILIPS 286, SYNTAX 380, WEARNS 386SX, IBM PHILIPS AT, IPC 286	11 210 72	APPLE MAC, PLUS, SE, CLASSIC 80286 CLONES 80386 CLONES	299	27	1.1
NATIONAL TAIWAN UNIVERSITY	CRAY XMP EA/116SE VAX 785 *Z HP 9000/850, 855	6 80 80 15 91	APPLE MAC, PLUS, SE, CLASSIC 8086 CLONES 80286 CLONES 80386 CLONES 80486 CLONES	275	8	2.5
NATIONAL INST OF DEV (THAILAND)					0	0
SOUTH-EAST ASIA UNIVERSITY (THAILAND)					0	0

INSTITUTION	MAINFRAME MODEL(S), YR(S)	#	MICROCOMPUTERS (N>3)	MICROS	MICRO	MICRO
	* B-SCHOOL ACCESS ONLY					
FGV-FUNDAGAO GETULIO VARGAS (BRAZIL)				129	43	20.1
	IBM 4341	47	8086 CLONES			
	NOT GIVEN	12	80286 CLONES			
		42	80386 CLONES			
		4	80486 CLONES			
		24	8/16 BITS			
INDIAN INST OF MANAGEMENT (INDIA)	VAX 11/750 (1985)	21	80286 CLONES	148	25	1.1
	* SUN-3 (1988)	119	8088			
	* LANDMARK-4860 (1991)	6	SUN			
NARSEE MONJEE INSTITUTE OF MGT (INDIA)				0	0	
TEL AVIV UNIVERSITY (ISRAEL)		15	APPLE MAC, PLUS, SE, CLASSIC	194	32	1.6
		8	APPLE MAC SE/30, CLASSIC II			
		60	IBM PC/XT,PS2/25			
		13	IBM PC/AT,PS2/30,50,55,60			
		38	8086 CLONES			
		43	80286 CLONES			
		11	80386 CLONES			
		4	SUN			
KING FAHD UNIVERSITY (SAUDI ARABIA)	IBM 4043	4	APPLE MAC IICI, CX, SI	71	12	2.8
	AMDAL 1600	46	IBM PC/XT,PS2/25			
		19	IBM PC/AT,PS2/30,50,55,60			
UNIV OF STELLEN BOSCH (S. AFRICA)	VAX 6000/410	10	AT & T 6300	69	14	2.3
	VAX 8550	32	8086 CLONES			
	PRIME EXL 7360	17	80286 CLONES			
		7	80386 CLONES			
UNIV OF PRETORIA (S.AFRICA)		5	8086 CLONES	22	0	1
		15	80286 CLONES			
IESA (VENEZUELA)	* HP 3000 - 1981	40	APPLE MAC, PLUS, SE, CLASSIC	110	3	0
	* RS/6000 - 1991	31	IBM PC/AT,PS2/30,50,55,60			
		9	8086 CLONES			
		4	80286 CLONES			
		15	8088			